Atlantic States Marine Fisheries Commission

1050 N. Highland Street • Suite 200A-N • Arlington, VA 22201
703.842.0740 • 703.842.0741 (fax) • www.asmfc.org

James J. Gilmore, Jr. (NY), Chair *Patrick C. Keliher (ME), Vice-Chair* *Robert E. Beal, Executive Director*

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

MEMORANDUM

July 23, 2019

TO: Commissioners; Proxies; American Eel Management Board; Atlantic Menhaden Management Board; Atlantic Striped Bass Management Board; Committee on Economics and Social Sciences; Executive Committee; Horseshoe Crab Management Board; ISFMP Policy Board; South Atlantic State/Federal Fisheries Management Board; Spiny Dogfish Management Board; Summer Flounder, Scup, and Black Sea Bass Management Board; Tautog Management Board

FROM: Robert E. Beal REB
Executive Director

RE: ASMFC Summer Meeting: August 6 – 8, 2019 (TA 19-060)

The Atlantic States Marine Fisheries Commission's Summer Meeting will be held August 6 – 8, 2019 at **The Westin Crystal City** (Telephone: 703.486.1111), located at 1800 South Eads Street, Arlington, VA. Meeting materials are currently available on the Commission website at http://www.asmfc.org/home/2019-summer-meeting and supplemental materials will be posted there on Wednesday, July 31, 2019.

The agenda is subject to change. The agenda reflects the current estimate of time required for scheduled Board meetings. The Commission may adjust this agenda in accordance with the actual duration of Board meetings. Interested parties should anticipate Boards starting earlier or later than indicated herein.

Board meeting proceedings will be broadcast daily via webinar beginning at 10:15 a.m. on Tuesday, August 6th and continuing daily until the conclusion of the meeting (expected to be 5:00 p.m.) on Thursday, August 8th. The webinar will allow registrants to listen to board deliberations and view presentations and motions as they occur. No comments or questions will be accepted via the webinar. Should technical difficulties arise while streaming the broadcast the boards/sections will continue their deliberations without interruption. We will attempt to resume the broadcast as soon as possible. To register, please go to https://attendee.gotowebinar.com/register/3215930074468838914

We look forward to seeing you at the Summer Meeting. If the staff or I can provide any further assistance to you, please call us at 703.842.0740.

Enclosures: Final Agenda, Hotel Directions, TA 19-060, and Travel Reimbursement Guidelines

Atlantic States Marine Fisheries Commission

Summer Meeting

August 6 – 8, 2019

The Westin Crystal City

Arlington, Virginia

Public Comment Guidelines

With the intent of developing policies in the Commission's procedures for public participation that result in a fair opportunity for public input, the ISFMP Policy Board has approved the following guidelines for use at management board meetings:

For issues that are not on the agenda, management boards will continue to provide opportunity to the public to bring matters of concern to the board's attention at the start of each board meeting. Board chairs will use a speaker sign-up list in deciding how to allocate the available time on the agenda (typically 10 minutes) to the number of people who want to speak.

For topics that are on the agenda, but have not gone out for public comment, board chairs will provide limited opportunity for comment, taking into account the time allotted on the agenda for the topic. Chairs will have flexibility in deciding how to allocate comment opportunities; this could include hearing one comment in favor and one in opposition until the chair is satisfied further comment will not provide additional insight to the board.

For agenda action items that have already gone out for public comment, it is the Policy Board's intent to end the occasional practice of allowing extensive and lengthy public comments. Currently, board chairs have the discretion to decide what public comment to allow in these circumstances.

In addition, the following timeline has been established for the **submission of written comment for issues for which the Commission has *NOT* established a specific public comment period** (i.e., in response to proposed management action).

1. Comments received 3 weeks prior to the start of a meeting week will be included in the briefing materials.
2. Comments received by 5:00 PM on the Tuesday immediately preceding the scheduled ASMFC Meeting (in this case, the Tuesday deadline will be ***July 30, 2019***) will be distributed electronically to Commissioners/Board members prior to the meeting and a limited number of copies will be provided at the meeting.
3. Following the Tuesday, ***July 30, 2019 5:00 PM deadline***, the commenter will be responsible for distributing the information to the management board prior to the board meeting or providing enough copies for the management board consideration at the meeting (a minimum of 50 copies).

The submitted comments must clearly indicate the commenter's expectation from the ASMFC staff regarding distribution. As with other public comment, it will be accepted via mail, fax, and email.

Final Agenda

The agenda is subject to change. The agenda reflects the current estimate of time required for scheduled Board meetings. The Commission may adjust this agenda in accordance with the actual duration of Board meetings. Interested parties should anticipate Boards starting earlier or later than indicated herein.

<u>Tuesday, August 6</u>

8:00 – 10:00 a.m. ***Breakfast will be available at 7:30 a.m.***	**Executive Committee** *(A portion of this meeting may be a closed session for Committee members and Commissioners only)* *Members:* Abbott, Bowman (Bolen), Boyles, Jr. (Bell), Cimino, Clark, Estes (Burgess), Fegley/Luisi, Gilmore, Grout, Haymans, Keliher, McNamee, Miller, Miner, Murphey, Pierce, Shiels *Chair:* Gilmore *Staff:* Leach

1. Welcome/Call to Order *(J. Gilmore)*
2. Committee Consent
   - Approval of Agenda
   - Approval of Meeting Summary from May 2019
3. Public Comment
4. Consider Policy Addressing Non-Payment of State Assessments *(R. Beal)* **Action**
5. Consider Proposed Revision to the Annual Report *(R. Beal)* **Action**
6. Decision on Transitioning the For-hire Telephone Survey to State/ACCSP Conduct *(R. Beal)* Action
7. Discuss Commission Involvement in Biosecurity and Bait Sources *(R. Beal)*
8. Other Business/Adjourn

10:15 a.m. – Noon	**South Atlantic State/Federal Fisheries Management Board** *Member States:* New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida *Other Members:* DC, NMFS, PRFC, SAFMC, USFWS *Chair:* Geer *Other Participants:* McDonough, Rickabaugh, Lynn *Staff:* Schmidtke

1. Welcome/Call to Order *(P. Geer)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from May 2019
3. Public Comment
4. Amendment 1 to the Cobia Fishery Management Plan for Final Approval *(M. Schmidtke)* **Final Action**
   - Review Options and Public Comment Summary
   - Review Committee Reports
   - Consider Final Approval of Amendment 1
5. Consider 2018 Traffic Light Analyses for Atlantic Croaker and Spot *(C. McDonough)* **Action**
6. Consider Approval of 2019 Fishery Management Plan Reviews and State Compliance for Atlantic Cobia and Atlantic Croaker *(M. Schmidtke)* **Action**
7. Other Business/Adjourn

Noon – 1:15 p.m. **Legislators and Governors' Appointees (LGAs) Luncheon**

Noon – 1:15 p.m. **Lunch provided for Commissioners, Proxies, Other Members, Participants and Staff. LGAs should pick up lunch and continue to their meeting.**

1:30 – 2:30 p.m. **American Eel Management Board**

Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Other Members: DC, NMFS, PRFC, USFWS
Chair: Gary
Other Participants: Zimmerman, Beal
Staff: Rootes-Murdy

1. Welcome/Call to Order *(M. Gary)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from October 2018
3. Public Comment
4. Update on Board Working Group Recommendations on Addressing Coastwide Cap Overages *(K. Rootes-Murdy)*
5. Review and Consider Approval of 2020 Aquaculture Proposals *(K. Rootes-Murdy)* **Action**
6. Other Business/Adjourn

2:45 – 3:30 p.m. **Horseshoe Crab Management Board**

Member States: Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Other Members: PRFC, NMFS, USFWS
Chair: Rhodes
Other Participants: Brunson, Messeck
Staff: Schmidtke

1. Welcome/Call to Order *(M. Rhodes)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from May 2019
3. Public Comment
4. Consider Management Response to the 2019 Horseshoe Crab Benchmark Stock Assessment *(M. Rhodes)* **Possible Action**
5. Other Business/Adjourn

3:45 – 5:15 p.m. **Atlantic Menhaden Management Board**

Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Other Members: NMFS, PRFC, USFWS
Chair: Meserve
Other Participants: Ballenger, Kersey
Staff: Appelman

1. Welcome/Call to Order *(N. Meserve)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from February 2019
3. Public Comment
4. Progress Update on 2019 Menhaden Single-Species and Ecological Reference Point Benchmark Stock Assessments *(K. Anstead, K. Drew)*
5. Consider Approval of 2019 Fishery Management Plan Review and State Compliance *(M. Appelman*) **Action**
6. Set 2020 Atlantic Menhaden Specifications *(N. Meserve)* **Final Action**
7. Other Business/Adjourn

Wednesday, August 7

8:30 – 10:30 a.m. **Interstate Fisheries Management Program Policy Board**

Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Other Members: DC, NMFS, PRFC, USFWS
Chair: Gilmore
Staff: Kerns

1. Welcome/Call to Order *(J. Gilmore)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from May 2019
3. Public Comment
4. Update from Executive Committee and State Director's Meeting *(J. Gilmore)*
5. Review 2019 Annual Performance of the Stocks *(T. Kerns*)
6. Review and Consider Changes to Commission Guiding Documents *(T. Kerns*)
   - ISFMP Charter **Final Action**
   - Technical Support Group Guidance and Benchmark Stock Assessment Process **Final Action**
   - Working Group Standard Operating Procedures and Policies **Possible Action**
7. Update on American Lobster Enforcement Vessel *(R. Beal)*
8. Atlantic Coastal Fish Habitat Partnership Committee Report *(L. Havel)*
9. Progress Update on the Shad Benchmark Stock Assessment (*J. Kipp)*
10. Review Noncompliance Findings (If Necessary) **Action**
11. Other Business/Adjourn

8:30 a.m. – 4:00 p.m. **Committee on Economics and Social Sciences (CESS)**
Members: Clemetson, Colburn, Hadley, Holzer, Lovell, McPherson, Montanez, Rhodes, Robertson, Scheld, Scott, Shivlani, Sproul, Stemle, Stoll
Chair: Ebbin
Staff: Murray

1. Welcome/Introductions *(S. Ebbin)*
2. Approval of Agenda
3. Updates from CESS Species Representatives *(S. Ebbin)*
4. Discussion of Draft Risk and Uncertainty Policy *(S. Murray)*
5. Overview of ASMFC Processes *(S. Murray)*
6. Discussion of ASMFC Socioeconomic Information Needs *(S. Ebbin, S. Murray)*
7. Recess to Observe Summer Flounder, Scup, and Black Sea Bass Board Meeting
8. Discussion of Committee's Current and Future Role in ASMFC Processes *(S. Ebbin)*
9. Other Business
10. Public Comment
11. Adjourn

10:30 – 10:45 a.m. **Business Session**
Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Chair: Gilmore
Staff: Beal

1. Welcome/Call to Order *(J. Gilmore)*
2. Committee Consent
   - Approval of Agenda
   - Approval of Proceedings from May 2019
3. Public Comment
4. Consider Approval of Atlantic Cobia Amendment 1 **Final Action**
5. Consider Noncompliance Recommendations (if necessary) **Final Action**
6. Other Business/Adjourn

11:00 a.m. – Noon **Spiny Dogfish Management Board**
Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina
Other Members: NMFS
Chair: O'Reilly
Other Participants: Newlin, Moran
Staff: Rootes-Murdy

1. Welcome/Call to Order *(R. O'Reilly)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from October 2018
3. Public Comment

4. Consider Draft Addendum VI for Public Comment *(K. Rootes-Murdy)* **Action**
5. Other Business/Adjourn

Noon – 1:00 p.m. **Lunch** *(On Your Own)*

1:00 – 3:45 p.m. **Summer Flounder, Scup, and Black Sea Bass Management Board**
Member States: Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina
Other Members: NMFS, PRFC, USFWS
Chair: Ballou
Other Participants: Wojcik, Snellbaker, Stevens
Staff: Colson Leaning, Starks

1. Welcome/Call to Order *(R. Ballou)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from May 2019
3. Public Comment
4. Review Potential Black Sea Bass Commercial Management Strategies and Consider Initiating Management Action to Address Commercial Allocation *(C. Starks)* **Possible Action**
5. Update on the Summer Flounder Management Strategy Evaluation: A Recreational Fishery Project *(J. McNamee)*
6. Report from the Atlantic Coastal Fish Habitat Partnership/Mid-Atlantic Fishery Management Council Project: Characterizing Black Sea Bass Habitat in the Mid-Atlantic Bight *(B. Stevens)*
7. Discussion on Discard Mortality *(C. Starks)*
8. Progress Update on the Recreational Management Reform Working Group *(C. Starks)*
9. Other Business/Adjourn

4:00 – 5:00 p.m. **Tautog Management Board**
Member States: Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia
Other Members: NMFS, USFWS
Chair: McKiernan
Other Participants: Barry, Snellbaker
Staff: Rootes-Murdy

1. Welcome/Call to Order *(D. McKiernan)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from October 2018
3. Public Comment
4. Review Implementation Guidelines for the Commercial Harvest Tagging Program *(C. Starks*) **Possible Action**
5. Consider Approval of 2019 Fishery Management Plan Review and State Compliance *(K. Rootes-Murdy)* **Action**
6. Elect Vice-Chair **Action**
7. Other Business/Adjourn

Thursday, August 8

8:30 – 11:30 a.m. **Atlantic Striped Bass Management Board**

Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina
Other Members: DC, NMFS, PRFC, USFWS
Chair: Armstrong
Other Participants: Lengyel, Blanchard
Staff: Appelman

1. Welcome/Call to Order *(M. Armstrong)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from April 2019
3. Public Comment
4. Consider Draft Addendum VI for Public Comment *(M. Appelman)* **Action**
5. Consider Postponed Motions from April 2019 *(M. Armstrong)* **Action**
   Main Motion: Move to initiate an Amendment to the Atlantic Striped Bass Fishery Management Plan to address the needed consideration for change on the issues of fishery goals and objectives, empirical/biological/spatial reference points, management triggers, rebuilding biomass, and area-specific management. Work on this amendment will begin upon the completion of the previously discussed addendum to the management plan.

   Motion to Amend: Move to amend to add reallocation of commercial quota between states.
6. Consider Approval of 2019 Fishery Management Plan Review and State Compliance *(M. Appelman)* **Action**
7. Other Business/Adjourn

11:30 a.m. – 12:30 p.m. **Lunch** *(On Your Own)*

12:30 – 5:00 p.m. **NOAA Fisheries Wind Power Workshop for New England and Mid-Atlantic Commissioners**

(This Workshop is focused on wind energy activities in New England and the Mid-Atlantic, however, all Commissioners are welcome to participate).

1. Welcome/Introductions *(J. Gilmore/M. Pentony)*
2. Public Comment
3. Presentation on Scope and Status of Planned Offshore Wind Projects *(A. Lipsky)*
4. Presentation on NOAA Fisheries Role in Offshore Wind Activities *(M. Pentony)*
5. Questions and Discussion on Projects and Federal Role

6. Presentations on State Level Policy and Research Activities Associated with Offshore Wind Development
   - Massachusetts
   - Rhode Island
   - Connecticut
   - New York
   - New Jersey
7. Fishing Industry Engagement in Research and Development *(A. Hawkins)*
   - Responsible Offshore Development Alliance (RODA)
   - Responsible Offshore Science Alliance (ROSA)
8. Discussion on Coordination of State and Federal Activities
   - Would Increased State Coordination Improve Engagement in Wind Power Development?
   - What is the Best Approach to Ensure State Coordination?
   - What is the Best Approach to Ensure State/Federal/Regional Council Coordination?
   - Is There a Role for ASMFC in State Coordination or State/Federal Coordination?
9. Other Business/Adjourn

THE WESTIN CRYSTAL CITY

1800 S. Eads Street · Arlington, Virginia, 22202 · Phone: 703.486.1111

AIRPORT TRANSPORTATION

The Westin Hotel is just minutes from Ronald Reagan National Airport (DCA), and within two hours of Dulles International Airport (IAD) and Baltimore Washington International Airport (BWI). Transportation options from each airport to The Westin Alexandria are shown below and numerous rental agencies are located in the airports.

Ronald Reagan National Airport (DCA)

Travel Distance: Approximately 1.0 mile

THE WESTIN CRYSTAL CITY SHUTTLE (COMPLIMENTARY)

The Westin Crystal City Shuttle, which is a white van, makes stops at Reagan National Airport (DCA) at Terminal A, Terminal B - Door 5 and Terminal C - Door 9.
The shuttle runs every 30 minutes. From the hotel: first departure is 5:00 AM; last departure is 11:30 PM. From the airport: first departure is 5:15 AM; last departure is 11:45 PM.
Hours of operation: Monday – Sunday 5:00 AM - 11:45 PM

BY METRO FROM NATIONAL AIRPORT METRO STATION TO CRYSTAL CITY METRO STATION

- **Yellow Line** to MOUNT VERNON SQUARE or
- **Blue Line** to LARGO TOWN CENTER

Travel Time: 5 minutes; the hotel is within walking distance from Crystal City Metro Station

DRIVING DIRECTIONS

From West

- Continue on 66 East to Route 110 (National Airport).
- Proceed to Route 1 South (Crystal City).
- Turn right on 20th Street.
- Turn right on Eads Street.

From Downtown Washington

- Continue on Interstate 395 South across the 14th Street Bridge.
- Exit US Route 1 South.
- Turn right on 20th Street.
- Turn right on Eads Street.
- The hotel is 1 block on the right.

From South

- Continue on I-95 North to 395 North.
- Take Exit 8C (Crystal City).
- Proceed through 6 lights to Eads Street.

From North

- Continue on Interstate 95 South to D.C. Beltway
- Continue on D.C. Beltway to Interstate 495 to Virginia.
- Exit 395 North.
- Take Exit 8C (Crystal City).
- Proceed through 6 lights to Eads Street.

Atlantic States Marine Fisheries Commission

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Vision: Sustainable and Cooperative Management of Atlantic Coastal Fisheries

TRAVEL AUTHORIZATION

TA No. 19-060 **Charge To:** 0296000ESUM **Approved by:** Laura Leach

Meeting Name: ASMFC Summer Meeting 2019

Meeting Date: AUG-06-2019 - AUG-08-2019

Meeting Location: Arlington, Virginia

Hotel Details: The Westin Crystal City 1800 S. Eads Street, Arlington, VA 22202. Reservations can be made online via Star Group Website or 703.486.1111 and identify Atlantic States Marine Fisheries Commission to receive discounted rate.

Cutoff Date: JUL-07-2019

Per Diem: Hotel: $179 plus tax (sgl/dbl) Meals: $71 ($18/$19/$34)

Mileage Rate: $0.58/mile, eff. January 1, 2019. Rental cars must be specifically authorized.

Airport Transportation: The Westin Crystal City provides complimentary shuttle (white van) which operates Monday-Sunday and stops at Reagan National Airport (DCA) Terminal A, Terminal B (Door 5) & Terminal C (Door 9), and runs every 30 minutes. From the hotel: first departure is 5:00AM; last departure is 11:30PM. From DCA: first departure: 5:15 AM; last departure is at 11:45 PM. By Metro from DCA: Yellow Line to MOUNT VERNON SQUARE or Blue Line to LARGO TOWN CENTER. Exit at Crystal City Metro Station. Travel Time: 5 minutes; the hotel is within walking distance from Crystal City Metro Station

Local Transportation: Hotel is located across from Crystal City Metro station and its underground shops and restaurants. Additional restaurants are within walking distance

Basic Guidelines: In consideration of the Commission's budget please attempt to select the most reasonable airfare. You are responsible for determining your arrival and departure times. Commissioners (or their proxies) are eligible to attend all meetings; all others are eligible for reimbursement to attend board/committee meetings of which they are a member. If the distance from your office to the meeting site is under 35 miles, ASMFC will not reimburse hotel, mileage or per diem but may reimburse any miscellaneous expenses that would not normally occur during a work day (i.e., parking, tolls). ASMFC reserves the right to disallow travel expenses it deems excessive or unnecessary to conduct ASMFC business.

Parking: (underground) Self-parking $25/day

Reimbursement: You must submit an ASMFC travel voucher with receipts within 30 days of the final day of travel. Electronic travel vouchers and scanned receipts are preferred and should be sent to accounting@asmfc.org. Vouchers and receipts will also be accepted via snail mail if emailing is not an option.

General Notes: Complete ASMFC Travel Reimbursement Guidelines can be found at http://www.asmfc.org/files/Meetings/TravelReimbursementGuidelines_Jan2019.pdf and the Electronic Travel Voucher: http://www.asmfc.org/files/Meetings/ASMFCElectronicTravelVoucher_Jan19.xlsx. Please contact the ASMFC office if you have questions or would like staff assistance.

Authorized Travelers:

Abbott, Dennis	Allen, Russ	Altman, Thad
Andrzejczak, Robert	Anstead, Kristen	Appelman, Max
Armstrong, Mike	Ballenger, Joey	Ballou, Bob
Barry, Linda	Batsavage, Chris	Beal, Rob

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Vision: Sustainable and Cooperative Management of Atlantic Coastal Fisheries

Authorized Travelers:

Beal, Robert	Bell, Mel	Berger, Tina
Blanchard, Kurt	Blanton, Michael	Bolen, Ellen
Borden, David	Bowman, Steven	Boyles, Robert
Brown, Robert	Brunson, Jeff	Campfield, Patrick
Carson, William	Cimino, Joe	Clark, John
Colden, Allison	Colson Leaning, Dustin	Corbett, Heather
Cromer, Ronnie	Davidson, Maureen	Davis, Justin
Dize, Russell	Drew, Katie	Eastman, Michael
Edwards, Phillip	Estes, Jim	Fegley, Lynn
Ferrara, Sarah	Fote, Tom	Gary, Marty
Gates, Matthew	Geer, Patrick	Gilmore, Jim
Grout, Doug	Hasbrouck, Emerson	Havel, Lisa
Haymans, Doug	Hyatt, William	Jacobs, Chris
Kaminsky, Todd	Kane, Raymond	Keliher, Pat
Kerns, Toni	Kersey, Robert	King, Bryan
Kipp, Jeff	Konell, Heather	Langley, Phil
Leach, Laura	Lengyel, Nicole	Luisi, Michael
Lustig, Loren	Lynn, Bob	Mannen, Jerry
Mason, T. Montgomery	Mccawley, Jessica	Mccreight, Jay
Mcdonough, Chris	Mckiernan, Dan	Mcmanus, Conor
Mcmurray, John	Mcnamee, Jason	Meserve, Nichola
Messeck, Douglas	Michels, Stewart	Miller, Roy
Miner, Craig	Miramant, David	Moran, Pat
Murphey, Steve	Murray, Sarah	Newlin, Scott
Nowalsky, Adam	O'Reilly, Rob	Orndorf, Bill
Patterson, Cheri	Peake, Sarah	Pierce, David
Plumlee, J. Bryan	Powers, Thomas	Pugh, Craig
Reid, Eric	Rhodes, Malcolm	Rickabaugh, Harry
Robertson, Cynthia A	Robson, Mark	Rootes-Murdy, Kirby
Ryan, Daniel	Saveikis, David	Schaeffer, Tim
Schmidtke, Michael	Self, Ross	Shiels, Andrew
Snellbaker, Jason	Sosnowski, Susan	Starks, Caitlin
Stein, Dana	Steinburg, Bob	Stevens, Brad
Sullivan, Kevin	Tompkins, Deke	Train, Stephen
Ware, Megan	Watters, David	White, Geoffrey
White, Ritchie	Wojcik, Greg	Woodward, Spud
Zimmerman, Jordan	Ziobron, Melissa	Zobel, Renee

Atlantic States Marine Fisheries Commission

Travel Reimbursement Guidelines

Following are guidelines for use when traveling on Atlantic States Marine Fisheries Commission business. If, after reading these guidelines, you have questions that remain unanswered, please call Laura Leach at the Commission (703)842-0740.

When you receive a travel authorization from the Commission, it will list your name as eligible for reimbursement. It is your responsibility to make your travel arrangements, based on meetings that you are required to attend. For example, if the Commission is meeting in Maine, you live in Georgia, and your meeting begins at 10:00 a.m., you will need to arrive the day before. You will probably need to stay over the night of your meeting, if it ends at 5:00 p.m. or later. If, however, you have a meeting that lasts 4 hours on one day but you stay at the meeting all week, you will not be reimbursed for expenses that are incurred outside of your meeting.

The basic guidelines for travel are outlined on the travel voucher. Additional details:

- *"Per Diem"* varies by location of the meeting, and will be listed on each travel authorization.
- *"Transportation Fares"* covers airfare, train, bus or rental car utilized for getting to the meeting. *Please try to find a reasonable airfare by researching different airports and airlines.* If you would like staff to help, please give us a call.
- *Rental cars* used AT a meeting must be specifically authorized by ASMFC.
- *"Mileage"* is currently $.**580** per mile (effective 1/15/19). You may claim mileage when using your privately owned vehicle as transportation to and from the meeting; as well as to and from your departure terminal.
- *"Incidentals" of $5.00/day* cover maid, shuttle or bellman tips; however taxi tips are part of the taxi expense.
- *"Other Expenses"* covers expenses not specifically listed (i.e. the registration fee for the annual meeting).

Please note that all expenses must be itemized separately on the travel form which can be found at http://www.asmfc.org/files/Meetings/ASMFCElectronicTravelVoucher_Jan19.xlsx. Original receipts must be provided for all expenses claimed, except for meals. Your airline itinerary is not an acceptable receipt; you must submit the "passenger receipt" from the actual ticket. For electronic tickets (e-tickets), we will accept a copy of your confirmation; or simply your boarding passes if you only have a confirmation number. Receipts for all tolls, cabs, and parking must be submitted in order to receive reimbursement for those charges. Any toll, cab, or parking charges lacking a receipt will be disallowed. EZ Pass statements will be accepted as a valid receipt for tolls. **If you received pre-approval for a rental car that correspondence must be submitted with your travel voucher.**

If you make your hotel reservation after the cutoff date and cannot get our negotiated rate, the Commission cannot pay the higher rate that the hotel will charge, unless there are mitigating circumstances such as a request issued by ASMFC, after the cut-off date, to attend the meeting.

If you attend a meeting that is within 35 miles of your office, you will not be reimbursed for mileage or meals; however, you will be reimbursed for parking, tolls, or other expenses that you would not normally incur on a regular work day.

Your voucher must be submitted within thirty days of the last day of the meeting. Please attach original receipts when submitting by U.S. mail; if forwarding electronically, please scan receipts and include as an attachment to the electronic voucher, to accounting@asmfc.org.

Revised January 15, 2019

Atlantic States Marine Fisheries Commission

South Atlantic State/Federal Fisheries Management Board

August 6, 2019
10:15 a.m. – Noon
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Call to Order (*P. Geer*)	10:15 a.m.
2.	Board Consent • Approval of Agenda • Approval of Proceedings from May 2019	10:15 a.m.
3.	Public Comment	10:20 a.m.
4.	Amendment 1 to the Cobia Fishery Management Plan for Final Approval (*M. Schmidtke*) **Final Action** • Review Options and Public Comment Summary • Review Committee Reports • Consider Final Approval of Amendment 1	10:30 a.m.
5.	Consider 2018 Traffic Light Analyses for Atlantic Croaker and Spot (C. *McDonough*) **Action**	11:20 a.m.
6.	Consider Approval of 2019 Fishery Management Plan Reviews and Compliance for Atlantic Cobia and Atlantic Croaker *(M. Schmidtke)* **Action**	11:35 a.m.
7.	Other Business/Adjourn	12:00 p.m.

The meeting will be held at the Westin Crystal City, 1800 S Eads Street, Arlington, VA 22202; 703.486.1111

MEETING OVERVIEW

South Atlantic State/Federal Fisheries Management Board Meeting
Tuesday, August 6, 2019
10:15 a.m. – 12:00 p.m.
Arlington, Virginia

Chair: Pat Geer (VA) Assumed Chairmanship: 02/18	Technical Committee (TC) Chairs: Black Drum: Harry Rickabaugh (MD) Cobia: Vacant Atlantic Croaker: Chris McDonough (SC) Red Drum: Vacant	Law Enforcement Committee Representative: Capt. Bob Lynn (GA)
Vice Chair: Robert H. Boyles, Jr.	Advisory Panel Chair: Tom Powers (VA)	Previous Board Meeting: February 6, 2019
Voting Members: NJ, DE, MD, PRFC, VA, NC, SC, GA, FL, NMFS, USFWS, SAFMC (12 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from May 2, 2019

3. Public Comment – At the beginning of the meeting public comment will be taken on items not on the agenda. Individuals that wish to speak at this time must sign-in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Amendment 1 to the Cobia Fishery Management Plan (10:30 a.m. – 11:20 p.m.) Final Action
Background • In May 2018, the Board initiated Draft Amendment 1 to the Cobia Fishery Management Plan (FMP) to reflect removal of Atlantic cobia from the South Atlantic and Gulf of Mexico Fishery Management Councils' Coastal Migratory Pelagic Resources FMP and establish recommendations for measures in federal waters. • In October 2018, the Board reviewed public comment on a Public Information Document (PID) and gave direction to the Cobia Plan Development Team (PDT) on options to be included in Draft Amendment 1. • In May 2019, the Board approved Draft Amendment 1 for Public Comment. Four public hearings were held via webinar and in-person in Virginia, North Carolina, and South Carolina (**Briefing Materials**). Written comments were accepted through July 15, 2019 (**Briefing Materials**).

- The Advisory Panel (**Briefing Materials**) and Cobia Technical Committee (**Supplemental Materials**) met via webinar and have developed or will develop recommendations for Board consideration.

Presentations

- Public Comment Summary for Draft Amendment 1 to the Interstate Fishery Management Plan for Atlantic Migratory Group Cobia by M. Schmidtke.
- Advisory Panel and Cobia Technical Committee Report on Draft Amendment 1 by M. Schmidtke.

Board actions for consideration at this meeting

- Review public comment and consider final approval for Draft Amendment 1 to the Cobia FMP.

5. 2019 Traffic Light Analyses for Atlantic Croaker and Spot (11:20 a.m. – 11:35 a.m.) Action

Background

- Addendum II (2014) of the Atlantic Croaker Fishery Management Plan (FMP) and Addendum II (2014) of the Spot FMP establish the Traffic Light Analyses (TLA) as a new management framework for these species in non-assessment years (**Supplemental Materials**).

Presentations

- 2019 TLA Reports for Atlantic croaker and Spot by C. McDonough.

6. Consider Approval of 2019 Fishery Management Plan Reviews and Compliance for Atlantic Cobia and Atlantic Croaker (11:35 a.m. – 12:00 p.m.) Action

Background

- Atlantic cobia state compliance reports are due on July 1. The Atlantic Croaker Plan Review Team (PRT) has reviewed state reports and compiled the annual FMP Review. New Jersey, Delaware, and Maryland have requested *de minimis* status (**Supplemental Materials**).
- Atlantic croaker state compliance reports are due on July 1. The Atlantic Croaker Plan Review Team (PRT) has reviewed state reports and compiled the annual FMP Review. Delaware (commercial), South Carolina (commercial), Georgia (commercial), and Florida (commercial) have requested *de minimis* status (**Supplemental Materials**).

Presentations

- 2019 FMP Reviews for Atlantic cobia and Atlantic croaker by M. Schmidtke.

Board actions for consideration at this meeting

- Consider approval of the 2019 FMP Reviews, state compliance, and *de minimis* requests for Atlantic cobia and Atlantic croaker.

7. Other Business/Adjourn

South Atlantic Board

Activity level: High

Committee Overlap Score: Moderate (American Eel TC, Horseshoe Crab TC, Shad and River Herring TC, Sturgeon TC, Weakfish TC)

Committee Task List

- Cobia PDT – May – August 2019: Draft Amendment 1 process; current step: Board Review of Public Comment and Draft Amendment 1 for Final Approval
- Cobia TC – Involvement of certain members in SEDAR 58 assessment process
- Atlantic Croaker and Spot PDT: Draft Addendum III (croaker) and Draft Addendum II (spot) to incorporate updated Traffic Light Analyses; Board Review for Public Comment in Fall 2019
- Red Drum SAS – Develop assessment roadmap; awaiting guidance from ASC
- Atlantic Croaker TC - July 1: Compliance Reports Due
- Red Drum TC – July 1: Compliance Reports Due
- Cobia TC – July 1: Compliance Reports Due
- Atlantic Croaker PRT – August 1: Update Traffic Light Analysis
- Spot PRT – August 1: Update Traffic Light Analysis
- Black Drum TC – August 1: Compliance Reports Due
- Spotted Seatrout PRT – September 1: Compliance Reports Due
- Spanish Mackerel PRT – October 1: Compliance Reports Due
- Spot PRT – November 1: Compliance Reports Due

TC Members:
Atlantic Croaker: Chris McDonough (SC, Chair), Kristen Anstead (ASMFC), Michael Schmidtke (ASMFC), Shanna Madsen (NJ), Michael Greco (DE), Harry Rickabaugh (MD), Somers Smott (VA), Jason Rock (NC), Dan Zapf (NC), Dawn Franco (GA), Joseph Munyandorero (FL), Erik Williams (NMFS)
Black Drum: Harry Rickabaugh (MD, Chair), Jeff Kipp (ASMFC), Michael Schmidtke (ASMFC), Craig Tomlin (NJ), Jordan Zimmerman (DE), Ethan Simpson (VA), Chris Stewart (NC), Chris McDonough (SC), Ryan Harrell (GA), Liz Herdter Smith (FL)
Cobia: Michael Schmidtke (ASMFC), Shanna Madsen (NJ), Angela Giuliano (MD), Alex Aspinwall (VA), Anne Markwith (NC), Mike Denson (SC), Chris Kalinowsky (GA), Christina Wiegand (SAMFC), Michael Larkin (SERO)

Red Drum: Jeff Kipp (ASMFC), Michael Schmidtke (ASMFC), Shanna Madsen (NJ), Michael Greco (DE), Robert Bourdon (MD), Ethan Simpson (VA), Lee Paramore (NC), Joey Ballenger (SC), Chris Kalinowsky (GA), Behzad Mahmoudi (FL), Roger Pugliese (SAFMC)
Spanish Mackerel (PRT): Michael Schmidtke (ASMFC), Randy Gregory (NC), BJ Hilton (GA), Dustin Addis (FL), Christina Wiegand (SAFMC), John Hadley (SAFMC)
Spot (PRT): Michael Schmidtke (ASMFC), Harry Rickabaugh (MD), Adam Kenyon (VA), Dan Zapf (NC), Chris McDonough (SC), Dawn Franco (GA)
Spotted Seatrout (PRT): Michael Schmidtke (ASMFC), Douglas Lipton (MD), Tracey Bauer (NC), Joey Ballenger (SC), Chris Kalinowsky (GA)

SAS Members:
Red Drum: Jeff Kipp (ASMFC), Michael Schmidtke (ASMFC), Angela Giuliano (MD), Lee Paramore (NC), Joey Ballenger (SC), Liz Herdter Smith (FL)

PDT Members:
Atlantic Croaker and Spot: Michael Schmidtke (ASMFC), Harry Rickabaugh (MD), Dan Zapf (NC), Chris McDonough (SC)
Cobia: Michael Schmidtke (ASMFC), Alex Aspinwall (VA), Anne Markwith (NC), Mike Denson (SC), Andrew Scheld (VIMS), Christinia Wiegand (SAFMC)

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

SOUTH ATLANTIC STATE/FEDERAL FISHERIES MANAGEMENT BOARD

The Westin Crystal City
Arlington, Virginia
May 2, 2019

TABLE OF CONTENTS

INDEX OF MOTIONS

1. **Approval of Agenda** by Consent (Page 1).

2. **Approval of Proceedings of February 2019** by Consent (Page 1).

3. **Move to approve Draft Amendment I to the Cobia Fishery Management Plan for public comment as modified today** (Page 16). Motion by Spud Woodward; second by Mel Bell. Motion carried (Page 16).

4. **Move to initiate addenda to the Spot and Croaker Fishery Management Plans to incorporate the revised TLA and redefine management response** (Page 23). Motion by Chris Batsavage; second by Lynn Fegley. Motion carried (Page 25).

5. **Motion to adjourn** by Consent (Page 25).

ATTENDANCE

BOARD MEMBERS

Jim Gilmore, NY (AA)
Emerson Hasbrouck, NY (GA)
Adam Nowalsky, NJ, proxy for Sen. Andrzejczak (LA)
John Clark, DE, proxy for David Saveikas (AA)
Roy Miller, DE (GA)
Craig Pugh, DE, proxy for Rep. Carson (LA)
Russell Dize, MD (GA)
Lynn Fegley, MD, proxy for D. Blazer (AA)
Phil Langley, MD, proxy for Del. Stein (LA)
Pat Geer, VA, proxy for S. Bowman (AA), Chair
Chris Batsavage, NC, proxy for S. Murphey (AA)
Robert Boyles, SC (AA)
Mel Bell, SC, proxy for Sen. Cromer (LA)
Spud Woodward, GA (AA)
Doug Haymans, GA (GA)
Erika Burgess, FL, proxy for J. McCawley (AA)
Marty Gary, PRFC

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Staff

Toni Kerns
Robert Beal
Mike Schmidtke
Jessica Kuesel
Jeff Kipp

Guests

Dave Bard, ECS/NOAA
Arnold Leo, E. Hampton, NY
Catherine Krikstan, ECS/NOAA
Mike Millard, USFWS
Derek Orner, NOAA
Jack Travelstead, CCA

The South Atlantic State/Federal Fisheries Management Board of the Atlantic States Marine Fisheries Commission convened in the Jefferson Ballroom of the Westin Crystal City Hotel, Arlington, Virginia on Thursday, May 2, 2019, and was called to order at 10:00 o'clock a.m. by Chairman Pat Geer.

CALL TO ORDER

CHAIRMAN PAT GEER: Good morning everybody. My name is Pat Geer and I'm the Chairman of the South Atlantic State/Federal Fisheries Management Board. I welcome you all here this morning and I know we're between you and going home, so we will try to expedite this meeting as quickly as possible.

APPROVAL OF AGENDA

CHAIRMAN GEER: The first order of business is to approve the agenda. Are there any changes or modifications to the agenda? Hearing none the agenda is approved by consent.

APPROVAL OF PROCEEDINGS

CHAIRMAN GEER: The next item is approval of the proceedings from the February, 2019 meeting. Are there any issues with that at all, any changes? Hearing none, the proceedings from the February, 2019 meeting are approved by consent.

PUBLIC COMMENT

CHAIRMAN GEER: Is there any public comment from anybody? I haven't heard of any public comment. Is there anybody from the public who would like to speak about something that is not on the agenda today? Hearing none, well, Mike is going to go check real quick, to see if anybody signed up. Thumbs up, nobody, okay.

REVIEW AND CONSIDER DRAFT AMENDMENT 1 TO THE COBIA FISHERY MANAGEMENT PLAN FOR PUBLIC COMMENT

CHAIRMAN GEER: We're moving on. The first item of business is Review Amendment 1 of the Cobia Fishery Management Plan for Public Comment. The PDT has been working on this for the last several months. We have a draft ready for you today and Mike is going to take the lead on that; so Mike, you have the floor.

DR. MIKE SCHMIDTKE: As Pat said the Plan Development Team has been working for the past few months on developing Draft Amendment 1 to the Cobia Fishery Management Plan. I will go through that now. First, before I get into the actual draft Amendment, just a reminder of the timeline that we're working on. We've gone through the whole PID process and we are currently at the highlighted step, where the Board is reviewing draft Amendment 1 for public comment. If everything goes through on the anticipated schedule, then final consideration for this amendment would occur at the August meeting of this year, preceded by a public comment period over the summer.

Here is a basic outline for today's presentation; and it generally follows that of the amendment. There are sections on compliance, research needs, and protected species information. Those are included in the Amendment; but won't be covered in today's presentation, since they don't include really any substantial changes or management decisions. But I do encourage the Board and the public to review these sections if they haven't already; during or after this meeting. If you see any necessary edits please let me know.

First, I'll go through the introductory section of the amendment. You'll notice throughout the presentation that I will be skipping over some sections; trying to stick to those that are most pertinent for evaluating the management options. There were some updates to the background information in the Amendment from the original FMP to reflect the most recent information for the fishery.

One example of this is included information from the SEDAR 58 Stock ID process. Again, I encourage review of these types of sections; to make sure everybody is working on current knowledge. First of all I'll start off with the statement of the problem. On March 21, 2019, Regulatory Amendment 31 to the Coastal Migratory Pelagics FMP became effective; which means that Atlantic Cobia is now managed solely through the Commission's FMP.

The Commission's FMP was originally written to be complementary and dependent on the Coastal Migratory Pelagics FMP. For example, we use things like the ACL set through the Council, and the EEZ regulations that were previously recommended by the Council. That all came through the Coastal Migratory Pelagics FMP; and we kind of adopted that as part of our management process as well.

The Board also gave direction to the Plan Development Team in the process of switching this management plan to more of a sole management to establish a process for specifying aspects of harvest quickly, and through Board action, so harvest specification process is spelled out in this draft Amendment.

The most recent stock assessment was completed in 2013 and it indicated that the stock was not overfished, and overfishing was not occurring. A new assessment is currently underway through the SEDAR process. Prior to this assessment to SEDAR 58, a Stock ID process was conducted to evaluate the boundary between the Atlantic and Gulf stocks of cobia. This boundary remains at the Florida/Georgia line.

Results of the process do not dispute the boundary so it's continuing to be used for management and assessment purposes. However, the results were not clear on a specific boundary or the specifics of a transition area. Instead, they basically defined a region in northeastern Florida up into Georgia as an area of uncertainty; north and south of this area cobia show different genetic and movement characteristics.

The data workshop for the SEDAR 58 Assessment was completed a few weeks ago and assessment webinars will be held over the summer. The anticipated completion date for the assessment is January of 2020. Presumably those results would be made available in time to set regulations for the 2020 fishing year. The commercial fishery for cobia has increased over the last 15 years; particularly due to increased landings in Virginia and North Carolina. A coastwide ACL was established in 2015 by the South Atlantic Council; and this was set at 50,000 pounds. Since the establishment of the ACL, it has been exceeded in every year leading to midseason closures of this fishery from 2016 through 2018. As has often been mentioned with cobia being that it is a recreational heavy fishery. MRIP recalibrated the landings estimates to the new mail-based fishing effort survey.

Currently management is operating on estimates from the former coastal household telephone survey and will continue to do so until the completion of SEDAR 58, after which landings, quotas, and targets will be based on the new FES estimates. Just to show a comparison of what we're managing on right now.

The telephone survey landings estimates, you see those here. With the ACL that was formerly in place through the coastal migratory pelagics FMP. That is shown there; and you can see the overages that occurred in 2015, '16, and '18. By comparison the landings estimates through the Fishing Effort Survey are shown here.

The overall picture, if you're comparing the numbers between the two; is that the FES landings are approximately double, in some cases a little bit more than double those of the telephone survey estimates. But one thing that I do want to be clear about here is that we are still managing on those telephone survey estimates; because all of the targets and the recreational harvest limit that we're operating on right now, were derived using the telephone survey landings.

Now I'll move into the goals and objectives section. First of all a brief summary of the brief management history, the Commission's FMP was established in 2017; and first implemented last year. This adopted the coastwide commercial ACL from the coastal migratory pelagics FMP, and also set a recreational harvest limit, which was derived from the recreational ACL. The recreational harvest limit is the ACL less a 1 percent *de minimis* set-aside, and this is allocated as state harvest targets. Those targets are shown in the table.

Recreational landings are evaluated against these targets as three-year averages. The goal of the FMP is shown here on the screen with a recommended edit from the Plan Development Team; that includes language about equitable and sustainable access, while maintaining the original language concerning the timeliness of management.

If this Amendment is ultimately approved, this edit would be part of that decision making process. The Board would have to include it in a motion; along with any of the other options that are selected for approval. Similarly, the Plan Development Team recommends two additional objectives to those already in the management plan.

These would be subject to a similar process for approval as the edit to the goal. The additional objectives include implementation of management measures that allow stable, sustainable harvest to Atlantic cobia in state and federal waters; and establishment of a harvest specification procedure that will allow flexibility to respond quickly to a stock assessment results or problems in the fishery, while also providing opportunities for public input on more significant proposed management changes.

A third section that was considerably revised in the draft and it will also be subject to Board approval if you all approve the Amendment; would be the definition of overfishing. Previously we adopted the overfished or overfishing status as determined by reference points from the South Atlantic Council.

This section defines a Commission process for setting these reference points; based on peer-reviewed stock assessment information. The primary peer review processes that are mentioned here are SEDAR, which would be the primary over the ASMFC process; as the assessments are still being conducted through SEDAR going forward.

But if anything were to happen to that, then obviously the Commission would be able to use the independent external peer review process as well. Now I'll move into the monitoring program. There were a few changes that will need to be made to the monitoring programs concerning the shift over in management.

From the commercial side in 2019, NOAA Fisheries will continue to monitor the landings. However, beginning in 2020 non-*de minimis* states from the commercial side, which through the criteria that are being proposed later on in this draft Amendment that would include Virginia, North Carolina, and South Carolina.

Those states would begin monitoring the landings of the commercial fishery. On the recreational side the primary landings monitoring tool will continue to be MRIP. We are aware that Virginia has a required reporting process. This does not replace the MRIP estimates. To this point it may help inform some management decisions; but MRIP is still going to be the primary method by which recreational landings are estimated.

As I said previously, stock assessments will continue to be conducted through SEDAR. The Commission will work through the representation on the SEDAR Steering Committee to schedule future cobia assessments and monitor the status of this stock. Finally I'll get into the management program.

Within the management program there are nine issues that are laid out. Some of them have multiple options; some of them do not, and I'll identify those as we go through them. But this is a section that I'll try to take a little bit more time and give some explanation on these different options; and what's being proposed here.

Issue 1 is the harvest specification process. There are really two parts to this; and you can read the specifics of the different options in Section 4.1 of the draft Amendment. But there are really two big parts to these options; the first part is what measures are subject to the harvest specification process.

As we have it, it's the same in all three options. That would be the total harvest quota, so a quota for both sectors could be set through this process. Vessel limits, possession or bag limits, minimum size limits, and the commercial closure triggering mechanism, which I will talk about a little bit later in the presentation. The other component of these options is the timing with which they would be set; and for which they would be in place. Option A has these measures set up to every two years; B is up to every three years, C is up to every four years. Really the distinction between the options is just the timing how long can the Board put management measures in place. The next section is the Sector Quota Allocation. There weren't any alternatives recommended by the PDT, mainly because there isn't any information that would suggest a deviation from what's currently in place.

The recommendation from the PDT, the only option that is spelled out in the draft Amendment is to adopt the sector allocation that was in place from the Council management, in which 92 percent of the coastwide total harvest quota is allocated to the recreational fishery, 8 percent is allocated to the commercial fishery.

Moving into the recreational management measures section, there were a few items there, a few management measures that are simply being carried over from the previous management plan; with no recommended deviation from those measures. The minimum size limit remains 36 inches fork length with the total length equivalent for states that use that measurement.

The bag limit remains one fish per person. The vessel limit continues to be set by the states; not to exceed six fish per vessel, and the seasons and the allocations the methods for setting those remain the same. The table that you see on the screen is adapted from Table 10 in the draft Amendment; and these just show the allocation percentages that we're working under right now, and the corresponding state targets under the current 620,000 pound recreational quota.

The percentages that you see here, if you compare them to the original FMP they're going to be slightly off; because the original FMPs table did not include the *de minimis* set-aside that's included here. That causes a little bit of change to the percentage; but the numbers and allocations themselves are the same.

For Issue 3 under the Recreational Management Measures, this was the only option that was identified by the PDT; there weren't alternatives. This had to do with the evaluation of recreational landings; and a response to an overage. This really is trying to clarify some of the implementation of the process that was originally proposed in the FMP.

When the PDT took a look at that process from the original plan there was a lot of ambiguity in the language; so we're trying to shore up some of that more, distinctly spell out that process. The recreational landings as proposed here; the recreational landings would be evaluated at the same time as whenever the Board specifies harvest.

Those two processes would be tied together. The recreational landings would be evaluated as an average of annual landings; and this average would include up to the three most recent years of data. It would be a rolling average. The average would include years only with the same regulations, even if less than three.

I have a specific example that I'll go through after this slide; to try to spell out some of the different scenarios that may play out under this. The terminal year for evaluating landings will be the previous year. For example, if the evaluation or specification occurs at the August, 2020 meeting, the terminal year of the landings that would be used in that meeting would be 2019. We wanted to spell this out; because of the timing of the availability of data for the recreational and the commercial sectors of the fishery. States with consistent underharvest for at least three years may apply to relax measures while still remaining under their target. This is again something that was brought up in the original FMP.

But the PDT felt that adding the language of consistent underharvest, and putting a length of time to that would be helpful for spelling out which states can and can't apply for relaxed measures. Table 11 in the draft Amendment is a large, and looks like a pretty intimidating table. I want to step through that; because what it does is it shows a variety of different scenarios in which this landings evaluation and the management response process, how it plays out.

I'm going to be taking it section by section looking at these different time blocks. Looking at this first time block, these are all hypothetical harvests, and a hypothetical state that has a harvest target of 100,000 pounds. In order to accomplish this harvest target that state set the shown vessel limit and season; a four-fish season going from June 1st to August 30th.

The harvests that are shown there occurred and, when you average out the harvest from 2018 through 2020, they come out to an average of about 98,000 pounds. The state is in good shape there. They've achieved their target in those three years; so in 2021 when they're evaluated no changes are necessary, and they set their regulations for '22 through '24 based on the same ones that were already in place.

We move into the next evaluation time block, '21 through '23; with that evaluation and specification process happening in 2024. In this case the harvest generally increased; so the average harvest over that three year time period from '21 through '23 is 5,000 pounds per year over the target. Therefore that state is required to reduce their season or their vessel limit in the next specification period.

Moving into the next period, you'll notice that there was a color change to these boxes. It doesn't show up on the screen quite well but 2025 and '26 are different colors there, because instead of having a season from June 1 through August 30 that state reduced their harvest by reducing their season. Now their season starts June 10; it starts a little bit later, and they're hoping that that would achieve their target of 100,000 pounds.

When we look at 2027 that is an evaluation year, you'll notice that the years that are evaluated in '27 are only '25 and '26. 2024, since it was on the old regulations, it is not included in that average. We're only looking at that two-year average instead of a three-year average, but those are the most recent years available under that management regime.

According to those landings they're under their target so they're in good shape. Regulations are then set for the next three years. Finally, we look at the three-year time block from '27 through '29. The state has consistently in every single year from '27 through '29 harvested under their target.

Because they have harvested under their target in every single year throughout that time block, they are able to submit liberalized measures to the TC and Board for their review; and for implementation in 2031. Obviously considering the previous management regime that was in place with a June 1 start date, if they were to only change their season they would have to go somewhere between June 1 and June 10. That information would be considered in the evaluation of whether the proposed measures would achieve the target.

But they are eligible to submit for those liberalized measures. Looking in previous years, there were years where it kind of bounced around or up and down; above and below the target. If that's the case then the state would not be eligible to submit for those liberalized measures. Again, the regulations will be set based on that information for the following three years.

Hopefully that was not too confusing when stepped through like that. But at the end of the presentation if there are questions about that I am certainly open to answering them. Moving on to the next issue, Issue 4, the options that are here are really just two options; the current the status quo option is to continue managing in terms of pounds for the recreational fishery.

Option B is to convert the pounds into numbers of fish; and that process is spelled out below the option itself, and the management would occur with landings, quotas and targets all being set in the numbers of fish. Moving into commercial management measures, Issue 5 is looking back at the minimum size limit for the commercial fishery.

Status quo option is to maintain the 33-inch-fork-length; which is equivalent to 37-inch-total-length minimum size limit. From public comments there was also some desire to set the commercial minimum size limit to be equal to the recreational. That is Option B. Option B has 36-inches-fork-length, 40-total-length, and that is equivalent to what the recreational minimum size is.

Another one of kind of the carryover measures that's not being reevaluated in this Amendment is the possession limit for the commercial fishery. The commercial possession limit would be maintained at two per person, not to exceed whatever the vessel limit is for that state. It's a coastwide vessel limit that would be set through Issue 6.

There was some desire through the public comment to reevaluate the commercial vessel limit and look at reducing that. We have options here for 6-fish, 5-fish, or 4-fish vessel limit in the commercial fishery. Then moving into Issue 7, this is one of the issues where there was only a single option recommended by the PDT.

This involves the new quota-based management that would have to be operated by the Commission. It's really a somewhat similar management regime to what was in place under the Council; but now the Commission has to kind of accommodate the state processes for being able to close the fishery if the quota is met.

The coastwide commercial quota would be set through the harvest specification and sector allocation processes defined in the earlier sections. Landings would be monitored by the states in season; and there would be a trigger mechanism that would be set through that harvest specification process as well. In general it would be set such that if coastwide non *de minimis* landings hit X percent of the non *de minimis* quota, a coastwide closure would occur Y days later. To accommodate state processes, this trigger would need to be set allowing at least 30 days from the estimated trigger data to the estimated closure data. The trigger percentage and the number of days until the closure again would be set through the harvest specification process. Just giving an example, based off of recent commercial data using 2015 through '17 weekly commercial data and the 2019 quota that is currently kind of carried over from the previous council management.

The commercial fishery would close 32 days after the commercial landings reached 77 percent of the commercial quota. That is what would be in place. The landings will be monitored and, once they hit that threshold point, a closure date would be set and after that date a coastwide closure would occur. That would occur in the state waters. It would also be recommended to NOAA Fisheries for that closure to be enforced in the EEZ.

For Issue 8, Issue 8 brings up the establishment of a commercial *de minimis* status. Option A is the status quo that there is no commercial *de minimis* status. Option B would bring that status into place. It spells out the eligibility criteria; state commercial landings for two of the previous three years must be less than 2 percent of the coastwide commercial landings for the same time period.

Many Commission plans use 1 percent as their threshold; but due to the small size of the commercial quota, there were one or two states that if 1 percent were the threshold they would kind of be flip flopping back and forth, in and out of *de minimis* status. That would be due to a fraction of a percent being over that threshold in some years.

To eliminate that it was set at 2 percent. The PDT felt comfortable with that still being a fairly minimal amount of landings. The commercial *de minimis* states would be subject to all coastwide commercial regulations including *de minimis* size, possession, vessel limits, as well as closures of the commercial fishery that would result from the quota being reached.

De minimis status would not be required to monitor commercial cobia landings for their state within the fishing year but they still would be required to report the annual landings through their state compliance reports. To account for the unmonitored landings in *de minimis* states, 3 percent of the commercial quota would be set aside and not accessible to the non *de minimis* states.

Finally Issue 9, the Recommendation for Federal Waters. This is the issue that gave Law Enforcement Committee all kinds of headaches on Tuesday. The recommendation is able to be set through the ACFCMA process. As I said in the commercial measures, and this would also be in place for recreational measures.

If any coastwide closure occurred in state waters through the Commission process, the Commission would recommend that NOAA Fisheries also close the EEZ in the same way. There were three options that were laid out for this issue. Option A, regulations in federal waters would be recommended to correspond to those of the vessel's state of landing. Option B, the regulations would be recommended to correspond to the location of catch with essentially an extension of state regulations into federal waters. Option C would have kind of a hybrid of those two; in which the regulations in federal waters would be recommended to correspond to the state of landing, but there would also be the ability for states to apply for specified areas of restricted harvest, in which those specified areas would have a different set of measures than the general EEZ related to that state.

A rough example is shown at the bottom there where you have your state waters, hypothetical state with a three-fish-vessel limit going out into federal waters. The vessel would be accountable to whatever the landing state is; but you see that kind of dotted area. That would be one of those specified areas; and within that specified area there would be a one-fish vessel limit.

As I mentioned, this was brought to the Law Enforcement Committee on Tuesday and they gave some recommended edits to this section. First of all they are not in favor of Option C. The complexity of it and the enforceability of it doesn't seem realistic to them. They also recommended for Option A due to some individuals within the fishery having multiple licenses coming from multiple states, to try to diffuse any confusion about where that vessel may be landing to tie state of landing to the permits.

There is some language here. The regulations would be recommended to correspond to those of the vessels permitted or licensed state of landing. If that vessel or that individual possesses a permit or license for multiple states, all of which are open, then they would be fishing on the regulations for the most restrictive state.

If that individual possesses a permit or license for multiple states but only one of them is open, then they are able to fish on the regulations for the state that is open. Then Option B; they in general supported that because when on-the-water intercepts occur, they are able to determine a location. Then they can see from the location these are the regulations for fishing in this location.

That was probably the most supported option from the Law Enforcement Committee although they did also put forth a recommendation that I believe in previous meetings wasn't heavily supported by the Board. But to have just kind of a blanket set of measures for federal waters that would be more easily enforceable than sectioning off sections of the EEZ, especially with respect to the seasons and the vessel limits that may differ by the corresponding state waters, or the adjacent state waters.

We did have a call with the Advisory Panel. There were two attendees to this call. One additional member did write in some comments. Nobody from the Advisory Panel objected to the options as presented in the draft Amendment that you see. The attendees supported equal minimum size limits between the sectors.

They did not express any preference for any of the federal recommendation options; but they do recognize that there are some difficulties really with any of those that would eventually be chosen. With that I can answer any questions; and just a carryover from my AP presentation, I am always looking for cobia pictures that we can put in presentations and on the website; so anyone that has those I would appreciate them.

CHAIRMAN GEER: Thank you very much, Mike for that great summary and all the work you've done on this document. I'll take comments at this time with discussion. Robert.

MR. ROBERT H. BOYLES, JR.: Mike thank you for that excellent summary. This is a lot of work and we're excited about taking a lead role in cobia stewardship. I want to go back to your last Section 4.9 and just remind the Board that these are federal waters management. Just be advised that in South Carolina, cobia are a game fish.

They have been a game fish for a number of years. Our legislature did that. Again, our commercial landings, very low documented commercial landings. That may throw a potential wrench in the works; because I like Option B, in terms of extension of those. But I think that's going to be something that we have to acknowledge and work through.

CHAIRMAN GEER: Adam.

MR. ADAM NOWALSKY: Obviously New Jersey is not going to be a large player in this fishery; but as I've sat through these Board meetings I've consistently been willing to engage on the recreational component, based on our experiences in other fisheries. When I look at Section 4.3.5, I'm encouraged by the multiyear evaluation perspective; to bring some stability. I had a question though with regards to the required reductions.

One of the things GARFO has moved towards is willing to accept the need for reductions or liberalizations based on confidence intervals around the harvest estimates. Is there consideration of that in here; or are we taking a step back from what we've moved to in the Mid-Atlantic and Northeast, with regards to using those catch estimates to determine whether or not we have exceeded or not exceeded a catch target?

DR. SCHMIDTKE: There isn't any consideration of confidence intervals about the estimates. I guess I would ask if GARFO has a multiyear averaging process there because, really, if they don't then there are just two different approaches to try to address the uncertainty associated with the recreational estimates.

One of them is looking at the three-year average; taking in multiyear uncertainty. The other is looking at confidence intervals for a given estimate in one year. There are two different ways of trying to get at the same goal of not taking a specific point estimate in one year; and using that to determine to make management decisions on that one estimate, and try to incorporate some of that uncertainty and look at an overall trend.

CHAIRMAN GEER: Follow up.

MR. NOWALSKY: Yes, by and large we're doing things on an annual basis right now; although there is hope we can move to a multiyear basis. I think the takeaway is, is this Board comfortable that that has been given adequate consideration, and that the averaging approach will account for the interannual differences with the catch estimates? If you are okay great; move forward with it. If you're not I would encourage additional consideration of those widely varying fluctuations that are going to occur on a year-to-year basis. The second item here that caught my attention was that in the example, 2024 stated required reduction based on the over target average of the last three years. When we jump down to 2030, we go to may submit liberalized measures for TC and Board review. What caught my attention here is that one of the issues we've run into is that when states have had the opportunity to liberalize measures.

In many cases they have chosen not to take the full liberalization, or any liberalization, on the basis of well we're afraid of overharvesting in future years. There is a conservation benefit here to not liberalizing. The takeaway from that the unintended consequence however, is that you've now given up what you've been able to give back when you have to take a reduction.

I would be interested in hearing thoughts about this element of required reduction versus may liberalize; as that has proven to have a significant impact on our recreational fisheries. Is that how you want to proceed here? Is that going to not cause you to have the same deficit in regulations that we've had further north on the coast?

CHAIRMAN GEER: I'll chime in on that. I think using the word may, gives the state the option. The idea of this plan is to try to have as much flexibility as possible. I see where you're coming from; but relaxing regulations, I think that's up to the individual states in that regard. That is my opinion. I don't know what everyone else around the table thinks. Spud.

MR. A. G. "SPUD" WOODWARD: I think Adam we're going into this realizing that we're probably going to have situations where we have recreational harvest estimates that are going to be very troublesome. In fact I would probably use the term "unconfidence" index around them instead of confidence indices; because that's what's plaguing us in this situation.

I think we're trying to find a balancing point where you have enough stability to be able to look at an annual estimate; and make some almost informed judgment determination of whether that estimate is valid to consider, in the aggregate of all the estimates. We know we're going to face this to some degree; and we're going to have to just probably make some difficult decisions.

I mean, the state of Georgia has literally gone from recreational catch estimates of zero to 250,000 pounds; over the course of three or four years. I mean that's how widely variable it can be; and that's not going to change. I think on the issue of liberalization. I think the thought there is as Pat said is to give states the option; because it's a risk and uncertainty analysis is what it comes down to.

If we liberalize, knowing that we're going to have catch estimates with unpredictable outcomes; then you could very easily come back in a situation where the pendulum swings back to the other end. I think this is going to be one of those situations where we're going to do it; and we're going to learn as we go. Then we're having an assessment that is coming forth based on new MRIP estimates; so who knows? There is a lot of uncertainty going on right now in this fishery.

CHAIRMAN GEER: I have Mike and then Lynn.

DR. SCHMIDTKE: I just wanted to add one additional comment related to the requirement to reduce. One thing to point out in this entire thing; and to highlight what this plan is. The reduction is not a reduction in the target. It's not what the state would be shooting for. It would you know essentially what it means is the season and the vessel limit that you set is not achieving the target. We're still trying to achieve the same target. There are no types of reduction to that or payback. But in order to achieve that target we need to narrow on what is an appropriate season, what is an appropriate vessel limit to be able to catch that amount of fish.

CHAIRMAN GEER: Then I have Lynn.

MS. LYNN FEGLEY: Thank you, Mike, and to the PDT this is just a good document and a lot of work. To Adam's point about the averages, if I remember we had a really long conversation in regards to the *de minimis* states about whether to use an average or two out of three years, in determining whether a state was *de minimis*. Because the thought was just that if you have a sudden really large estimated catch; then using an average you could pay for it for a while. We wound up for the *de minimis* criteria it's two out of three years.

I don't know at this point. As Spud said there is a lot of uncertainty here. But we did have this conversation in regards to *de minimis*. I'm not sure we had it in regards to the evaluation. Then my other question was to the liberalization point. Because we're in a situation where the *de minimis* states match their neighbors, Maryland is matching Virginia.

If Virginia gets to a point where they submit to liberalize; and its decided they can liberalize, but Maryland doesn't want to liberalize, because to us it looks like if we did liberalize we could be kicked out of *de minimis*. How would that work? Because the Plan says we're matching; would we have the ability to maintain status quo, even if our neighbor state liberalizes? I assume we can always be more conservative than the Plan.

DR. SCHMIDTKE: That's something that is not quite addressed and that may be something that requires some additional thought. I mean the first thought that comes to my mind is the ability for states to be more conservative; and trying to reconcile that with the *de minimis* criteria of matching a neighboring state. That is something that I don't have an immediate answer for.

CHAIRMAN GEER: Let's go to Toni.

MS. TONI KERNS: I have to think through it in full. A state can always be more conservative than the FMP; it is their prerogative to do that. But for the *de minimis* measures they're tied to their neighboring state. If you want to be more conservative than your neighboring state then I think you should probably be able to figure that out.

I need to read the *de minimis* language again; and see if it would cause any issues, because then does that require – so if we have Maryland, Delaware, New Jersey are all *de minimis*. Say Delaware decides to be more conservative than Maryland. Does that mean New Jersey has to match Delaware's regulations? I need to think through that issue.

CHAIRMAN GEER: Lynn, follow up.

MS. FEGLEY: I think it might be worth just thinking through that one, thank you Toni, a little more; and really what happens as the year's progress. If you're getting farther apart, how does that play out in the future? I don't have a suggested answer right now; but we may want to think about it.

Then Mike, I guess my question to you is, as for the averaging issue on the evaluation, do you have any thoughts as to whether or not using that rolling average is a better solution in the face of widely varying estimates than using a two out of three years? Do you have any thoughts on that particular issue?

DR. SCHMIDTKE: I couldn't advocate one versus the other. I wouldn't really want to because it's not fully my decision to make. But if it's the Board's pleasure of having an option of consideration for that evaluation response to be two out of three years, as opposed to an average. I guess now that I'm thinking about it, one issue that it brings up is if management changes, because if you go with a two out of three, then that means you need three years in there to evaluate.

If you have an evaluation year, specification year where there was a recent management change; would you want to include a year or up to two years of management that was already determined to be unsustainable, and be evaluated based off of those regulations? The thought that the PDT had was no; which is why the rolling average was introduced; so that you would only be evaluated based on management that at the time seems like it is going to be sustainable.

CHAIRMAN GEER: I have Chris next.

MR. CHRIS BATSAVAGE: I would like to go back to; I think it is Option 9, and Robert's concerns on how that's written relative to the game fish status in state waters for South Carolina. I think his concern was going under Option B where the state measures get extended out into federal waters. That would extend gamefish status out into federal waters; where right now commercial fishing is allowed in federal waters off South Carolina.

When we were putting these options together, we were really contemplating the recreational fishery; because we don't have state-specific-commercial measures. It's going to be basically whatever the size limit is and whatever the per person and vessel limit out coastwide. To fix this issue that South Carolina faces, can we specify that these options are for the recreational fishery or won't impact the commercial regulations in federal waters, to kind of work around the problem South Carolina currently has that the other states don't have?

CHAIRMAN GEER: I have Mel.

MR. MEL BELL: Just to follow up on that a bit. We do have a different approach from our conservation measures and our regulations that are in place; if we had the ability to extend some of our state codified measures into federal waters that would be great, not necessarily all of them. That would be one solution I guess; to tease out commercial specifically. But we've also got some differences too in that we have an area in the southern counties that the three sounds down there that are the spawning grounds for this distinct population segment that we're trying to rebuild right now. Right now, the month of May, it's no retention. Wouldn't necessarily want to extend that out into federal water; and then draw another line. You know you would have, let's say the boundary between Georgia and South Carolina and North Carolina and South Carolina extended out. I'm not looking to extend another line out for the southern counties.

If we have the flexibility to implement at least some of our state codified measures that would be great, but I don't really know if the way things are worded that it allows you to do that or not. It's sort of all of nothing; or could we actually just propose to extend specific things out, or do we need to change something right now to facilitate that?

CHAIRMAN GEER: Toni.

MS. KERNS: I have a question about the Law Enforcement Committee's recommended language to add to the document. In lobster we use the most restrictive rule; and when you have the most restrictive rule and one state is closed, then that permit you cannot fish in either of the areas that you're allowed to fish in.

Under the first part of this I would think that that would apply. If you have multiple permits and one of those seasons is closed, then you wouldn't be able to fish at all. But then in the second sentence it says if you have multiple states, only one of which is open, then you could fish. You see where I'm going.

Under one it doesn't let you fish; and then in the other it does let you fish. It's sort of counter intuitive to me. I'm trying to figure out the rationale there. Is it that you're trying to prevent someone from fishing that has multiple permits; but then giving them the opportunity when only one state is open? But you're not giving them that opportunity when one state is closed and the rest are open.

CHAIRMAN GEER: I have Mike.

DR. SCHMIDTKE: The first part of that it's a conditional statement. There are two conditions. If they have obviously multiple permits and if the permits for both of those states are open. Then it is more restrictive; and the goal of that was so that you can't just have multiple permits and pick the one that is least restrictive.

That was the reasoning behind that. But at the same time if somebody has multiple permits, they have multiple permits so that they can be able to fish from multiple states. The second part is if there was a closure in one of those that they are still able to operate. I mean this can certainly be edited; but this was something that was proposed there. Because of the conditions I think that is why it wasn't seen as contradictory.

MS. KERNS: I guess my point. I'll use an example to try to make my point come home. If you have a permit from Georgia, South Carolina, and North Carolina, and two of those states are open but one is closed. Under that first condition you wouldn't be able to fish; because the most restrictive rule would apply, and one state is closed. But under the second condition it says that only one state is open; then you could fish. See where I'm going?

DR. SCHMIDTKE: In the example that you stated, multiple states have open seasons. Right, but multiple states have open seasons, therefore you can fish on the most restrictive, and maybe it's most restrictive open state. Maybe that needs to be added.

MS. KERNS: Okay, it needs to say the most restrictive open state because if it's the most restrictive rule applies, the most restrictive is closed.

CHAIRMAN GEER: Adding the word most restrictive open state shall be applied. Is that okay with everybody? Mel's looking it over. Are there any other questions or comments? Lynn.

MS. FEGLEY: I just had one question and one editorial comment. The question was, I just wanted to clarify under Issue commercial *de minimis*. Under the option, Option A, where a state cannot apply for *de minimis* for commercial, if that option was chosen then that means that that state has to figure out how to monitor its landings in season? Is that correct? Okay, all right thank you for that.

Then the other one I just wanted to say was there is language in the Plan; and I think I wrote it down. It's on Page 42 that talks about the TC and the Management Board coming up with an equivalent total length for a 36-inch-fork length, but a 40-inch-fork length is offered later in the document in a couple of spots as an equivalent to 36 inches. Just be aware that that slight inconsistency is there. I can send it; mail it to you if you want.

CHAIRMAN GEER: Mel and then Adam.

MR. BELL: I think Robert mentioned this earlier but, related to what we're looking at there. Option B under there appeals to me. Our focus is really more on the recreational fishery. We had a commercial fishery in state waters; and our recreational fishery was predominantly state waters forever.

What we did for decades was we heavily fished spawning aggregations of these fish in the southern counties, which is what we've now determined genetically is a distinct population segment. But because of what we did to that DPS, that resulted in us achieving gamefish status for cobia, because basically that was the heart and soul of our cobia fishery.

The commercial fishery is gone in state waters. We've dealt with that for a few years. The recreational aspect now, so B appeals to me if what we're able to do there is extend our conservation practices related to that distinct population segment out into federal waters. I'm not so much concerned about the May closure, again, because when we're out there it's kind of a mixed stock, if you will.

When they come into our sounds, we can genetically distinguish them as sort of our fish but would like to afford the degree of protection in the recreational fishery through implementation of the three-fish boat limit out there. Regardless of where your boat is from, and since we're fairly close to Georgia at that point, and we know we get fishermen out of Savannah that do fish on the artificial reefs off this area that are potentially right now allowed six fish in the boat. What we would prefer to do; and it's not a matter of equitability or fairness to our fishermen, because they would tell you they're not happy with that six-fish boat limit either. Our fishermen will tell me as they have consistently; I mean they would even go for a two-fish boat limit. But they would prefer to see, if South Carolina is going to take some responsibility for management of cobia in our waters out there, they would like to be more conservative. If B allows us the ability to have that as an option, where you would abide by a three-fish boat limit in federal waters off of South Carolina, then I think we're good.

I just want to make sure that I'm reading this right; and that we could actually do that because I know there was some concern about okay what is the registration of the boat, is it a Georgia boat, is it a South Carolina boat that sort of thing? But implementing enforcement on the site where the fish are aggregated, where the fishermen are aggregated. To me that makes sense from an enforcement standpoint. You go where the fishermen are if you want to check cobia fishermen.

I just want to make sure B allows for that option, because that's our concern. Right now the recreational state fishery is really no longer there. We're a federal fishery now. I'm real sensitive to our ability to influence federal waters. If we're allowed to do that this way then I'm fine with that. If I'm not reading that right or there are some issues, then maybe we need to discuss that or seek some other wisdom.

CHAIRMAN GEER: Mel that is my understanding, if anybody on the PDT thinks differently, I think that was our thought on that. It's extending it out into the federal waters along those lines. I get thumbs up; Spud.

MR. WOODWARD: That is thoroughly my understanding. I do think this matter of being able to land fish caught in federal waters and sell them in South Carolina is still somewhat uncertain. But as I understand it, if the state of South Carolina says that you can land and sell a cobia caught in federal waters, then that applies along that same corridor just like your bag limit and anything else would. I mean it's my understanding that that's how that would work.

CHAIRMAN GEER: Mel, follow up on that.

MR. BELL: Yes and to that point. We have no intention of desiring to close down the federal fishery out there; the commercial aspect of it. We're fine with that. We don't have a huge fishery anyway; it's maybe 4,000 pounds or something. If B works for those purposes then we're happy.

CHAIRMAN GEER: Adam, I saw you had your hand raised.

MR. NOWALSKY: Yes, I was going to go back to the recreational issues unless you would like me to defer to make sure that conversation about this topic is complete first.

CHAIRMAN GEER: Let's make sure this is done first, thank you. Are there any other comments or questions on this issue? Wait one second, a couple more minutes' folks, all right Toni. I apologize for the delay.

MS. KERNS: Sorry, Mike and I were trying to think this through. I think under Option B, you might want to have sort of a sub-layer, one for recreational one for commercial. On the recreational one you would say you would extend your boundaries for your recreational fishery; but for the commercial fishery.

I think maybe the solution would be to make a recommendation to NOAA Fisheries that the regulations in federal waters are bound to the commercial vessels landing permit in order to give them a set of regulations that they could enforce when offshore in federal waters for South Carolina because, if you just extended the boundaries then it would be nothing. There would be no regulation because you're gamefish. You would need something for them to have. That is the only solution I can think of off the top of my head.

CHAIRMAN GEER: Mel.

MR. BELL: Yes to that specifically. There is no federal cobia permit within the coastal migratory pelagics group, which it was.

CHAIRMAN GEER: It was it's not any more.

MR. BELL: Cobia didn't have a permit and that was part of the problem we were having in managing it. There isn't anything to reference there.

MS. KERNS: That's why I would suggest tying it to their landing; the commercial vessels landing permit, because they would have to land somewhere.

MR. BELL: You mean their state license.

MS. KERNS: Their state license or landing permit, yes.

CHAIRMAN GEER: Does anybody have problems with us adding that wordage? Does everyone feel comfortable with the PDT taking that on; or do they want to see it first? Just try to do it on the fly? Mel.

MR. BELL: Can I just clarify something in my mind how this works? The states monitor their commercial landings. No problem. We reach the allocation or the limit or whatever. Then we as a state would notify the Commission, who notifies NOAA or we notify NOAA that we've reached that limit? You mentioned earlier that then NOAA Fisheries would have to actually close the fishery in federal waters. I was just trying to figure out the mechanics of that how it works.

CHAIRMAN GEER: Mike.

DR. SCHMIDTKE: The states would monitor the landings. They would report the landings; and I guess the way that I'm envisioning it is the states would report commercial landings to the Commission. When the non *de minimis* landings hit that 77 percent or whatever that example was. But whenever they hit that threshold, then the Commission would inform NOAA. We would recommend that NOAA close the EEZ on this date. We would also be informing the states that the closure date is this date.

CHAIRMAN GEER: Toni.

MS. KERNS: I would just say that under this extension scenario federal waters wouldn't necessarily close on the commercial fishery side, when one state harvested their quota, because if there are other states that can still fish in federal waters they could still do that. Then bring home to their state of landing for commercial. It is similar to how we manage summer flounder, in the sense that a state may achieve their quota, but other states haven't, so there is still fishing going on in federal waters. For the recreational it would be different.

CHAIRMAN GEER: Yes Mike.

DR. SCHMIDTKE: Commercial is a coastwide quota. It's not state quotas. Coastwide measures, coastwide quota.

CHAIRMAN GEER: I have Spud, and then I have Lynn.

MR. WOODWARD: Yes I can give you a scenario. Georgia is a miner contributor to the coastwide commercial harvest; but what would happen is basically when North Carolina and Virginia sort of hit that 77 percent mark, then we're going to be notified and we'll basically advise the Commissioner of DNR to take action at some point, 30 days or whatever later, to basically prohibit the commercial sale of cobia in Georgia. That's how it would work. It will be whatever happens as a coastwide aggregate drives the process.

CHAIRMAN GEER: Lynn, did that answer your question?

MS. FEGLEY: Yes, I think it did. I think so. I know in Maryland when we vote regulations for cobia, it's very small, but all of our fish harvested from our coastal waters are required to go through federal dealers so that NOAA gets that information pretty much immediately. I don't know, just to make you aware in the monitoring. Like I said, we're a really small player; but I think the scenario that Spud laid out makes sense.

CHAIRMAN GEER: The *de minimis* states that quota is already taking out and considered already. That is off the board already. Then I have Mel.

MR. BELL: In that scenario the actual closure of the federal waters would be an action taken by NOAA Fisheries. Okay, because where I'm going with this is then therefore by reference we would automatically close. I don't have to go to a Commission or I don't have to go to my legislature to close it. Just like previously, whatever they said. We call it the, what they say we say law, so if the Feds say it's closed it is closed. That works for us.

CHAIRMAN GEER: Lucky you. Okay anything else on this issue? Not hearing anything else everyone is satisfied? Okay, Adam.

MR. NOWALSKY: Going back to the recreational side again. The states reporting a consistent underharvest for liberalization, am I to read that as a consistent underharvest means underharvest every year? Is that what that is supposed to mean?

DR. SCHMIDTKE: Underharvest every year for at least a three year period.

MR. NOWALSKY: What was the rationale that the PDT used for using those criteria versus the average landings during the three year timeframe?

DR. SCHMIDTKE: Because of the fluctuations that landings may have above and below the target; in the same way that you know the landing may go above and below the target within a three year timeframe and still achieve the goal, the target, the average landings are beneath whatever that target is.

The scenario for liberalized measures, the PDT really wanted to apply only to states where it is abundantly clear that these measures could be liberalized; that an additional fish could be taken, and they would not exceed their target. The PDT felt well if they're bouncing around their target already then there is a probability there that if they liberalized that they would start exceeding.

CHAIRMAN GEER: Follow up.

MR. NOWALSKY: But yet in the previous paragraph we're saying that if it's bouncing around there is no chance that we may be under. We're bouncing around, our average is over, and therefore we have to reduce. I'm not comfortable with it. Just from the experiences, the pain we've had. I mean to channel Robert Boyles' comments about using state descriptions earlier.

This is supposed to be the kinder, gentler Board that we have here. I don't really want to see the South Atlantic Board in front of the Policy Board the way the Summer Flounder Board has consistently been there. I think this section should be modified to at least provide options;

so that the opportunity to liberalize and reduce are treated the same.

I think that there should be an option to consider the confidence interval or "unconfidence" interval around the three-year average. If we can't get there in a reasonable timeframe, if there is no consensus around the table here to do that. I think I would probably find myself in abstaining on the vote to release this; just because I don't endorse, and I wouldn't endorse this in our other recreational fisheries.

I think it's a step forward. It's there. But I think the options here can be better; especially for a fishery that is 92 percent recreational. I know there has been a lot of pain already. I think the fact that there are no members of the public here today speaks to the pain that has already been suffered with this. I see these options here as causing more pain for the recreational sector.

CHAIRMAN GEER: If we take that up, the PDT would have to meet again and we would have to – we could put some wordage. If it's the pleasure of the Board that we do that we can address it. We would probably have to send final approval out through an e-mail or some other manner. Nobody really wants to do it that way. What does the Board think about this? I'm not hearing anything from anybody? Chris.

MR. BATSAVAGE: I don't have a solution. But I would expect to hear some concern, definitely feedback from the recreational community on this option. I'm on the PDT. I understand why we put in this measure we need to have three years of consistent underharvest before a state could consider liberalizing; just due to the very high variability in recreational cobia harvest. We want to prevent states from chasing one year estimates. But I agree with Adam. There is going to be a lot of, I think concern from the recreational community on this issue.

I don't know a way around it because we've seen with other fisheries with better, more consistent recreational harvest estimates that we can get into a trap where we think we're liberalizing a little bit, and then the landings are much higher than expected. I guess all I'm doing is acknowledging Adam's concerns that we will hear this when we go out for public comment. But I don't know what the solution is. It's based on the nature of the harvest estimates.

CHAIRMAN GEER: The PSEs for some of the states are very high. Like Spud pointed out, some years in Georgia it is zero, some years it's a quarter million pounds. That is a part of the nature of this fishery and the MRIP data. I'm not sure if I know how to address that. If we put confidence intervals on these they are going to be so broad. I don't know if the management action is going to be useful at all; that's the problem. I agree; I mean I think you brought up some very good points, Adam. I'm just not sure how we can address them with this species. Mel.

MR. BELL: It just seemed like we're taking the approach where we're looking at the three year period versus what we used to do. When we were living under federal management we were living from year to year and we were having some horrible things happen, you know in a given year. It seems like we are heading in the right direction. We're better off than we were.

We may hear some more from the public when this goes out. But you know I don't know how to tweak it at this point and any more. But I am more comfortable with looking at three years of data than just what we were doing under the old process with federal management. I feel we're better off than we were.

CHAIRMAN GEER: I see a halfhearted hand from Lynn.

MS. FEGLEY: I'm really torn. This is very difficult; and I don't have a solution, except that I wonder if there is a way to incorporate some language that would allow during this evaluation for a year, for an outlier harvest estimate to be considered differently. I think it was New Jersey that had that really large estimate in one year that was an outlier.

I think that is what led us to those two out of three years, versus average for *de minimis*. But I wonder in this case, because we want to be evaluated over this time period, if there is a way to just categorize a particular estimate as an outlier, which might provide the Board some flexibility during the evaluation and harvest specifications.

CHAIRMAN GEER: Mike.

DR. SCHMIDTKE: The Cobia TC, this was something that they were tasked with previously; and the Cobia TC their basic statement on this is MRIP is going to have outliers in either direction, so if you treat the high as an outlier are you also going to be treating the low as an outlier? That was the concern the TC had about recommending any type of outlier analysis in this type of plan is will it be one directional.

CHAIRMAN GEER: Are there any other comments? What is the pleasure of the Board at this point? What would you like to do? Do you want this moving forward or do you want it to go back to the PDT at this time for further refinement; Spud?

MR. WOODWARD: I'll make a motion that we approve Amendment 1 to the Cobia Plan for public comment.

CHAIRMAN GEER: Seconded by Mel Bell. Toni.

MS. KERNS: Spud, would you be open to adding as modified today?

CHAIRMAN GEER: Any further discussion on this? Hearing none I'll read the motion. Move to approve Draft Addendum I to the Cobia Fishery Management Plan for public comment as modified today; motion by Mr. Woodward seconded by Mr. Bell. Chris.

MR. BATSAVAGE: Never mind, they changed it to Amendment 1 up there on the board now, thanks.

CHAIRMAN GEER: I'll read it again. Move to approve Draft Addendum I, Amendment I'm sorry. I'll start over again. It's been a long week. Move to approve Draft Amendment 1 to the Cobia Fishery Management Plan for public comment as modified today; motion by Mr. Woodward, seconded by Mr. Bell.

All those in favor please raise your hand; those opposed, abstentions, null votes. The motion passes 8 to 0 to 1 to 0. Thank you very much for that and it will be going out on public comment on this. Mike will be getting with everybody about that and having comments in your states. I'm sure in Virginia, hopefully it will be very lively in Virginia, North Carolina, and more people will show up. He'll be getting with everyone about that soon.

REVIEW STATE-GATHERED PUBLIC INPUT FOR POTENTIAL MANAGEMENT ACTION, ATLANTIC CROAKER AND SPOT

CHAIRMAN GEER: Moving on the other item on the agenda today is Review State-Gathered Public Input for Potential Management Action, Atlantic Croaker and Spot. Back in August we talked about an addendum to the spot and croaker plans, the omnibus for spot and croaker FMP to make changes to the traffic light approach, to do a regional approach. Oh, he has a presentation. I don't have to say anything. Okay, Mike here you go.

DR. SCHMIDTKE: All right so a brief presentation; just kind of bringing everybody back up to speed on what has occurred to bring this about. In 2017 a benchmark stock assessment was completed for both Atlantic croaker and spot; but it did not pass peer review for several reasons. But one of the difficulties that occurred with that was due to the conflicting abundance in harvest signals; which are also used in the traffic light analysis.

In February 2018, the Plan Review Team for spot and the croaker TC recommended changes to the traffic light analysis and that's included in the memo that is in your materials. These changes, if all implemented, would result in management action being triggered. Here is a table that you've seen before, a comparison of the current TLA and the proposed new TLA. There are changes there to the adult abundance indices.

Additional indices would be incorporated as well as a regional type of approach for evaluating those indices; then an incorporation of ages into those index evaluations, also a change to the reference time period. The triggering mechanism and ultimately the result that you saw last year, when there was a direct comparison made between these two methods for croaker and spot, there was no trigger in 2018.

But using the updated proposed TLA, both species would be triggered due to the indices in harvest that are seen in the Mid-Atlantic region. Following these results the Board talked about potential management actions; and also asked the PDT what the recommendations would be, as far as this regional approach, and what resulting management actions would follow from there.

The Croaker, Spot PDT recommended that management action be taken as the result of a trigger; that some form of baseline management measures be established in the form of seasons and/or trip limits. Right now neither croaker nor spot have a coastwide management in place; any type of management measures in place.

There are some state level management measures for one or both species; but nothing from a coastwide level, so the PDT would be recommending that the Board consider a coastwide set of measures in response to a management trigger, if the new TLA were adopted. As a result of this the Board requested additional time to gather some public input from the stakeholders; and several states went out to gather this input.

I have a really short summary of the different state public input summaries that were submitted in materials. You can reference those for more complete description and the state representatives can certainly bring up details that I don't include here. But I tried to stick mostly to the potential management measures that would result. Maryland, their public were focused more on spot; because they already have size, creel, and season limits in place for croaker at the state level.

The public were hesitant to support any form of reduction to the harvest or setting any minimum size, possession or season limit. There was also the comment that any regulations leading to reductions in Maryland should also be reciprocated in other states. For Virginia there was general comment against size limits; but they weren't completely against an adequately sized bag limit. They provided a suggested bag limit of 30 to 50 fish per day. In North Carolina there was not much support for any new spot or croaker measures. They suggested that the declines in landings were due to reduced effort as a result of commercial regulations. Again, if there are additional details or if I misstated something, feel free to correct me, representatives from those states. But I can take questions on that and turn it back over to Pat for discussion.

CHAIRMAN GEER: Does anyone have any questions for Mike on that? Chris.

MR. BATSAVAGE: Thank you, Mike, I appreciate the presentation, kind of showing what we've done over the last year or so. A good reminder to me and I'm sure others. Just to add to the general comments we heard in North Carolina besides not wanting to implement any additional measures or any measures for spot and croaker. I think the public acknowledge the fact there are fewer spot and croaker around than in the past.

There is really not much dispute to that. But there were also, they mentioned that just environmental changes were potentially a cause. Natural predation may also contribute; so things kind of out of the control of what we manage, and not necessarily a result of fishing being the primary reason why there are fewer spot and croaker found in the state. But I just wanted to add that to the general list of comments we received in our state.

CHAIRMAN GEER: I'll go to Lynn.

MS. FEGLEY: I just want to echo what Chris said. I think there was also a lot of discussion in Maryland about the environmental variables; and an acknowledgement that there are fewer fish. But the other thing that came up in our discussion was really the question if anything that we can do for spot could offset the issues with the shrimp trawl bycatch. If there is anything that we can do to offset that they had a lot of concerns about that.

We've gone back with North Carolina has got the additional bird requirements going in place in July, so we've updated our constituents with that information. But I just want to go on the record that there was a lot of concern that by implementing regulations in these little fisheries would just be nibbling at the edges and not attacking the problem where it lies.

CHAIRMAN GEER: That was expressed in Georgia as well as surprisingly, sorry in Virginia, forgive me. A lot of folks said that we're nibbling at the edges if we're not addressing the shrimp trawl fishery. A lot of our folks were saying it's cyclic. It's just a cycle issue. But surprisingly there was a fair amount of support for a bag limit; as Mike said.

During our discussions we didn't know what they were talking about because they said they need them for bait. That is why they didn't want a size limit. When we asked them well how many, they kind of said numbers that we were thinking anyway, so that was pretty promising in some regards for us. Commercially we get a more difficult time.

They threw out some ideas. Obviously they weren't crazy about size limit, because of culling and everything. But we were kind of trying to ask them about shortening the season just a little bit; you know trying to do something. We didn't have a lot of folks at our meeting. We had to actually create a subpanel for one of our fisheries panels to do it, so we only had a few people actually come and speak about it. Marty, you had something to say?

MR. MARTIN GARY: PRFC didn't submit any formal comments to Mike with the other jurisdictional partners. But we did participate in the calls. I did note, and I'll note for the record now that we have several boat liveries along the river that rent boats. A lot of the folks come from metropolitan D.C. area, for instance, come down to fish with their families; a lot of them that are subsistence fishers.

Those two species are important to them; but again the abundance has been down, as we've already noted and heard from a couple people. I did broach the subject with them to talk about what if we started to see resurgence in either species, would there be a thought on adjusting creels or anything like that.

They didn't have interest; similar to what Chris said in doing that. I just want to make a note that that is an important species. We're hoping that maybe in the future that that we'll be able to have something similar to what we've had historically. In the meantime it's all you can catch invasive blue catfish for those folks. But croaker and spot are important and we'll continue to follow it.

CHAIRMAN GEER: What about the other states? Did they talk, I'll go with Delaware with John Clark first.

MR. JOHN CLARK: I would just follow up with what we've heard in the past. We didn't specifically go out and ask on this. But we already have a size limit in place for croaker; and for spot we hear the same thing the other states do, people want no size limits so it can be used as bait. In terms of a possession limit, we haven't broached that. But I don't think that would be a problem; similar to what you found in Virginia.

CHAIRMAN GEER: Any of the southern states? I know South Carolina already has an aggregate bag. I mean Georgia already has a 25 fish limit on both spot and croaker. Adam, is there anything from New Jersey at all? We're kind of at a point where we have this traffic light approach that we've been going under.

Do we want to continue to task them to do things when we're not? We keep seeing problems but we're not doing management actions as a result; no management measures are coming forth. If we want to use these new measures we have to do an addendum, we'll have to do an addendum. The TC has put a lot of time into this. They've gone ahead and made several recommendations. We're kind of like in this, as Mike said, I kind of chuckled, the saga continues.

I mean it's like we've kind of been going around with this. What do we want to do? Do we want to move forward? Do we want the TC to continue to approach this? But I've sat up here at this table. Mike is on one side, you know the TC Chair is on the other side, and they both tell me we need recommendations for management measures from the Board.

What are we going to do? We're seeing that the abundance is low; but we haven't come up with any kind of recommendations. What does the Board want to do? I'm looking for something we can tell the TC we want them to move forward with. I mean do we want to wait until August and see what the new numbers look like? Do we want them to run the numbers both in the old method and the new method? It's a fair amount of work. I'm looking out for you folks to provide some guidance to the TC. Let's go with Chris and then Mike.

MR. BATSAVAGE: Yes we're definitely at a crossroads now. If we initiate an addenda to adopt these new traffic light analyses that would result in some sort of management response, if we went that route, if you look at how it's written in the current addenda as far as what we need to do. That doesn't really match up with what we can do with the TLAs.

It talks about percent reductions. We've talked about it in previous Board meetings that the traffic light analyses aren't designed to do that. I guess that would be one option to initiate addenda for both species to adopt the new traffic light analyses; but also to modify the management response to have it more in line with what we can do.

Going back to the comments that we received from the public, there was concern that under the harvest metric there is a lot of red showing up; due to the lower landings. It was pointed out there is just a lot less fishing going on; due to just less people in the fishery, but also due to other management measures that impact the spot and croaker fisheries, at least in North Carolina.

Things such as the hundred pound trip limit for weakfish; you know really had an impact on the long haul seine fishery. Management measures in place to protect bottlenose dolphin have also impacted where commercial fishermen can set gillnets for spot. I guess this is a question for Mike. Is it possible for the Technical Committee to explore incorporating some sort of effort component into the harvest traffic light?

Because right now we just see the trends in overall landings, commercial and recreational. But it doesn't speak to whether it's just less people fishing. But is there some way to work in an effort component into that to just get a better sense of what's driving the trends? Is it just less people fishing; or is it a lower catch per unit effort, which would indicate a problem with those populations?

CHAIRMAN GEER: Jeff.

MR. JEFF J. KIPP: The TC did look at effort data and talk about effort data. I think that we would be comfortable with that for some states; but from a coastwide perspective is where we would run into issues on adequate effort data to do something like that.

CHAIRMAN GEER: Lynn.

MS. FEGLEY: Maybe the way forward, you know in our state there was a lot of conversation, and I suspect this was true up and down the coast to the degree of the conversations we had. The idea of equity, you know making sure that if action is taken that there is parity amongst the states was of critical importance.

Also, a subject of discussion was the idea that we cannot quantify any sort of percent reduction that is required or would work to get us out of the red in the traffic light. The memo to the Board said that rather than focusing on a specific numeric goal for percentage red that may not be attainable through management alone. The PDT Recommends an alternative goal of initially establishing management measures for those fisheries which have no regulations. Maybe knowing that there is a commercial season which seems somewhat palatable. I mean the idea of a commercial season seems somewhat palatable, and the idea of a bag limit for recreational seems somewhat palatable.

Maybe the way forward would be to accept the new traffic light and, in the course of management response could the TC or the PDT, look at options which result in a neutral state for the fisheries? By that I mean, the states are truly bookending. You know Maryland's commercial season would be set so that there would be a bookend to the season as it runs on average; but not necessarily a reduction, so that it can be moved in the future if we need a reduction.

If there is a year when the fish appear, when we have spot in the Bay in an anomalous time that those spot would be sheltered from the fishery, because we've set the season. Ditto bag limits that we're basically we're going forward with a bookend. We have something on the books that could potentially be adjusted in the future if needed. But we're not having the coastal, we're doing the best we can to achieve equity among the states. I hope that made sense, thank you.

CHAIRMAN GEER: That's a good idea, Lynn. Lynn, I think you and I, we've talked about this. A lot of what you were doing, we were doing independently, coming up with the same kind of things where you can look at the bookends of the fishery by looking at cumulative percent by date; and you really end up, you're not having that much of an impact if you take a little bit off the beginning of the year, a little bit off the end of the year.

I know in our state we did look at effort data; and we were seeing in some fisheries catch per unit effort was not going down that much for a couple of fishers; gillnets it definitely was. But what we were seeing was a fairly good decline in the size of the fish. You know the fish were declining in size as well. I think that's an interesting approach and I would support that. Mel.

MR. BELL: That's kind of how we ended up with our aggregate bag limit for small sciaenids. We were basically just trying to put something in place; almost as a firewall. You just got to get a placeholder, get it in place, and the public got used to that. We were seeing some things; particularly during the spot run where a garbage can full of spot. That stuff went away.

We did have a little bit of an impact; but it was more of just kind of get us going in that direction, because anything related to small sciaenids for us, I mean we just didn't have it. I guess it was kind of a baby step or a first step; but I think that's a great concept. I think we do need to move in this direction.

If you're being advised by the TC, here is what we're seeing, here are some recommendations. We admit, well things may not be like they used to be with the fishery or maybe not be what we would like to see. But then we just don't act and don't act. That doesn't send a good message to the public; and it doesn't send a good message I think to the TC if we're kind of not listening to them. If there is a way to adopt some things to at least get us going? I think that does make sense.

CHAIRMAN GEER: I agree. Phil.

MR. PHIL LANGELY: I would support some type of additional effort looking into this; just to the fact that the importance of this fishery, I know it is spot and croaker and it's been something that's been unmanaged. But you know this is the fishery that most of the children are introduced to. There are peer fishermen that may not be able to maybe vacation and they may not be able to economically afford to go out on a charterboat or take their kids out.

But this is how we introduce young fishermen to the fishery; and young fishermen make big fishermen. I just think it's important as well as the charter, and especially the headboat fishery. You know within our states it's an important fishery. Certainly we have seen a decline; which is alarming to a lot of constituents, you know within the state. But as was stated here, it's kind of hard for one state to make adjustments and with a species that is up and down the coast to make it more impactful.

CHAIRMAN GEER: I agree with that. As Mr. Woodward once called it the under loved sciaenids. We've been down this road before a few times, huh Spud? Are there any other comments? What I'm hearing right now is that we should be moving forward with something. I've heard potentially asking the TC to look at effort data if that is available. I know it's available in Virginia. Jeff, is it available in the Mid-Atlantic? I mean is it better in one region than in another?

MR. KIPP: Yes, so I think certainly some of the states from a commercial perspective have what we thought was good effort data; and then recreationally there is effort data. But I think there was some concern with that is from MRIP how to quantify that as effort. There is kind of different metrics you can consider from an effort standpoint with MRIP data; and I think we kind of circulated around that but didn't come to any conclusion.

CHAIRMAN GEER: I think Chris's concern with the effort was primarily probably commercial, right, Chris?

MR. BATSAVAGE: Yes I think it's going to have to be looked at, at the gear level to follow trends. I don't know if every state has that; and I'm guessing that is some of the concerns that the TC has is just as far as what level of effort data is available from the individual states.

CHAIRMAN GEER: I know we can provide that. I've run that analysis for our meeting that we have with the general public.

MR. KIPP: Yes, I think the Technical Committee didn't really consider smaller spatial scales when doing this. We were kind of looking from a coastwide perspective. If we could come up with something that we think is representative from a smaller spatial scale, either regional or coastwide trend. That is I think something that we could look into a little bit further.

CHAIRMAN GEER: Does anybody want to make a recommendation to the TC? We're going down that route; but we've talked about asking to look at effort data. Do we want them to continue to pursue looking at the new regional approach? I mean we're hoping that those numbers can be ready by August; and be provided, so this will be the second year we can have those new numbers. I don't think we're going to see anything different though. I think it's from what everyone said you know 2018 wasn't any better than the previous years. Mike.

DR. SCHMIDTKE: I guess one additional thing; I mean it's not a huge addition to the workload, but it is an additional workload to what the current TLA is. I would ask if there is specific direction from the Board to the TC to run the updated TLA for this year; given that the side-by-side comparison was done last year.

Is there additional information that the Board things that they're going to get out of seeing another year of side-by-side, or should the standard TLA that is currently in place be the one that is run and used in management this year? Regardless of what the Board decides today, there isn't going to be something passed by August, which is when we normally do the TLA that would change the methodology in the way that this is talked about. Is there any direction to do the updated TLA in addition to the current TLA for 2019?

CHAIRMAN GEER: Any thoughts on that? I am kind of the thought; I mean Jeff, tell me if I'm wrong. I mean once they have the datasets is it that difficult to run the TLA?

MR. KIPP: I think a lot of it is gathering the data; but yes the actual framework is pretty much set in place. It depends also on the framework which you go with. The regional one would take, I think, a bit more work, because there is splitting indices based on size and that stuff. There is a little bit more from the regional perspective than the coastwide, I believe.

CHAIRMAN GEER: Well at the very least we have to do coastwide. At the very least we must do coastwide; and we need those numbers by the August meeting. I didn't know if Toni wanted to talk or not. Okay. Even if we don't take on the regional approach, and that continues to show, well we had the conflict in mind on that.

I would like them to see if we could do both that would be my, but I don't want to task them with something. I don't want to set them up for failure is my concern; and then if we asked them to look at effort data too that's going to be even additional work. Mike.

DR. SCHMIDTKE: I do have a question about the tasking; just to make sure that it's clear when talking about TC looking at the effort data. Is that looking at it in the context of trying to alter the recommended changes and possibly incorporating a CPUE style of approach to replace the harvest metric, or I guess what's the end goal in looking at the effort data that the TC should be driving towards in that task?

CHAIRMAN GEER: Chris.

MR. BATSAVAGE: My thought was if there was a way to incorporate effort into the harvest component, not replace it but just give it some context. But I'm getting the sense that the data is a little sparse; and it could be a pretty heavy lift for the TC in terms of just the workload versus what we may get. We don't know if this is even doable. If the Board supports having the TC look at that that's great. If we're concerned about the time and effort this would take in addition to other tasks such as the annual TLA update. Maybe we could forego this exercise and think about moving forward with maybe an addendum to accept the new revised traffic light approach, and then go from there.

CHAIRMAN GEER: Chris, are you suggesting that now or in the August meeting?

MR. BATSAVAGE: It might be, if we could decide which path to go today, whether we task the TC with looking at this effort idea, or just based on the conversations that we've had and heard from Jeff and Mike that that may not bear the fruit that we're hoping. Then the other option is at least entertain a motion for the revised traffic light analyses as they are, and then talk about how to handle the management response.

CHAIRMAN GEER: Any discussion on that? Lynn, you look like you're hesitating.

MS. FEGLEY: I think Chris is on the right track. I think we need to bust a move here one way or the other.

CHAIRMAN GEER: It's the pleasure of the Board. Chris.

MR. BATSAVAGE: Okay to get off the dime. I move to initiate addenda to the Spot and Croaker FMPs to incorporate the revised traffic light analyses and redefine the management responses.

CHAIRMAN GEER: We'll get that up in a second. We have a second by Lynn Fegley. Is there any discussion on this? Roy.

MR. ROY W. MILLER: Mr. Chairman, perhaps Chris or Lynn could inform us. If we're going to incorporate the revised TLA, and redefine management response, I presume that the management responses suggested would have the goal of moving this out of the red zone and into the green zone. Is that the general idea or not? Lynn is shaking her head.

CHAIRMAN GEER: No. Lynn, do you want to respond to that?

MS. FEGLEY: As I understood and as it's written in the memo to the Board, there is no way to define what those responses should be to get us out of the red. It struck me that what we would go forward is as Mr. Bell said, rather than asserting that we're going to get ourselves out of the red that if there are no regulations on a species that we will simply bookend that species. We will simply put a firewall in place that is not necessarily a reduction; it's just something to bookend the fishery.

If the fishery expands out of where it has historically been functioning, either by a season or by a bag limit. Then it provides a buffer. But it's not designed to produce as a particular reduction; because we don't know what that reduction should be. The goal is to get something on the books; so that if we get an assessment that's helped us understand what a reduction should be, we are basically set up to get there, because we have something on the books. The question becomes, well I'll leave it there.

CHAIRMAN GEER: Roy, did you have a question, follow up on that?

MR. MILLER: Would we be taking this action if the TLA wasn't in the red zone? In other words this bookending process, would we do that if it was in the green zone or the yellow zone?

CHAIRMAN GEER: We would have to adopt the new traffic light approach. We would have to do an addendum anyway. This new regional approach, we would have to go through an addendum process just to adopt that if we did nothing else. But talking to some folks, they're feeling that why go through an addendum process to adopt this new traffic light approach if we're not going to try to have some kind of management measure associated with it. Yes, regardless of what it was. If we're using this new method we would have to have an addendum; any other discussion on this? I see Lynn's hand again.

MS. FEGLEY: I guess my question is when we say redefine management response. We would adopt these TLAs. Currently the way the plans are written as I understand, once we adopt the TLAs, they trigger, we are required to take some sort of action. In that wording of redefine management response, does that mean that this would give us the opportunity to adopt the new TLA but not be bound to take immediate action? Is that what redefine management response means? Could we just do an addendum to adopt the TLAs and nothing else? That's the shorter way to ask the question.

CHAIRMAN GEER: I guess I would ask Chris what his thought was on the terms.

MR. BATSAVAGE: I didn't know how best to word that part. But as I mentioned earlier, if you look at the current addenda I think it talks about a management response that incorporates percent reductions, which you really can't do. We talked a lot today about the Technical Committee's recommendation of kind of bookending the fishery; and Lynn has talked about how that could possibly be done.

Replace the language that is in the current addenda with that. Although now the question as to whether we would have to take action after adopting the revised TLAs, I think we would. But that's where you're redefining the management response. We can say what that is, who would have to implement management.

We've heard from states that already have management in place. Maybe the Board feels that the states that have already implemented measures already have those bookends for their fisheries, and it may not be necessary to do more, as opposed to states that don't have any management that perhaps they should be the ones putting in measures.

CHAIRMAN GEER: I would assume those measures and actions are going to be defined in how we do the addendum; how we write the addendum. **Is there any other discussion on this? All right let me read the motion. Move to initiate addenda to the Spot and Croaker FMPs to incorporate the revised TLA and redefine management response.**

Motion by Mr. Batsavage and seconded by Ms. Fegley. All those in favor raise your hand; all those opposed, abstentions, null votes. The vote carries unanimously. Okay, is there anything else on spot and croaker we have to address today? Anything else this Board has to consider today, any other items? Chris.

MR. BATSAVAGE: Just a quick heads up to the Board. Normally this is the meeting that we would request an e-mail Board vote on an exemption to the Spanish mackerel size limit. After evaluating the information that we received from sampling, we are not going to move forward with that this year. We're going to stay at the 12 inch size limit that's in place coastwide.

ADJOURNMENT

CHAIRMAN GEER: Thank you, Chris; is there anything else to come before this Board today? Motion to adjourn, seconded. Thank you very much for coming and safe travels home, folks.

(Whereupon the meeting adjourned at 12:00 o'clock p.m. on May 2, 2019)

Atlantic States Marine Fisheries Commission

Draft Amendment 1 to the Atlantic Migratory Group Cobia Interstate Fishery Management Plan for Board Review

This draft document was developed for Management Board review and discussion. This document is not intended to solicit public comment as part of the Commission/State formal public input process, as this process has already concluded.

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

August 2019

DRAFT AMENDMENT FOR BOARD REVIEW; NOT FOR PUBLIC COMMENT

Amendment 1 to the Interstate Fishery Management Plan for Atlantic Migratory Group Cobia

Prepared by

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This is a report of the Atlantic States Marine Fisheries Commission pursuant to U.S. Department of Commerce, National Oceanic and Atmospheric Administration Award No. NA15NMF4740069.

The process and current timeline for completion of Amendment 1 is as follows:

Step	**Anticipated Date**
Approval of Draft PID by the Board	Aug 2018
Public review and comment on PID	Aug – Oct 2018
Board review of public comment; Board direction on what to include in Draft Amendment 1	Oct 2018
Preparation of Draft Amendment 1	Oct 2018 – May 2019
Review and approval of Draft Amendment 1 by Board for public comment	May 2019
Public review and comment on Draft Amendment 1	May 9 – July 15, 2019
Board review of public comment on Draft Amendment 1 and consideration for final approval by the Board and Commission ***Current step***	Aug 2019

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1.0 INTRODUCTION

The Atlantic States Marine Fisheries Commission (Commission), under the authority of the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA), is responsible for managing the Atlantic Migratory Group of cobia (Atlantic cobia) (*Rachycentron canadum)* from Georgia through New York. The Commission has coordinated the interstate management of Atlantic cobia in state waters (0-3 miles) since 2017. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Migratory Group Cobia (FMP) establishes management measures that transition the FMP from complementary management with the South Atlantic and Gulf of Mexico Fishery Management Councils' (SAFMC and GMFMC, respectively) Fishery Management Plan for Coastal Migratory Pelagic Resources in the Gulf of Mexico and Atlantic Region (CMP FMP) to sole management by the Commission. Amendment 1 to the FMP was initiated in response to Regulatory Amendment 31 to the CMP FMP, which removes Atlantic cobia from the CMP FMP. Management authority in the exclusive economic zone (3-200 miles from shore) lies with the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NOAA Fisheries), but the Commission, through the ACFCMA, is able to recommend management measures in this area for implementation by NOAA Fisheries.

Updates from the FMP have been made to introductory sections to reflect the most up-to-date information about the Atlantic cobia fishery.

1.1 BACKGROUND INFORMATION

At their May 2018 meeting, the South Atlantic State/Federal Fisheries Management Board (Board) initiated the development of Amendment 1 to the Cobia FMP to establish recommended management for Atlantic cobia in federal waters and a process by which aspects of harvest regulations may be specified through a Board vote. The Board approved the Amendment 1 Public Information Document for public comment in August 2018. Public comment was received and hearings were held between August 2018 and October 2018. At their October 2018 meeting, the Board tasked the Plan Development Team (PDT) with developing Draft Amendment 1.

1.1.1 Statement of Problem

1.1.1.1 Recommended Management for Federal Waters

In June 2018, the SAFMC and GMFMC approved Regulatory Amendment 31 to the CMP FMP, which would remove Atlantic cobia from the CMP FMP (SAFMC, 2018a). This removal was approved and became effective on March 21, 2019. Therefore, the SAFMC no longer manages Atlantic cobia, and the Commission has sole management authority for this stock. The SAFMC is the management body that previously recommended the annual catch limit (ACL) and other measures used by NOAA Fisheries to manage federal waters. Additionally, the Recreational Harvest Limit (RHL) from the FMP is currently dependent on the federal ACL, and state commercial fisheries are required to close if a federal closure occurs due to the commercial ACL being met. To accommodate the SAFMC's and GMFMC's action to remove Atlantic cobia from the CMP FMP, the Commission is working to establish a mechanism for recommending management measures to NOAA Fisheries for implementation in federal waters, through authority and process defined in the ACFCMA.

1.1.1.2 Harvest Specification Process

Recent concerns for the Atlantic cobia fishery include multiple overages of the commercial and recreational ACLs, early fishing season closures due to the ACLs being met or exceeded, and in-season evaluation of recreational harvest estimates from the Marine Recreational Information Program (MRIP) against the recreational ACL. Recent ACL overages have caused concern among managers about the status of this stock, which was last assessed in 2013 (Southeast Data, Assessment, and Review [SEDAR], 2013). Additionally, the recent transition of MRIP from estimating effort through the Coastal Household Telephone Survey to the current, mail-based Fishing Effort Survey in 2018 required a re-calibration of previous recreational effort and harvest estimates. The change in harvest estimates is likely to impact stock assessment results. Thus, assessments must be conducted to update biological reference points and better inform future management for species impacted by the re-calibration, including cobia. A stock assessment is currently being conducted for Atlantic cobia through the SEDAR process (SEDAR 58). Assessment results are anticipated to be available for management use early in 2020.

In order to quickly respond to assessment results and to address other areas of concern in the fishery, management through a harvest specification process is considered in this draft amendment. Several Commission-managed species are managed through a harvest specification process, a process by which the Management Board may specify regulations controlling future harvest within a meeting, through a Board vote. Typically, regulations are annually specified for the following year. However, one of the primary desires expressed by managers and stakeholders is for regulatory stability. Thus, a multi-year specification process is also considered in this draft amendment.

1.1.2 Benefits of Implementation

Amendment 1 is designed to respond to the removal of Atlantic cobia from SAFMC management. Amendment 1 will establish a process for recommending how NOAA Fisheries should enforce management regulations in federal waters. Since the approval of Regulatory Amendment 31 to the CMP FMP in March, 2019, the Commission is now the only management body that will make such recommendations.

Amendment 1 will also establish a process by which the Board may specify harvest regulations for one or more future years. Through this process, the Board can implement regulations that remain in place throughout entire fishing seasons or across multiple seasons, allowing for increased regulatory stability. An additional advantage of management through this approach is increased flexibility for states to establish or revise measures in response to changes in the fishery or stock status, without needing to alter the FMP through an addendum or amendment. Measures that may be set through the specification process are defined in *Section 4.1*.

1.1.2.1 Social and Economic Benefits

Draft Amendment 1 proposes a management regime that will help ensure the long-term sustainability of the Atlantic cobia population, enhancing the social and economic benefits attributable to Atlantic cobia fisheries in Commission member states. In addition to ensuring the cobia fishery for future generations, socioeconomic benefits of implementation may arise from increased flexibility and the capacity to accommodate differences in member state fisheries and fishery management regimes. Amendment 1 will also enable the Board to specify harvest regulations for periods possibly exceeding one year. Increased stability in harvest regulations could be beneficial for individuals, businesses, and communities that depend on cobia fisheries financially or otherwise. In addition, the recognition of important socioeconomic monitoring requirements and research needs in Amendment 1 will increase the likelihood of implementing and/or continuing those monitoring and research tasks essential for effective fishery management at the state and regional levels.

1.2 DESCRIPTION OF THE RESOURCE

1.2.1 Species Life History

Cobia are a member of the family Rachycentridae and are distributed worldwide in tropical, subtropical and warm-temperate waters. In the western Atlantic they occur from Nova Scotia, Canada, south to Argentina, including the Caribbean Sea. They are abundant in warm waters off the coast of the U.S. from the Chesapeake Bay south and throughout the Gulf of Mexico (Gulf). Cobia prefer water temperatures between 68-86°F. As a pelagic fish, cobia are found over the continental shelf as well as around offshore natural and artificial reefs. Cobia frequently reside near any structure that interrupts the open water such as pilings, buoys, platforms, anchored boats, and flotsam, and are often seen under or accompanying rays, large coastal sharks, and sea turtles. Cobia are also found inshore inhabiting bays, inlets, and mangroves.

1.2.1.1 Stock Structure and Migration

Microsatellite-based analyses demonstrated that tissue samples collected from North Carolina, South Carolina, east coast Florida (near St. Lucie), Mississippi, and Texas showed disparate allele frequency distributions, and subsequent analysis of molecular variance showed population structuring occurring between the states (Darden et al., 2014). Results showed that the Gulf of Mexico stock appeared to be genetically homogeneous and that a segment of the population continued around the Florida peninsula to St. Lucie, FL, with a genetic break somewhere between St. Lucie, FL, and Port Royal Sound, SC. However, no samples were available from Cape Canaveral, FL, to Hilton Head Island, SC. Tag-recapture data across multiple studies and locations also suggested two stocks of fish that overlap at Brevard County, FL, corroborating the genetic findings (Burns and Neidig, 1992; Hendon and Franks, 2010; Wiggers, 2010; Denson, 2012; Orbesen, 2012; Perkinson and Denson, 2012).

The Atlantic and Gulf stocks were separated at the Florida-Georgia (FL/GA) line during SEDAR 28 because genetic data suggested that the split is north of the Brevard/Indian River County line and tagging data did not dispute this split (SEDAR, 2013). The FL/GA line was selected as the stock boundary based on recommendations from the commercial and recreational work groups and comments that this boundary would allow easier management and did not conflict with the life history information available. However, there was not enough resolution in the genetic or tagging data to suggest that a biological stock boundary exists specifically at the FL-GA line, only that a mixing zone occurs around Brevard County, FL, and potentially to the north. The Atlantic stock was determined to extend northward, as far as New York.

In preparation for SEDAR 58, a Stock Identification Workshop was conducted in 2018. This workshop found similar results to those of SEDAR 28 using more recent tagging and genetic data. The Stock ID Workshop identified biologically distinct Atlantic and Gulf stocks separated by a transition zone that occurs from the southern boundary of Brevard County, FL, to Brunswick, GA (SEDAR, 2018). Data that would categorize cobia within the transition zone as belonging to either of the two defined stocks (Atlantic or Gulf) are not available. Additionally, this Workshop identified sub-regional population structure within the Atlantic stock, in which inshore populations from SC were biologically distinct from those in NC/VA. However, data did not support fish found in NC/SC offshore areas as being biologically distinct from either of these populations. Due to uncertainty surrounding biological structure within the Atlantic stock, the Workshop recommended to continue assessing this region as a single stock, from the FL/GA border north through New York.

Several ongoing research projects are expanding sample collection throughout coastal Georgia and northern Florida, which may help provide better resolution within the transition zone. In addition, a few hundred cobia have been tagged with acoustic tags in South Carolina, Georgia, and the east coast of Florida to evaluate movement patterns along the South Atlantic (FL-NC) coast of the United States.

During autumn and winter months, cobia presumably migrate south and offshore to warmer waters. In early spring, migration occurs northward along the Atlantic coast. However, tagging information from the 2018 Stock ID Workshop suggests a greater amount of inshore-offshore movement than was previously thought. Significant efforts are currently underway using various tagging methods to better understand the migratory behavior of cobia.

1.2.1.2 Age and Growth

Weighing up to a record 135 pounds whole weight (lb ww), cobia are more common along the US Atlantic coast at weights of approximately 40 lb ww (SEDAR, 2013). In this region, they reach lengths exceeding 160 cm (63 inches). Cobia grow quickly and have a moderately long life span. Maximum ages observed for Atlantic cobia were 15 and 16 years for males and females, respectively (SEDAR, 2013). Cobia sexual maturity is more closely linked to size than age, with nearly all females maturing by the time they reach 80 cm (31.5 inches, approximately 2-3 years old) (SEDAR, 2013).

1.2.1.3 Spawning and Reproduction

Cobia form large aggregations, spawning during daylight hours between June and August in the Atlantic Ocean near the Chesapeake Bay and off South and North Carolina in May and June, respectively (SEDAR, 2013). Spawning is done through the release of multiple batches during the spawning season, at a frequency of once every 4-6 days (Brown-Peterson et al., 2001; Lefebvre and Denson, 2012; SEDAR, 2013). During spawning, cobia undergo changes in body coloration from brown to a light horizontal-striped pattern, releasing eggs and sperm into offshore open water. Cobia have also been observed spawning in estuaries and shallow bays with the young heading offshore soon after hatching. Cobia eggs are spherical, averaging 1.24 mm in diameter. Larvae are released approximately 24-36 hours after fertilization.

Newly hatched larvae are 2.5 mm (1 inch) long and lack pigmentation. Five days after hatching, the mouth and eyes develop, allowing for active feeding. A pale yellow streak is visible, extending the length of the body. By day 30, juveniles take on the appearance of adult cobia with two color bands running from the head to the posterior end.

1.2.2 Stock Assessment Summary

1.2.2.1 SEDAR 28

As described in *Section 1.2.1.1*, the most recent stock assessment, SEDAR 28, established the stock boundary between Atlantic and Gulf of Mexico cobia at the FL/GA border, based on tagging and genetic information and applicability to management (SEDAR, 2013). Therefore, the stock boundary for the assessment was also established at the FL/GA line. The Atlantic stock extends northward to New York.

The primary model used in SEDAR 28 was the Beaufort Assessment Model (BAM), a forward-projecting statistical catch-at-age model (SEDAR, 2013). This model included data from two fishery-dependent surveys and the recreational and commercial fisheries. Results of this assessment are summarized in the following sections.

1.2.2.1.1 *Abundance and Structure*

Estimated abundance at age since the 1990s showed a slight truncation of the oldest ages compared to the 1980s, but in general there was little obvious change in age structure over time. Total estimated abundance has varied about two-fold since the 1980s with a general decline since 2005. A strong year class was predicted to have occurred in 2005 comparable to those predicted periodically in the late 1980s and throughout the 1990s. However, predicted recruitment in later years (2007-2009) was below average.

1.2.2.1.2 *Fishing Mortality*

The estimated time series of fishing mortality rates (F) from the BAM was highly variable, with F for fully selected ages varying greater than four-fold since the 1980s. There was a drop in F in the 1990s following the implementation of the 2-fish per person bag limit, but there was a notable increase since the early 2000s. Since 2003, estimates of F averaged about 0.30. The recreational fleet has been the largest contributor to total F throughout the time series.

The estimated time series of F divided by F producing Maximum Sustainable Yield (F_{MSY}) from the base run suggested that overfishing has not been occurring over the course of the assessment period but with considerable uncertainty, particularly since the mid-2000s. Current fishery status, with current F represented by the geometric mean from 2009-2011, is estimated by the base run to be $F_{2009-2011}/F_{MSY} = 0.599$, but with much uncertainty in that estimate. As current F is less than F_{MSY}, overfishing is not occurring.

1.2.2.1.3 *Spawning Stock Biomass*

Estimated biomass at age followed the same general pattern as estimated abundance at age. Total biomass and spawning biomass showed similar trends - generally higher biomass in the 1990s and early 2000s compared to the 1980s and a decline in more recent years. The stock was estimated to be at its lowest point in the late 1980s and was estimated to be at a comparable level in the terminal year.

Estimated time series of stock status (Spawning Stock Biomass [SSB]/ Minimum Stock Size Threshold [MSST], SSB/SSB producing Maximum Sustainable Yield [SSB_{MSY}]) showed a general decline through the 1980s, an increase in the late 1980s and early 1990s, followed by a decline in more recent years. The increase in stock status in the 1990s may have been driven by several strong year classes and perhaps reinforced by the 2-fish per person bag limit implemented in 1990. Base run estimates of spawning biomass have remained above MSST throughout the time series. Current stock status from the base run was estimated to be $SSB_{2011}/MSST = 1.75$, indicating that the stock is not overfished. Age structure estimated from the base run shows more old fish than the (equilibrium) age structure expected at MSY. However, in the most recent year, ages 1-7 approached the MSY age structure.

1.2.2.2 SEDAR 58

Another stock assessment, SEDAR 58, is currently ongoing and scheduled for completion by the beginning of 2020. A Stock Identification Workshop was conducted in 2018 to prepare for this assessment. This Workshop maintained the FL/GA border as the stock boundary, because this border is within a transition zone that occurs from the southern boundary of Brevard County, FL, to Brunswick, GA (SEDAR, 2018). Data that would categorize cobia within the transition zone as belonging to either of the two defined stocks (Atlantic or Gulf) are not available.

1.2.3 Current Stock Status

The Gulf and Atlantic migratory groups of cobia were last assessed by SEDAR 28 in 2013. The SEDAR 28 stock assessment for Atlantic migratory group cobia (Atlantic cobia) determined that the stock is not overfished nor experiencing overfishing.

1.3 DESCRIPTION OF THE FISHERY

1.3.1 Commercial Fishery

Commercial fisheries statistics throughout this amendment were obtained from the Atlantic Coastal Cooperative Statistics Program (ACCSP), unless otherwise stated.

From 2010 through 2017, annual commercial landings of Atlantic cobia ranged from approximately 33,000 to 91,000 lb ww (Table 1). Total coastwide dockside revenues in constant 2017 dollars from those landings have generally increased since 2010, ranged from approximately $80,000 to $ $235,000 in 2016 (Table 1). The annual average dockside price in 2017 dollars for those eight years was $2.43 per lb ww. The highest landings and revenues occurred in 2016, whereas the lowest for both landings and revenues occurred in 2011. When the Florida east coast zone was still part of the management area for Atlantic cobia, commercial harvest reached the sector's quota of 125,712 lb ww in 2014 and closed on December 11, 2014. Under the modified management area excluding the Florida east coast zone (SAFMC Amendment 20B to CMP FMP – May 2014), the quota for Atlantic cobia was revised to 60,000 lb landed weight (lw) in 2015 and 50,000 lb lw in 2016 and thereafter. Although landings exceeded the 2015 quota, no quota closure was imposed. Commercial landings for 2016 were 90,887 lb (ACCSP, queried April, 2019) and the federal commercial fishery closed on December 6, 2016. Although 2018 landings are not finalized, the 50,000 lb quota was exceeded each of the past two years (2017: 61,817 lb, 2018: TBD) with the federal commercial fishery closing September 5th of each year (Table 1).

Commercial landings of Atlantic cobia have predominantly come from North Carolina, followed by Virginia and South Carolina (Table 1). Georgia landings are relatively small and confidential. Cobia landings north of Virginia are relatively rare and sporadic, thus, Virginia is considered the northernmost major contributor to the commercial Atlantic cobia fishery. One notable feature for Virginia is the surge in landings since 2014, although they were still typically lower than landings in North Carolina. However, after 2016, North Carolina commercial cobia landings and related dockside revenues declined substantially and were much lower than Virginia.

Commercial fishermen harvest cobia using a variety of gear types. Table 2 shows commercial Atlantic cobia landings and revenues by major gear types. Gill nets are the foremost gear type used in harvesting cobia for most years (Table 2), followed by hook and line. Hand line landings have increased substantially since 2010. Longline has been a minor gear type in the commercial harvest of cobia. The 8-year averages for annual dockside revenues from major gear categories range from $80,000-$235,000 (Table 2).

Table 1. Annual commercial Atlantic cobia landings (lb ww) and dockside revenues (2017 $) by state/area 2010-2017. State landings outside of VA-SC are small and may be confidential. Coastwide total landings include all commercial landings in the management unit, GA-NY. Source: ACCSP, queried April, 2019.

Year	SC	NC	VA	Coastwide Total	Federal Season Close Date
	Pounds (whole weight)				
2010	2,749	43,715	8,852	56,255	
2011	4,466	19,924	8,522	33,708	
2012	3,731	31,972	5,389	42,401	
2013	4,254	35,456	11,073	53,313	
2014	3,880	41,798	22,345	69,366	12/12/2014*
2015	2,763	52,684	27,722	84,367	
2016	4,532	48,244	36,460	90,887	12/6/2016
2017	4,590	20,842	36,384	66,289	9/5/2017
2018					9/5/2018
Average	3,871	36,829	19,593	62,073	
Year	**SC**	**NC**	**VA**	**Coastwide Total**	**Federal Season Close Date**
	Annual Dockside (Ex-vessel) Revenues in Constant 2017 Dollars[a]				
2010	$10,709	$72,722	$19,511	$105,149	
2011	$19,578	$38,395	$19,994	$80,182	
2012	$15,063	$66,591	$12,036	$97,340	
2013	$15,253	$77,638	$29,569	$129,432	
2014	$11,666	$91,457	$61,993	$169,305	12/12/2014*
2015	$9,043	$114,602	$79,052	$205,779	
2016	$16,664	$110,120	$104,507	$235,023	12/6/2016
2017	$17,409	$50,076	$110,123	$186,964	9/5/2017
2018					9/5/2018
Average	$14,423	$77,700	$54,598	$151,147	

* Included Florida

[a] Nominal dollars converted to 2017 constant dollars using the annual, not seasonally adjusted, GDP implicit price deflator (Index = 2015) provided by the U.S. Bureau of Economic Analysis.

Table 2. Commercial Atlantic cobia landings (lb ww) and dockside revenues (2017 $) by gear, 2010-2017. Source: ACCSP, queried April, 2019.

	Hook and Line	Gill nets	Hand Line	Others	Total
Year	**Pounds (Whole Weight)**				
2010	14,474	23,327	3,899	14,554	56,255
2011	10,651	9,168	5,463	8,426	33,708
2012	9,854	21,027	2,651	8,869	42,401
2013	20,512	13,279	5,285	14,237	53,313
2014	18,779	23,416	12,895	14,276	69,366
2015	18,535	36,737	16,510	12,585	84,367
2016	17,471	35,426	22,529	15,462	90,887
2017	12,994	21,397	19,348	12,550	66,289
Average	15,409	22,972	11,072	12,620	62,073
Year	**Annual Dockside (Ex-vessel) Revenues in Constant 2017 Dollars[a]**				
2010	$30,884	$39,643	$9,344	$25,279	$105,149
2011	$30,707	$18,476	$13,877	$17,122	$80,182
2012	$27,683	$43,649	$6,177	$19,831	$97,340
2013	$51,298	$29,339	$14,905	$33,889	$129,432
2014	$45,702	$51,884	$38,621	$33,098	$169,305
2015	$46,786	$80,467	$49,060	$29,465	$205,779
2016	$48,112	$81,962	$64,992	$39,956	$235,023
2017	$39,682	$53,233	$59,516	$34,533	$186,964
Average	$40,107	$49,832	$32,061	$29,147	$151,147
[a] Nominal dollars converted to 2017 constant dollars using the annual, not seasonally adjusted, GDP implicit price deflator (Index = 2015) provided by the U.S. Bureau of Economic Analysis.					

1.3.1.1 State-Specific Commercial Fisheries

1.3.1.1.1 *Virginia*

Virginia has had variable commercial landings of cobia since the Virginia Marine Resources Commission instituted mandatory reporting in 1993, with landings being high in the mid-1990s (Appendix I, Table A1), lower in the mid-2000s, steadily increasing from 2013-2017, and peaking in 2016 and 2017. There was a decline in commercial landings in 2018 (preliminary from VMRC; Appendix I, Table A1) contributed in part to state regulations limiting harvest to two fish per commercial license holder, or six per vessel. In most circumstances, there is only one licensed fishermen onboard each vessel, restricting daily landings to two fish. There is a small but directed hook-and-line fishery, which has been the prominent gear since 2007 with over 71% of the harvest the past ten years. Bycatch landings occur from gillnets (12.1%) and pound nets (8.2%), although these landings can be sizable. Other gears that have caught cobia include haul seines (1.34%) and trawls (1.99%).

1.3.1.1.2 *North Carolina*

Commercial landings of cobia in North Carolina are available from 1950 to the present.

However, monthly landings are not available until 1974. North Carolina instituted mandatory reporting of commercial landings through their Trip Ticket Program, starting in 1994. Landings information collected since 1994 are considered the most reliable. The primary fisheries associated with cobia in North Carolina are the snapper-grouper, coastal pelagic troll, and the large mesh estuarine gill net fisheries. Cobia landings from 1950 – 2018 have ranged from a low of 600 lb (1951; 1955) to a high of 52,684 lb (2015) with average landings of 16,730 lb over the 68-year time series (landings since 1981 shown in Appendix I, Table A1). Since 2010, landings have ranged from 19,924 lb (2011) to 52,684 lb (2015), averaging 36,829 lb (Table 1).

The primary commercial gear used to harvest cobia has changed over time. This is most likely due to changing fisheries and the fact that it is mostly considered a marketable bycatch fishery, especially after North Carolina adopted the CMP FMP measures of 33-inches minimum fork length and two-per person possession limit in 1991. From 1950 to the late 1970s, cobia were mostly landed out of the haul seine fishery. Most landings that occurred during the 1980s came from the pelagic troll and hand line fishery with modest landings from the haul seine and anchored gill net fishery. From 1994-2018, the majority of landings have occurred from the anchored gill net and pelagic troll and hand line fisheries with gill nets being the top gear during most of those years.

1.3.1.1.3 *South Carolina*

There is a limited commercial fishery for cobia in South Carolina. Cobia are a state-designated Gamefish, and as such, cobia landed in state waters may not be sold commercially. However, cobia landed in Federal waters can be sold commercially under current regulations. Commercial cobia landings have ranged from 2,700-4,600 lb per year with an annual mean of 3,800 lb per year for 2010-2017 and dollar values (2017 dollars) ranging from $9,000-$19,600 annually (Table 1).

1.3.1.1.4 *Georgia*

There is no directed commercial fishery for cobia in Georgia. Commercial landings may occur but they are typically the result of bycatch in other targeted fisheries. Some illegal sale of recreationally-caught cobia may occur; however, the total amount and dockside value is relatively small. The greatest recorded landings in Georgia (since annual landings became available in 1979) occurred in 1993 when 2,730 lb of cobia were landed resulting in a market value of $4,728 (in nominal dollars).

1.3.2 Recreational Fishery

The recreational sector is comprised of a private component and a for-hire component. The private component includes anglers fishing from shore (including all land-based structures) and private/rental boats. The for-hire component is composed of charter boats and headboats (also called party boats). Although charter boats tend to be smaller, on average, than headboats, the key distinction between the two types of operations is how the fee is typically determined. On a charter boat trip, the fee charged is for the entire vessel, regardless of how many passengers are carried, whereas the fee charged for a headboat trip is paid per individual angler.

1.3.2.1 Permits

There are no specific federal permitting requirements for recreational anglers to fish for or harvest cobia. Instead, anglers are required to possess either a state recreational fishing permit that authorizes saltwater fishing in general, or be registered in the federal National Saltwater Angler Registry system, subject to appropriate exemptions.

Recently, the states of North Carolina and Virginia have developed programs to survey recreational cobia fishermen. These programs may provide information in the future that would help characterize the cobia fisheries in these states.

1.3.2.2 Harvest

In July, 2018, the MRIP began releasing recreational harvest information with fishing effort estimated or calibrated according to the mail-based Fishing Effort Survey (FES), rather than the previously used Coastal Household Telephone Survey (CHTS). Recreational landings shown in this section and throughout the amendment are shown as FES estimates/calibrations, although 2018 and 2019 regulations and landings are based on calibrations to CHTS effort. The FES calibrations and estimates are being incorporated into the ongoing stock assessment. Upon completion of the stock assessment and acceptance by the Board for management use, FES estimates will be used for setting quotas and targets and evaluating recreational harvests. For comparative and short-term management purposes, Appendix I, Table A2, shows recreational harvest estimates in pounds since 1981 based on the CHTS effort estimates or calibrations. Appendix I, Table A3, shows recreational harvest estimates in pounds since 1981 based on the FES effort estimates or calibrations.

On average, from 2010 through 2018, the recreational sector landed approximately 1,837,610 lb ww of Atlantic cobia (Table 3). North Carolina has been the dominant state in recreational landings of cobia, followed by Virginia, South Carolina, and Georgia. Cobia landings north of Virginia are relatively rare and sporadic, thus, Virginia is considered the northernmost major contributor to the recreational Atlantic cobia fishery. However, in 2018, recreational landings of cobia were reported in Delaware, as well as outside of the management unit in Connecticut. Harvests from these states are considered minimal, however this information could indicate that cobia migrate further north than expected.

The private/rental mode has been the most dominant fishing mode for harvesting cobia (Table 4). Party boats have provided the lowest contribution to recreational landings of cobia. Information reported in Table 4 indicates that harvest estimates in 2018 were the highest across all modes in the time-series except for the private/rental mode in 2015. Harvest levels in 2018 were also higher across all modes in comparison to the long-term average (2010 through 2018).

Table 3. Annual recreational landings (lb ww) of Atlantic cobia, by state, 2010-2018 preliminary). Source: MRIP, queried April, 2019.

Year	NJ	DE	MD	VA	NC	SC	GA	Total
2010	0	0	1,179	557,907	808,227	100,614	230,865	1,698,792
2011	0	0	0	341,751	399,192	0	182,799	923,742
2012	60,473	0	0	47,547	102,077	214,512	512,499	937,108
2013	0	0	0	488,181	980,541	24,005	43,915	1,536,642
2014	0	0	0	499,218	645,427	79,171	42,481	1,266,297
2015	0	0	0	1,166,000	1,925,762	434,899	102,917	3,629,578
2016	0	0	307	1,505,528	838,363	159,345	0	2,503,543
2017	0	0	0	488,287	872,861	0	390	1,361,538
2018	0	9,664	3,254	1,936,274	561,526	160,191	6,226	2,677,135
Average	6,719	1,074	527	781,188	792,664	130,304	124,677	1,837,153

Source: MRIP, queried April, 2019.

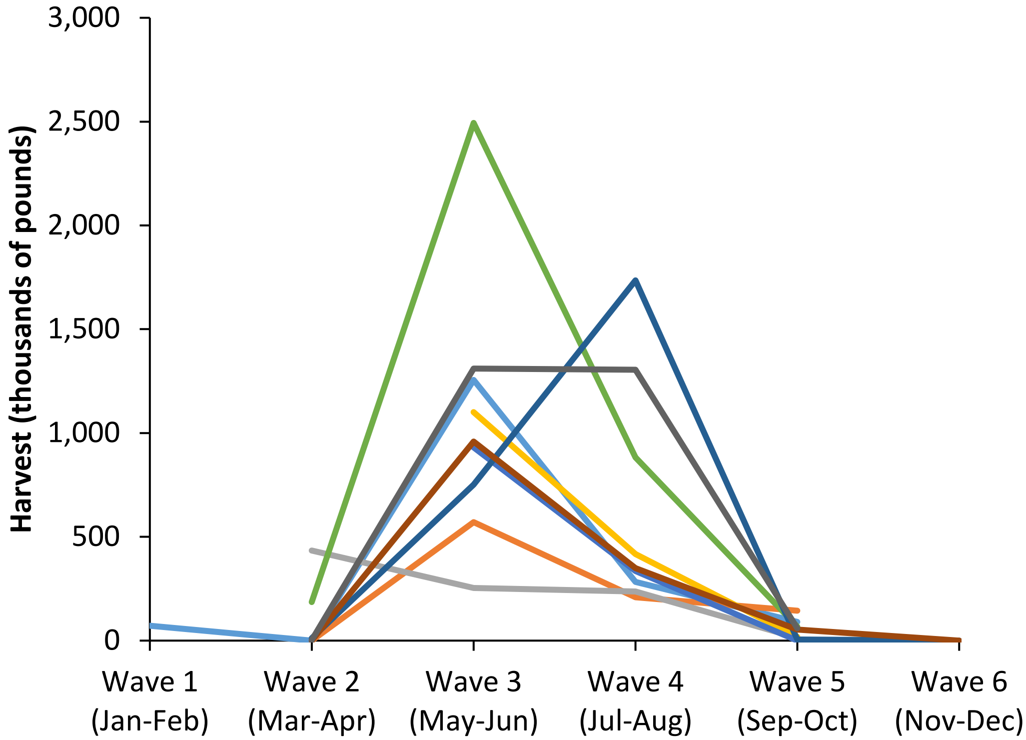
Table 4. Annual recreational landings (lb ww) of Atlantic cobia, by fishing mode, 2010-2018 (preliminary).

Year	CHARTER BOAT	PRIVATE/RENTAL BOAT	SHORE	Grand Total
2010	99,424	1,550,698	48,670	1,698,792
2011	17,668	771,218	134,856	923,742
2012	21,605	855,030	60,473	937,108
2013	98,524	1,438,118	0	1,536,642
2014	56,727	1,057,192	152,377	1,266,296
2015	70,342	3,303,860	255,375	3,629,577
2016	116,598	1,921,275	465,671	2,503,544
2017	47,407	1,314,131	0	1,361,538
2018	138,276	1,977,726	559,635	2,675,637
Average	74,063	1,576,583	186,340	1,836,986

Source: MRIP, queried April, 2019.

Peak recreational landings of cobia typically occur in Wave 3 (May-June) each year (Figure 1). In 2016, recreational landings peaked in Wave 4 (July-August). Recreational landings steeply increased from Wave 2 (March-April) to their peak and also steeply declined after the peak wave. Landings are concentrated around the Waves 3 and 4. In 2018, the peak was broader with similar landings in Waves 3 and 4.

Figure 1. Distribution of Atlantic cobia recreational harvest, by wave, 2010-2018 (preliminary). Source: MRIP, queried April, 2019.



1.3.2.3 Effort

Recreational effort derived from the Marine Recreational Fisheries Statistics Survey (MRFSS)/MRIP database can be characterized in terms of the number of trips as follows:

Target effort - The number of individual angler trips, regardless of duration, where the intercepted angler indicated that the species or a species in the species group was targeted as either the first or second primary target for the trip. The species did not have to be caught.

Catch effort - The number of individual angler trips, regardless of duration and target intent, where the individual species or a species in the species group was caught. The fish did not have to be kept.

Total recreational trips - The total estimated number of recreational trips in the Atlantic, regardless of target intent or catch success.

Other measures of effort are possible, such as the number of harvest trips (the number of individual angler trips that harvest a particular species regardless of target intent), and directed trips (the number of individual angler trips that either targeted or caught a particular species), but the three measures of effort listed above are used in this assessment.

Estimates of annual Atlantic cobia effort (in terms of individual angler trips) for 2010-2018 are provided in Table 5 for target trips and Table 6 for catch trips. Target and catch trips are shown by fishing mode (charter, private/rental, shore) for Georgia, South Carolina, North Carolina, and Virginia. These are trips for cobia in state or federal waters off of these states. Estimates of cobia target and catch trips for additional years, and other measures of directed effort, are available at http://www.st.nmfs.noaa.gov/recreational-fisheries/access-data/run-a-dataquery/queries/index.

Cobia is one of the few species where target trips generally exceed catch trips. The 2010-2018 average target trips were 4,721 for the charter mode, 291,682 for the private/rental mode, and 143,999 for the shore mode (Table 5). In contrast, the average catch trips were 2,896 for the charter mode, 38,965 for the private/rental mode, and 3,240 for the shore mode (Table 6). This is suggestive of a relatively strong interest in fishing for cobia among recreational anglers across all fishing modes. For each state, the private/rental mode has been the most dominant fishing mode both in target and catch effort.

Headboat data in the Southeast do not support the estimation of target or catch effort because target intent is not collected and the harvest data (the data reflects only harvest information and not total catch) are collected on a vessel basis and not by individual angler. Table 7 contains estimates of the number of headboat angler days for the South Atlantic states for 2010-2017. Georgia and South Carolina data are combined for confidentiality purposes. Virginia information was not available because only South Atlantic headboats are included in the SRHS.

Table 5. Target trips for Atlantic cobia, by fishing mode and state, 2010-2018 (preliminary). Source: NOAA Fisheries, Fisheries Statistics Division, queried April, 2019.

Year	Georgia	S. Carolina	N. Carolina	Virginia	Total
			Charter		
2010	0	3,239	1,904	499	5,642
2011	21	1,423	1,386	245	3,075
2012	0	987	251	10	1,248
2013	0	0	2,446	24	2,470
2014	0	1,247	1,463	299	3,009
2015	658	1,430	2,541	1,430	6,059
2016	0	1,477	4,192	519	6,188
2017	0	1,409	3,723	678	5,810
2018	359	570	6,953	1,103	8,985
Average	115	1,309	2,762	534	4,721
			Private/Rental		
2010	5,725	28,751	74,155	159,971	268,602
2011	8,774	46,087	39,326	105,236	199,423
2012	12,959	96,256	40,374	52,301	201,890
2013	38,131	60,983	97,360	121,668	318,142
2014	1,754	37,370	111,211	125,694	276,029
2015	47,929	36,447	146,966	120,189	351,531
2016	7,332	42,256	147,313	192,557	389,458
2017	402	1,352	140,667	152,785	295,206
2018	3,861	14,945	69,677	236,378	324,861
Average	14,096	40,494	96,339	140,753	291,682
			Shore		
2010	0	0	26,791	32,717	59,508
2011	0	0	23,836	10,078	33,914
2012	0	5,304	36,502	92,793	134,599
2013	0	3,528	58,781	21,160	83,469
2014	0	77,879	49,807	77,879	205,565
2015	0	1,583	106,171	96,147	203,901
2016	0	171	132,730	85,610	218,511
2017	0	0	102,087	130,665	232,752
2018	0	11,563	75,279	36,931	123,773
Average	0	11,114	67,998	64,887	143,999

Table 6. Catch trips for Atlantic cobia, by fishing mode and state, 2010-2018 (preliminary). Source: NOAA Fisheries, Fisheries Statistics Division, queried April, 2019.

Year	Georgia	S. Carolina	N. Carolina	Virginia	Total
			Charter		
2010	74	942	3,297	179	4,492
2011	369	0	778	25	1,172
2012	63	0	306	10	379
2013	160	48	1,802	24	2,034
2014	54	0	1,702	0	1,756
2015	0	598	2,047	1,302	3,947
2016	0	809	2,818	208	3,835
2017	37	0	1,237	133	1,407
2018	314	796	5,173	759	7,042
Average	119	355	2,129	293	2,896
			Private/Rental		
2010	7,776	2,322	15,713	15,876	41,687
2011	7,898	0	4,870	5,867	18,635
2012	15,090	5,830	2,946	1,348	25,214
2013	788	1,566	28,193	15,753	46,300
2014	3,667	4,727	18,101	17,444	43,939
2015	8,934	13,320	35,080	9,744	67,078
2016	0	5,892	8,392	13,863	28,147
2017	0	0	16,982	10,652	27,634
2018	0	4,521	11,151	36,378	52,050
Average	4,906	4,242	15,714	14,103	38,965
			Shore		
2010	0	0	2,447	0	2,447
2011	0	0	6,583	0	6,583
2012	0	0	0	0	0
2013	0	0	0	0	0
2014	0	0	5,437	0	5,437
2015	0	0	7,591	0	7,591
2016	0	0	4,918	0	4,918
2017	0	0	0	0	0
2018	0	1,375	806	0	2,181
Average	0	153	3,087	0	3,240

Table 7. South Atlantic headboat angler days, by state, 2010-2017. Source: NOAA Fisheries Southeast Region Headboat Survey (SRHS).

Year	GA/SC	NC	TOTAL
2010	46,908	21,071	67,979
2011	46,210	18,457	64,667
2012	42,064	20,766	62,830
2013	42,853	20,547	63,400
2014	44,092	22,691	66,783
2015	41,479	22,716	64,195
2016	43,954	21,565	65,519
2017	38,655	20,170	58,825
Average	43,277	20,998	64,275

1.3.2.4 State Specific Recreational Fisheries

1.3.2.4.1 *Virginia*

Virginia's recreational landings of cobia have been highly variable since the mid-1980s, with the lowest estimate being 21,167 lb in 1987 and the highest being 1,936,274 lb in 2018. The recreational fishery seems to have grown in recent years, both in the number of participants, and the effectiveness of fishing due to the advent of sight-casting – especially when aided by "cobia towers." Traditionally, cobia had been targeted using live-bait bottom-fishing, but these new techniques are causing a shift in preference among anglers.

Other states experience pulses of abundance in cobia as they migrate up and down the Atlantic coast. However, the amount of time cobia spend in Virginia waters is substantially longer that of other Mid-Atlantic states. Cobia can be found in Virginia waters from mid-May through the end of October.

In 2016, Virginia developed a monitoring program to survey recreational cobia fisherman. The program was developed to characterize Virginia's cobia fishery for future management.

1.3.2.4.2 *North Carolina*

Historically, recreational fisherman targeted cobia from a vessel by anchoring and fishing with dead, live, or a mixture of both bait types near inlets and deep water sloughs inshore (Manooch, 1984). Fish were also harvested from shore or off of piers using dead or live bait. In the early 2000s, fishermen began outfitting their vessels with towers to gain a higher vantage point to spot and target free-swimming cobia along tidelines and around bait aggregations. This method of fishing actively targets cobia in the nearshore coastal zone and has become the primary mode of fishing in most parts of the state.

Recreational harvests of cobia in North Carolina from 1981-2018 have ranged from a low of 0 lb (1983) to a high of 1,925,762 lb (2015) (Appendix I, Table A3). Landings during the 1980s and 1990s remained relatively constant from year to year. Landings began to increase and become more variable beginning in the mid-2000s. From 2010-2018, recreational cobia landings in North Carolina ranged from 102,077 to 1,925,762 lb (792,664 lb on average). Seasonally, cobia are landed mostly in the spring and summer months corresponding with their spring spawning migration (Smith, 1995). Peak landings occur during the latter part of May into June and quickly diminish thereafter. However, recreational landings of cobia can occur through the month of October.

1.3.2.4.3 *South Carolina*

The recreational fishery accounts for the majority of cobia landings in South Carolina. The fishery occurs in both nearshore waters and around natural and artificial reefs offshore. Historically, the majority of cobia landings have occurred in state waters in and around spawning aggregations from April through May. However, due to intense fishing pressure in the inshore zone, annual landings of cobia have fallen drastically since 2009, such that the majority of recreationally caught cobia in South Carolina now come from offshore (federal) waters. Anglers begin targeting cobia in late April-early May with the peak of the season typically occurring May into early June. Late season catches can occur on nearshore reefs through October depending on water temperatures.

1.3.2.4.4 *Georgia*

A large recreational fishery exists for cobia in Georgia. The majority of this fishery occurs in nearshore waters around natural and artificial reefs. While there are some instances of cobia being caught inshore and on beach front piers in Georgia, most landings come from outside state waters. Anglers begin targeting cobia in late April-early May with the peak of the season typically occurring in June. Late season catches often occur on nearshore reefs through October depending on water temperatures. However, these fall runs of fish are sporadic and are often missed by anglers.

1.3.3 Subsistence Fishing

No subsistence fisheries for Atlantic cobia have been identified at this time.

1.3.4 Non-Consumptive Factors

No significant non-consumptive factors for Atlantic cobia have been identified at this time.

1.3.5 Interactions with Other Fisheries

The recreational cobia fishery tends to be a targeted fishery. Various small and large coastal sharks and ray species are the most common bycatch. Cobia are encountered as bycatch in the troll and live bait fisheries for king and Spanish mackerel, dolphin, and other pelagic species. Additionally, cobia are taken incidental to offshore bottom fishing activities for snapper/grouper species.

The commercial cobia fishery is primarily bycatch in the same troll fisheries and taken incidental to snapper/grouper fisheries. Some directed harvest does occur; however, low limits preclude a large scale fishery.

1.4 HABITAT CONSIDERATIONS

1.4.1 Habitat Important to the Stocks

1.4.1.1 Description of the Habitat

1.4.1.1.1 *Spawning Habitat*

Cobia spawn in nearshore waters along the South Atlantic coast from April through June. Nearby states (South Carolina) have documented the presence of inshore spawning aggregations of cobia (Lefebvre and Denson, 2012). However, there have been no such aggregations identified in Georgia. Eggs and larvae are typically found in nearshore waters and juveniles most often occur inshore or in protected nearshore waters.

Cobia enter nearshore waters along the south Atlantic Coast when water temperatures reach 20-21 °C, usually late April and aggregate to spawn through June. Histological evaluation of gonads from these nearshore collections suggest cobia are mature and spawning in inshore waters of high salinity estuaries (Callibogue, Port Royal Sound and St. Helena Sound in SC) (Lefebvre and Denson, 2012). The inshore spawning aggregations in South Carolina have been determined to be genetically distinct from the Atlantic stock of cobia (Darden et al., 2014). These findings are corroborated by conventional tag-recapture information and show estuarine fidelity for spawning fish and natal homing annually into estuaries. Eggs and larvae are typically found in nearshore waters where there is significant retention time of estuarine waters; however, juveniles (< 2yrs of age) are only occasionally caught inshore or in protected nearshore waters making it unclear what habitat the majority of this life stage utilizes until they mature and join spawning aggregations (Lefebvre and Denson, 2012).

1.4.1.1.2 *Larval Habitat*

Little is known about the larval stages of cobia. Larvae have been collected in pelagic waters of the Gulf of Mexico (65-134 m isobaths), within a meter of the water column (Ditty and Shaw, 1992).

1.4.1.1.3 *Juvenile Habitat*

Juveniles, like larvae, have also been found in pelagic waters of the Gulf of Mexico, and are believed to utilize floating *Sargassum* as habitat in such areas (Ditty and Shaw, 1992). Early juveniles then move to high-salinity, inshore areas along beaches, river mouths, barrier islands, and bays/inlets (Swingle, 1971; McClane, 1974; Hoese and Moore, 1977; Benson, 1982).

1.4.1.1.4 *Adult Habitat*

Adults enter estuaries on a seasonal basis but otherwise inhabit coastal waters and the continental shelf (Collette et al., 1978; Benson, 1982; Robins and Ray, 1986). Although generally considered pelagic, adult cobia are found at various depths throughout the water column (Freeman and Walford, 1976). They do not appear to be substratum-specific, but extensive tagging research is currently being conducted by various states along the U.S. Atlantic coast to better determine movement and habitat usage.

1.4.1.1.4.1 South Atlantic Region

The continental shelf off the southeastern U.S., extending from the Dry Tortugas, FL, to Cape Hatteras, NC, encompasses an area in excess of 100,000 square km (Menzel, 1993). Based on physical oceanography and geomorphology, this environment can be divided into two regions: Dry Tortugas, FL, to Cape Canaveral, FL, and Cape Canaveral, FL, to Cape Hatteras, NC. The continental shelf from the Dry Tortugas, FL, to Miami, FL, is approximately 25 km wide and narrows to approximately 5 km off Palm Beach, FL. The shelf then broadens to approximately 120 km off Georgia and South Carolina before narrowing to 30 km off Cape Hatteras, NC. The Florida Current/Gulf Stream flows along the shelf edge throughout the region. In the southern region, this boundary current dominates the physics of the entire shelf (Lee et al., 1994).

In the northern region, additional physical processes are important and the shelf environment can be subdivided into three oceanographic zones (Atkinson et al., 1985; Menzel, 1993), the outer shelf, mid-shelf, and inner shelf. The outer shelf (40-75 meters (m)) is influenced primarily by the Gulf Stream and secondarily by winds and tides. On the mid-shelf (20-40 m), the water column is almost equally affected by the Gulf Stream, winds, and tides. Inner shelf waters (0-20 m) are influenced by freshwater runoff, winds, tides, and bottom friction.

Water masses present from the Dry Tortugas, FL, to Cape Canaveral, FL, include Florida Current water, waters originating in Florida Bay, and shelf water. Spatial and temporal variation in the position of the western boundary current has dramatic effects on water column habitats. Variation in the path of the Florida Current near the Dry Tortugas induces formation of the Tortugas Gyre (Lee et al., 1992; Lee et al., 1994). This cyclonic eddy has horizontal dimensions of approximately 100 km and may persist near the Florida Keys for several months. The Pourtales Gyre, which has been found to the east, is formed when the Tortugas Gyres moves eastward along the shelf. Upwelling occurs in the center of these gyres, thereby adding nutrients to the near surface (<100 m) water column. Wind and input of Florida Bay water also influence the water column structure on the shelf off the Florida Keys (Smith, 1994; Wang et al., 1994). Further downstream, the Gulf Stream encounters the “Charleston Bump”, a topographic rise on the upper Blake Ridge where the current is often deflected offshore resulting in the formation of a cold, quasi-permanent cyclonic gyre and associated upwelling (Brooks and Bane, 1978). On the continental shelf, offshore projecting shoals at Cape Fear, Cape Lookout, and Cape Hatteras, NC, affect longshore coastal currents and interact with Gulf Stream intrusions to produce local upwelling (Blanton et al., 1981; Janowitz and Pietrafesa, 1982). Shoreward of the Gulf Stream, seasonal horizontal temperature and salinity gradients define the mid-shelf and inner-shelf fronts. In coastal waters, river discharge and estuarine tidal plumes contribute to the water column structure.

The water column from Dry Tortugas, FL, to Cape Hatteras, NC, serves as habitat for many marine fish and shellfish. Most marine fish and shellfish release pelagic eggs when spawning and thus, most species utilize the water column during some portion of their early life history (Leis, 1991; Yeung and McGowan, 1991). Many fish inhabit the water column as adults. Pelagic fishes include numerous clupeoids, flying fish, jacks, cobia, bluefish, dolphin, barracuda, and the mackerels (Schwartz, 1989). Some pelagic species are associated with particular benthic habitats, while other species are truly pelagic.

1.4.1.1.4.2 Mid-Atlantic Region

Information about the physical environment of the Mid-Atlantic region was provided by the Mid-Atlantic Fishery Management Council (MAFMC) and adapted from the 2016 Mackerel, Squid, and Butterfish Specifications Environmental Assessment, available at: http://www.greateratlantic.fisheries.noaa.gov/regs/2016/January/16msb2016specspr.html.

Climate, physiographic, and hydrographic differences separate the Atlantic Ocean from Maine to Florida into the New England-Middle Atlantic Area and the South Atlantic Area (division/mixing at Cape Hatteras, NC). The inshore New England-Middle Atlantic area is fairly uniform physically and is influenced by many large coastal rivers and estuarine areas. The continental shelf (characterized by water less than 650 ft. in depth) extends seaward approximately 120 miles off Cape Cod, narrows gradually to 70 miles off New Jersey, and is 20 miles wide at Cape Hatteras. Surface circulation is generally southwesterly on the continental shelf during all seasons of the year, although this may be interrupted by coastal indrafting and some reversal of flow at the northern and southern extremities of the area. Water temperatures range from less than 33°F from the New York Bight north in the winter to over 80°F off Cape Hatteras in summer.

Within the New England-Middle Atlantic Area, the Northeast U.S. Continental Shelf Large Marine Ecosystem includes the area from the Gulf of Maine to Cape Hatteras, extending from the coast seaward to the edge of the continental shelf, including the slope sea offshore to the Gulf Stream. The Northeast U.S. Continental Shelf Large Marine Ecosystem is a dynamic, highly productive, and intensively studied system providing a broad spectrum of ecosystem goods and services. This region, encompassing the continental shelf area between Cape Hatteras and the Gulf of Maine, spans approximately 250,000 km^2 and supports some of the highest revenue fisheries in the U.S. The system historically underwent profound changes due to very heavy exploitation by distant-water and domestic fishing fleets. Further, the region is experiencing changes in climate and physical forcing that have contributed to large-scale alteration in ecosystem structure and function. Projections indicate continued future climate change related to both short and medium-term cyclic trends as well as non-cyclic climate change.

A number of distinct subsystems comprise the region. The Gulf of Maine is an enclosed coastal sea, characterized by relatively cold waters and deep basins, with various sediment types. Georges Bank is a relatively shallow coastal plateau that slopes gently from north to south and has steep submarine canyons on its eastern and southeastern edge. It is characterized by highly productive, well-mixed waters and fast-moving currents. The Mid-Atlantic Bight is comprised of the sandy, relatively flat, gently sloping continental shelf from southern New England to Cape Hatteras, NC. Detailed information on the affected physical and biological environments inhabited by the managed resources is available in Stevenson et al. (2004).

1.4.2 Identification and Distribution of Habitat and Habitat Areas of Particular Concern

Habitat information for Atlantic cobia is sparse. Few, if any, fishery independent surveys consistently interact with cobia in numbers adequate to develop any trends or conclusions. Much of the habitat data presented is generic for the coastal migratory pelagic fishes that include king and Spanish mackerel. Species-specific habitat information is a data and research need.

A description of the Habitat Areas of Particular Concern (HAPC) for CMP species is provided in Amendment 18 to the CMP FMP (GMFMC and SAFMC, 2011), and is incorporated herein by reference. Areas which meet the criteria for HAPCs include sandy shoals of Cape Lookout, Cape Fear, and Cape Hatteras from shore to the ends of the respective shoals, but shoreward of the Gulf Stream; The Point, the Ten-Fathom Ledge, and Big Rock (North Carolina); The Charleston Bump and Hurl Rocks (South Carolina); The Point off Jupiter Inlet (Florida); *Phragmatopoma* (worm reefs) reefs off the central east coast of Florida; nearshore hard bottom south of Cape Canaveral; The Hump off Islamorada (Florida); The Marathon Hump off Marathon (Florida); The “Wall” off of the Florida Keys; Pelagic *Sargassum*; and Atlantic coast estuaries with high numbers of Spanish mackerel and cobia based on abundance data from the Estuarine Living Marine Resources Program. Estuaries meeting this criteria for Spanish mackerel include Bogue Sound and New River (North Carolina), for cobia, Broad River (South Carolina).

1.4.3 Present Condition of Habitats and Habitat Areas of Particular Concern

1.4.3.1 Coastal Spawning Habitat: Condition and Threats Coastal Spawning

It is reasonable to assume that areas where coastal development is taking place rapidly, habitat quality may be compromised. Coastal development is a continuous process in all states and all coastal areas in the nation are experiencing significant growth. The following section describes particular threats to the nearshore habitats in the South Atlantic that meet the characteristics of suitable spawning habitat for cobia.

One threat to the spawning habitat for cobia is navigation and related activities such as dredging and hazards associated with ports and marinas (ASMFC, 2013). According to the SAFMC (1998), impacts from navigation related activities on habitat include direct removal/burial of organisms from dredging and disposal of dredged material, effects due to turbidity and siltation; release of contaminants and uptake of nutrients, metals, and organics; release of oxygen-consuming substances, noise disturbance, and alteration of the hydrodynamic regime and physical characteristics of the habitat. All of these impacts have the potential to substantially decrease the quality and extent of cobia spawning habitat.

Besides creating the need for dredging operations that directly and indirectly affect spawning habitat for cobia, ports also present the potential for spills of hazardous materials. The cargo that arrive and depart from ports include highly toxic chemicals and petroleum products. Although spills are rare, constant concern exists, since huge expanses of productive estuarine and nearshore habitat are at stake. Additional concerns related to navigation and port utilization are discharge of marine debris, garbage, and organic waste into coastal waters.

Maintenance and stabilization of coastal inlets is of concern in certain areas of the southeastern U.S. Studies have implicated jetty construction to alterations in hydrodynamic regimes, thus, affecting the transport of estuarine-dependent organisms' larvae through inlets (Miller et al., 1984; Miller, 1988).

1.4.3.2 Estuarine Nursery, Juvenile and Sub-adult Habitat: Condition and threats

Coastal wetlands and their adjacent estuarine waters likely constitute primary nursery, juvenile, and sub-adult habitat for cobia along the coast. Between 1986 and 1997, estuarine and marine wetlands nationwide experienced an estimated net loss of 10,400 acres. However, the rate of loss was reduced over 82% since the previous decade (Dahl, 2000). Most of the wetland loss resulted from urban and rural activities and the conversion of wetlands for other uses. Along the southeast Atlantic coast, the state of Florida experienced the greatest loss of coastal wetlands due to urban or rural development (Dahl, 2000). However, the loss of estuarine wetlands in the southeast has been relatively low over the past decade, although there is some evidence that invasion by exotic species, such as Brazilian pepper (*Schinus terebinthifolius*), in some areas could pose potential threats to fish and wildlife populations in the future (T. Dahl, pers. comm.).

Throughout the coast, the condition of estuarine habitat varies according to location and the level of urbanization. In general, it can be expected that estuarine habitat adjacent to highly developed areas will exhibit poorer environmental quality than more distant areas. Hence, environmental quality concerns are best summarized on a watershed level.

Threats to estuarine habitats of the southeast were described in Amendment 2 to the Red Drum FMP (ASMFC, 2002). Due to the cobia's similar dependence on estuarine habitats throughout its early life history, these same threats are likely to impact cobia as well.

Nutrient enrichment of estuarine waters throughout the southeast is a major threat to the quality of estuarine habitat. Forestry practices contribute significantly to nutrient enrichment in the southeast. Areas involved are extensive and many are in proximity to estuaries. Urban and suburban developments are perhaps the most immediate threat to cobia habitat in the southeast. The almost continuous expansion of ports and marinas in the South Atlantic poses a threat to aquatic and upland habitats. Certain navigation-related activities are not as conspicuous as port terminal construction but have the potential to significantly impact the estuarine habitat upon which cobia depend. Activities related to watercraft operation and support pose numerous threats including discharge of pollutants from boats and runoff from impervious surfaces, contaminants generated in the course of boat maintenance, intensification of existing poor water quality conditions, and the alteration or destruction of wetlands, shellfish and other bottom communities for the construction of marinas and other related infrastructure.

Estuarine habitats of the southeast can be negatively impacted by hydrologic modifications. The latter include activities related to aquaculture, mosquito control, wildlife management, flood control, agriculture and silviculture. Also, ditching, diking, draining, and impounding activities associated with industrial, urban, and suburban development qualify as hydrologic modifications that may impact the estuarine habitat. Alteration of freshwater flows into estuarine areas may change temperature, salinity, and nutrient regimes as well as alter wetland coverage. Studies have demonstrated that changes in salinity and temperature can have profound effects in estuarine fishes (Serafy et al., 1997) and that salinity partly dictates the distribution and abundance of estuarine organisms (Holland et al., 1996). Cobia may be similarly susceptible to such changes in the physical regime of their environment.

1.4.3.3 Adult Habitat: Condition and Threats

Threats to the cobia's adult habitat are not as numerous as those faced by postlarvae, juveniles, and sub-adults in the estuarine and coastal waters. Current threats to the nearshore and offshore habitats that adult cobia utilize in the South Atlantic include navigation and related activities, dumping of dredged material, mining for sand and minerals, oil and gas exploration, offshore wind facilities, and commercial and industrial activities (SAFMC, 1998).

An immediate threat is the sand mining for beach nourishment projects. Associated threats include burial of bottoms near the mine site or near disposal sites, release of contaminants directly or indirectly associated with mining (i.e. mining equipment and materials), increases in turbidity to harmful levels, and hydrologic alterations that could result in diminished desirable habitat.

Offshore mining for minerals may pose a threat to cobia habitat in the future. Currently, no mineral mining activities are taking place in the South Atlantic. However, various proposals to open additional areas off the Atlantic coast to seabed mining have been introduced by the Federal Executive and Legislative branches.

Offshore wind farms may also pose a threat to cobia habitat throughout different life stages in the future (ASMFC, 2012). The first US offshore wind farm was established in 2016. Several additional wind farm projects have been proposed, including locations off the US Mid-Atlantic, which could impact cobia habitat.

1.5 IMPACTS OF THE FISHERY MANAGEMENT PROGRAM

1.5.1 Biological and Environmental Impacts

Significant recreational fishery overages of the ACL in 2015 and 2016 raise concerns over the future status of the stock and potential of the stock becoming overfished. Adoption of coastwide management measures can provide flexibility to states while maintaining harvest within the ACL and protecting a portion of the spawning stock. Limits on catch can provide additional protection throughout cobia's geographic range to support a sustained population and fishery.

1.5.2 Social Impacts

This section and the following, *1.5.3 Economic Impacts*, summarize selected impact considerations that are mainly based on social and economic analyses in Chapters 3 and 4 of Amendment 31 to the CMP FMP (see SAFMC, 2018) and Amendment 20B to the CMP FMP (GMFMC and SAFMC, 2014).

In order to understand the possible social impacts that any proposed and/or new rules and regulations may have on participants in any fishery, in-depth community profiles are needed. Very limited applied social science research has been conducted on recreational and commercial fishing communities identified as being linked to Atlantic cobia harvesting. Therefore, adequate information to qualitatively or quantitatively address the possible social impacts of proposed cobia fishery management actions on communities are not currently available.

Regardless, notable social science research completed during the previous decade included a NOAA funded project that employed rapid assessment methods to document the location, type, and history of fishing communities in the South Atlantic region. SAFMC staff worked collaboratively with the University of Florida on a project that described fishing communities in a broad manner (for example, whether the community is characterized mostly by the commercial fishing sector, the for-hire component, the recreational angler component or some combination of these), and linked on-the-ground fieldwork with the collection of secondary data including U.S. Census records, landings, permits, and state information (see Jepson et al., 2005). This research contributed to forming an important historical South Atlantic fishery baseline dataset that has assisted in the measurement of social and economic impacts related to fishery management actions and has also helped to better understand external socioeconomic factors (e.g. demand for coastal waterfront property) influencing South Atlantic fishing communities.

Limited, currently available social impact information includes demographic descriptions of South Atlantic fishing communities (see the SERO (2019) Community Snapshots 10[1]) as well as three sets of 2016 indices generated to judge the potential social vulnerability of Atlantic fishing communities (SAFMC, 2018a). The indices' variables were identified through the literature as being important components that contribute to a community's vulnerability (Jepson and Colburn, 2013; Jacob et al., 2013). While this information is useful in broadly characterizing fishing communities, there is currently no social impact information available that is specific to Atlantic cobia fisheries.

1.5.2.1 Recreational Fishery

The recreational sector of the Atlantic cobia fishery is much larger than the commercial sector, and cobia is an important species for the recreational sector that includes the private angler and for-hire components. Recreational landings estimates indicate that private recreational anglers constitute the dominant component of the fishery (Table 4), and most landings are associated with Virginia and North Carolina (Table 3). Therefore, implementation of Amendment 1 to the cobia FMP is expected to impact the recreational sector. Specifically, it is likely that social impacts would be most significant for private recreational fishermen and related businesses as well as for-hire businesses and their angler customers in Virginia and North Carolina.

Using 2016 data, South Atlantic (excluding Florida) fishing communities were evaluated according to recreational engagement scores, which were based on a factor analysis of several criteria including the number of charter permits and level of recreational fishing infrastructure (SAFMC, 2018). This metric was not specific to cobia, so it was assumed that the overall recreational engagement measure would be generally congruent with engagement specific to cobia. SAFMC (2018) concluded that the South Atlantic communities of Atlantic Beach, Hatteras, Manteo and Morehead City, North Carolina, and Charleston, Hilton Head, Little River and Murrells Inlet, South Carolina all exceeded the 2016 ranking threshold of 1 standard deviation and therefore would "…likely have some dependence upon recreational fishing."

With regard to Virginia recreational fishing communities, SAFMC (2018) noted that recreational fishing communities of Northumberland and Hampton have seen recent increases (e.g. during 2015 and/or 2016) in their cobia harvest. Input from public comments and attendance at public hearings also indicted that Virginia Beach, Virginia, is an important community for recreational cobia harvesting.

[1] https://sero.nmfs.noaa.gov/sustainable_fisheries/social/community_snapshot/index.html

1.5.2.2 Commercial Fishery

The commercial sector has historically operated primarily as a bycatch fishery. The 2019 ACL for the commercial fishery is 50,000 lb from Georgia-New York. Current measures and those proposed in this document essentially maintain status quo for the commercial fishery. Depending on the timing of any closure, social impacts would vary.

Based on a regional quotient (RQ) metric, the SAFMC (2018a) identified and ranked the top 16 coastal communities in terms of their annual commercial landings of cobia within the South Atlantic states using 2010-2016 dealer data aggregated at the community level. The RQ measures how commercial harvest is distributed throughout a region and can be used to identify “top commercial communities”. This is helpful in determining which communities might be most affected by changes to commercial cobia management. During the analysis period, the community of Washington, NC, saw a marked increase in its cobia RQ in 2015 and 2016, especially since it had little to no reported landings before 2015. Avon, NC, had a marked decline in their 2014 RQ, followed by an increase in 2015 and 2016. Wanchese, NC, was previously in the top 16 but has dropped out in recent years (2015-2016). In general, most of the Carolinas’ commercial fishing communities that engaged in cobia harvesting had a decline in their RQs (SAFMC, 2018). Commercial landings of cobia in Virginia have been increasing recently, though no communities displayed consistently high RQs.

1.5.3 Economic Impacts

1.5.3.1 Recreational Fishery

Consumer spending on various goods and services needed for recreational fishing generates economic activity that spurs direct, indirect and induced economic effects or economic contribution effects[2] that ripple through the region. Estimates of the business activity, i.e. economic contribution effects, associated with recreational angling for Atlantic cobia annually averaged for the 2012-2016 period were approximated by the SAFMC (2018a) using average trip-level impact coefficients (NOAA Fisheries, 2017) and related data provided by the NOAA Fisheries Office of Science and Technology. The SAFMC estimated that the total average annual (2012-2016) economic contribution sales effects (in 2016 dollars) attributable to Atlantic recreational cobia target trips based on aggregating state-level effects for the Carolinas, Georgia and Virginia cobia were approximately $13.0 million and these sales generated about

2 In this section, the term “economic contribution” denotes an economic distributional analysis that estimates the status quo economic contributions (e.g. jobs and household income) to local and/or regional economies (see Watson et al., 2007) due to economic activities such as those associated with recreational or commercial fishing. However, economic contribution analysis results (e.g. total economic contribution sales and income effects) should not be interpreted to represent the net economic impact effects if managed fish species were not available for harvest or purchase (SAFMC, 2018b).

$4.6 million in income and 130 jobs in the recreational harvest sector (SAFMC, 2018a). However, the SAFMC (2018b) noted that these figures were based upon MRIP trip estimates before effort recalibrations took place in 2018. Economic contribution effects may be several times larger if based on recalibrated MRIP effort estimates. Additionally, these estimates may represent lower bounds on the economic activities associated with recreational cobia fishing because expenditures on durable goods were not included (SAFMC, 2018a). Furthermore, as noted by the SAFMC (2018b), aggregating state-level economic contribution estimates to produce a regional four state total most likely underestimates the actual amount of total business activity because state-level economic contribution multipliers do not account for interstate and interregional trading (IMPLAN, 2019).

The Commission currently limits Atlantic cobia recreational harvests to the recreational Atlantic cobia ACL established by the SAFMC (ASMFC, 2017). Upon approval of Amendment 1, the level of recreational harvest allowed by the previous ACL would be maintained as the recreational quota, at least until completion of the next stock assessment. However, if Board actions following a future assessment lead to changes in the recreational quota, this could lead to shifts in benefits for the recreational sector due to changes in the amount or quality of fishing trips. Recreational sector quota changes might also lead to changes in local economic contribution effects due to shifts in Atlantic cobia fishing-related expenditures by recreational anglers and individuals in the for-hire component (e.g., local spending on lodging, restaurant meals, groceries, etc.).

While SAFMC estimates of cumulative economic effects of previous closures of the Atlantic cobia fishery in federal waters are not available, it is apparent that these in-season closures had a proportionally more negative economic effect on recreational and related fishing communities in Georgia and South Carolina compared to those found further north (SAFMC, 2018a). If Amendment 1 reduces the likelihood or frequency of fishery closures in federal waters, it could possibly generate additional beneficial effects in the social and economic environments of these states.

1.5.3.2 Commercial Fishery

The commercial fishery for Atlantic cobia is small, though landings have been increasing in Virginia recently (see Table 1). Dockside prices (in 2017 $) are typically between $2/lb and $3/lb and total dockside revenues for the fishery are usually less than $200,000 annually, although they did exceed $200,000 (in 2017 $) in 2015 and 2016. Commercial vessels landing Atlantic cobia rely on other species for the majority of their revenues, with cobia accounting for less than 1% of annual all-species revenues (in 2016 $) on average for vessels landing cobia in Georgia, South Carolina, and North Carolina, from 2012 through 2016 (SAFMC 2018a). Using an input-output model developed to look at economic impacts of the seafood sectors broadly, SAFMC estimates that the commercial fishery for Atlantic cobia contributes 21 jobs, $1.6 million in sales impacts, and $0.8 million in value added impacts to the regional economy (SAFMC 2018a).

If Commission Atlantic cobia commercial fishery management measures implemented in the FMP are similar to the current federal CMP FMP regulations, the SAFMC (2018a) concluded that there should be no substantial near-term changes in commercial fishery economic value and economic impact effects compared to the current federal management regime. However, the SAFMC noted that it was uncertain how future Commission regulations might affect Atlantic cobia commercial harvest in federal waters (SAFMC, 2018a), hence making the distribution, magnitude, and direction (negative or positive) of possible economic effects unclear.

1.5.4 Other Resource Management Efforts

1.5.4.1 Artificial Reef Development/Management

Approximately 120,000 acres (155 nm^2) of ocean and estuarine bottom along the South Atlantic coast have been permitted for the development of artificial reefs (ASMFC, 2002). The Georgia Department of Natural Resources is responsible for the development and maintenance of a network of man-made reefs both in estuarine waters and in the open Atlantic Ocean. Funding for the artificial reef program is provided by Federal Aid in Sport Fish Restoration, fishing license revenues, and private contributions. To date, there are 15 reefs within the estuary proper, which are constructed of a variety of materials including concrete rubble, metal cages, and manufactured reef units. These provide habitat for juvenile cobia and other species of recreationally important fishes. In 2001, three "beach" reefs were constructed in locations within Georgia's territorial waters just off the barrier island beaches. These are experimental in nature, but should provide some habitat for juvenile and adult cobia. There are 19 man-made reefs in the U.S. Exclusive Economic Zone (EEZ) ranging from depths of 40 to 130 feet. These reefs are constructed of a variety of materials including surplus vessels, concrete rubble, barges, bridge spans, and manufactured reef units. Both juvenile and adult cobia are known to use these reefs.

New Jersey has also developed and invested in an artificial reef program, with the state agency involved since 1984. Similarly, Delaware has invested in an artificial reef program, with 14 reef sites within Delaware Bay. Artificial reef construction is especially important in the Mid-Atlantic region, where near shore bottom is usually featureless sand or mud.

States should continue support for habitat restoration projects, including oyster shell recycling and oyster hatchery programs as well as seagrass restoration, to provide areas of enhanced or restored bottom habitat.

1.5.4.2 Bycatch

Cobia are uncommon bycatch components in most U.S. South and Mid-Atlantic fisheries. Mortalities resulting from cobia released from varying depths in the hook and line fisheries and regulatory discards from the large mesh gill fisheries in North Carolina are unknown.

2.0 GOALS AND OBJECTIVES

2.1 HISTORY OF MANAGEMENT

The Commission's Interstate Fishery Management Plan for Atlantic Migratory Group Cobia (FMP) was approved in November 2017 and first implemented in the 2018 fishing year (ASMFC, 2017). This FMP established the Commission's first involvement in Atlantic cobia management. The FMP was designed to complement federal management of Atlantic cobia by the SAFMC through the CMP FMP. Complementary measures mirrored by the FMP included vessel, bag/possession, and minimum size limits. Under Commission management, states were allowed to establish measures up to, but not exceeding, several measures that matched those of the CMP FMP. The Commission's FMP also established a Recreational Harvest Limit (RHL), derived from the federal Annual Catch Limit. The RHL is allocated among non-*de minimis* states (those harvesting greater than one percent of the coastwide recreational harvest) as state harvest targets (Table 8). Average landings over 3-year periods are evaluated against harvest targets to determine whether states can maintain their current recreational vessel limit and season or must adjust these measures to achieve their target. The FMP also established *de minimis* criteria and management options for the recreational fishery.

Table 8. State recreational harvest targets (lb) as established through the Commission's Cobia FMP. These targets were set based on recreational landings estimated with effort estimates from the Coastal Household Telephone Survey (CHTS). Therefore, these targets should only be compared to CHTS landings estimates (Appendix I, Table A2).

State	Recreational Harvest Target (lb)
VA	244,292
NC	236,316
SC	74,885
GA	58,311

2.2 PURPOSE AND NEED FOR ACTION

Currently, the Commission's FMP is designed for complementary management with the CMP FMP, with several management measures dependent upon the CMP FMP or SAFMC management. Since Regulatory Amendment 31 to the CMP FMP was approved and the Final Rule's implementation began on March 21, 2019 (NOAA, 2019), Atlantic cobia is no longer managed by a federal FMP. Additionally, this means that the SAFMC will no longer be recommending management measures for Atlantic cobia in federal waters to NOAA Fisheries.

Previous management relied on the SAFMC to set the ACL, then adapted that figure to the needs of Commission management. However, with the transition to sole management by the Commission comes the responsibility of specifying acceptable harvest levels. A harvest specification process allows such levels to be set in an expedient manner, allowing a quick response to significant events such as stock assessments, but also within bounds specified in this amendment. Certain aspects of management that are outside the specification process would require longer processes with more opportunities for public input.

2.3 GOAL

Issue 1

Bold language is a proposed addition to the following language from the FMP, subject to public comment and Board approval.

The goal of Amendment 1 is to provide for an efficient management structure that implements coastwide management measures, **providing equitable and sustainable access to the Atlantic cobia resource throughout the management unit** in a timely manner.

2.4 OBJECTIVES

Issue 2

Bold language is a proposed addition to the following language from the FMP, subject to public comment and Board approval.

The following objectives are intended to support the goal of Amendment 1.

1) Provide a flexible management system to address future changes in resource abundance, scientific information, and fishing patterns among user groups or area.
2) **Implement management measures that allow stable, sustainable harvest of Atlantic cobia in both state and federal waters.**
3) **Establish a harvest specification procedure that will allow flexibility to respond quickly to stock assessment results or problems in the fishery, while also providing opportunities for public input on potential significant changes to management.**
4) Promote continued, cooperative collection of biological, economic, and social data required to effectively monitor and assess the status of the cobia resource and evaluate management efforts.
5) Manage the cobia fishery to protect both young individuals and established breeding stock.
6) Develop research priorities that will further refine the cobia management program to maximize the biological, social, and economic benefits derived from the cobia population.

2.5 MANAGEMENT UNIT

The management unit is defined as the cobia (*Rachycentron canadum*) resource from Georgia through New York within U.S. waters of the northwest Atlantic Ocean, from the U.S. Atlantic coastal estuaries eastward to the offshore boundaries of the EEZ. The selection of this management unit is based on genetic analysis and tag-recapture data described in *Section 1.2.1.1*.

2.5.1 Management Area

The management area is the Atlantic coast distribution of the resource from Georgia through New York.

2.6 DEFINITION OF OVERFISHING

Issue 3

Prior to this amendment and Amendment 31 to the CMP FMP, the CMP FMP specified that overfishing is occurring when current fishing mortality ($F_{Current}$), defined as the geometric mean of the 3 most recent annual estimates of F, exceeds the maximum fishing mortality threshold (MFMT), set at the fishing mortality that achieves maximum sustainable yield (MSY) (F_{MSY}) (SAFMC, 2011). The CMP FMP also specified that the stock is overfished when the current spawning stock biomass ($SSB_{Current}$), defined as the geometric mean of the 3 most recent annual estimates of SSB, is less than the minimum stock size threshold (MSST), defined as MSST=[(1-M) or 0.5, whichever is greater]*B_{MSY}, where M is natural mortality and B_{MSY} is the biomass at which MSY is achieved (SAFMC, 2011). Estimates for fishing mortality, biomass, and threshold levels are determined through a stock assessment. These levels were unknown at the time of CMP Amendment 18, but were updated following the most recent stock assessment, SEDAR 28, through CMP Amendment 20B (GMFMC and SAFMC, 2014). Through Amendment 1, these overfished and overfishing definitions shall be maintained until the Board accepts new definitions through the process defined below.

Although management of Atlantic cobia will occur solely through Amendment 1, without any complementary SAFMC FMP, stock assessments will primarily continue to be conducted through the Southeast Data, Assessment, and Review (SEDAR) process. The next peer-reviewed assessment is scheduled for completion early in 2020.

To allow flexibility in responding to assessment results, Amendment 1 allows for the incorporation of new, peer-reviewed stock status determination criteria (both the methods used to set reference points and the reference point values), when available, through Board action. This allows flexibility to incorporate changes to the definitions of MFMT or MSST as the best scientific information becomes available, while maintaining objective and measurable status determination criteria for identifying when the stock is overfished. Similar actions have been taken with other Commission-managed species' FMPs (e.g., Addendum XIX to the FMP for Summer Flounder, Scup and Black Sea Bass, Addendum XVI to the FMP for American Lobster, and Amendment 3 to the FMP for Northern Shrimp). To attain this information, stock assessment and peer review terms of reference will include evaluations of existing or proposed biological reference point definitions and values (if estimable).

This action allows for the incorporation of new, peer-reviewed stock status determination criteria as soon as it becomes available, through the harvest specification process (*Section 4.1*), allowing timely use of the best available scientific information in the management of Atlantic cobia. This action does not have a direct influence on fishing effort or fishery removals but, instead, facilitates use of the most current scientific information available to define the status determination criteria for the stock, so that the stock can be managed to prevent overfishing and such that it is not overfished.

The following describes the potential sources of peer-reviewed scientific advice on status determination criteria and the current process of how that scientific advice will move forward in the development of management advice through the Board's specification process.

Specific definitions or modifications to the status determinations criteria and their associated values would result from the most recent peer-reviewed stock assessments and their panelist recommendations. The primary peer-review processes for Atlantic cobia that may be used are:

- The SEDAR Peer Review process, which is the primary mechanism used in the Southeast Region at present to review scientific stock assessment advice, including status determination criteria, for Atlantic cobia. As part of this process, the Commission appoints scientists to serve as reviewers along with those appointed by SEDAR.
- The Commission's Independent External Peer Review process, which follows a similar process to SEDAR in contracting independent experts to review scientific stock assessment advice, including status determination criteria, but allows the Commission more flexibility in determining the timing of a benchmark assessment.

The above list of peer review entities does not preclude groups from bringing independent stock assessments performed for the Atlantic cobia stock forward to the attention of the Commission. The Commission may recommend that these independent reviewed stock assessments pass through either of the peer review processes above, to ensure that sufficient peer review of the information occurs before the scientific advice can be used in the management process.

The SEDAR and Commission review processes both operate with a goal of reaching consensus. If consensus opinion of the peer review is to maintain current definitions of status determination criteria for Atlantic cobia, values produced by current criteria definitions may be updated to reflect the most recent data without any specific Board action, as using updated values is implied in this provision of Amendment 1. In this case, the scientific advice can then move forward such that management advice can be developed. If consensus opinion of the peer review is to recommend changes or different definitions of the status determination criteria and the panelists reach consensus as to how these status determination criteria should be changed, this advice may also move forward without any specific Board action such that management advice can be developed. Under these first two potential scenarios, consensus has been reached. Therefore, the scientific advice moving forward to the Board's management advisory groups should be clear.

A third potential scenario is that peer review scientific advice with respect to the incorporation of status determination criteria are split (consensus is not reached) or uncertain recommendations are provided (weak consensus). In this case, the scientific advice provided by the reviewers may be conflicting or may not be specific enough to provide adequate guidance as to how the MFMT or MSST should be defined. Additionally, the resulting management advice that should be developed from these changes may be unclear. Under these circumstances, the Board may engage the Commission's Assessment Science Committee (ASC) to review the information and recommendations provided by the peer review panel and Technical Committee. Based on the terms of reference provided to the ASC, they may prepare a consensus report clarifying the scientific advice for the Board as to what the status determination criteria should be. At that point, the scientific advice on how the status determination criteria should be defined will be clear and can move forward such that management advice can be developed.

3.0 MONITORING PROGRAM SPECIFICATION

In order to meet the goals and objectives of Amendment 1, the collection and maintenance of quality data is necessary.

Updates from the FMP have been made to monitoring sections to reflect the most up-to-date information about the Atlantic cobia fishery.

3.1 SUMMARY OF MONITORING PROGRAMS

The FMP included no requirements regarding fishery-dependent monitoring programs, but all state fishery management agencies were encouraged to pursue full implementation of the standards of the Atlantic Coastal Cooperative Statistics Program (ACCSP). The Management Board recommended a transitional or phased-in approach be adopted to allow for full implementation of the ACCSP standards. Participation by program partners in the ACCSP does not relieve states from their responsibilities in collating and submitting harvest/monitoring reports to the Commission as required under the FMP.

3.1.1 Commercial Catch and Landings Program

The ACCSP's standard for commercial catch and effort statistics is mandatory, trip-level reporting of all commercially harvested marine species, with fishermen and/or dealers required to report standardized data elements for each trip by the tenth of the following month.

The current commercial ACL was set by the South Atlantic Fishery Management Council's (SAFMC) CMP FMP Amendment 20B; this was complemented by the ISFMP for Atlantic cobia. Quota monitoring is done by the NOAA Southeast Regional Office and landings are updated on a weekly basis. Monitoring data can be found at https://www.fisheries.noaa.gov/southeast/commercial-fishing/2019-preliminary-south-atlantic-commercial-landings.

Issue 4

Starting in 2020, due to the removal of the Atlantic cobia stock from SAFMC jurisdiction, all commercially non-*de minimis* states will be required to monitor cobia landings in order to maintain sustainable cobia harvest and minimize the potential for overages.

3.1.2 Recreational Catch and Effort Program

3.1.2.1 Recreational Fishery Catch Reporting Process

The Marine Recreational Information Program (MRIP) contains estimated Atlantic cobia catches from 1981-2018. The MRIP evolved from the Marine Recreational Statistics Survey (MRFSS; 1981-2003) and included improvements in survey and estimation methodologies to remove sources of bias. The MRFSS and MRIP programs were simultaneously conducted in 2004-2006 and this information was used to calibrate past MRFSS recreational harvest estimates against MRIP recreational harvest estimates.

The MRIP is a national program that uses several surveys to obtain catch and effort data at a regional level. The Access Point Angler Intercept Survey (APAIS) provides the catch rates and species composition from anglers fishing in estuarine or marine waters (not freshwater). Anglers who have completed a fishing trip are interviewed to gather catch and demographic data. Sampling is separated by fishing mode (charter boat, private/rental boat, beach/bank and man-made structures), area fished, and wave (two-month period).

The MRIP implemented the Fishing Effort Survey (FES) in 2018, an improved methodology to address several concerns with the prior survey (Coastal Household Telephone Survey) including under-coverage of the angling public, declining number of households using landline telephones, reduced response rates, and memory recall issues. The number of fishing households and the numbers of fishing trips taken are determined by FES. The data from the two surveys are combined to provide estimates of the total number of fish caught, released, and harvested. Additionally, information is collected on the weight of the harvest, total number of trips, and the number of people participating in marine recreational fishing. Improvements within APAIS and the adoption of FES have required calibrations of pre-existing data to standardize estimates and as such all recreational data presented herein represent the latest techniques. For additional information on the MRIP see https://www.fisheries.noaa.gov/topic/recreational-fishing-data.

Additionally, Virginia has a Cobia Recreational Permit that is required for all recreational fishermen (private and for-hire). Permit holders are required to report all trips, both those that resulted in catches and the zero-catch trips as well. Catch and effort information is captured by the reporting forms. This is permit was created to supplement the MRIP sampling.

3.1.2.1.1 *For Hire Fishery Catch-Reporting Process*

The ACCSP has selected the NOAA Fisheries For-Hire Survey as the preferred methodology for collecting data from charter boats and headboats (partyboats), also called the “for-hire” component. The For-Hire Survey is similar to the MRIP. The independent survey components of the For-Hire Survey include: 1) telephone survey to collect fishing effort data from vessel representatives; 2) an effort validation survey; 3) an access-site intercept survey for catch data; and 4) at-sea samplers on headboats for catch data. Using the data collected through these surveys, NOAA Fisheries generates catch and effort estimates for for-hire fisheries.

The vessel effort survey is a mandatory survey for the for-hire vessels which uses a coastwide directory of such vessels as the sampling frame for for-hire fishing effort. The directory is continually updated as intercept and telephone interviewers identify changes in the fleet. Optimal sampling levels will be determined following evaluation of the Atlantic coast For-Hire Survey results from the first three years. Until optimal sampling levels are determined, a minimum of 10% of for-hire vessels (or three charter boats and three headboats, whichever is greater), will be randomly sampled each week in each state. A vessel representative, usually the captain, is called and asked to provide information on the fishing effort associated with that vessel during the previous week. Vessel representatives are notified in advance that they have been selected for sampling and an example form is provided. To be included in the sample frame for particular wave, a vessel record must include: 1) at least one vessel representative’s telephone number; 2) the name of the vessel or a vessel registration number issued by a state or the U.S. Coast Guard; 3) the county the boat operates from during that wave, and 4) designation as either a charter or guide boat (both called “charter”) or headboat.

To validate the self-reported effort data collected through the vessel telephone survey, field samplers periodically check access sites used by for-hire vessels to observe vessel effort. Interviewers record the presence or absence of a for-hire vessel from its dock or slip, and if the vessel is absent, they try to ascertain the purpose of the trip. Those observations are compared to telephone data for accuracy and to make any necessary corrections.

3.1.2.1.1.1 Charter Boat Sampling

Vessels that meet the ACCSP definition of a charter boat, “typically hired on a per trip basis,” are sampled for catch data through an intercept site survey of anglers similar to the MRIP. The intercept survey has been ongoing since 1981.

Some partners collect for-hire effort data using Vessel Trip Reports (VTR), which are mandatory for some vessels and contain all minimum data elements collected by the For-Hire Survey. In areas where the survey runs concurrently with VTR programs, captains selected for the weekly telephone survey are permitted to fax their VTRs in lieu to being interviewed by phone.

Additionally, South Carolina requires charter boats to submit logbook trip reports to the state on a monthly basis. These logbooks capture catch and effort information. South Carolina is working to develop validation methods for self-reported data.

3.1.2.1.1.2 Headboat Sampling

Catch and effort data for federally permitted headboats operating in the South Atlantic (North Carolina – Georgia) is monitored through the Southeast Region Headboat Survey conducted by the Southeast Fisheries Science Center. Vessel operators are required to file weekly electronic reports for all trips to report catch and effort information. Dockside samplers collect biological samples from the catches, which supplement the samples collected by the at-sea observers.

3.1.2.1.1.3 South Atlantic Mandatory Reporting for Federally-Permitted Charter Vessels

In December 2016, the South Atlantic Fishery Management Council approved an amendment that, if implemented, would require weekly electronic reporting of all charter vessels operating under a South Atlantic federal for-hire permit. The amendment proposes to implement the same reporting requirements for federally-permitted charter vessels in the snapper grouper, dolphin wahoo, and coastal migratory pelagics (mackerel and cobia) fisheries that currently exist for federally-permitted headboats. A federal permit is required for all for-hire vessels (charter and headboats) operating in the exclusive economic zone (federal waters, more than 3 miles offshore). While Atlantic cobia are no longer part of the CMP FMP, they may be caught along with the affected SAFMC-managed fisheries and, thus, reported through this program. Mandatory electronic reporting for charter vessels is expected improve the data available for management and stock assessments, improve the accuracy and timeliness of data collection, and allow fishery managers to better monitor landings and discards, and more accurately assess the impacts of regulations on the for-hire industry fishing in federal waters. Currently, the amendment has been approved by the SAFMC and is under review by NOAA Fisheries and the US Secretary of Commerce.

3.2 BIOLOGICAL INFORMATION

The ACCSP has set standards for how biological data should be collected and managed for commercial, recreational, and for-hire fisheries. Trained field personnel, known as port agents or field samplers, should obtain biological samples. Information should be collected through direct observation or through interviews with fishermen. Detailed fishery statistics and/or biological samples should be collected at docks, unloading sites, and fish houses. Biological sampling includes species identification and disposition; individual lengths and weights; extraction of hard parts including otoliths; and tissue samples such as gonads, stomachs, fin clips, and scales.

Commercial fishery biological samples are collected by federal port agents through the Trip Interview Program (TIP). Some states supplement TIP with state sampling programs; these states are encouraged to continue with these programs.

All states are encouraged to continue sampling programs, such as freezer collection programs, that collect biological information. Information from these programs may be reviewed by the TC and Board on a case-by-case basis for use in management decisions. Examples of current programs include the Virginia Marine Resource Commission's Marine Sportfish Collection Project, North Carolina Division of Marine Fisheries Carcass Collection Program, South Carolina's Freezer Fish Program, and Georgia's Marine Sportfish Carcass Recovery Project.

Additionally, states are encouraged to continue to take biological samples from cobia encountered incidentally during fishery independent sampling to add to information on life history, stock ID, and individual weight.

3.3 SOCIAL AND ECONOMIC INFORMATION

Data on a number of variables relevant to social and economic dimensions of the cobia fishery are collected through existing ACCSP data collection programs and the MRIP; however, no explicit mandates to collect socioeconomic data for cobia currently exist. In addition to pounds landed, commercial cobia harvesters and dealers may report ex-vessel prices or value, fishing and landing locations, landing disposition, and a variety of measures capturing fishing effort. The MRIP regularly collects information on recreational fishing effort and landings, and occasionally gathers socioeconomic data on angler motivations and expenditures.

3.4 OBSERVER PROGRAMS

No specific observer programs are in place to monitor the cobia fishery. Observer programs already in place, whether state or federal, may observe capture of cobia in other monitored fisheries or specific gear types. A review of these programs should take place.

3.5 ASSESSMENT OF STOCK CONDITION

Although management of Atlantic cobia will occur solely through Amendment 1, without any complementary SAFMC FMP, stock assessments will primarily continue to be conducted through the Southeast Data, Assessment, and Review (SEDAR) process. Every five years, the Atlantic cobia stock assessment will be reviewed to determine whether stock assessment or update is necessary. The Commission, through participation in the SEDAR Steering Committee, will coordinate with partnering organizations to schedule SEDAR assessments. This schedule may be modified as needed to incorporate new information and in consideration of the Atlantic cobia stock.

Stock assessments may also be conducted through the Commission's assessment process by the Cobia Stock Assessment Subcommittee (SAS, *Section 4.8.5*). For this process, the TC and

Advisory Panel (AP) will meet to review the stock assessment and all other relevant data sources. The stock assessment report shall follow the general outline as approved by the Interstate Fisheries Management Program Policy Board (ISFMP Policy Board) for all Commission-managed species. In addition to the general content of the report as specified in the outline, the stock assessment report may also address the specific topics detailed in the following sections. Specific topics in the stock assessment may change as the SAS continues to provide the best model and metrics possible to assess the Atlantic cobia stock.

3.5.1 Assessment of Annual Recruitment

No programs currently collect data necessary to assess annual recruitment of cobia.

The original FMP (ASMFC, 2017) recommended examination of possible surveys from which Atlantic cobia abundance indices could be developed, as these indices would be valuable for informing future stock assessments. Pre-data workshop calls for SEDAR 58 cobia assessment did not identify any new data sources for recruitment.

3.5.2 Assessment of Spawning Stock Biomass

SEDAR 28 (2013) provides the most current information on spawning stock biomass. While the stock is not currently considered overfished, the 2013 stock assessment does indicate declines in biomass over the last few years of the assessment (terminal year: 2010). New information should be revealed by SEDAR 58, scheduled for completion in early 2020.

3.5.3 Assessment of Fishing Mortality Target and Measurement

SEDAR 28 (2013) provides the most current information on fishing mortality. The stock is not currently considered to be undergoing overfishing. Recent overages of the ACL for both the commercial and recreational sectors have raised concerns. New information should be revealed by SEDAR 58, scheduled for completion in early 2020.

3.6 STOCKING PROGRAM

The Virginia Institute of Marine Science (VIMS) began an experimental stocking program in the Chesapeake Bay in 2003 to explore stock enhancement and study juvenile movement and habitat utilization.[3] Juvenile cobia were tagged and released into the Chesapeake Bay in 2003, 2006, 2007, and 2008, with more than 300 tagged releases occurring in those first two years. Recapture information indicated habitats ranged from 1-4 m in depth and consisting of sandy and grass-bed bottoms. It is unclear whether this program had any effect on the population of

[3] https://www.vims.edu/research/departments/fisheries/programs/tagging_research/cobia/

cobia in Virginia, although it is assumed to have had minimal impact due to the small number of releases.

South Carolina has an experimental stock enhancement program designed to evaluate the methodology necessary for augmenting wild populations. Experiments have been designed to determine the best size and time of year to stock cobia in coastal rivers focusing on augmentation of the distinct population segment of cobia in South Carolina. Locally-caught brood stock are conditioned to spawn in recirculating seawater systems using temperature and photoperiod conditioning and hormone implantations to facilitate final oocyte maturation. Multiple years of spawning and grow out have occurred, and more than 50,000 (60-350 mm TL) cobia have been stocked in the Colleton and Broad rivers of Port Royal Sound. All fish are genetically identifiable to broodstock group and can be identified in the catch and distinguished genetically from wild-spawned fish. Cobia tissue samples collected from charter boat captains and from carcasses collected at tournaments and cooperating recreational anglers show that as much as 50% of the catch from the 2007 year-class were from hatchery releases and that these animals have persisted in the catch each year since release. This research has demonstrated the application of stock enhancement as an additional management tool for cobia. In addition to research on production of animals, the SCDNR has developed predictive individual-based genetic models to determine the appropriate number of cobia that should be produced and stocked each year in order to grow the population while minimizing any negative impact on the genetic health of the wild population.

3.7 BYCATCH REDUCTION PROGRAM

Bycatch is defined as "portion of a non-targeted species catch taken in addition to the targeted species. It may include non-directed, threatened, endangered, or protected species, as well as individuals of the target species below a desired or regulatory size" (ASMFC, 2009). Bycatch can be divided into two components: incidental catch and discarded catch. Incidental catch refers to retained or marketable catch of non-targeted species, while discarded catch is the portion of the catch returned to the sea because of regulatory, economic, or personal considerations.

The recreational cobia fishery is largely a directed fishery with bycatch occurring in fisheries directed towards other species. Mortality associated with regulatory discards of undersized cobia or fish taken after the bag limit is reached is largely unknown but likely varies based on depth caught and methods used to boat the catch. Several ongoing tagging studies will aid in estimating survivability.

The commercial cobia fishery tends to be a bycatch fishery in the hook-and-line and large mesh gill net fisheries. Regulatory discards do occur, but the mortality associated with those discards varies with gear. Juvenile cobia have been documented as bycatch in shrimp trawls off the Atlantic coast, although this is not a frequent occurrence. From 1998-2010, only five cobia were observed from approximately 1,700 shrimp nets and only three of the five were within the stock boundary (SEDAR, 2013). As of Amendment 2 to the federal Shrimp Fishery Management

Plan for the South Atlantic Region (SAFMC, 1996), all shrimp trawlers in the South Atlantic are required to use bycatch reduction devices.

3.8 HABITAT PROGRAM

Particular attention should be directed toward cobia habitat utilization and habitat condition (environmental parameters). A list of existing state and federal programs generating environmental data such as sediment characterization, contaminant analysis, and habitat coverage (marsh grass, oyster beds, submerged aquatic vegetation) should also be produced and updated as new information arises. Habitats utilized by cobia range from the middle portions of estuaries and coastal rivers out to and likely beyond, the shelf break. Thus, virtually any study generating environmental data from estuarine or coastal ocean systems could be of value.

4.0 MANAGEMENT PROGRAM

4.1 HARVEST SPECIFICATION PROCESS

Issue 5

Options

a. The coastwide total harvest quota, vessel limits, possession or bag limits, minimum size limits, and commercial closure triggering mechanism may be specified by Board action for up to two years. Subsequent harvest specification would occur for implementation after expiration of the previous specification (up to two years apart) or following a completed stock assessment.

b. The coastwide total harvest quota, vessel limits, possession or bag limits, minimum size limits, and commercial closure triggering mechanism may be specified by Board action for up to three years. Subsequent harvest specification would occur for implementation after expiration of the previous specification (up to three years apart) or following a completed stock assessment.

c. The coastwide total harvest quota, vessel limits, possession or bag limits, minimum size limits, and commercial closure triggering mechanism may be specified by Board action for up to four years. Subsequent harvest specification would occur for implementation after expiration of the previous specification (up to four years apart) or following a completed stock assessment.

For all options, in years when harvest specifications are conducted, they will occur no later than the Fall Board Meeting, and resulting measures will be implemented in the following year.

4.2 SECTOR QUOTA ALLOCATION

Issue 6

The recreational quota will be 92% of the coastwide total harvest quota set through Board specification. The commercial quota will be 8% of the coastwide total harvest quota set through Board specification. These allocation percentages were derived from those previously in place through the CMP FMP. These percentages may be changed in the future through an addendum to this amendment.

4.3 RECREATIONAL FISHERY MANAGEMENT MEASURES

4.3.1 Size Limit

All states shall maintain a recreational minimum size limit of 36 inches fork length or the total length equivalent (40 inches).

4.3.2 Bag Limit

All states shall maintain a 1 fish per person recreational bag limit.

4.3.3 Vessel Limit

All states shall maintain a recreational daily vessel limit, not to exceed 6 fish per vessel.

4.3.4 Seasons and Allocations

Management of the coastwide recreational quota shall be accomplished by state-specific seasons and allocations. One percent of the recreational quota shall be set aside to account for harvests in *de minimis* states.

State-defined seasons must adhere to state shares (harvest targets) of the coastwide recreational quota. Percentage allocations are based on states' percentages of the coastwide historical landings in numbers of fish, derived as 50% of the 10-year average landings from 2006-2015 and 50% of the 5-year average landings from 2011-2015. Table 9 shows landings used to develop percentage allocations. Numbers of fish are used for allocation percentages to eliminate confusion from differences in average weights applied to numbers data by the MRIP and Southeast Fishery Science Center (SEFSC). Table 10 shows state allocation percentages of the recreational quota, including a one percent set aside that accounts for landings in states with *de minimis* status for their recreational fisheries. These percentages would be used to determine state allocation percentages regardless of whether pounds or numbers of fish are used to evaluate compliance.

Table 9. Average AMG Cobia recreational landings in numbers (n) from Georgia through Virginia for establishing soft recreational harvest targets as an average of the 5-year and 10-year time periods (5-yr/10-yr Average), 2011-2015 and 2006-2015. Data Source: SEFSC (with headboat), queried 2017.

State	5-yr/10-yr Average
Georgia	n = 2,298
South Carolina	n = 2,935
North Carolina	n = 9,273
Virginia	n = 9,589
Total	n = 24,095

Table 10. Allocation percentages for Atlantic cobia by state, with recognition of 1% of the quota being set aside for recreational harvest in *de minimis* states, based on percentages derived from Table 9. State allocation percentages are the same as those found in Table 10 of the Cobia FMP (ASMFC, 2017), except with the inclusion of the 1% *de minimis* set aside from the total recreational quota.

State	Allocation Percentage
GA	9.4%
SC	12.1%
NC	38.1%
VA	39.4%
De Minimis	1.0%
Total	100%

4.3.5 Evaluation of Landings against State Harvest Targets and Overage Response

Issue 7

Bold language is a proposed addition to the following language from the FMP, subject to public comment and Board approval.

The following language describing the landings evaluation process and response to an overage is similar in concept to what was included in the FMP. However, additional details are included, which further clarify the implementation protocol with consideration of the new harvest specification process (*Section 4.1*).

Recreational landings will be evaluated against state recreational harvest targets at the same time (i.e., in the same meeting) as Board specification of harvest. Recreational landings for each non-*de minimis* state will be evaluated against that state's target as an average of annual landings. **The timeframe for this average will only include years that had the same recreational season and vessel limit. The timeframe will include the most recent years with**

the same season and vessel limit. If the same season and vessel limit have been in place for at least three years, the timeframe will include the three most recent years under these regulations (a rolling average). If the same season and vessel limit have been in place for less than three years, the timeframe will include all years under these regulations.

The terminal year of the evaluated time period will be the year before the evaluation and specification processes are conducted, e.g., 2019 would be the terminal year for data used in an evaluation conducted in 2020, coinciding with a specification of regulations for 2021-2023.

If a state's averaged recreational landings exceed its annual recreational harvest target, that state must adjust its recreational vessel limit or season to reduce harvest, such that its average landings over the following period of specified harvest will achieve the state recreational harvest target.

States reporting a **consistent** under-harvest during an evaluation time period **of at least 3 years** may present a plan to extend seasons or increase vessel limits, if desired, to allow increased harvests that will not exceed the harvest target.

Changes to management measures for states with overages or states that wish to liberalize management measures must be reviewed by the TC and approved by the Management Board prior to implementation. A hypothetical example of several potential evaluation and response scenarios is depicted in Table 11.

Allocation of the recreational quota may be reevaluated by the Management Board if a recreational *de minimis* state exceeds the recreational *de minimis* landings threshold. **Reallocation of the recreational quota among states may be accomplished through an addendum to Amendment 1.**

Table 11. A hypothetical example timeline for a state with a recreational harvest target of 100,000 lb. Evaluation years depict examples of an achieved target (2021), overharvest (2024), short-term underharvest (2027), and long-term underharvest eligible to apply for more liberal measures (2030). Rows with the same shading have the same season and vessel limit regulations. Evaluations occur in August-October, before harvest data for the current year is available.

	Year	Vessel Limit/Season	Harvest	Evaluation Status & Specification
Harvest Target: 100,000 lb	2018	Vessel Limit: 4 fish Season: June 1-Aug. 30	110,000	Not evaluated
	2019	Vessel Limit: 4 fish Season: June 1-Aug. 30	90,000	Not evaluated
	2020	Vessel Limit: 4 fish Season: June 1-Aug. 30	95,000	Not evaluated
	2021	Vessel Limit: 4 fish Season: June 1-Aug. 30	105,000 lb	Evaluated: Achieved target in **2018-2020**. Regulations set for 2022-2024.
	2022	Vessel Limit: 4 fish Season: June 1-Aug. 30	115,000 lb	Not evaluated
	2023	Vessel Limit: 4 fish Season: June 1-Aug. 30	95,000 lb	Not evaluated
	2024	Vessel Limit: 4 fish Season: June 1-Aug. 30	110,000 lb	Evaluated: Over target by average of 5,000 lb per year in **2021-2023**. Required reduction of season or vessel limit. Regulations set for 2025-2027.
	2025	Vessel Limit: 4 fish Season: June 10-Aug. 30	80,000 lb	Not evaluated
	2026	Vessel Limit: 4 fish Season: June 10-Aug. 30	75,000 lb	Not evaluated
	2027	Vessel Limit: 4 fish Season: June 10-Aug. 30	85,000 lb	Evaluated: Achieved target in **2025-2026** (different regulations in 2024). Regulations set for 2028-2030.
	2028	Vessel Limit: 4 fish Season: June 10-Aug. 30	65,000 lb	Not evaluated
	2029	Vessel Limit: 4 fish Season: June 10-Aug. 30	75,000 lb	Not evaluated
	2030	Vessel Limit: 4 fish Season: June 10-Aug. 30	70,000 lb	Evaluated: Achieved target in **2027-2029**. May submit liberalized measures for TC and Board review, for implementation in 2031. Regulations set for 2031-2033.

4.3.6 Units for Recreational Landings, Quotas, and Targets

Issue 8

Options

a. (Status Quo) Recreational landings, quotas, and targets will be evaluated and set in units of pounds.

b. Recreational landings, quotas, and targets will be evaluated and set in units of numbers of fish. The recreational quota and harvest targets will be converted to numbers of fish by dividing poundage amounts by the average of the three most recent annual average weights for cobia landed recreationally, as determined by data from the Marine Recreational Information Program (average weight = recreational pounds/recreational numbers).
Conversions conducted prior to the availability of average weight data from 2020 will exclude the use of 2016 and 2017, as a portion of the management unit was closed to recreational fishing during those years, and replace them with data from 2014 and 2015, respectively.
A state may submit alternative data sets that would provide more appropriate estimates of average weight for their state's fishery. Alternative data sets must be evaluated by the TC and approved by the Board before being implemented in converting that state's recreational harvest target from pounds to numbers.

4.4 COMMERCIAL FISHERY MANAGEMENT MEASURES

4.4.1 Size Limit Options

Issue 9

Options

a. (Status Quo) All states shall maintain a minimum size limit of 33 inches fork length or the total length equivalent (37 inches).

b. All states shall maintain a minimum size limit of 36 inches fork length or the total length equivalent (40 inches).

4.4.2 Possession Limit Options

All states shall maintain a commercial possession limit of no more than 2 cobia per person, not to exceed the vessel limit stated in *Section 4.4.3*.

4.4.3 Vessel Limits

Issue 10

Options

a. (Status Quo) All states shall maintain a daily vessel limit, not to exceed 6 fish per vessel.

b. All states shall establish a daily vessel limit, not to exceed 5 fish per vessel.

c. All states shall establish a daily vessel limit, not to exceed 4 fish per vessel.

4.4.4 Quota-based Management

Issue 11

The commercial fishery shall be managed by a coastwide, commercial quota, set through the harvest specification and sector allocation processes defined in *Sections 4.1* and *4.2*. If commercial *de minimis* states exist, three percent of the commercial quota will be set aside to account for commercial landings in *de minimis* states (qualifications for *de minimis* status are defined in Section 4.5.3).

Commercial landings shall be monitored in-season by non-*de minimis* states and NOAA Fisheries. If reported in-season commercial landings from non-*de minimis* states reach a trigger percentage of the commercial quota, the states will be informed and a future coastwide closure will be scheduled based on that date, after which the commercial fishery will be closed in all state waters within the management unit for the remainder of the calendar year. The Commission will also request through ACFCMA that NOAA Fisheries issue a similar closure in the Exclusive Economic Zone (EEZ).

The trigger percentage and number of following days until a closure occurs will be specified as part of the harvest specification process defined in *Section 4.1*. The number of days past the trigger percentage until a closure occurs will be calculated as the average number of days from the previous three years for commercial landings to go from the trigger percentage to the full commercial quota, less any *de minimis* set aside. The trigger shall be updated as part of the specification process, using similar methodology, to allow the states at least 30 days' notice of an impending commercial closure.

For example, the average number of days for weekly commercial landings in Virginia (VA)-South Carolina (SC) to go from 77% to 97% (accounting for a 3% *de minimis* set aside) of the 2019 commercial quota (50,000 lb) in 2015-17 was 32 days (ACCSP, queried April, 2019). Therefore, a commercial trigger based on these data would initiate a closure 32 days after in-season reported VA-SC landings reach 38,500 lb (77% of the commercial quota).

4.5 ALTERNATIVE STATE MANAGEMENT REGIMES

States are required to obtain prior approval from the Board of any changes to their management program for which a compliance requirement is in effect. Changes to non-compliance measures must be reported to the Board but may be implemented without prior Board approval. A state can request permission to implement an alternative management measure to any mandatory compliance measure only if that state can show, to the Board's satisfaction, that its alternative proposal will have the same or greater conservation value as the measure contained in this amendment or any addenda prepared under Adaptive Management (*Section 4.6*). States submitting alternative proposals must demonstrate that the proposed action will not contribute to overfishing of the resource. All changes to a state's plan must be submitted in writing to the Board and to the Commission as part of their annual compliance report.

4.5.1 General Procedures

A state may submit a proposal for a change to its regulatory program or any mandatory compliance measure under this amendment to the Commission. Such changes shall be submitted to the Chair of the Plan Review Team (PRT), who shall distribute the proposal to appropriate groups, including the Board, the PRT, the TC, and the AP.

The PRT is responsible for gathering the comments of the TC and the AP. The PRT is also responsible for presenting these comments to the Board for decision.

The Board will decide whether to approve the state proposal for an alternative management program if it determines that it is consistent with the goals and objectives of this amendment.

In order to maintain consistency within a fishing season, new rules should be implemented prior to the start of the fishing season. Given the time needed for the TC, AP, and Board to review the proposed regulations, as well as the time required by an individual state to promulgate new regulations, it may not be possible to implement new regulations for the on-going fishing season. In this case, new regulations should be effective at the start of the following season after a determination to do so has been made.

4.5.2 Management Program Equivalency

The TC, under the direction of the PRT, will review any alternative state proposals under this section and provide its evaluation of the adequacy of such proposals to the Board. The PRT can also ask for reviews by the Law Enforcement Committee (LEC) or the AP.

Following the first full year of implementation of an alternate management program, the PRT shall be responsible for evaluating the effects of the program to determine if the measures were equivalent with the standards of the FMP and subsequent amendments or addenda. The PRT will report to the Management Board on the performance of the alternate program.

4.5.3 *De Minimis* Fishery Guidelines

The Commission's Interstate Fisheries Management Program Charter (ISFMP Charter) defines *de minimis* as "a situation in which, under the existing condition of the stock and scope of the fishery, the conservation and enforcement actions taken by an individual state would be expected to contribute insignificantly to a coastwide conservation program required by a Fishery Management Plan or amendment," (ASMFC, 2016).

4.5.3.1 Recreational De Minimis Eligibility

A state can apply annually for *de minimis* status for their recreational fishery. To be eligible for *de minimis* consideration, a state's recreational landings for 2 of the previous 3 years must be less than 1% of the coastwide recreational landings for the same time period. Once *de minimis* status is granted, designated states must submit annual reports including commercial and recreational landings to the Management Board, justifying the continuance of *de minimis* status. States must include *de minimis* requests as part of their annual compliance reports.

4.5.3.1.1 *Procedure to Apply for De Minimis Status*

States must request *de minimis* status each year. Requests for *de minimis* status will be reviewed by the PRT as part of the annual FMP review process (*Section 5.3*). Requests for *de minimis* must be submitted to the Commission's Cobia FMP Coordinator as a part of the state's annual compliance report. The request must contain the following information: all available recreational landings data for the three previous full years of data and the proposed management measures the state plans to implement for the year *de minimis* status is requested. The FMP Coordinator will then forward the information to the PRT.

In determining whether a state meets the *de minimis* criteria, the PRT will consider the information provided with the request, the most recent available coastwide landings data, any information provided by the TC and SASC, and projections of future landings. The PRT will make a recommendation to the Board to either accept or deny the *de minimis* request. The Board will then review the PRT recommendation and either grant or deny the *de minimis* classification.

The Board must make a specific motion to grant a state *de minimis* status. By deeming a given state *de minimis*, the Board is recognizing that: the state has a minimal Atlantic cobia recreational fishery; there is little risk to the health of the Cobia stock if the state does not implement the full suite of management measures; and the overall burden of implementing the complete management and monitoring requirements of the FMP outweigh the conservation benefits of implementing those measures in that particular state.

If the Board denies a state's *de minimis* request, the state will be required to implement all the provisions of the FMP, including adherence to an allocation of the coastwide recreational quota. When a state rescinds or loses its *de minimis* status, the Board will set a compliance date by which the state must implement the required regulations.

4.5.3.2 Plan Requirements if De Minimis Status is Granted

One percent (1%) of the recreational quota shall be set aside to account for harvests in *de minimis* states. If a state qualifies for *de minimis*, the state may choose to match the recreational management measures implemented by an adjacent non-de minimis state (or the nearest non-de minimis state if none are adjacent) or the state may choose to limit its recreational fishery to 1 fish per vessel per trip with a minimum size of 29 inches fork length. A total length equivalent may be considered by the TC and Management Board. Should a *de minimis* state choose to match an adjacent (or the nearest) non-*de minimis* state, the *de minimis* state shall be subject to all recreational cobia regulations, including bag, size, vessel, and season restrictions, of their adjacent (or nearest) non-*de minimis* state. *De minimis* states that choose to limit their recreational fisheries to 1 fish per vessel per trip will not be subject to seasonal restrictions for their recreational fishery.

If the coastwide fishery is closed for any reason through Emergency Procedures (*Section 4.7*), *de minimis* states must close their fisheries as well.

Any additional components of the FMP, which the Board determines necessary for a *de minimis* state to implement, can be defined at the time *de minimis* status is granted.

4.5.3.3 Commercial De Minimis Options

Issue 12

Options

a. (Status quo) States may not apply for *de minimis* status for their commercial fishery.

b. States may apply for *de minimis* status for their commercial fishery. To be eligible for commercial *de minimis* consideration, a state's commercial landings for 2 of the previous 3 years must be less than 2% of the coastwide commercial landings for the same time period. States must annually request and prove their eligibility to maintain *de minimis* status. These states would be subject to all coastwide commercial regulations, including minimum size, possession, and vessel limits, as well as closures of the commercial fishery resulting from the commercial quota being reached. States with *de minimis* status for their commercial fishery would not be required to monitor commercial cobia landings for their state within the fishing year. They would still be required to report annual landings through their annual state compliance report. To account for potential, unmonitored landings in these states, 3% percent of the commercial quota would be set aside and not accessible to non-*de minimis* states.

4.6 ADAPTIVE MANAGEMENT

The Board may vary the requirements specified in this FMP as a part of adaptive management in order to conserve the Atlantic cobia resource. Specifically, the Board may change target fishing mortality rates, harvest specifications, or other measures designed to prevent overfishing of the stock complex or any spawning component. Such changes shall be instituted to become effective on the first fishing day of the following year, but may be put in place at an alternative time when deemed necessary by the Board.

4.6.1 General Procedures

The PRT shall monitor the status of the fisheries and the resources and report on that status to the Board annually or when directed to do so by the Board. The PRT shall consult with the TC, SAS, and AP in making such a review and report. The report will contain recommendations concerning proposed adaptive management revisions to the management program.

The Board shall review the report of the PRT, and may consult further with the TC, SAS, or AP. The Board may, based on the PRT Report or on its own discretion, direct the PDT to prepare an addendum to make any changes it deems necessary. An addendum shall contain a schedule for the states to implement its provisions.

The PDT will prepare a draft addendum, as directed by the Board, and distribute it to all states for review and public comment. The document will be released for public comment for a minimum of 30 days. A public hearing will be held in any state that requests one. After the comment period, the PDT will summarize the comments and present them to the Board along with the recommendations of the TC, SAS, LEC, and AP, when applicable. The Board shall then decide whether to adopt or revise and then adopt the addendum.

Upon adoption of an addendum by the Board, states shall prepare plans to carry out the addendum and submit them to the Board for approval, according to the schedule contained in the addendum.

4.6.1 Measures Subject to Change

The following measures are subject to change under adaptive management upon approval by the Management Board:

(1) Fishing year and/or seasons;
(2) Area closures;
(3) Overfishing definition, MSY and OY;
(4) Rebuilding targets and schedules;
(5) Fishery Specifications;
(6) Catch controls, including bag and size limits;
(7) Effort controls;

(8) Bycatch allowance
(9) Reporting requirements;
(10) Gear limitations;
(11) Measures to reduce or monitor bycatch;
(12) Observer requirements;
(13) Management areas;
(14) Recommendations to the Secretaries for complementary actions in federal jurisdictions;
(15) Research or monitoring requirements;
(16) Frequency of stock assessments;
(17) *De minimis* specifications;
(18) Management unit;
(19) Maintenance of stock structure;
(20) Catch allocation; and
(21) Any other management measures currently included in Amendment 1.

4.7 EMERGENCY PROCEDURES

Emergency procedures may be used by the Board to require any emergency action that is not covered by or is an exception or change to any provision in Amendment 1. Procedures for implementation are addressed in the Commission's ISFMP Charter, Section Six (c) (10) (ASMFC, 2016).

4.8 MANAGEMENT INSTITUTIONS

The management institution for cobia will be subject to the provisions of the ISFMP Charter (ASMFC, 2016). The following are not intended to replace any or all of the provisions of the ISFMP Charter. All committee roles and responsibilities are included in detail in the ISFMP Charter and are only summarized here.

4.8.1 Commission and the ISFMP Policy Board

The Commission and the ISFMP Policy Board are generally responsible for the oversight and management of the Commission's fisheries management activities. The Commission must approve all fishery management plans and amendments, including Amendment 1, and must make all final determinations concerning state compliance or non-compliance. The ISFMP Policy Board reviews any non-compliance recommendations of the various Management Boards and Sections and, if it concurs, forwards them on to the Commission for action.

4.8.2 South Atlantic State/Federal Fisheries Management Board

The South Atlantic State/Federal Fisheries Management Board (Board) was established under the provisions of the Commission's ISFMP Charter (Section Four; ASMFC, 2016) and is responsible for carrying out all activities under this Amendment.

The Management Board establishes and oversees the activities of the PDT, PRT, TC, and SAS, as well as the South Atlantic Species AP. Among other things, the Board makes changes to the management program under adaptive management and approves state programs implementing the amendment and alternative state programs under Sections 4.5 and 4.6. The Management Board reviews the status of state compliance with the management program annually, and if it determines that a state is out of compliance, reports that determination to the ISFMP Policy Board under the terms of the ISFMP Charter.

4.8.3 Plan Development Team / Plan Review Team

The Cobia Plan Development Team (PDT) and Cobia Plan Review Team (PRT) are composed of scientists and/or managers whose responsibility is to provide all of the technical support necessary to carry out and document the decisions of the Board. A Commission FMP Coordinator chairs the PDT and PRT. The PDT and PRT will be directly responsible to the Management Board for providing information and documentation concerning the implementation, review, monitoring and enforcement of the species management plan. The PDT and PRT will be comprised of personnel from state and federal agencies who have scientific and management ability and knowledge of the relevant species. The Cobia PDT is responsible for preparing all documentation necessary for the development of management documents, using the best scientific information available and the most current stock assessment information. The PDT will either disband or assume inactive status upon completion of Amendment 1. Alternatively, the Board may elect to retain PDT members as members of the species-specific PRT, or appoint new members. The PRT provides annual advice concerning the implementation, review, monitoring, and enforcement of the FMP once it has been adopted by the Commission.

4.8.4 Technical Committee

The Cobia Technical Committee (TC) will consist of representatives from state and/or federal agencies, Regional Fishery Management Councils, Commission, university or other specialized personnel with scientific and technical expertise and knowledge of Atlantic cobia. The Management Board will appoint the members of a TC and may authorize additional seats as it sees fit. The role of the TC is to assess the species' population, provide scientific advice concerning the implications of proposed or potential management alternatives, and respond to other scientific questions from the Board, PDT, or PRT. The SAS reports to the TC.

4.8.5 Stock Assessment Subcommittee

Atlantic cobia will be primarily assessed through the Southeast Data, Assessment, and Review (SEDAR) process. However, in addition to SEDAR, the Management Board may appoint members to the Cobia Stock Assessment Subcommittee (SAS). The SAS is approved by the Management Board, with consultation from the TC, and consists of scientists with expertise in the assessment of Atlantic cobia. Its role is to assess the species population and provide scientific advice concerning the implications of proposed or potential management alternatives, or to respond to other scientific questions from the Management Board, TC, PDT or PRT. The SAS reports to the TC.

4.8.6 Advisory Panel

The South Atlantic Species Advisory Panel (AP) was established according to the Commission's Advisory Committee Charter. Members of the AP are citizens who represent a cross-section of commercial and recreational fishing interests and others who are concerned about the conservation and management of cobia, as well as Atlantic croaker, black drum, red drum, Spanish mackerel, spot, and spotted seatrout. The AP provides the Management Board with advice directly concerning the Commission's management programs for these seven species.

4.8.7 Federal Agencies

4.8.7.1 Management in the Exclusive Economic Zone (EEZ)

Management of Atlantic cobia in the EEZ was previously under the jurisdiction of the SAFMC under the Magnuson-Stevens Fishery Conservation and Management Act, as amended (16 U.S.C. 1801 et seq.). However, in the absence of a Council Fishery Management Plan for Atlantic cobia, as is the case under Amendment 31 to the CMP FMP, management of this species is the responsibility of NOAA Fisheries, as mandated by the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5105 et seq.). The Commission may recommend regulatory measures to NOAA Fisheries for implementation in the EEZ.

4.8.7.2 Federal Agency Participation in the Management Process

The Commission has accorded the United States Fish and Wildlife Service (USFWS) and NOAA Fisheries voting status on the ISFMP Policy Board and the South Atlantic State/Federal Fisheries Management Board in accordance with the Commission's ISFMP Charter. NOAA Fisheries and the USFWS may also participate on the Management Board's supporting committees described in *Sections 4.8.3-4.8.6*.

4.8.7.3 Consultation with Fishery Management Councils

As of March 21, 2019, Atlantic cobia is no longer included in any SAFMC or other Council FMP. No Regional Fishery Management Councils have indicated an intent to develop a future plan for this stock. However, the SAFMC will continue to have a role in stock assessments for Atlantic cobia by conducting them through the SEDAR process. Additionally, in accordance with the Commission's ISFMP Charter, a representative of the SAFMC shall be invited to participate as a full member of the South Atlantic State/Federal Fisheries Management Board.

4.9 RECOMMENDATION TO THE SECRETARY OF COMMERCE FOR COMPLEMENTARY ACTIONS IN FEDERAL JURISDICTIONS

Through approval of Amendment 31 to the CMP FMP, the SAFMC no longer manages cobia in the EEZ. Therefore, it is necessary for the Commission to recommend measures to be implemented by NOAA Fisheries in the EEZ through authority and process defined in the ACFCMA.

If, for any reason, the coastwide fishery for either the commercial or recreational fishery are closed within state waters, the Commission will request through the ACFCMA that NOAA Fisheries issue a similar closure in the EEZ.

Issue 13

Options

a. Regulations in federal waters will be recommended to correspond to those of the vessel's permitted or licensed state of landing. If possessing permits or licenses for multiple states with open seasons, regulations for the most restrictive open state shall apply. If possessing permits or licenses for multiple states, only one of which is open, regulations for the state with an open season shall apply.

b. Regulations for the recreational fishery in federal waters will be recommended to correspond to the location of catch, with regulations persisting along a latitudinal extension of state boundaries into federal waters. This extension for all boundaries would be directly due east, not along any alternative trajectory of these boundaries as they approach the Atlantic coast.

   Regulations for the commercial fishery in federal waters will be recommended to correspond to the vessel's permitted or licensed state of landing. If possessing permits or licenses for multiple states with open seasons, regulations for the most restrictive open state shall apply. If possessing permits or licenses for multiple states, only one of which is open, regulations for the state with an open season shall apply.

4.10 COOPERATION WITH OTHER MANAGEMENT INSTITUTIONS

The Board will cooperate with other management institutions during the implementation of this amendment, including NOAA Fisheries and the SAFMC.

5.0 COMPLIANCE

The full implementation of the provisions included in this amendment is necessary for the management program to be equitable, efficient, and effective. States are expected to implement these measures faithfully under state laws. The Commission will continually monitor the effectiveness of state implementation and determine whether states are in compliance with the provisions of this fishery management plan.

The Board sets forth specific elements that the Commission will consider in determining state compliance with Amendment 1, and the procedures that will govern the evaluation of compliance. Additional details of the procedures are found in the Commission's ISFMP Charter (ASMFC, 2016).

5.1 MANDATORY COMPLIANCE ELEMENTS FOR STATES

A state will be determined to be out of compliance with the provisions of this fishery management plan, according to the terms of Section Seven of the ISFMP Charter if:

- Its regulatory and management programs to implement Section 4 have not been approved by the Board; or
- It fails to meet any schedule required by *Section 5.1.2*, or any addendum prepared under Adaptive Management (*Section 4.6*); or
- It has failed to implement a change to its program when determined necessary by the Board; or
- It makes a change to its regulations required under Section 4 or any addendum prepared under Adaptive Management (*Section 4.6*), without prior approval from the Board.

5.1.1 Mandatory Elements of State Programs

To be considered in compliance with this Amendment, all state programs will include harvest controls on cobia fisheries consistent with the requirements of *Sections 4.3, 4.4, 4.5*; except that a state may propose an alternative management program under *Section 4.5*, which, if approved by the Board, may be implemented as an alternative regulatory requirement for compliance.

5.1.1.1 Regulatory Requirements

States may begin to implement Amendment 1 after final approval by the Commission. Each state will be required to submit its Atlantic cobia regulatory program to the Commission through the Commission staff for approval by the Board. During the period between submission and the Board approval of the state's program, a state may not adopt a less protective management program than contained in this Amendment or contained in current state law. The following lists the specific compliance criteria that a state/jurisdiction will be required to implement in order to be in compliance with Amendment 1:

- Recreational fishery management measures as specified in *Section 4.3* including the size limit (*Section 4.3.1*), bag limit (*Section 4.3.2*), coastwide vessel limit (*Section 4.3.3*), and adherence to a state recreational harvest target (*Section 4.3.4*).

- Commercial fishery management measures as specified in *Section 4.4* including the size limit (*Section 4.4.1*), possession limit (*Section 4.4.2*), coastwide vessel limit (*Section 4.4.3*), and closures of the commercial fishery if the commercial quota is met (*Section 4.4.4*).

- Monitoring requirements as specified in *Section 3.1.1*.

- All state programs must include law enforcement capabilities adequate for successful implementation of the compliance measures contained in this Amendment.

- There are no mandatory research requirements at this time; however, research requirements may be added in the future under Adaptive Management, *Section 4.6*.

- There are no mandatory habitat requirements in Amendment 1.

5.2 COMPLIANCE SCHEDULE

States must implement this Amendment according to the following schedule:

Month Day, 201X: Submission of state programs to implement Amendment 1 for approval by the Board. Programs must be implemented upon approval by the Board.

Month Day, 201X: States with approved management programs must implement Amendment 1. States may begin implementing management programs prior to this deadline if approved by the Board.

5.3 COMPLIANCE REPORTS

Each state must submit to the Commission an annual report concerning its Atlantic cobia fisheries and management program for the previous year, no later than July 1st. A standard compliance report format has been prepared and adopted by the ISFMP Policy Board. States should follow this format in completing the annual compliance report.

5.4 PROCEDURES FOR DETERMINING COMPLIANCE

Detailed procedures regarding compliance determinations are contained in the ISFMP Charter, Section Seven (ASMFC, 2016). In brief, all states are responsible for the full and effective implementation and enforcement of fishery management plans in areas subject to their jurisdiction. Written compliance reports as specified in this amendment must be submitted annually by each state with a declared interest. Compliance with Amendment 1 will be reviewed at least annually; however, the Board, ISFMP Policy Board, or the Commission may request the PRT to conduct a review of state's implementation and compliance with Amendment 1 at any time.

The Board will review the written findings of the PRT within 60 days of receipt of a State's compliance report. Should the Board recommend to the Policy Board that a state be determined out of compliance, a rationale for the recommended noncompliance finding will be addressed in a report. The report will include the required measures of Amendment 1 that the state has not implemented or enforced, a statement of how failure to implement or enforce required measures jeopardizes Atlantic cobia conservation, and the actions a state must take in order to comply with Amendment 1 requirements.

The ISFMP Policy Board will review any recommendation of noncompliance from the Board within 30 days. If it concurs with the recommendation, it shall recommend to the Commission that a state be found out of compliance.

The Commission shall consider any noncompliance recommendation from the ISFMP Policy Board within 30 days. Any state that is the subject of a recommendation for a noncompliance finding is given an opportunity to present written and/or oral testimony concerning whether it should be found out of compliance. If the Commission agrees with the recommendation of the ISFMP Policy Board, it may determine that a state is not in compliance with Amendment 1 and specify the actions the state must take to come into compliance.

Any state that has been determined to be out of compliance may request that the Commission rescind its noncompliance findings, provided the state has revised its Atlantic cobia conservation measures.

5.5 ANALYSIS OF THE ENFORCEABILITY OF PROPOSED MEASURES

The Commission's Law Enforcement Committee will, during the implementation of this FMP, analyze the enforceability of new conservation and management measures as they are proposed.

6.0 RESEARCH NEEDS

These management and research needs will be reviewed annually as part of the Commission's FMP Review process. The annual Cobia FMP Review will contain an updated list for future reference.

6.1 STOCK ASSESSMENT AND POPULATION DYNAMICS

An updated stock assessment for the Atlantic cobia has been scheduled for completion in 2020, led by SEFSC Beaufort Lab. The assessment will provide updated status information since the terminal year of the last assessment (2012). Anticipated results will include updated stock status and reference points and contribute to recommendations for additional management needs, if any.

6.2 RESEARCH AND DATA NEEDS

The following research recommendations were developed by the Cobia PDT and are ordered, within each category, from highest to lowest recommended priority.

6.2.1 Biological

1) Obtain more precise and timely estimates of harvest from the cobia recreational fishery.
2) Investigate release mortality and fishing mortality within the commercial and recreational fisheries in along the US Atlantic coast.
3) Continue to collect and analyze current life history data from fishery independent and dependent programs, including full size, age, maturity, histology workups and information on spawning season timing and duration. Any additional data that can be collected on any life stages of cobia would be highly beneficial.
4) Increase spatial and temporal coverage of age samples collected regularly in fishery dependent and independent sources. Prioritize collection of age data from fishery dependent and independent sources in all states.
5) Collect genetic material to continue to assess the stock identification and any Distinct Population Segments that may exist within the management unit relative to recommendations made by the SEDAR 58 Stock ID Process.
6) Conduct a high reward tagging program to obtain improved return rate estimates. Continue and expand current tagging programs to obtain mortality and growth information and movement at size data.
7) Conduct studies to estimate fecundity-at-age coastwide and to estimate batch fecundity.
8) Obtain better estimates of bycatch and mortality of cobia in other fisheries, especially juvenile fish.
9) Obtain estimates of selectivity-at-age for cobia through observer programs or tagging studies.
10) Define, develop, and monitor adult and juvenile abundance estimates through the expansion of current or development of fishery independent surveys.

6.2.2 Social

1) Using social impact analysis approaches such as updating applicable recreational and commercial fisheries community profiles and measures of social vulnerability

(See Jepson & Colburn, 2013), evaluate the local and regional dependency on cobia resources managed by the Commission.

6.2.3 Economic

1) Obtain better data (e.g. more comprehensive and timely) to estimate the annual economic impacts, net benefits, and economic contributions of recreational and commercial Atlantic cobia fishing on coastal communities and regions.
2) Obtain cost and expenditure data for recreational fishing trips targeting cobia by fishing mode, for different states, and for anglers returning to private sites, who would not be sampled by the MRIP.
3) Estimate willingness-to-pay associated with recreational cobia angling.

6.2.4 Habitat

1) Expand existing fishery independent surveys in time and space to better define and cover cobia habitats.
2) Conduct otolith microchemistry studies to identify regional recruitment contributions.
3) Conduct new and expand existing satellite tagging programs to help identify spawning and juvenile habitat use and regional recruitment sources.

6.2.5 State-specific

6.2.5.1 Georgia

Little is known regarding cobia stocks off Georgia. It is unclear if Georgia has a unique subpopulation of East-West migration cobia as seen in other nearby states (South Carolina). Currently cobia in Georgia are recognized and managed as part of the Atlantic Migratory Group (AMG). It is possible that some portion of Georgia fish could be mixing more with the Florida East Coast/Gulf stock rather than the AMG. If this is occurring, it could have important management implications for the species. Furthermore, the range of habitat types (inshore vs. nearshore) utilized by cobia in Georgia remains unknown. It would be beneficial to better explain the range of habitats utilized by cobia in Georgia as well as identify overwintering locations for Georgia cobia. This could be easily done through a simple acoustic telemetry study. Identifying these basic life history characteristics for cobia in Georgia will aid in the management of the species both at a state and a regional level. Additionally, better socio-economic estimates of the impact of cobia fishing in Georgia would aid in understanding how regulatory changes may impact the socio-economic benefits of cobia fishing to the State of Georgia and the South Atlantic region.

7.0 PROTECTED SPECIES

In the fall of 1995, Commission member states, the National Marine Fisheries Service (NMFS; now, NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS) began discussing ways to improve implementation of the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA) in state waters. Historically, these policies have been minimally enforced in state waters (0-3 miles). In November 1995, the Commission, through its ISFMP Policy Board, approved amendment of its ISFMP Charter (Section Six (b)(2)) so that interactions between Commission-managed fisheries and species protected under the MMPA, ESA, and other legislation, including the Migratory Bird Treaty Act be addressed in the Commission's fisheries management planning process. Specifically, the Commission's fishery management plans describe impacts of state fisheries on certain marine mammals and endangered species (collectively termed "protected species"), and recommend ways to minimize these impacts. The following section outlines: (1) the federal legislation which guides protection of marine mammals, sea turtles, and marine birds; (2) the protected species with potential fishery interactions; (3) the specific type(s) of fishery interactions; (4) population status of the affected protected species; and (5) potential impacts to Atlantic coastal state and interstate fisheries.

7.1 MARINE MAMMAL PROTECTION ACT (MMPA) REQUIREMENTS

Since its passage in 1972, one of the primary goals of the MMPA has been to reduce the incidental mortality and serious injury of marine mammals permitted in the course of commercial fishing operations to insignificant levels approaching a zero mortality and serious injury rate. Under the 1994 Amendments, the MMPA requires the NMFS to develop and implement a take reduction plan to assist in the recovery or prevent the depletion of each strategic stock that interacts with a Category I or II fishery. Specifically, a strategic stock is defined as a stock: (1) for which the level of direct human caused mortality exceeds the potential biological removal (PBR) level; (2) which is declining and is likely to be listed under the Endangered Species Act (ESA) in the foreseeable future; or (3) which is listed as a threatened or endangered species under the ESA or as a depleted species under the MMPA. Category I and II fisheries are those that have frequent or occasional incidental mortality and serious injury of marine mammals, respectively, whereas Category III fisheries have a remote likelihood of incidental mortality and serious injury of marine mammals. Each year, NOAA Fisheries publishes an annual List of Fisheries which classifies commercial fisheries into one of these three categories.

Under the 1994 mandates, the MMPA also requires fishermen participating in Category I and II fisheries to register under the Marine Mammal Authorization Program (MMAP), the purpose of which is to provide an exception for commercial fishermen from the general taking prohibitions of the MMPA for non-ESA listed marine mammals. All fishermen, regardless of the category of fishery they participate in, must report all incidental injuries and mortalities caused by commercial fishing operations within 48 hours.

Section 101(a)(5)(E) of the MMPA allows for the authorization of the incidental taking of individuals from marine mammal stocks listed as threatened or endangered under the ESA in the course of commercial fishing operations if it is determined that: (1) incidental mortality and serious injury will have a negligible impact on the affected species or stock; (2) a recovery plan has been developed or is being developed for such species or stock under the ESA; and (3) where required under Section 118 of the MMPA, a monitoring program has been established, vessels engaged in such fisheries are registered in accordance with Section 118 of the MMPA, and a take reduction plan has been developed or is being developed for such species or stock. Permits are not required for Category III fisheries; however, any mortality or serious injury of a marine mammal must be reported.

7.2 ENDANGERED SPECIES ACT (ESA) REQUIREMENTS

The taking of endangered sea turtles, fish, seabirds, and marine mammals is prohibited and considered unlawful under Section 9(a)(1) of the ESA. In addition, NOAA Fisheries or the USFWS may issue Section 4(d) protective regulations necessary and advisable to provide for the conservation of threatened species. The ESA defines take as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." There are several mechanisms established in the ESA to allow exceptions to the take prohibition in Section 9(a)(1). Section 10(a)(1)(A) of the ESA authorizes NOAA Fisheries to allow the taking of listed species through the issuance of research permits for scientific purposes or to enhance the propagation or survival of the species. Section 10(a)(1)(B) authorizes NOAA Fisheries to permit, under prescribed terms and conditions, any taking otherwise prohibited by Section 9(a)(1)(B) of the ESA, if the taking is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Finally, Section 7(a)(2) requires federal agencies to consult with NOAA Fisheries to ensure that any action that is authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat of such species. If, following completion of consultation, an action is found to jeopardize the continued existence of any listed species or cause adverse modification to critical habitat of such species, reasonable and prudent alternatives will be identified so that jeopardy or adverse modification to the species is removed and Section

7(a)(2) is met (see Section 7(b)(3)(A)). Alternatively, if, following completion of consultation, an action is not found to jeopardize the continued existence of any listed species or cause adverse modification to critical habitat of such species, reasonable and prudent measures will be identified that minimize the take of listed species or adverse modification of critical habitat of such species (see Section 7(b)(4)). Section (7)(o) provides the actual exemption from the take prohibitions established in Section 9(a)(1), which includes Incidental Take Statements that are provided at the end of consultation via the ESA Section 7 Biological Opinions.

7.3 MIGRATORY BIRD TREATY ACT (MBTA) REQUIREMENTS

Under the Migratory Bird Treaty Act it is unlawful "by any means or in any manner, to pursue, hunt, take, capture, [or] kill" any migratory birds except as permitted by regulation (16 USC. 703). Section 50 CFR 21.11 prohibits the take of migratory birds except under a valid permit or as permitted in the regulations. Many migratory waterbirds occur within the boundaries of cobia fisheries. USFWS Policy on Waterbird Bycatch (2000) states: "It is the policy of the U.S. Fish and Wildlife Service that the Migratory Bird Treaty Act of 1918, as amended, legally mandates the protection and conservation of migratory birds. The USFWS seeks to actively expand partnerships with regional, national, and international organizations, States, tribes, industry, and environmental groups to address seabird bycatch in fisheries, by promoting public awareness of waterbird bycatch issues, and facilitating the collection of scientific information to develop and provide guidelines for management, regulation, and compliance."

Birds of Management Concern are a subset of MBTA-protected species which pose special management challenges because of a variety of factors (e.g., too few, too many, conflicts with human interests, societal demands). These species are of concern because of: documented or apparent population declines; small or restricted populations; dependence on restricted or vulnerable habitats; or overabundant to the point of causing ecological and economic damage.

7.4 PROTECTED SPECIES WITH POTENTIAL FISHERY INTERACTIONS

The management unit of the cobia Atlantic Migratory Group extends from the Georgia/Florida line through New York. There are numerous protected species that inhabit the range of the cobia management unit covered under this FMP. Listed below are ESA and MMPA protected species found in coastal and offshore waters of the Atlantic Ocean within the range of cobia fisheries. USFWS species of management concern that have the potential to interact with cobia fisheries are also listed. Species of management concern are protected under the MBTA, but lack the protections mandated by the ESA.

ESA – Endangered[4]

- Atlantic sturgeon *(Acipenser oxyrinchus oxyrinchus)*, NY Bight, Chesapeake Bay, Carolina, and South Atlantic Distinct Population Segments (DPSs)[5]
- Shorthnose sturgeon (*Acipenser brevirostrum*)
- Smalltooth sawfish (*Pristis pectinata*)
- Blue whale (*Balaenoptera musculus*)

[4] http://www.nmfs.noaa.gov/pr/species/esa/listed.htm

[5] A distinct population segment (DPS) is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or DPS of vertebrate species.

- Fin whale (*Balaenoptera physalus*)
- Humpback whale (*Megaptera novaeangliae*)
- North Atlantic right whale (*Eubalaena glacialis)*
- Sei whale (*Balaenoptera borealis*)
- Sperm whale (*Physeter microcephalus*)
- Hawksbill sea turtle (*Eretmochelys imbricata*)
- Kemp's ridley sea turtle *(Lepidochelys kempii)*
- Leatherback sea turtle (*Dermochelys coriacea)*
- Bermuda petrel (*Pterodroma cahow*)
- Roseate tern *(Sterna dougallii dougallii*), northeastern U.S. and Nova Scotia breeding population

ESA – Threatened[6]

- Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), Gulf of Maine DPS
- Nassau grouper (*Epinephelus striatus*)
- Green sea turtle (*Chelonia mydas),* North Atlantic and South Atlantic DPSs
- Loggerhead sea turtle *(Caretta caretta)*, Northwest Atlantic Ocean DPS
- Roseate tern *(Sterna dougallii dougallii*), Southeastern U.S. and Caribbean breeding population (FL, GA, NC, SC, Puerto Rico, Virgin Islands)
- Piping plover (*Charadrius melodus*)

MMPA – Protected[7]

Includes all marine mammals above in addition to:

- Atlantic spotted dolphin *(Stenella frontalis)*
- Bottlenose dolphin (*Tursiops truncatus*)
- Atlantic white-sided dolphin *(Lagenorhynchus acutus)*
- Clymene dolphin (*Stenella clymene*)
- Pantropical spotted dolphin *(Stenella attenuata)*
- Risso's dolphin (*Grampus griseus*)
- Rough-toothed dolphin (*Steno bredanensis*)
- Short-beaked common dolphin *(Delphinus delphis)*
- Spinner dolphin (*Stenella longirostris*)
- Striped dolphin (*Stenella coeruleoalba*)
- Gray seal (*Halichoerus grypus*)
- Harbor porpoise (*Phocoena phocoena*)
- Harbor seal (*Phoca vitulina*)

[6] http://www.nmfs.noaa.gov/pr/species/esa/listed.htm

[7] http://www.nmfs.noaa.gov/pr/species/mammals

- Minke whale (*Balaenoptera acutorostrata*)
- Cuvier's beaked whale (*Ziphius cavirostris*)
- Gervais' beaked whale (*Mesoplodon europaeus*)
- True's beaked whale *(Mesoplodon mirus)*
- Bryde's whale (*Balaenoptera edeni*)
- Dwarf sperm whale *(Kogia sima)*
- False killer whale (*Pseudorca crassidens*)
- Killer whale (*Orcinus orca*)
- Long-finned pilot whale *(Globicephala melas)*
- Melon-headed whale (*Peponocephala electra*)
- Pygmy killer whale (*Feresa attenuate*)
- Pygmy sperm whale (*Kogia breviceps*)
- Short-finned pilot whale (*Globicephala macrorhynchus*)

ESA – Species of Concern[8]

- Alewife (*Alosa pseudoharengus*)
- Blueback herring (*Alosa aestivalis*)
- Dusky shark (*Carcharhinus obscures*)
- Porbeagle shark *(Lamna nasus)*
- Rainbow smelt (*Osmerus mordax*)
- Sand tiger shark (*Carcharias taurus*)
- Speckled hind (*Epinephelus drummondhayi*)
- Striped croaker (*Bairdiella sanctaeluciae*)
- Warsaw grouper (*Epinephelus nigritus*)

MBTA—USFWS Species of Management Concern

- Canvasback (*Aythya valisineria*)
- Redhead (*Aythya americana*)
- Greater scaup (*Aythya marila*)
- Lesser scaup (*Aythya affinis*)
- Surf scoter (*Melanitta perspicillata*)
- White-winged scoter (*Melanitta fusca*)
- Black scoter (*Melanitta americana*)
- Long-tailed duck (*Clangula hyemalis*)
- Common goldeneye (*Bucephala clangula*)
- Red-throated loon (*Gavia stellata)*
- Black-capped petrel (*Pterodroma hasitata*)
- Greater shearwater (*Puffinus gravis*)

[8] http://www.nmfs.noaa.gov/pr/species/concern/

- Audubon's shearwater (*Puffinus lherminieri*)
- Band-rumped storm-petrel (*Oceanodroma castro*)
- Masked booby (*Sula dactylaria*)
- Brown booby (*Sula leucogaster*)
- Pied-billed grebe (*Podilymbus podiceps*)
- Horned grebe (*Podiceps auritus*)
- Magnificent frigatebird (*Fregata magnificens*)
- Least tern (*Sternula antillarum*), non-listed Atlantic coast subspecies
- Gull-billed tern (*Gelochelidon nilotica*)

7.5 PROTECTED SPECIES INTERACTIONS WITH EXISTING FISHERIES

7.5.1 Overview of the Cobia Fishery and Gears Used

Recreational fisheries are prosecuted similarly along the coast. The directed cobia fishery is prosecuted in two distinct ways. Bottom fishing with live or dead baits, often while chumming, in estuarine waters or around inlets or offshore around structure, buoys, markers, natural and artificial reefs. More recently, an active method of searching for fish traveling alone or in small groups on the surface or associated with schools of Atlantic menhaden or other bait fishes has grown in popularity. This newer method has resulted in the further development of the for-hire component for cobia, as well as the development of specific artificial baits and boat modifications (e.g., towers) to facilitate spotting and catching the fish. A third method primarily prosecuted in offshore waters is to target large rays, large sharks, sea turtles or floating debris around which cobia congregate. However, the practice of targeting sea turtles while cobia fishing is considered a "take" under the Endangered Species act and is, therefore, unlawful. Additionally, the Atlantic coast of Florida is starting to see more directed spearfishing pressure on cobia. Specifically, spearfishers are chumming for bull shark and then diving/free-diving to spear cobia that associate with them. Spearfishing also occurs off North Carolina, along with a popular pier fishery.

The recreational fishery also takes cobia as bycatch in offshore bottom fisheries such as snapper/grouper, nearshore trolling for king mackerel, bluefish, and dolphin and any other fishery that employs live or dead bait fished on or near the bottom. While the directed fishery appears to focus more on the spring-summer spawning migration, bycatch, especially offshore, can yield cobia virtually year round. The average of recreational Atlantic cobia landings from 2010-2018 is 1.8 million lb (MRIP, queried April, 2019).

The commercial fishery has traditionally been a bycatch in other directed fisheries such as the snapper/grouper hook and line fishery and troll fisheries for various species (e.g., king mackerel, dolphin, wahoo, amberjack). Directed fisheries are generally precluded as a result of the low possession limits, but do occur, specifically Virginia's commercial hook and line fishery. Cobia from for-hire trips may also be sold commercially, depending on the state's permit requirements for selling fish. The average of commercial Atlantic cobia landings from 2010-

2017 is 62,073 lb (ACCSP, queried April, 2019). In 2017, the predominant gear categories that were used commercially to capture Atlantic cobia were gill nets (33%), hand line (29%), hook and line (20%), and pound nets (11%) (ACCSP, queried April, 2019).

7.5.2 Marine Mammals

NMFS completed a biological opinion on June 18, 2015, evaluating the impacts of the CMP fishery on ESA-listed species. In the biological opinion, NMFS determined that the proposed continued authorization of the CMP Fishery, is not likely to adversely affect any listed whales (i.e., blue, sei, sperm, fin, humpback, or North Atlantic right whales). NMFS also determined that the CMP fishery will have no effect on designated critical habitat for North Atlantic right whale (NMFS, 2015).

The Gulf and South Atlantic CMP hook-and-line fishery (which includes fisheries that capture cobia) is classified in the 2017 MMPA List of Fisheries as a Category III fishery (82 FR 3655; January 12, 2017). This means the annual mortality and serious injury of a marine mammal resulting from the fishery is less than or equal to 1% of PBR, the maximum number of animals, not including natural moralities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. In other words, there is a remote likelihood of or no known incidental mortality and serious injury of marine mammals resulting from these fisheries.

The Gulf and South Atlantic CMP gillnet fishery is classified as Category II fishery in the 2017 MMPA List of Fisheries. This classification indicates an occasional incidental mortality or serious injury of a marine mammal stock resulting from the fishery (1-50% annually of PBR). The fishery has no documented interaction with marine mammals; NMFS classifies this fishery as Category II based on analogy (i.e., similar risk to marine mammals) with other gillnet fisheries.

7.5.3 Sea Turtles

7.5.3.1 Overview

As mentioned above, the NMFS completed a biological opinion on June 18, 2015, evaluating the impacts of the CMP fishery (including king mackerel, Spanish mackerel, and cobia) on ESA-listed species (NMFS, 2015). According to the biological opinion, green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles are all likely to be adversely affected by the CMP fishery. Green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles are all highly migratory, travel widely throughout the GOM and South Atlantic, and are known to occur in area of the fishery. The biological opinion evaluated the potential for the following gears to interact with protected species: hook-and-line gear, cast net gear, and gill net gear. The biological opinion found that gill net gear is the only gear used in the CMP fisheries that may adversely affect sea turtles. Gill net gear is used to target both Spanish and king mackerel, but not cobia.

7.5.3.2 Hook-and-Line Fishing

The 2015 biological opinion for CMP resources concluded that sea turtles (as well as smalltooth sawfish and Atlantic sturgeon) are not likely to be adversely affected by CMP hook-and-line fishing. The 2015 biological opinion stated: "*The hook-and-line gear used by both commercial and recreational fishers to target CMP species is limited to trolled or, to a much lesser degree (e.g., historically ~2% by landings for king mackerel), jigged handline, bandit, and rod-and-reel gear. Sea turtles, Atlantic sturgeon, and smalltooth sawfish are both vulnerable to capture on hook-and-line gear, but the techniques commonly used to target CMP species makes effects on these listed species extremely unlikely and, therefore, discountable. Sea turtles are unlikely to be caught during hook-and-line trolling because of the speed (4-10 kt) at which the lure is pulled through the water. As cedar plugs and spoons are generally used when trolling, it is unlikely that a sea turtle of any size would actively pursue the gear and get hooked. Likewise, we also believe sea turtles would be unlikely to be snagged by jigged gear as it is deployed at or near the surface and constantly reeled and jigged back to the boat. It is possible that a sea turtle could be incidentally snagged if it comes in contact with a trolled or jigged hook, but the chances of this occurring are extremely low… We believe that CMP species caught on bandit gear or standard rod-and-reel gear (i.e., baited and deployed as passive, vertical gear) are largely bycatch when targeting other species closer to the bottom (e.g., snapper and grouper); use of the gear in this method (i.e., mid-water placement) is not effective at catching mackerel based on available information (e.g., landings data). In summary, we believe effects from these gear types on Atlantic sturgeon, smalltooth sawfish, and sea turtles are extremely unlikely to occur, and are therefore discountable*" (NMFS, 2015).

There is limited information about protected species interactions within recreational fisheries.

In 2015, The North Carolina Division of Marine Fisheries conducted a project funded under the ACCSP to examine potential protected species interactions and finfish discards and releases in the recreational cobia hook-and-line fishery. Observations were made via an alternative observer platform, where recreational fishing activity was monitored at close proximity from individuals on state owned vessels. From April 27, 2015, through October 29, 2015, 552 recreational hook-and-line observations (observed fishing trips) were completed over 138 observed fishing days with 16.2% of fishing trips targeting cobia. Observations occurred in inshore (estuarine) and near-shore waters (≤ 3 miles) of Carteret County. No protected species interactions were observed (Boyd, 2016).

7.5.3.3 Gill Net

Cobia are generally considered a bycatch species within gill net fisheries. The 2015 biological opinion for CMP resources concluded that gill net gear used in the federal CMP fisheries of the Atlantic and GOM have adversely affected sea turtles, smalltooth sawfish, and Atlantic sturgeon in the past via entanglement and, in the case of sea turtles, via forced submergence (NMFS, 2015).

7.5.3.4 Targeting of Large Animals

One known method used to prosecute cobia in offshore waters is to target large rays, large sharks, sea turtles, or floating debris around which cobia congregate. However, the practice of targeting sea turtles while cobia fishing is considered a “take” under the Endangered Species act and is, therefore, unlawful. Not much is known about this method or its impacts on protected species.

7.5.4 Sturgeon, Smalltooth Sawfish, Nassau Grouper

The 2015 biological opinion for CMP resources concluded that gill net gear used in the federal CMP fisheries of the Atlantic and GOM have adversely affected smalltooth sawfish[9] and Atlantic sturgeon in the past via entanglement.

The biological opinion also concluded that smalltooth sawfish and Atlantic sturgeon are not likely to be adversely affected by CMP hook-and-line fishing. Fishers who capture smalltooth sawfish most commonly report that they were fishing for snook, redfish, or sharks (Simpfendorfer and Wiley, 2004), not CMP species. Additionally, Atlantic sturgeon and smalltooth sawfish are largely bottom-dwelling species, whereas CMP lures and baits are typically fished near the surface of the water. This also greatly reduces the likelihood of Atlantic sturgeon and smalltooth sawfish interactions with trolling gear (NMFS, 2015).

On June 29, 2016, NMFS published a final rule listing Nassau grouper as threatened under the ESA. Reinitiation of Section 7 consultation on the CMP FMP is needed to address newly listed species. NOAA Fisheries is currently prioritizing completion of the consultation along with other consultations required after recent listings.

7.5.5 Seabirds

The roseate tern, Bermuda petrel, and piping plover are the only ESA listed bird species within the mid-and south-Atlantic maritime regions. The roseate tern and Bermuda petrel are uncommon in inshore and coastal waters of the mid- and south-Atlantic and thus, have relatively low likelihoods of interacting with cobia fisheries. Nevertheless, exceptional efforts to avoid deleterious interactions with these species are warranted as they are rare and highly vulnerable to even minimal levels of mortality. The piping plover could be impacted by shore-based fishing activity if individuals were disturbed or killed by vehicles related to fishing efforts. However, during the nesting season, when plovers are highly vulnerable to beach disturbance, sensitive areas are posted and beach access is often restricted.

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[9] Although smalltooth sawfish are typically found in the peninsula of Florida, there have been recent interactions as far north as North Carolina.

Bermuda petrels are occasionally seen in the waters of the Gulf Stream off the coasts of North Carolina and South Carolina during the summer. Sightings are considered rare and only occurring in low numbers. Roseate terns occur widely along the Atlantic coast during the summer but in the southeast region, they are found mainly off the Florida Keys (unpublished USFWS data). Interaction with fisheries has not been reported as a concern for either of these species. Although, the Bermuda petrel and roseate tern occur within the action area, these species are not commonly found and neither has been described as associating with vessels or having had interactions with the CMP fishery. Framework Amendment 4 to the FMP for CMP resources in the Gulf of Mexico and Atlantic Region concluded that the CMP fishery is not likely to negatively affect the Bermuda petrel and the roseate tern.

7.6 POPULATION STATUS REVIEW OF RELEVANT PROTECTED SPECIES

7.6.1 Marine Mammals

The status review of marine mammal populations inhabiting the Southwest Atlantic are discussed in detail in U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments. The most recent assessment was published in 2016 (Waring et al., 2016). The report presents information on stock definition, geographic range, population size, productivity rates, PBR, fishery specific mortality estimates, and compares the PBR to estimated human-caused mortality and serious injury for each stock.

7.6.2 Sea Turtles

All sea turtles that occur in U.S. waters are listed as either endangered or threatened under the ESA. The Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and hawksbill (*Eretmochelys imbricata*) are listed as endangered. The Northwest Atlantic Ocean DPS of loggerhead turtles (*Caretta caretta*) and the North Atlantic and South Atlantic DPSs of green turtle (*Chelonia mydas*) are listed as threatened. All five of these species inhabit the waters of the U.S. Atlantic and Gulf of Mexico.

Atlantic coastal waters provide important developmental, migration, and feeding habitat for sea turtles. The distribution and abundance of sea turtles along the Atlantic coast is related to geographic location, reproductive cycles, food availability, and seasonal variations in water temperatures. Water temperatures dictate how early northward migration begins each year and are a useful factor for assessing when turtles will be found in certain areas. Sea turtles can occur in offshore as well as inshore waters, including sounds and embayments. More information about sea turtles can be found here: https://www.fisheries.noaa.gov/sea-turtles.

7.6.3 Sturgeon, Smalltooth Sawfish, and Nassau Grouper

No estimate of the historical population size of shortnose sturgeon is available. While the shortnose sturgeon was rarely the target of a commercial fishery, it often was taken incidentally in the commercial fishery for Atlantic sturgeon. In the 1950s, sturgeon fisheries declined on the east coast, which resulted in a lack of records of shortnose sturgeon. Shortnose sturgeon has been listed as endangered since 1967. A status assessement of shortnose sturgeon was last published in 2010 (SSSRT, 2010).

In 2012, NOAA Fisheries listed four DPSs of Atlantic sturgeon *(Acipenser oxyrinchus oxyrinchus)* as endangered (NY Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs) and one as threatened (Gulf of Maine). More information about Atlantic sturgeon can be found here: https://www.fisheries.noaa.gov/species/atlantic-sturgeon.

The U.S. DPS of smalltooth sawfish was listed as endangered in 2003. No accurate estimates of abundance trends over time are available, but available data, including museum records and anecdotal observations from fishers, indicate that the population has declined dramatically by about 95%. Smallooth sawfish were once common throughout their historic range, but they have declined dramatically in U.S. waters over the last century. Still, there are few reliable data available, and no robust estimates of population size exist.[10]

In 2016, NOA Fisheries listed Nassau grouper as threatened under the ESA (81 FR 42268; June 29, 2016). While the species still occupies its historical range, overutilization through historical harvest has reduced the number of individuals which in turn has reduced the number and size of spawning aggregations. Although harvest of Nassau grouper has diminished due to management measures, the reduced number and size of spawning aggregations and the inadequacy of law enforcement continue to present extinction risk to Nassau grouper. The Nassau grouper's confirmed distribution currently includes Bermuda and Florida (U.S.A.), throughout the Bahamas and Caribbean Sea. Many earlier reports of Nassau grouper up the Atlantic coast to North Carolina have not been confirmed.

7.6.4 Seabirds

The overall population status of the Bermuda Petrel is unknown. The Bermuda Petrel is a pelagic seabird, and its range and distribution at sea make it very difficult to survey. It is known to nest only on five small islets in Bermuda. Surveys are limited to the breeding grounds. The total population of the Bermuda Petrel is estimated as 101 breeding pairs (USFWS, 2013).

The roseate tern is a federally protected and endangered seabird that is mainly found in the Northern Hemisphere on the northeastern coast of North America, extending from Nova Scotia to the southern tip of Florida, as well as several islands in the Caribbean Sea. Populations in the northeastern U.S. greatly declined in the late 19th century due to hunting for the millinery, or hat trade. In the 1930s, protected under the MBTA, the population reached a high of about 8,500, but since then, population numbers have declined and stayed in the low range of 2,500 to 3,300. The species was listed in 1987 as endangered in the northeastern U.S. Populations in

[10] https://www.fisheries.noaa.gov/species/smalltooth-sawfish

Florida, Georgia, North Carolina, Puerto Rico, South Carolina and the Virgin Islands are listed as threatened.[11]

The piping plover breeds on coastal beaches from Newfoundland and southeastern Quebec to North Carolina. These birds winter primarily on the Atlantic Coast from North Carolina to Florida, although some migrate to the Bahamas and West Indies. Piping plovers were common along the Atlantic Coast during much of the 19th century, but nearly disappeared due to excessive hunting for the millinery trade. The current population decline is attributed to increased development and recreational use of beaches. The most recent surveys place the Atlantic population at less than 2000 pairs.[12]

7.7 EXISTING AND PROPOSED FEDERAL REGULATIONS/ACTIONS PERTAINING TO RELEVANT PROTECTED SPECIES

7.7.1 Marine Mammals

Species of large whales protected by the ESA that occur throughout the Atlantic Ocean include the blue whale, humpback whale, fin whale, North Atlantic right whale, sei whale, and the sperm whale. Additionally, the West Indian manatee also occurs in both the Gulf of Mexico and the Atlantic Ocean. These species are also considered depleted under the Marine Mammal Protection Act (MMPA). Depleted and endangered designations afford special protections from captures, and further measures to restore populations to recovery or the optimum sustainable population are identified through required recovery (ESA species) or conservation plans (MMPA depleted species). Numerous other species of marine mammals listed under the MMPA occur throughout the Atlantic Ocean.

The MMPA mandates NOAA Fisheries to develop and implement Take Reduction Plans for preventing the depletion and assisting in the recovery of certain marine mammal stocks that are seriously injured or killed in commercial fisheries. In the Atlantic, the following Take Reduction Plans have been developed, which address in part, gears that have been used to capture cobia (gillnet):

- The Atlantic Large Whale Take Reduction Plan is designed to reduce the risk of mortality and serious injury of large whales (right, fin, humpback) incidental to U.S. commercial trap/pot and gillnet fisheries, including Southeast Atlantic gillnet.
- The Bottlenose Dolphin Take Reduction Plan is designed to reduce the incidental mortality and serious injury of the western North Atlantic coastal bottlenose dolphin stock in several coastal fisheries, including the Southeast Atlantic gillnet fishery.

[11] https://www.fws.gov/northeast/pdf/Roseatetern0511.pdf
[12] https://www.fws.gov/northeast/pipingplover/overview.html

7.7.2 Sea turtles

Under the ESA, and its implementing regulations, taking sea turtles – even incidentally – is prohibited, with exceptions identified in 50 CFR 223.206. The incidental take of endangered species may only legally be authorized by an incidental take statement or an incidental take permit issued pursuant to Section 7 or 10 of the ESA, respectively. According to the 2015 biological opinion on CMP fisheries, green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles are all likely to be adversely affected by the CMP fishery (NMFS, 2015). Green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles are all highly migratory, travel widely throughout the GOM and South Atlantic, and are known to occur in the area of the fishery. The 2015 biological opinion for CMP established an incidental take statement with reasonable and prudent measures and terms and conditions for incidental take coverage in the federal CMP fisheries for sea turtles takes throughout the action area.

On April 6, 2016, NMFS published a final rule (81 FR 20058) listing 11 distinct population segments (DPSs) for green sea turtles. The listing of the DPSs of green turtles triggers reinitiation of consultation under Section 7 of the ESA because the previous opinion did not consider what effects the CMP fishery is likely to have on this species, therefore NOAA Fisheries must analyze the impacts of these potential interactions. NOAA Fisheries is also in the process of identifying critical habitat, which will be proposed in a future rulemaking.

In 2013, the North Carolina Division of Marine Fisheries was issued a permit for the incidental take of listed sea turtles associated with the otherwise lawful large and small mesh gill net fishing in specified inshore estuarine areas. This permit requires North Carolina to close designated areas to avoid approaching the take limit.

Existing NOAA Fisheries regulations specify procedures that it may use to determine that unauthorized takings of sea turtles occur during fishing activities, and to impose additional restrictions to conserve sea turtles and to prevent unauthorized takings (50 CFR 223.206(d)(4)). Restrictions may be effective for a period of up to 30 days and may be renewed for additional periods of up to 30 days each. In 2007, NMFS issued a regulation (50 CFR 222.402) to establish procedures through which each year NMFS will identify, pursuant to specified criteria and after notice and opportunity for comment, those fisheries in which the agency intends to place observers (72 FR 43176, August 3, 2007). NOAA Fisheries issues a notice or regulation each year maintaining or updating the fisheries listed on the annual determination. The most recent determination was in December 2016 (81 FR 90330, December 14, 2016). NOAA Fisheries may place observers on U.S. fishing vessels, either recreational or commercial, operating in U.S. territorial waters, the U.S. exclusive economic zone (EEZ), or on the high seas, or on vessels that are otherwise subject to the jurisdiction of the U.S. Failure to comply with the requirements under this rule may result in civil or criminal penalties under the ESA.

7.7.3 Sturgeon, Smalltooth Sawfish, and Nassau Grouper

Shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*A. oxyrinchus*) were listed under the ESA in 1967 and 2012, respectively. The Commission and federal government implemented a coastwide moratorium on sturgeon harvest in late 1997 and early 1998. Bycatch remains an important issue in the recovery of Atlantic sturgeon populations throughout their range (ASMFC, 2007). The National Marine Fisheries Service established a recovery plan for shortnose sturgeon in 1998.

In 2013, the Georgia Department of Natural Resources was issued a permit for the incidental take of shortnose and Atlantic sturgeon associated with the otherwise lawful commercial shad fishery in Georgia. In 2014, the North Carolina Division of Marine Fisheries was issued a permit for the incidental take of Atlantic sturgeon DPSs associated with the otherwise lawful commercial inshore gillnet fishery in North Carolina.

The 2015 biological opinion for the Federal CMP fisheries established an incidental take statement with reasonable and prudent measures and terms and conditions for incidental take of Atlantic sturgeon (as well as sea turtles and smalltooth sawfish) throughout the action area (NMFS, 2015). In June 2016, NOAA Fisheries published proposed rules to designate critical habitat for Atlantic sturgeon (81 FR 36077; 6/3/2016 and 81 FR 35701; 6/3/2016).

The U.S. DPS of smalltooth sawfish was listed as endangered in 2003. Critical habitat was designated for it in 2009 (74 FR 45353; 9/2/2009) and a recovery plan was finalized in 2009 as well.

Harvest and possession of Nassau grouper is prohibited in the United States, Puerto Rico, and the U.S. Virgin Islands. NOAA Fisheries is evaluating potential management actions, such as critical habitat or application of the 4(d) rule in the ESA. When NMFS listed Nassau grouper as threatened, it solicited information from the public that may be relevant to the designation of critical habitat for Nassau grouper. A 4(d) rule provides regulations necessary for the conservation of any threatened species

7.7.4 Seabirds

Under the ESA and its regulations, take of Bermuda petrels, roseate terns, and piping plovers, even incidentally, is prohibited. The incidental take of an ESA listed species may only be legally authorized by an incidental take statement or incidental take permit issued pursuant to Section 7 or 10 of the ESA. No incidental takes of ESA listed bird species is currently authorized for cobia fisheries.

Section 316(c) of the Magnuson-Stevens Fishery Conservation and Management Act authorizes the Interior and Commerce Departments to undertake projects, in cooperation with industry, to improve information and technology to reduce seabird-fisheries interactions. USFWS seeks to partner with State, regional, and Federal agencies; industry; tribes; and NGOs to facilitate outreach and improve information and technology to reduce seabird bycatch in fisheries within state and Federal waters. A Memorandum of Understanding between NMFS and the USFWS (2012) describes additional collaborative efforts recommended to better understand and reduce bird bycatch in fisheries.[13]

Most actions to understand and reduce marine bird bycatch in the U.S. have occurred in Pacific waters. However, in 2011, the USFWS issued a business plan for addressing and reducing marine bird bycatch in U.S. Atlantic fisheries. The plan identified priority goals and actions to target the following marine bird-fisheries interactions: greater shearwaters in the New England groundfish fishery, and red-throated loons in the mid-Atlantic gillnet fisheries.[14]

7.8 POTENTIAL IMPACTS TO ATLANTIC COASTAL STATE AND INTERSTATE FISHERIES

Regulations under the take reduction plans for Atlantic large whales and bottlenose dolphins have the potential to impact gill net fisheries that capture cobia as bycatch.

7.9 IDENTIFICATION OF CURRENT DATA GAPS AND RESEARCH NEEDS

7.9.1 General Bycatch Related Research Needs

The following activities would improve our understanding of bycatch of fish and protected species in the Southeast Region. These activities were identified within NOAA Fisheries' Southeast Regional Office's FY16-20 Strategic Plan[15]:

- In coordination with the Marine Recreational Information Program (MRIP), test and validate the use of on-board recording systems (e.g., electronic logbooks) for capturing information on discarded fishes and bycatch of protected species in the commercial and recreational fisheries including species, length, depth, location, and disposition; priority fisheries include shrimp (including assessing TED compliance), South Atlantic snapper grouper, other Southeast Region recreational hook-and-line fisheries, and fisheries under take reduction teams.
- Enhance existing tools (e.g., observers, logbook requirements, electronic technologies) to collect bycatch data that inform agency bycatch priorities; priority fisheries include shrimp (including assessing TED compliance), South Atlantic snapper-grouper, other Southeast Region recreational hook-and-line fisheries, and fisheries under take reduction teams.
- Invest in new, innovative fishery monitoring techniques, such as electronic fishing logbooks and video monitoring, to provide a cost effective means of producing more

[13] https://www.fws.gov/migratorybirds/pdf/management/mounmfs.pdf
[14] https://www.fws.gov/migratorybirds/pdf/management/focal-species/GreaterShearwater.pdf
[15] https://sero.nmfs.noaa.gov/documents/main_articles/pdfs/final_strategic_plan_october_2015.pdf

information to effectively quantify bycatch; priority fisheries include shrimp (including assessing TED compliance), South Atlantic snapper-grouper, other Southeast Region recreational hook-and-line fisheries, and fisheries under take reduction teams.
- Improve the discard estimates needed for informing snapper-grouper, reef fish, dolphin wahoo, and coastal migratory pelagic SEDAR assessments in the next 3-5 years.

7.9.2 Marine Mammals

The following bycatch related research needs were identified within NOAA Fisheries' Southeast Regional Office's FY16-20 Strategic Plan[16]:

- Characterize frequency, scope, and scale of bottlenose dolphin interactions with recreational rod/reel fishing gear.
- Enhance and increase observer coverage for gillnet fisheries under the bottlenose dolphin take reduction plans by focusing observer coverage in specific geographic areas and fisheries, improving observer data collection and quality, and measures of fishing effort, as well as coordinating with state observer programs.
- Experimentally investigate possible attractants/deterrents for pilot whale/Risso's dolphins to pelagic longline gear and gear modifications to decrease the likelihood of hooking and/or entanglement.

7.9.3 Sea Turtles

Observer coverage of recreational fisheries has been relatively limited (Boyd, 2016). Expansion of observer programs to recreational hook-and-line fisheries would help determine the level of protected species interactions in those fisheries.

The following bycatch related research needs were identified within NOAA Fisheries' Southeast Regional Office's FY16-20 Strategic Plan[17]:

- Improved methods/models/techniques for estimating sea turtle bycatch in commercial fisheries including accounting for life stage and recovery unit (where applicable) impacts.
- Produce annual bycatch estimates for the shrimp trawl fisheries, pelagic longline, Gulf and South Atlantic reef fish, and Gulf and South Atlantic shark gillnet and bottom longline fisheries.

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[16] https://sero.nmfs.noaa.gov/documents/main_articles/pdfs/final_strategic_plan_october_2015.pdf
[17] https://sero.nmfs.noaa.gov/documents/main_articles/pdfs/final_strategic_plan_october_2015.pdf

- Implement monitoring program to assess bycatch of sea turtles in recreational fisheries, including piers, jetties, head boats and FMP covered recreational fisheries.
- Develop tools to reduce recreational fishing bycatch including on piers/jetties.
- Develop and improve analytic methods for sea turtle bycatch estimation and sampling design to optimally allocate observer coverage and identify gaps and recommend improvements/changes to improve sea turtle bycatch information.
- Ensure sea turtle bycatch data collected across fisheries is standardized and contains all necessary elements to assess post interaction mortality and to inform conservation management.
- Conduct gear research and technology transfer to reduce sea turtle interactions and mortalities in both domestic and foreign trawl, longline, and gill net fisheries.
- Develop sea turtle observer programs for commercial fisheries not currently observed but for which data are needed.

7.9.4 Sturgeon

NOAA Fisheries Southeast Regional Office has identified the following research needs for Atlantic sturgeon[18]:

- Identification of spawning and nursery grounds and overwintering areas.
- Long-term population monitoring programs.
- Population genetics.
- Toxic contaminant and biotoxin impacts and thresholds.
- Develop fish passage devices for sturgeon.
- Impacts of dredging.
- Reducing bycatch and bycatch mortality.

Regarding bycatch, very little information is available on current levels of bycatch and bycatch mortality occurring in fisheries in the Southeast. Research is needed to identify the spatial and temporal distribution of bycatch throughout the species range, and to identify measures that can be implemented to reduce bycatch and/or bycatch mortality.

NOAA Fisheries Southeast Regional Office has identified the following research needs for shorthnose sturgeon[19]:

- Genetic assessments.
- Surveys and presence/absence studies.
- Identification of spawning and nursery grounds and overwintering areas.
- Develop fish passage devices for sturgeon.

[18] https://sero.nmfs.noaa.gov/protected_resources/sturgeon/documents/ats_research_priorities.pdf

[19] https://sero.nmfs.noaa.gov/protected_resources/sturgeon/documents/sns_research_priorities.pdf

- Contaminant research.
- Impacts of dredging.

7.9.5 Sawfish

The following research needs were identified within NOAA Fisheries' Southeast Regional Office's FY16-20 Strategic Plan[20]:

- Develop a functional assessment model of juvenile sawfish habitat use within the critical habitat units.
- Determine the post-release mortality of sawfish from various types of fishing gear.
- Investigate movements (short-term and seasonal) of adult sawfish to identify aggregation habitats and habitat use patterns.
- Develop habitat models to identify potential sawfish nursery habitats in areas unsurveyed or outside of the currently known habitat areas.
- Continue current sawfish surveys as these will be the basis of monitoring recovery.
- Conduct juvenile sawfish surveys beyond the boundaries of current surveys (e.g., east coast or north of Charlotte Harbor) to refine a baseline abundance estimates and monitor recovery.
- Conduct adult surveys throughout the range of smalltooth sawfish to determine a relative abundance estimate, the distribution of adults, and to identify sawfish mating and pupping habitats.

7.9.6 Seabirds

- Initiate and expand observer coverage/bycatch monitoring and collection and analysis of bird bycatch data to better understand extent of bird bycatch and identify bycaught bird species within the target fisheries (state waters).
- Collaborate with fishermen to develop and test gear and identify deployment practices that reduce bird bycatch within the target fisheries (state waters).
- Conduct outreach activities to facilitate sharing of bird bycatch information in the target fisheries among agencies, industry and the public.

[20] https://sero.nmfs.noaa.gov/documents/main_articles/pdfs/final_strategic_plan_october_2015.pdf

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APPENDIX I

Table A1. Commercial landings by state, in pounds, 1981-2018. 2018 data is preliminary and provided by individual states. * indicates confidential data. Source: ACCSP, queried April, 2019.

Year	NY	NJ	DE	MD	VA	NC	SC	GA	Total
1981					1,400	5,260	10,137	1,126	17,923
1982				100	2,000	10,574	16,286	2,304	31,264
1983					900	4,279	11,357	1,497	18,033
1984					1,900	6,701	2,523	2,570	13,694
1985				100	2,300	6,640	1,464	611	11,115
1986					1,200	18,303	3,690	2,561	25,754
1987	100				300	32,672	4,718	2,705	40,495
1988		100			5,700	15,690	5,224	1,924	28,638
1989		200		300	10,600	14,898	6,835	440	33,273
1990	17	1,649		431	16,532	21,938	1,802	1,367	43,736
1991		1,155		2,045	11,743	23,217	3,005	2,651	43,816
1992		1,037		1,882	6,110	18,534	6,925	2,187	36,675
1993		792		471	5,986	20,431	9,092	2,730	39,502
1994	165	483		*	7,817	30,586	5,488	2,483	47,022
1995	411	1,736		*	22,011	35,143	6,133	1,543	66,977
1996	*	2,295		*	*	33,404	4,483	675	40,857
1997	89	3,989		377	11,710	42,063	3,513	1,742	63,484
1998	60	2,853		*	13,419	22,197	3,481	*	42,010
1999	46	1,432		*	5,808	15,491	2,568	*	25,345
2000	101	1,762		*	7,525	28,754	2,974	*	41,116
2001	252	683		*	*	24,718	4,395	*	30,048
2002	70	2,086		*	11,445	21,058	5,007	*	39,666
2003	84	621	*	*	7,387	21,313	4,746	*	34,151
2004	758	576		211	6,143	20,162	4,459	705	33,014
2005	*	329		*	6,108	17,886	4,192	*	28,515
2006	*	*	*	398	6,369	20,270	2,672	*	29,709
2007	*	1,650		*	6,086	19,005	3,786	245	30,771
2008	*	*		*	6,978	22,047	3,464	*	32,488
2009	*	1,134		196	6,197	31,898	2,275	*	41,701
2010	*	270		*	8,852	43,715	2,749	*	55,586
2011	408	*		*	8,522	19,924	4,466	*	33,320
2012	152	701		*	5,389	31,972	3,731		41,945
2013	841	885	*	*	11,073	35,456	4,254	*	52,509
2014	311	366		*	22,345	41,798	3,880	*	68,701
2015	235	226		*	27,722	52,684	2,763	*	83,631
2016	129	312	*	*	36,460	48,244	4,532	*	89,677
2017	81	*	*	*	36,384	20,842	4,590	*	61,898
2018**					25,194	20,447			

Table A2. Cobia recreational harvest (A + B1) by state, in pounds, 1981-2018, with effort estimated by or calibrated to the Coastal Household Telephone Survey (CHTS). 2018 data is preliminary. Source: MRIP, queried April, 2019.

Year	NY	NJ	DE	MD	VA	NC	SC	GA	TOTAL
1981					4,705	6,484			11,189
1982						66,342	22,215	24,997	113,554
1983				0				20,894	20,894
1984						191,237	125,332	78,428	394,997
1985	0			49,528	103,391	20,985	104,178	17,817	295,899
1986		108,701		4,416	77,695	178,128	145,843	15,252	530,035
1987					24,956	79,944	44,033	17,994	166,927
1988						106,749	42,133	3,927	152,809
1989				65	105,819	115,373	60,962	38,687	320,905
1990					86,345	118,387	16,923	16,677	238,331
1991				23,667	412,996	128,710	123,868		689,241
1992					159,502	120,261	40,285	24,977	345,025
1993					93,858	94,990			188,848
1994	0				159,460	94,394	31,994		285,848
1995					200,794	144,757	16,629		362,180
1996					152,759	99,867	82,476	9,347	344,449
1997					358,225	154,862	28,916	1,555	543,558
1998					141,566	125,545	35,561		302,673
1999				6,787	101,308	47,477	178,753	5,192	339,517
2000					324,562	118,349	763		443,674
2001					367,003	74,757		10,074	451,834
2002					75,489	209,043	10,691	1,172	296,395
2003				0	37,213	84,773	425,939	342	548,266
2004					35,189	294,042	649,803	44,045	1,023,079
2005			818		516,764	239,195	3,130	774	760,680
2006		17,035			898,542	184,300	53,634	1,733	1,155,244
2007					352,071	106,213	271,431	46,729	776,444
2008					116,420	82,566	32,497	320,174	551,657
2009					445,993	166,195	62,332	2,009	676,530
2010				1,069	254,414	498,581	67,946	89,840	911,850
2011					107,424	145,796		74,651	327,871
2012		6,796			26,537	104,106	201,223	97,766	436,427
2013					224,442	506,067	9,873	25,183	765,565
2014					173,772	247,386	26,439	19,079	466,677
2015					882,022	695,842	124,933	26,499	1,729,296
2016				193	915,151	298,090	76,754		1,290,187
2017					252,683	259,737		328	512,748
2018			4,840	3,254	843,994	364,810	36,683	6,226	1,259,807

Table A3. Cobia recreational harvest (A + B1) by state, in pounds, 1981-2018, with effort estimated by or calibrated to the mail-based Fishing Effort Survey. 2018 data is preliminary. Source: MRIP, queried April, 2019.

Year	NY	NJ	DE	MD	VA	NC	SC	GA	Total
1981					5,788	3,726			9,514
1982						8,430	9,991	26,075	44,496
1983				0		0		73,504	73,504
1984						259,354	194,569	130,102	584,025
1985	0	0		63,281	78,704	2,720	193,778	47,167	385,650
1986		48,781		20,807	134,568	533,982	76,547	5,633	820,318
1987					21,167	81,833	4,477	9,989	117,466
1988						103,975	62,918	2,434	169,327
1989				25	262,795	208,259	91,078	50,169	612,326
1990					86,491	188,539	22,471	37,195	334,696
1991				2,095	118,737	266,633	477,604		865,069
1992					229,977	317,628	53,255	47,111	647,971
1993					113,636	168,142			281,778
1994	0		0		196,525	169,168	26,051		391,744
1995					637,842	302,745	20,718		961,305
1996					1,287,826	102,899	821,361	11,902	2,223,988
1997					516,108	129,299	90,931	1,498	737,836
1998					379,056	117,754	18,991		515,801
1999				1,387	164,817	101,465	100,955	3,446	372,070
2000					383,077	91,143	1,267	0	475,487
2001					283,256	121,751		8,354	413,361
2002					242,697	319,178	3,446	3,557	568,878
2003				98,524	120,097	223,508	940,447	459	1,383,035
2004		0			76,408	420,684	426,301	106,405	1,029,798
2005			5,044		792,006	401,557	1,549	899	1,201,055
2006		6,768			1,596,234	196,330	148,146	1,918	1,949,396
2007					499,736	218,447	538,625	63,024	1,319,832
2008		0			182,451	167,463	37,124	499,198	886,236
2009					855,629	320,075	94,996	1,831	1,272,531
2010		0		1,179	557,907	808,227	100,614	230,865	1,698,792
2011					341,751	399,192	0	182,799	923,742
2012		60,473		0	47,547	102,077	214,512	512,499	937,108
2013					488,181	980,541	24,005	43,915	1,536,642
2014					499,218	645,427	79,171	42,481	1,266,297
2015		0			1,166,000	1,925,762	434,899	102,917	3,629,578
2016				307	1,505,528	838,363	159,345	0	2,503,543
2017					488,287	872,861	0	390	1,361,538
2018		0	9,664	3,254	1,936,274	561,526	160,191	6,226	2,677,135

Summary of Public Comment on Draft Amendment 1 to the Atlantic Cobia Fishery Management Plan

The Public Comment period for Draft Amendment 1 to the Atlantic Cobia Fishery Management Plan (FMP) closed on July 15, 2019, and 8 written comments were received. Of the 8 written comments, 3 were organizational letters from the American Sportfishing Association (ASA), Hilton Head Island Sportfishing Club (HHISC), and Virginia Saltwater Sportfishing Association (VSSA). Comments are described below according to numbered options from Draft Amendment 1, along with general comments provided that did not pertain to these options.

Issue 1: Edit to Section 2.3 Goal

The ASA and VSSA support the edit.

Issue 2: Edit to Section 2.4 Objectives

The ASA and VSSA support the edit.

Issue 3: Edit to Section 2.6 Definition of Overfishing

The VSSA supports the edit, specifically incorporation of stock status criteria through Board action and potential use of the Commission's Independent External Peer Review Process.

The ASA supports incorporation of peer-review stock status determination criteria through Board action, but recommends adding language that would allow this process to establish fishing mortality and spawning stock biomass targets, in addition to the thresholds currently described in the Draft Amendment. The ASA also recommends renaming Section 2.6 to "Stock Status Criteria" or "Reference Points" to reflect inclusion of overfished status definition.

Issue 4: Edit to Section 3.1.1 Commercial Landings/Catch Monitoring

The VSSA supports state monitoring of commercial landings. The VSSA also supports current recreational monitoring efforts through Virginia's Cobia Recreational Permit, and recommends the Commission encourage other states to implement similar monitoring to supplement Marine Recreational Information Program (MRIP) information.

Issue 5: Section 4.1 Harvest Specification Process

The ASA and VSSA support **Option a (Harvest specification on a 2-year timeframe)**.

Issue 6: Section 4.2 Sector Quota Allocation

The ASA recommends a description of the methods for the current sector quota allocation and recalculation of sector allocations using the recalibrated MRIP harvest estimates.

The VSSA supports maintaining the current sector allocation.

Issue 7: Edit to Section 4.3.5 Evaluation of Recreational Landings and Overage Response

The ASA generally supports the edit, but recommends changing the time period of consecutive underharvest for a state to apply for relaxed measures to be reduced from 3 years to 2 years.

The VSSA supports the edit.

Issue 8: Section 4.3.6 Recreational Units

The ASA supports use of the option recommended by the Cobia Technical Committee.

The VSSA supports **Option b (numbers)**.

Issue 9: Section 4.4.1 Commercial Size Limit
The VSSA supports **Option b (36-inch fork length minimum commercial size)**.

Issue 10: Section 4.4.3 Commercial Vessel Limit
The VSSA supports **Option a (maximum commercial vessel limit of 6 fish)**.

Issue 11: Section 4.4.4 Commercial Quota Based Management
The VSSA supports the drafted language for managing the commercial quota.

Issue 12: Section 4.5.3.3 Commercial *De Minimis*
The VSSA supports **Option b (establishment of commercial *de minimis* status)**.

Issue 13: Section 4.9 Recommendation to the Secretary of Commerce for Complementary Actions in Federal Jurisdictions
The ASA supports **Option a (recreational and commercial regulations by licensed/permitted state)**, but also recommends seeking input from the Commission's Law Enforcement Committee before taking final action.

Two (2) SC individual written comments and the HHISC support **Option b (recreational regulations by area fished, commercial by licensed/permitted state)**.

The VSSA supports regulations corresponding to the state of landing, regardless of where the fish is caught or licenses/permits for other states.

General Comments:

- One VA commenter recommends delaying action on Amendment 1 until the SEDAR 58 stock assessment is complete. This commenter also described harvest overestimation by the MRIP in comparison to data collected by the Virginia Marine Resources Commission.
- One SC commenter supports a closure of all cobia fishing, except for those below the poverty line and fishing only for subsistence, due to cobia's ecological role as prey for large animals such as orcas and large sharks.
- One SC commenter supports management of cobia off South Carolina should be done exclusively by South Carolina due to a resident population of cobia there. This commenter also supports recreational limits of 1 fish per person (currently in place) and up to 2 fish per vessel.
- One commenter supports recreational limits of 1 fish per person (currently in place), a 36-inch total length minimum size limit, and up to 3 fish per vessel.
- The ASA also commented that the recalibrated MRIP harvest estimates should be used to recalculate state allocation percentages.

In addition to written comments, four public hearings were held, three in person in Virginia, North Carolina, and South Carolina, and one via webinar. Numeric counts of votes on issues with multiple options are shown in the Summary Table below. Comments beyond these votes for the Virginia, North Carolina, and South Carolina hearings are also summarized in this report, and recordings of hearing comments are available upon request. No public attended the webinar hearing.

Summary Table

	Comments in Favor of Options for Multi-Option Issues													
Issue	**Issue 5 (Harvest Spec)**			**Issue 8 (Rec Units)**		**Issue 9 (Com Min Size)**		**Issue 10 (Com Vessel Limit)**			**Issue 12 (Com *De Min*)**		**Issue 13 (Fed Regs)***	
Option	**a**	**b**	**c**	**a**	**b**	**a**	**b**	**a**	**b**	**c**	**a**	**b**	**a**	**b**
Individual														2
Organization	2			1			1	1				1	1	1
Hearings														
VA	5	1		5		3		5		1		1	3**	
NC	7			7		7		7				7	7	
SC	3	3		6			6			6				6
TOTAL	**17**	**4**	**0**	**19**	**0**	**10**	**7**		**0**	**7**	**0**	**9**	**11**	**9**

*VSSA supports federal recreational regulations according to the state of landing, regardless of catch location or multiple state licenses/permits.

**These individuals only support Issue 13 Option a with the removal of language requiring fishers with multiple licenses/permits for states with open seasons to fish using the most restrictive state's regulations.

Cobia Draft Amendment 1 Public Hearing Summary
Hampton, Virginia
June 12, 2019
8 Public Attendees

Staff: Dr. Michael Schmidtke (ASMFC), Pat Geer (VMRC), Alex Aspinwall (VMRC)
Attendees: Chris Ludford, Mike Gurley, Pat Link, Mike Avery, Jerry Hughes, John Sawyer, Wes Blow, Chris Martin

For Issues with multiple options (5, 8, 9, 10, 12, and 13), votes were taken to show attendees' preferred options. Totals for these votes are recorded in the Summary Table.

Issue 5

Patrick Link supported Option a, commenting the two years would allow flexibility and quicker ability to change management, while four years could lock in management that is unsustainable for the stock or the fishery.

John Sawyer supported Option a, due to the newness of management and knowledge about the fishery. Option a would allow necessary tweaks to management to be made more quickly.

Issue 6

Chris Martin commented that there should be consideration of expanding the commercial quota.

Issue 8

Patrick Link supports Option b, and commented that number of fish should be used throughout recreational management. **Mike Avery** agreed.

John Sawyer commented that the current VA limits reduce the average weight for that state's harvest (only 1 fish over 50 inches is allowed), so using number of fish makes harvests across states more comparable.

Issue 9

Wes Blow commented that current minimum size limits may not be useful and should be further evaluated.

Issue 13

Mike Avery commented that the port of departure and return should determine regulations, regardless of catch location or whether multiple licenses are held. **John Sawyer** supported this. If law enforcement intercepts a vessel in federal waters on which licenses for multiple states are possessed, law enforcement should ask the license holders where they left and are returning to and enforce the corresponding regulations. Mr. Avery commented that the currently drafted language is confusing for anglers with licenses from multiple states to determine which regulations apply to them.

Additional Comments:

Attendees expressed concern about MRIP recreational harvest estimates.

Mike Avery raised concerns regarding the lack of language that would prevent the Commission from closing the fishery mid-season. Dr. Schmidtke explained that one of the primary intentions of the plan is to avoid mid-season closures, although the Commission would retain the ability to close the fishery in an emergency situation. Mr. Avery also commented on current Virginia commercial regulations that set a vessel limit of two fish per license holder, and the difficulty for commercial fishers to find multiple license holders to harvest the vessel limit of 6 fish. Dr. Schmidtke noted that the per license holder regulation is set by Virginia, but is not required of the Commission's FMP, which sets the commercial possession limit as per person.

Patrick Link would like to see the Commission consider recreational harvest data other than MRIP. In comparing VMRC harvest data to that of MRIP, the 2018 MRIP estimate of harvest is 11 times greater than VMRC data. Mr. Link would like to see such data used to supplement MRIP data when evaluating recreational harvests and making management decisions.

Chris Martin commented on current Virginia commercial regulations that set a vessel limit of two fish per license holder, and the difficulty for commercial fishers to find multiple license holders to harvest the vessel limit of 6 fish. Mr. Martin also supports expanding the commercial fishery through increased quota and/or possession limits.

VIRGINIA MARINE RESOURCES COMMISSION

ASMFC Cobia Public Hearing on Amendment 1

380 FENWICK RD, BUILDING 96, FORT MONROE, VA

VMRC COMMISSION ROOM

KW

Tuesday, June 12, 2019 - 6:00 PM

Public Sign-In Sheet
PLEASE PRINT CLEARLY
Chris Ludford
Mike Gurley
Pat Link
Mike Avery
JERRY NUGHES
John Sawyer
Wes Blow
C... Martin

Cobia Draft Amendment 1 Public Hearing Summary
Manteo, North Carolina
June 13, 2019
7 Public Attendees

Staff: Dr. Michael Schmidtke (ASMFC), Chris Batsavage (NC DMF)
Attendees: Kyle Berry, Jack Piddington, Garrett Grant, Jake Worthington, Bill Gorham, Ward Trotter, David Wilson

For Issues with multiple options (5, 8, 9, 10, 12, and 13), votes were taken to show attendees' preferred options. Totals for these votes are recorded in the Summary Table.

Issue 2

Bill Gorham asked about the extent of flexibility that the Board will have through the new objectives. Dr. Schmidtke explained that the parameters of the Board's flexibility for the harvest specification process are defined within Issue 5.

David Wilson asked about how stock assessments will be conducted. Dr. Schmidtke explained that stock assessments will be conducted through the Southeast Data, Assessment, and Review (SEDAR) process, which primarily uses scientists from the NOAA Southeast Fisheries Science Center to conduct assessments.

Issue 3

Bill Gorham asked about what would happen if the ongoing assessment does not produce results usable for management use. Dr. Schmidtke explained that, for other Commission assessments that were not recommended for management use, if no information indicated that the stock was in jeopardy, status quo measures have continued. In the case of Atlantic cobia, continuation of any status quo beyond the stock assessment timeline would likely require a conversion of recreational quotas and targets from Coastal Household Telephone Survey (CHTS) units to those of the mail-based Fishing Effort Survey (FES). Mr. Gorham commented that continuation of status quo measures would be troubling.

David Wilson asked about whether SEDAR would be the only assessment process that the Board could use for management. Dr. Schmidtke explained that SEDAR will be the primary process moving forward, but if something happens that would prevent Atlantic cobia from being assessed in this manner, language in the Draft Amendment allows consideration of a Commission-conducted assessment or an assessment from another source that is approved by the Board and Cobia TC.

Issue 4

Bill Gorham asked about consideration of recreational state reporting for monitoring recreational harvests. He expressed concern with continued use of MRIP for recreational harvest monitoring without consideration of other recreational data sources.

__Issue 5__

Bill Gorham expressed concern with leaving current NC regulations in place for a long period of time via Option c. Mr. Gorham also commented that he would like to add an option of 1-year specification for Board consideration.

David Wilson asked about how the recreational allocations and targets were calculated. Dr. Schmidtke explained that the allocation percentages were based on a weighted average of MRIP landings from 2006-2015. Mr. Wilson also asked why management through a specification process is being considered. Dr. Schmidtke explained that the immediate need is to respond to results from the ongoing stock assessment in a timelier manner than would be allowed under an addendum or amendment, but on a longer term basis, this would allow the Board also to quickly make necessary changes to the fishery.

Kyle Berry asked about how often a vessel limit would change through harvest specification. Dr. Schmidtke explained that the vessel limit referred to in the specification process is the coastwide maximum, currently at 6 fish for both sectors. For the recreational sector, states set lower vessel limits to achieve their state recreational harvest targets.

Garrett Grant asked whether the timeframe of the specification process could vary. Dr. Schmidtke explained that the Draft Amendment allows specification for up to a certain number (2, 3, or 4) of years, but the average timeframe used to evaluate harvest would be up to 3 years, regardless of the specification timeframe selected.

__Issue 6__

Bill Gorham asked if the sector allocation percentages would remain after incorporation of the FES MRIP harvest estimates. Dr. Schmidtke explained that the percentages would remain in place and would require an addendum to change.

__Issue 7__

Bill Gorham would like to increase communication of MRIP methods to stakeholders, and to incorporate some sense of the estimate uncertainty. Mr. Gorham expressed a desire for stability, but would like to see stability at a harvest level that better allows businesses to persist.

__Issue 8__

Bill Gorham asked whether language could be added that would allow consideration of alternative data for estimating harvest. Mr. Batsavage followed up by asking if alternative harvest data were considered, would those data need to be certified by MRIP. Dr. Schmidtke explained that any decision on consideration of alternative recreational harvest data would need to be made by the Board.

__Issue 9__

Bill Gorham expressed concern with increasing the size limit for a small fishery, which would also increase discards and associated mortality.

__Issue 13__

David Wilson asked about the distinction between options. Mr. Batsavage explained that these options are really applicable to on-the-water enforcement, because a fisher would still have to adhere to state possession and landing rules, i.e. if Option b were preferred, a recreational fisher from NC could fish in federal waters off VA under VA rules, but if they return to NC state waters, NC state laws would still apply.

Additional Comments:
Attendees expressed concern about MRIP recreational harvest estimates.

Bill Gorham expressed concern with Florida voting on any issues pertaining to Atlantic cobia management. Mr. Gorham stated that any Florida vote that is a deciding vote for Atlantic cobia management would be challenged, because cobia in FL waters are not included in the Atlantic stock or management unit.

Ward Trotter asked about how a stock assessment accounts for management that limits the amount of fish harvested. Dr. Schmidtke explained some basic stock assessment principles used to account for this.

David Wilson expressed concern with a lack of stakeholder involvement in the stock assessment process. Dr. Schmidtke explained that SEDAR directly incorporates stakeholders by appointing them as observers. Additionally, all SEDAR, Commission stock assessment, and Commission management meetings are open to the public, and stakeholders often attend to provide comments.

Cobia Draft Amendment 1 Public Hearing

Atlantic States Marine Fisheries Commission

June 13, 2019

North Carolina

-- PLEASE PRINT CLEARLY --

Name	Company/Organization	City, State
Kyle Berry		Kill Devil Hills, NC
Jack Piedmann		Kill devil Hills
Garrett Grant		Manteo NC
Jake Worthington		Southern Shores, NC
Bill Graham	Towed Up Lures	Southern Shores, NC
David Trotter	Tie m Off	Grandy, NC
[illegible]		

Cobia Draft Amendment 1 Public Hearing Summary
Okatie, South Carolina
June 13, 2019
6 Public Attendees

Staff: Dr. Michael Schmidtke (ASMFC), Mel Bell (SCDNR), Wallace Jenkins (SCDNR), Amy Dukes (SCDNR) , Jake Morgenstern (SCDNR)
Attendees: Rick Percy, Dave Harter, Chris Kehner, Al Stokes, Earl Swierkowski, Dan Utley

For Issues with multiple options (5, 8, 9, 10, 12, and 13), votes were taken to show attendees' preferred options. Totals for these votes are recorded in the Summary Table.

Issue 5

Rick Percy supported Option a as this would allow for quicker conservation measures if needed.

Issue 8

David Harter supported Option b (number of fish), as records kept by the Hilton Head Sportfishing Club indicate that the coastwide average weight being used to convert pounds to numbers seems accurate for cobia caught in SC.

Issue 13

Rick Percy asked whether a Georgia angler fishing in federal waters would be required to have a South Carolina license. Mel Bell explained that if the angler left and returned to Georgia, they would not need an SC license, but if they trailered the boat up to SC and left or returned to an SC port, they would. Mr. Percy also commented that current management and any regulations for federal waters off SC that would allow more fish per recreational vessel than allowed in SC state waters is counterproductive to the conservation efforts SC has made to rebuild their distinct population segment of cobia. This includes the May closure that occurs in state waters south of Jeremy Inlet.

Al Stokes commented that recreational fishers from Savannah, GA, do continue to go to the Betsy Ross Reef (in federal waters off SC) and keep 6 fish per vessel, which differs from the 3 fish per vessel allowed in SC state waters.

Mel Bell noted that tagging and genetic information indicate a distinct population segment that migrates inshore and offshore of SC and that past and current SC state management actions, called for by the recreational fishery, have been geared toward conserving this population segment.

Cobia Draft Amendment 1 Public Hearing

Atlantic States Marine Fisheries Commission
July 1, 2019
South Carolina

-- PLEASE PRINT CLEARLY --

Name	Company/Organization	City, State
Rick Perry	Reel Chance Charters	Beaufort SC
Dave Harter	HHISFC	Hilton Head
Chris Kehrer	Port Royal Sound Foundation	Bluffton, SC
Al Stokes	Fisherman	Bluffton SC 29910
Earl Swiatkowski	Fisherman	Beaufort SC 29907
Dan Utley	Fishin Cuda Charters	Bluffton SC 29910
Jolie Morgenstern	SCDNR	Bluffton, SC 29910
Walker Jenkins	SCDNR	Mt Pleasant SC 29464
Amy Dukes	SCDNR	Charleston

July 15, 2019

Dr. Michael Schmidtke
Atlantic States Marine Fisheries Commission
1050 North Highland Street, Suite 200
Arlington, Virginia 22201

Dear Dr. Schmidtke,

The American Sportfishing Association (ASA) appreciates the opportunity to provide comments to the Atlantic States Marine Fisheries Commission (ASMFC) on Draft Amendment 1 to the Atlantic Migratory Group Cobia Fishery Management Plan (FMP).

ASA is the nation's recreational fishing trade association and represents sportfishing manufacturers, retailers, wholesalers, and angler advocacy groups, as well as the interests of America's 49 million recreational anglers. ASA also safeguards and promotes the social, economic, and conservation values of sportfishing in America, which results in a $125 billion per year impact on the nation's economy.

The recreational fishery for Atlantic cobia is socially and economically important to many states throughout the Southeast and Mid-Atlantic regions. ASA is encouraged that ASMFC now has sole management authority of this important fishery, and we recognize that with that authority comes great responsibility. To help assist ASMFC in developing a comprehensive FMP for cobia that is responsible to the resource and its fisheries, we submit the following comments on Draft Amendment 1 to the cobia FMP.

Goal (2.3)—ASA supports changing the FMP goal to include the language "…providing equitable and sustainable access to the Atlantic cobia resource throughout the management unit…"

Objectives (2.4)—ASA supports adding the two new objectives as proposed to the FMP. We believe the use of management measures that provide stability to the fishery, while also maintaining flexibility in the harvest specification process are useful objectives that will help achieve the FMP goal.

Definition of Overfishing (2.6)—ASA supports allowing for the incorporation of new, peer-reviewed stock status determination criteria through Board action. However, we recommend adding language to this section that enables the Management Board to establish fishing mortality and spawning stock biomass targets (in addition to already established thresholds). Additionally, we recommend renaming this section "stock status criteria" or "reference points" as this portion of the FMP contains both overfishing and overfished definitions.

AMERICAN SPORTFISHING ASSOCIATION
1001 N. Fairfax Street, Suite 501, Alexandria, VA 22314 • 703-519-9691 • Fax: 703-519-1872
Web: www.ASAFishing.org • Email: info@ASAFishing.org

Harvest Specification Process (4.1)—ASA supports Option A, establishing a two-year harvest specification process to provide flexibility to the fishery while balancing that with some stability.

"The coastwide total harvest quota, vessel limits, possession or bag limits, minimum size limits, and commercial closure triggering mechanism may be specified by Board action for up to two years. Subsequent harvest specification would occur for implementation after expiration of the previous specification (up to two years apart) or following a completed stock assessment."

Sector Quota Allocation (4.2)—ASA recommends adding a description of the sector quota allocation period to the document in this section. Additionally, we recommend considering using the revised recreational landings data from the recalibrated Marine Recreational Information Program (MRIP) to calculate sector allocation. As detailed in section 1.1.1.2 in the draft amendment, the revised catch data will be incorporated into the SEDAR 58 assessment currently underway and is expected to impact the results.

Note that management for other species that have used the recalibration recreational landings data in recent assessments are currently at odds with sector allocation in their FMPs because the allocations are based on old landings data (e.g., summer flounder). This can be avoided if revised recreational landings estimates are incorporated when allocation decisions are being considered.

Recreational Seasons and Allocations (4.3.4)—ASA also recommends considering the use of the revised MRIP recreational landings data to determine state specific allocations.

Evaluation of Landings against State Harvest Targets and Overage Response (4.3.5)—ASA generally supports the proposed added language that helps clarify the timeline and process for evaluating landings against harvest targets. However, we suggest the following change, "States reporting a consistent under-harvest during an evaluation time period of at least ~~3 years~~ (**we recommend changing to 2 years**) may present a plan to extend seasons or increase vessel limits, if desired, to allow increased harvests that will not exceed the harvest target."

Units for Recreational Landings (4.3.6)—ASA recommends using the option that the Technical Committee deems most dependable as it relates to the units for the recreational landings, quotas, and targets. It is difficult to evaluate the impacts of using pounds versus numbers of fish with the available information in the document.

Recommendation to the Secretary of Commerce for Complementary Actions in Federal Jurisdictions (4.9)—ASA recommends option A that regulations in federal waters will be recommended to correspond to the licensed state of landings. From a recreational angler perspective, it is much easier to keep track of the regulations that apply to your port state, then it is to determine the state boundary extensions into federal waters as described in option B. It will also likely be easier for enforcement as well, but we recommend seeking input from ASMFC's law enforcement committee on these options prior to taking final action.

Thank you for your consideration.

Sincerely,

Michael Waine
Atlantic Fisheries Policy Director
American Sportfishing Association

Virginia Saltwater Sportfishing Association, Inc (VSSA)
PO Box 28898
Henrico, VA 23228
www.ifishva.org

July 6, 2019

Dr. Michael Schmidtke
Atlantic States Marine Fisheries Commission (Subject: Cobia Amd 1)
1050 N. Highland Street, Suite 200 A
Arlington VA. 22201

I am writing on behalf of the six hundred plus (600+) members of the Virginia Saltwater Sportfishing Association (VSSA) to provide our comments on the Draft Amendment 1 to the Atlantic Migratory Group Cobia Interstate Fishery Management Plan. VSSA represents both recreational and commercial for hire charter boat captains in the Commonwealth of Virginia. VSSA looks forward to ASMFC's expeditious approval of the Interstate Fishery Management Plan. Our comments by issue are as follows:

Issue 1. Goal Section 2.3 (page 39) adds the language *"providing equitable and sustainable access to the Atlantic cobia resource throughout the management unit…"* VSSA supports the addition of the proposed language.

Issue 2. Objectives Section 2.4 (Page 39) adds the following:
2) Implement management measures that allow stable, sustainable harvest of Atlantic cobia in both state and federal waters.
3) Establish a harvest specification procedure that will allow flexibility to respond quickly to stock assessment results or problems in the fishery, while also providing opportunities for public input on potential significant changes to management.

VSSA supports the addition of the proposed language.

Issue 3. Definition of overfishing Section 2.6 (page 40). VSSA supports *"the incorporation of new, peer-reviewed stock status determination criteria as soon as it becomes available, through the harvest specification process (Section 4.1), allowing timely use of the best available scientific information in the management of Atlantic Cobia."*

Additionally, VSSA supports *utilizing "The Commission's Independent External Peer Review process, which follows a similar process to SEDAR in contracting independent experts to review scientific stock assessment advice, including status determination criteria, but allows the Commission more flexibility in determining the timing of a benchmark assessment."*

Issue 4. Recreational fishing effort and reporting Section 3.1.2 (page 43). VSSA supports all states reporting both recreational and commercial harvest of Cobia. Additionally, VSSA supports Virginia's Cobia Recreational Permit and would support ASMFC recommending same to the other member states to supplement MRIP sampling.

Issue 5. Harvest Specification Process Section 4.1 (page 49). VSSA supports Option A.
a. The coastwide total harvest quota, vessel limits, possession or bag limits, minimum size limits, and commercial closure triggering mechanism may be specified by Board action for up to two years. Subsequent harvest specification would occur for implementation after expiration of the previous specification (up to two years apart) or following a completed stock assessment

Issue 6. Sector Allocation Section 4.2 (page 42). VSSA supports maintaining 92% recreational and 8% commercial coast wide quota allocation. Additionally, VSSA supports state specific management of the size, bag, and vessel limits as well as seasonal allocation of the state specific quotas.

Issue 7. Evaluation of Landings against State Harvest Targets and Overage Response Section 4.3.5 (page 43). VSSA supports the language as proposed and supports individual states adjusting limits and seasons for reduced harvest to such that average landings will achieve the states recreational harvest target.

Issue 8. Units for Recreational Landings, Quotas, and Targets Section 4.3.6 (page 54). VSSA supports Option b.
b. Recreational landings, quotas, and targets will be evaluated and set in units of numbers of fish. The recreational quota and harvest targets will be converted to numbers of fish by dividing poundage amounts by the average of the three most recent annual average weights for cobia landed recreationally, as determined by data from the Marine Recreational Information Program (average weight = recreational pounds/recreational numbers). Conversions conducted prior to the availability of average weight data from 2020 will exclude the use of 2016 and 2017, as a portion of the management unit was closed to recreational fishing during those years, and replace them with data from 2014 and 2015, respectively.

A state may submit alternative data sets that would provide more appropriate estimates of average weight for their state's fishery. Alternative data sets must be evaluated by the TC and approved by the Board before being implemented in converting that state's recreational harvest target from pounds to numbers.

Issue 9. Commercial Size Limit options Section 4.4 (page 54). VSSA supports the Commercial Size limit Option b.
b. All states shall maintain a minimum size limit of 36 inches fork length or the total length equivalent (40 inches).

Issue 10. Vessel Limits Section 4.43 (page 47). VSSA supports the Commercial Vessel limit Option a.
c. All states shall establish a daily vessel limit, not to exceed 6 fish per vessel.

Issue 11. Quota Based Management Section 4.4.4 (page 55). VSSA supports the language as proposed.

Issue 12. Commercial De Minimus Options Section 4.5.3.3 (page 58). VSSA supports option b.

b. States may apply for de minimis status for their commercial fishery.

Issue 13. RECOMMENDATION TO THE SECRETARY OF COMMERCE FOR COMPLEMENTARYACTIONS IN FEDERAL JURISDICTIONS Section 4.9 (Page 63). VSSA believes the options offered will lead to confusion with both anglers and law enforcement. Accordingly we do support any of the options as offered. We recommend the regulations in Federal waters correspond to the actual state of landing regardless of where the fish is caught, or how many state licenses are held.

VSSA looks forward to Cobia being managed effectively and efficiently utilizing the best available science and management practices. Thank you for the opportunity to provide input on this important and valuable fishery.
Respectfully,

John J. Bello
Chairman Government Affairs Committee

cc. Mr. Rob O'Reilly, Virginia Marine Resources Commission
Alex Aspinwall, Virginia Marine Resources Commission
Pat Geer, Virginia Marine Resources Commission

From:	David Harter
To:	Comments
Cc:	Al Stokes; Bill Parker; Collins Doughtie
Subject:	Cobia Draft amendment
Date:	Monday, July 15, 2019 2:34:36 PM

The Hilton Head Reef Foundation and its parent organization, the Hilton Head Island Sportfishing Club is very much in favor of Option B for Issue 13.
In 2006-8, we were chief investigators for an archival satellite tagging program of our inshore spawning cobia to track their movements. This was funded by NOAA/Seagrant and conducted by marine biologist Don Hammond.
While several tags showed a distinctive straight offshore movement toward the Navy Towers, one cobia moved back and forth from Port Royal Sound to the Betsy Ross Reef several times.
Before extensive genetic studies, and in conjunction with returns from traditional dorsal tagging (which we were also heavily engaged in), we were convinced early on that our mature inshore cobia had minimal migration to other estuarine systems.
Subsequent results from the SCDNR DNA studies continue to confirm that position.
Thus, in order to protect our local cobia stocks they must be regulated by South Carolina and any size, catch or possession limits should apply to the harvest area rather than the port of origin.
Overall, we feel that the handoff of cobia fisheries management to the ASMFC is a very good step for the cobia fishery and the fishermen.

Sincerely
David Harter
Pres. HHI Sportfishing Club
VP Hilton Head Reef Foundation

"I like to see a man proud of the place in which he lives. I like to see a man live so that his place will be proud of him." Abe Lincoln

Tina Berger

From: marcuspor@aol.com
Sent: Monday, July 15, 2019 2:19 PM
To: Comments
Subject: Draft amendment 1 Issue 13 Option B

Allow SC to enforce existing and future state regulatory measures in the federal waters off S.C. regardless of the port of origin.or state registration of the vessel encountered.. Also one fish /person/day with 3 fish/boat/day. with 36" TL limit. Thanks Mark

Tina Berger

From: Richard Pollitzer <rpollitzer@gmail.com>
Sent: Friday, July 12, 2019 6:38 PM
To: Comments
Subject: Cobia Ammendments

To Those Concerned:

I am a Beaufort SC native and a charter captain in Hilton Head, SC and have been in the business for nearly 30 years. I also hold a degree in resource management with a minor in Fisheries Biology from Clemson. I spend countless hours in our offshore and inshore waters in pursuit of Cobia and have contributed 100's of carcasses and fin clippings to SCDNR for the research of Cobia. My interest in them is both professional and intellectual and I support the efforts being made to ensure their sustainability.

It is my opinion that the limits on Cobia set for SC Waters should be enforceable to boats of all ports of call not just those from SC. This is important for many reasons, not the least of which is the ease of enforcement. How would our enforcement officers know where a vessel registered in another state actually departed from? I'm certain that 1000's of vessels registered in other states are launched from one of our many boat landings each year with the intention of targeting Cobia. Our officers will not be able to monitor those boats, once checked, to make sure they are returning to non-SC ports. The other reason is scientific. If "our" Cobia are spawning locally, management should fall in the hands of our regulatory body not that of other states. I would also like to see the limit set at 2 per boat per day or 1 per person in both inshore and offshore waters. I urge my clients to allow me to implement that rule on my boat as 2 legal Cobia yield plenty of meat to make the day of fishing worth while.

As an aside I'd like to point out a cycle I have noticed in my lifetime of fishing in SC waters. The population (or perhaps fishing yield) of Cobia is directly reciprocal to King Mackerel. In years that the King Mackerel fishery is at its strongest, the Cobia fishery seems weakest. This is the second time I have observed this cycle which seems to reciprocate fully every 30 years.

Thank you for your attention to my email and to this very important facet of SC fishing.

Richard Pollitzer
Tallboy Fishing Charters
Tideland Realty
(843)575-2550

Tina Berger

From: Ellen Sinderman <ellenindia219@gmail.com>
Sent: Thursday, July 4, 2019 7:53 AM
To: Comments
Subject: Cobia Amd 1

Michael, I am against cobia fishing for the indefinite future. They are prey for larger pelagic fish like orcas and great white sharks, which are endangered.

In the future, only those below the poverty line, who own the right boat and equipment, should be allowed to catch certain species- for food only. Our economy is booming for most and so sport fishing and fishing for "fun" should be curtailed imo. Even catch and release leads to injury per the Lemon Island Maritime Center staff, where I volunteer.

I will be leaving $10k to WWF in my will- that's my commitment. And I am not some unbalanced liberal, but an independent and moderate.

Thanks for reading

Ellen Rebekah Drager
Beaufort, SC

He is born in vain, who having attained the human birth, so difficult to get, does not attempt to realize God in this very life. - Ramakrishna, born 1836, was an Indian Hindu mystic and saint in 19th century Bengal.

Tina Berger

From: Jonathan French <french60wasp@gmail.com>
Sent: Thursday, June 20, 2019 12:27 AM
To: Comments; Rob O'Reilly; Cimino, Joe (MRC); Ryan Jiorle; STEVEN G. BOWMAN; Bryan Plumlee; Monty Mason
Subject: Cobia Amd 1

Dear Members of the Atlantic States Marine Fisheries Council,

Thank you for the opportunity to comment on the proposed Cobia Amendment 1. Based on evidence being presented during the current cobia stock assessment activity regarding the size of the cobia biomass that runs counter to the conclusions made as part of the SEDAR28 process in 2014, I think it would be premature to take action on Cobia Amendment 1 until the new stock assessment is completed. I strongly encourage members of the ASMFC to vote against implementation of Amendment 1 until the new stock assessment is completed.

Virginia Institute of Marine Sciences tagging data and VMRC mandated reported directly refutes conclusions made about cobia behavior and catch estimates following 2014's SEDAR28, and that data is currently being weighed by the SEDAR cobia stock assessment group. Following a separation of stocks and allocations based on questionable assertions by SEDAR28, there was a significant spike in MRIP estimates for the cobia catch. The catch was a significant statistical outlier, over three standard deviations from the MRIP estimated annual catch of the previous decade. Despite the lack of data quality, the SAMFC chose to use the data, enacted a closure of federal water for cobia harvest, and pressured states to do the same.

The catch data was wildly inconsistent with state estimates as well. In response, the Commonwealth of Virginia enacted a mandatory cobia permit and mandatory trip reporting to provide an alternative data source to the MRIP estimates. In 2018, VMRC analysts estimated 27,342 cobia landed in Virginia waters, with 18,049 of those fish reported directly from the mandatory reporting program. VMRC estimated that 6,388 of those fish were harvested.

During the same measurement period, MRIP estimated a cobia catch of 262,916 fish landed for 2018 in Virginia waters. This reflects a ten fold increase over Virginia estimates, despite Virginia's sample size being much larger and reflecting a much more accurate reflection of the state of the fishery and fishing pressure. Making management decisions based on this data, coupled with biomass estimates and scientific assertions which have been proven to be inaccurate about cobia reproductive behavior and migration which completely failed to consider data and anecdotal evidence from Virginia does not reflect fisheries management using the best science available. Making management decisions without utilizing state collected data, even though variation exists in the federal data collection which no industry would credibly use for management decisions, is wrong and goes against the scientific method and every fisheries management principle emphasized in federal law.

Thank You,
Jonathan French
2820 Emma Lee St #303
Falls Church VA, 22042

Atlantic States Marine Fisheries Commission

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South Atlantic State/Federal Fisheries Advisory Panel
Meeting Summary

Conference Call/Webinar
July 8, 2019

Advisory Panel Members: Craig Freeman (VA)

ASMFC Staff: Mike Schmidtke

The South Atlantic Advisory Panel (AP) met via conference call to review Draft Amendment 1 to the Fishery Management Plan for Atlantic Migratory Group (Atlantic) Cobia (FMP). This meeting was to review the presented issues and options to and develop AP comments and recommendations to be considered with final action by the South Atlantic State/Federal Fisheries Management Board (Board) at their meeting in August, 2019.

Mike Schmidtke presented the Draft Amendment, focusing on the information and issues discussed in the first four sections of the document. Draft Amendment 1 addresses 13 issues. These issues, along with AP comments and recommendations, are listed below.

Issue 1: Edit to Section 2.3 Goal

The AP does not object to the edit.

Issue 2: Edit to Section 2.4 Objectives

The AP does not object to the edit.

Issue 3: Edit to Section 2.6 Definition of Overfishing

The AP does not object to the edit.

Issue 4: Edit to Section 3.1.1 Commercial Landings/Catch Monitoring

The AP does not object to the edit.

Issue 5: Section 4.1 Harvest Specification Process

The AP supports Option a: The coastwide total harvest quota, vessel limits, possession or bag limits, minimum size limits, and commercial closure triggering mechanism may be specified by Board action for up to two years. Subsequent harvest specification would occur for implementation after expiration of the previous specification (up to two years apart) or following a completed stock assessment.

Issue 6: Section 4.2 Sector Quota Allocation

The AP does not object to the section as written (92% recreational, 8% commercial allocations).

Issue 7: Edit to Section 4.3.5 Evaluation of Recreational Landings and Overage Response

The AP does not object to the edit.

Issue 8: Section 4.3.6 Recreational Units

The AP supports Option b: Recreational landings, quotas, and targets will be evaluated and set in units of numbers of fish.

Issue 9: Section 4.4.1 Commercial Size Limit

The AP supports Option a: (Status Quo) All states shall maintain a minimum size limit of 33 inches fork length or the total length equivalent (37 inches).

Issue 10: Section 4.4.3 Commercial Vessel Limit

The AP supports Option c: All states shall establish a daily vessel limit, not to exceed 4 fish per vessel.

- The AP's support of Option c is contingent that the 4 fish vessel limit would be able to apply regardless of the number of commercial license holders on the vessel. While the Commission's FMP does not specify commercial regulations on a per license holder basis, current Virginia regulations do.
- The AP supports the general principle that the commercial fishery's vessel limit should in effect be equal to or one fish greater than that of the recreational fishery.

Issue 11: Section 4.4.4 Commercial Quota Based Management

The AP does not object to the section as written.

Issue 12: Section 4.5.3.3 Commercial *De Minimis*

The AP supports Option b: States may apply for *de minimis* status for their commercial fishery.

Issue 13: Section 4.9 Recommendation to the Secretary of Commerce for Complementary Actions in Federal Jurisdictions

The AP supports Option a: Regulations in federal waters will be recommended to correspond to those of the vessel's permitted or licensed state of landing. If possessing permits or licenses for multiple states with open seasons, regulations for the most restrictive open state shall apply. If possessing permits or licenses for multiple states, only one of which is open, regulations for the state with an open season shall apply.

Following the webinar, the AP was contacted via email and additional comments were requested. No additional comments were provided through July 19, 2019.

Atlantic States Marine Fisheries Commission

American Eel Management Board

August 6, 2019
1:30 - 2:30 p.m.
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Call to Order *(M. Gary)*	1:30 p.m.
2.	Board Consent • Approval of Agenda • Approval of Proceedings from October 2018	1:30 p.m.
3.	Public Comment	1:35 p.m.
4.	Update on Board Working Group Recommendations on Addressing Coastwide Cap Overages (*K. Rootes-Murdy*)	1:45 p.m.
5.	Review and Consider Approval of 2020 Aquaculture Proposals (*K. Rootes-Murdy*) **Action**	1:55 p.m.
6.	Other Business/Adjourn	2:30 p.m.

The meeting will be held at the Westin Crystal City, 1800 S. Eads Street, Arlington, Virginia; 703.486.1111

MEETING OVERVIEW

American Eel Management Board
August 6, 2019
1:30 – 2:30 p.m.
Arlington, Virginia

Chair: Marty Gary (PRFC) Assumed Chairmanship: 10/17	Technical Committee Chair: Jordan Zimmerman (DE)	Law Enforcement Committee Representative: Cloutier
Vice Chair: Lynn Fegley (MD)	Advisory Panel Chair: Mari-Beth DeLucia	Previous Board Meeting: October 22, 2018
Voting Members: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, VA, NC, SC, GA, FL, D.C., PRFC, USFWS, NMFS (19 votes)		

2. Board Consent:

- Approval of Agenda
- Approval of Proceedings from October 2018 Board Meeting

3. Public Comment- At the beginning of the meeting, public comment will be taken on items not on the Agenda. Individuals that wish to speak at this time must sign-up at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Board Chair will not allow additional public comment. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Update on Board Working Group Recommendations on Addressing Coastwide Cap Overages (1:45 – 1:55 p.m.)
Background • In 2018, the Board approved Addendum V. To address management of the new Coastwide Cap and removal of state allocations, a Board Working Group was formed to develop a Coastwide Cap Overage Policy. • The Board Working Group met multiple times from December 2018-July 2019 to develop a draft Coastwide Cap Overage Policy.
Presentation • Update on Board Working Group Draft Policy on Coastwide Cap Overages by K. Rootes-Murdy

5. Consider 2020 Aquaculture Proposals (1:55 p.m. – 2:30 p.m.) Action
Background • Maine and North Carolina submitted aquaculture proposals for the 2020 fishing season. North Carolina is submitting a two year proposal starting in fall 2019. (**Briefing Materials**) • The Technical Committee met on July 15th to review the proposals (**Briefing Materials**)
Presentations • Overview of Maine and North Carolina aquaculture proposals by K. Rootes-Murdy • Technical Committee Report by K. Rootes-Murdy
Board actions for consideration at this meeting • Approval of Maine and North Carolina aquaculture proposals

6. Other Business/ Adjourn

American Eel

Activity level: Low

Committee Overlap Score: Medium (SAS overlaps with BERP, Atlantic herring, horseshoe crab)

Committee Task List
• TC –July 2019: review of Maine's aquaculture proposal • TC – September 1st: Annual compliance reports due

TC Members: Jordan Zimmerman (DE, TC Chair), Ellen Cosby (PRFC, Vice Chair), Ryan Harrell (GA), Kimberly Bonvechio (FL), Bradford Chase (MA), Chris Adriance (DC), Robert Atwood (NH), Sheila Eyler (USFWS), Alex Haro (USGS), Wendy Morrison (NOAA), Carol Hoffman (NY), Todd Mathes (NC), Patrick McGee (RI), Jennifer Pyle (NJ), Troy Tuckey (VIMS), Danielle Carty (SC), Keith Whiteford (MD), Gail Wippelhauser (ME), Tim Wildman (CT), Kirby Rootes-Murdy (ASMFC)

SAS Members: Greg Hinks (NJ), Bradford Chase (MA), Matt Cieri (ME), Sheila Eyler (USFWS), Laura Lee (NC), John Sweka (USFWS), Troy Tuckey (VIMS), Keith Whiteford (MD), Kristen Anstead (ASMFC), Kirby Rootes-Murdy (ASMFC)

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

AMERICAN EEL MANAGEMENT BOARD

The Roosevelt Hotel
New York, New York
October 22, 2018

These minutes are draft and subject to approval by the American Eel Management Board.
The Board will review the minutes during its next meeting.

TABLE OF CONTENTS

INDEX OF MOTIONS

1. **Approval of Agenda** by Consent (Page 1).
2. **Approval of Proceedings of August 2018** by Consent (Page 1).
3. **Move to add Richard Stoughton (SC) and Lawrence Voss (DE) to the American Eel Advisory Panel** (Page 10). Motion by Robert Boyles; second by John Clark. Motion carried (Page 10).
4. **Move to adjourn** by consent (Page 11).

ATTENDANCE

Board Members

Pat Keliher, ME (AA)
Steve Train, ME (GA)
Sen. David Watters, NH (LA)
Cheri Patterson, NH, proxy for D. Grout (AA)
G. Ritchie White, NH (GA)
Sarah Ferrara, MA, proxy for Rep. Peake (LA)
Dan McKiernan, MA, proxy for D. Pierce (AA)
Raymond Kane, MA (GA)
Phil Edwards, RI, proxy for J. McNamee (AA)
Eric Reid, RI, proxy for Sen. Sosnowski (LA)
David Borden, RI (GA)
Justin Davis, CT, proxy for P. Aarrestad (AA)
Sen. Craig Miner, CT (LA)
Bill Hyatt, CT (GA)
Maureen Davidson, NY, proxy for J. Gilmore (AA)
Emerson Hasbrouck, NY (GA)
Sen. Phil Boyle, NY (LA)
Mike Falk, NY, Legislative proxy
Heather Corbett, NJ, proxy for L. Herrighty (AA)
Tom Fote, NJ (GA)
Loren Lustig, PA (GA)
Andy Shiels, PA, proxy for J. Arway (AA)
John Clark, DE, proxy for D. Saveikis (AA)
Craig Pugh, DE, proxy for Rep. Carson (LA)
Roy Miller, DE (GA)
Russell Dize, MD (GA)
Lynn Fegley, MD, proxy for D. Blazer (AA)
Bryan Plumlee, VA (GA)
Sen. Monty Mason, VA (LA)
Pat Geer, VA, proxy for S. Bowman (AA)
Mike Blanton, NC, proxy for Rep. Steinburg (LA)
Chris Batsavage, NC, proxy for S. Murphey (AA)
Sen. Ronnie Cromer, SC (LA)
Robert Boyles, SC (AA)
Spud Woodward, GA (GA)
Doug Haymans, GA (AA)
Rep. Thad Altman, FL (LA)
Jim Estes, FL, proxy for J. McCawley (AA)
Chris Wright, NMFS
Mike Millard, USFWS
Martin Gary, PRFC

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Rene Cloutier, Law Enforcement Representative

Staff

Bob Beal
Toni Kerns
Kirby Rootes-Murdy
Jessica Kuesel
Kristen Anstead

Guests

Laura Noguchi, USFWS
Thomas Leuteritz, USFWS/DSA
Deborah Hahn, Assn. of Fish and Wildlife Agencies

The American Eel Management Board of the Atlantic States Marine Fisheries Commission convened in the Terrace Ballroom of the Roosevelt Hotel, New York, New York; Monday, October 22, 2018, and was called to order at 3:55 o'clock p.m. by Chairman Martin Gary.

CALL TO ORDER

CHAIRMAN MARTIN GARY: Welcome to the Annual Meeting, 2018. My name is Marty Gary; I'm with Potomac River Fisheries Commission, I am your Board Chair. Lynn Fegley from the state of Maryland is our Vice-Chair for this Board; and also to complete the introductions. Seated to my left is Thomas Leuteritz; Chief Branch of Conservation Science Policy for the U.S. Fish and Wildlife Service, and to my right is Laura Noguchi, Chief of Wildlife Trade and Conservation Branch, also with the U.S. Fish and Wildlife Service.

To my left is Major Rene Cloutier; he is our liaison for Law Enforcement for this species board. Also to my right we have Kristen Anstead; who is the Stock Assessment Scientist assigned to this species, and also Kirby Rootes-Murdy, Senior Fishery Management Plan Coordinator. The last introduction is we have one new Board member; scanning the roster, Mr. William Hyatt, for the state of Connecticut. Mr. Hyatt, announce yourself; thank you and welcome.

APPROVAL OF AGENDA

CHAIRMAN GARY: All that having been said we have the first item of our agenda is the approval of the agenda. Are there any additions or modifications to the agenda as presented? Seeing none; the agenda is approved.

APPROVAL OF PROCEEDINGS

CHAIRMAN GARY: Our next item on the agenda is the approval of the proceedings from August, 2018. Are there any modifications to those proceedings as presented? Seeing none; the approval of the meeting minutes from the August, 2018 meeting are approved.

PUBLIC COMMENT

CHAIRMAN GARY: I've been told there has not been anyone to sign up for public comment; but I'll put it out there again. Does anyone from the public like to make comment on items that are not on the agenda? Seeing none; we have no public comment, and we'll move on to our next step in the agenda.

PRESENTATION ON CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES WORKSHOP AND DISCUSS NEXT STEPS

CHAIRMAN GARY: We have a presentation; co-presented by Thomas Leuteritz and Laura Noguchi.

This is for the Convention of International Trade and Endangered Species of Flora and Fauna. After Thomas and Laura make their presentation, we'll have a brief verbal update by Ms. Deb Hahn from the Association of Fish and Wildlife Agencies; which will be followed by question and answers. Laura and Thomas, are you all ready for yours?

MS. LAURA NOGUCHI: We are ready. Good afternoon; we are happy to be here. This is going to be a pretty quick CITES 101; is what we've been asked to give. I will try to run through it fairly quickly; and then hopefully time for questions at the end. What is CITES; the Convention on International Trade and Endangered Species of Wild Fauna and Flora? This is a treaty; an agreement among nations on regulation of international wildlife trade. It establishes a legal framework that countries around the world recognize. The purpose of CITES is to ensure that international trade in wild fauna and flora is legal and sustainable. This is the point where I say; CITES is not the ESA, and the ESA is not CITES.

CITES is focused on trade; and species that are impacted by trade. Quickly how CITES works; regulates the import/export introduction from the sea that's species taken on the high seas and brought into a country, of live and dead animals and plants and their parts and derivatives, those that are listed.

International trade is regulated through a system of permits and certificates that have to be presented when entering or leaving a country. Those permits and certificates can only be issued when certain conditions have been met. Basically, the framework species are listed in one of three CITES appendixes. Appendix 1, the most restrictive, these are species that are threatened with extinction.

For the most part commercial trade is prohibited in Appendix 1 species. Appendix 2, not necessarily threatened with extinction; but they may become so if they're not regulated. To add a species to CITES Appendix 1 or Appendix 2, requires a two-thirds majority vote of parties present at a CITES meeting of the Conference of the Parties.

Appendix 3, this is a unilateral decision by a country to add something to this appendix. It does not need a vote; it can be done at any time by any country. Just a little more detail about, I probably have already run through this; Appendix 1, threatened with extinction, about 1,000 species listed on Appendix 1, this is pandas, tigers, pangolins, critically endangered species.

Requires both an export permit to be issued by the exporting country, and an import permit to be issued by the importing country, and there are findings required on both sides. CITES Appendix 2, this is where most species are listed under CITES; 30,000, way more than the other two, and trade is allowed, commercial trade is allowed, but it is regulated.

It requires an export permit only; issued by the country of export. There is no requirement for an import permit under the treaty. The European Union has a stricter domestic measure where they do require import permits for CITES Appendix 2; but that again is a stricter measure on their part. Appendix 3 is really focused on legal trade; as opposed to non-detrimental trade.

There is no non-detriment finding required; it's really the purpose is to be able to ensure that trade is legal, specimens have been legally acquired and the trade is being conducted in a legal manner. At just a very basic minimum, all CITES parties once you sign onto the treaty ratify the treaty; you are required to designate at least one management authority and one scientific authority.

The management authority is empowered to issue permits and communicate with the Secretariat and with other parties on your behalf; you as a party. The scientific authority, among other things, advises the management authority about whether or not trade will be detrimental to the survival of the species. The other basic requirement is you have to be able to prohibit trade in violation of the convention. These two key findings that I have mentioned that have to be made before you can issue an export permit. When something is listed on Appendix 2, before the United States or any other CITES party can issue an export permit, we have to be able to determine; the management authority needs to be able to determine that the specimen to be exported was legally acquired.

We also need to have advice from the scientific authority – Thomas works in our scientific authority – that the export of those specimens will not be detrimental to the survival of the species. The management authority cannot issue a permit until those two findings have been made.

Effective implementation requires a permitting system; an effective permitting system, control at the borders, national control of import and export, and measures in place, laws, regulations to stop international trade, a presence at the border, be able to confiscate specimens and penalize that type of illegal trade.

Common misconceptions, CITES deals only with international trade in species that are listed in the appendices; it doesn't cover all aspects of CITES conservation. It doesn't ban trade; it regulates trade. It does not regulate domestic trade. Again, not a listing of the world's endangered species; it's only those species that are or may be affected by international trade are listed on the CITES appendices.

Just quickly, CITES implementation in the United States. It's the Endangered Species Act; even though I just said the ESA is not CITES and CITES is not the ESA, it's the Endangered Species Act that authorizes the Secretary of the Interior and through the Fish and Wildlife Service to be the management authority and the scientific authority for CITES.

Our regulations, our CITES implementing regulations, are based on the Convention; the text of the Convention, and current resolutions that have been adopted by the parties at meetings of the Conference of the Parties. Our regulations, should you want to look at them, are at 50CFR Part 23. They're available online; you can get on the ECFR, Title 50, Part 23, they're all right there.

In the United States we have one management authority and one scientific authority. Other countries, many other countries, have many. They will have a management authority for timber, for sturgeon, for whatever, plants, terrestrial species; in the U.S. one management authority, one scientific authority.

The most important point here is that the findings of the scientific authority cannot be disregarded by the management authority. Permits have to be denied if the scientific authority findings are negative. In the U.S. we also have a broad collaborative consultative process to implement CITES.

This is a graphic showing our CITES Interagency Coordination Committee. Fish and Wildlife Service at the center; because we are the ones who are tasked with implementing the treaty, and you also see that APHIS, the Animal and Plant Health Inspection Service, and Customs and Border Protection are also in red up there, because they have authority to enforce CITES at the borders for plants. Fish and Wildlife Service enforces for animals; CDP and APHIS for plants. But all of these other agencies are involved to one degree or another. We work really closely with the National Marine Fisheries Service; obviously for marine species. The U.S. Trade Representative, our Office of the Solicitor, the Forrest Service, Department of Justice, Department of State, our International Affairs Program in the Department, and also the states, through AFWA, are integrally involved in our process.

The CCC, this is the consultative body that we have, meets on a regular basis. The purpose is to connect the Service with other agencies, other federal agencies that have a nexus to CITES through their work. We try to make sure that they are aware of what's going on in CITES; and we are aware of what they're doing that may impact CITES or CITES decisions.

The idea is to provide an opportunity for other federal agencies and for the states through AFWA, to participate in the decision making process. We use this as a framework for developing U.S. negotiating positions for CITES meetings; and our decision making leading up to that. Coming up in May of 2019, is the next meeting of The Conference of the Parties.

This will be where all the parties, most of the parties, are present. The purpose is to review implementation; what's going right, what's going wrong, resolve policy issues, and amend those Appendix 1 and Appendix 2. There will be proposals to amend both of those; they will be decided up at the COP. It's an opportunity to work together; to ensure that trade is carried out in accordance with the treaty.

Just a little bit about the benefits of CITES. It establishes a legal framework to regulate international trade; to prevent overexploitation, and it does promote cooperation between importing and exporting countries. Within countries, it's an opportunity to work with other agencies that may be involved in the trade or with the trade; National Marine Fisheries Service for example, Forrest Service, et cetera.

It does encourage analysis of population status of native species, species in trade, and the effects of international trade on wild populations. I do just want to mention briefly our public process that we have. It's very much a public process; as we get ready for a meeting of The Conference of the Parties.

As I said, the next one is coming up in May. I think we published our first Federal Register Notice asking for input over a year ago. I'm looking at Thomas, he probably knows exactly. You may or may not know that we received recommendations to list; to take a proposal to list American eel in Appendix 2, from the Wildlife Conservation Society and the Species Survival Network, I believe.

We have analyzed the recommendations that we got; and we have just last month, or the first part of this month, perhaps published another Federal Register Notice to alert the public that we have taken all their suggestions into consideration, and we have ranked them all as likely to take forward, unlikely to take forward, or undecided. We published a Federal Register Notice that says that we are unlikely to take a proposal forward to list the American eel in Appendix 2. That is a decision that ultimately will be made by people at a higher pay grade than Thomas and me. It goes up into the Department, up to the Assistant Secretary level probably. But we have no indication at this point that there is any interest in taking an Appendix 2 proposal forward for American eel. That's a really quick run through of how CITES works; and happy to take any questions.

UPDATE FROM THE OCTOBER CITES MEETING

CHAIRMAN GARY: Thank you, Laura. Before we take questions from the Board; I would like to invite to the speaker's podium Ms. Deb Hahn from the Association of Fish and Wildlife Agencies. Deb, you're there, and Deb has an update from the October CITES meeting. Deb.

MS. DEBORAH HAHN: Yes, thank you Marty, I appreciate it. Thank you for a few minutes. I do work for the Association of Fish and Wildlife Agencies; and just quickly for those that don't know, the 50 state Fish and Wildlife Agencies are members of ours. Some of those agencies include the Marine Agencies, some do not.

I also work with four regional state agency representatives in the northeast; it's Rick Jacobson from Connecticut, and in the southeast it's Buddy Baker from Louisiana. What we do is we attend CITES meetings. We work closely with Fish and Wildlife Service; and we communicate with Marty and Kirby and Bob about kind of what is going on with American eel, and what actions may or may not be taken through CITES.

I'm just going to follow up with Laura, and say that this year at the 2018, July Animals Committee Meeting; they did pass a set of draft recommendations that will be considered at the May and June Conference of the Parties in 2019 that Laura mentioned. I believe those were in your agenda; but just to give you a flavor of what those draft recommendations are.

They talk about collaborating and cooperating with other range states on shared stocks. They talk about establishing monitoring programs and developing abundance indices, improving traceability for Anguilla species. They talk about implementing conservation and management measures and related legislation; realizing that this is for all non-CITES listed Anguilla eel species, including the American eel.

Then the last one is that they ask the parties to report on progress at the 32nd Animals Committee, which will be held in 2021. If these recommendations are passed in May of '19, then the U.S. Fish and Wildlife Service, Laura and Thomas, will be required to report back on how we in the U.S. have taken these recommendations forward.

The other thing at our October CITES meeting, we learned that the European Union is highly unlikely to also bring a proposal forward to list American eel in Appendix 2; and to our knowledge there are no other parties that are considering bringing a proposal forward for American eel for The Conference of the Parties in 2019.

We also had a side conversation with some of our Canadian colleagues about their interest in discussing how we might increase communication and collaboration on our shared stocks; based on those draft recommendations I mentioned earlier. Then the last thing that was raised was that the International Union for the Conservation of Nature, or IUCN, their Anguillaed Eel Specialist Group is going to assess 16 species of eel starting in November of this year. The intent is to present an updated red list assessment in 2019 for those 16 species of eel; which includes American eel. With all that said, and understanding kind of where the CITES parties are right now; that we do not believe, very unlikely there would be a listing proposal brought forward in May.

I think the opportunity for the Eel Board to discuss is your ability to position yourself to address some of those draft recommendations in 2021; if they are approved. Then also, to be prepared to address any potential future listing proposals that would come forward for the 2022 Conference of the Parties of CITES.

CHAIRMAN GARY: Thank you, Deb. Before we open it up to questions for Thomas, Laura, or Deb, just a couple of observations, I think we heard pretty clearly that either from domestically or from the European Union Parties, the possibility of a proposal for Appendix 2 listing, it's pretty remote. We can have some dialogue in the very narrow amount of time we have before our hard stop at five o'clock; and talk about maybe what we want to do related to Appendix 2.

Maybe the better course of action might be to talk as Deb was saying, about where we position ourselves through communication, collaboration, and then ultimately perhaps talk about the data that's going to be generated as part of the stock assessment process. As I understand it, now I'll lean to Kristen to confirm or deny, but I don't see the American eel listed on the schedule for a benchmark update. That's something maybe that we want to consider adjusting; Kristen.

DR. KRISTEN ANSTEAD: Currently the stock assessment schedule goes through 2021; as developed by AFC and approved by the Policy Board. American eel is not on it right now. I will remind you we did a benchmark in 2012; and an update to that benchmark in 2017. Theoretically, based on that time scale, we would think about doing a benchmark in 2022. But that's obviously the will of the Board.

If you wanted to get ahead of some of these other deadlines, if you are interested in moving forward with that that would be something that we would discuss with ASC and the American eel TC about data availability and staff time, and then it would go in front of the Policy Board. But currently through 2021, America eel is not on the stock assessment schedule.

CHAIRMAN GARY: Thank you, Kristen, for that clarification. I'll turn to the Board now to see where you would like to go forward with this discussion. Again, we have our two presenters and we have Deb from American Fish and Wildlife Association; and feel free to ask them questions.

But again, I think we should probably reserve some time to determine whether or not we want to look at the assessment schedule for eels; to better position ourselves in advance of what Deb was explaining to us, in terms of the timeline, as the process for CITES moves forward. I'll open it up to the Board now for questions. John.

MR. JOHN CLARK: Just a process question. It was said that the European Union was unlikely to move ahead also with an Appendix 2 listing. Does this mean that any country can ask for a species that doesn't occur in that country to be listed? In our situation with the American eel spanning several countries, do all the countries where the species occurs have to agree to a listing?

MS. NOGUCHI: It's a great question. Any country, any CITES party can bring a listing proposal. It is much more difficult to do it if you are not a range country. It has happened; but it is much more difficult. CITES parties are required when they bring a listing proposal to consult with other range countries.

This is part of the reason we are so confident that the eel in particular is not going to bring a listing proposal. The deadline for submission of proposals is December 24 of this year; and they have not consulted with us. They have consulted with us on other species listing proposals that they're thinking of bringing forward; but not this one.

The way it would play out at a CITES meeting, always they try to achieve consensus. However, there is voting in CITES, where there isn't consensus there will be a vote. It's quite possible that you will not support a listing that comes into effect; and then you as a CITES party, figure out how to implement it.

CHAIRMAN GARY: Thank you, Laura, for the clarification on the shorter timeline. There is a deadline of December 24, as Laura noted; other questions? Lynn.

MS. LYNN FEGLEY: I just had a curiosity question. In the United States, and I expect that sharks are among this number. Are there other marine commercial fished species that are CITES listed, and does anyone know what the impacts of an Appendix 2 CITES listing are on a commercial fishery? I'm just kind of curious. Our constituents tend to ask that question; and I don't know how to answer it.

MS. NOGUCHI: That's another great question; and Thomas might have some comments here as well. There are sharks listed that are commercially exploited for their fins mostly. We have non-detriment findings in place for those; hammerhead sharks in particular. We have been issuing export permits. I don't believe that this has been a particular burden on the industry. It's a learning process right, going from no regulation to having to go through the process; but I feel like we are moving forward pretty well with that. Thomas, do you have any?

MR. THOMAS LEUTERITZ: Of course NOAA is heavily involved with that process; so there is expertise coming in those decisions from there.

MS. NOGUCHI: When we make a non-detriment finding, and Thomas, it's his group that does, for the sharks in particular. If they can demonstrate that they have taken those sharks in accordance with the management plan that NMFS has in place; then that works for non-detriment.

CHAIRMAN GARY: Pat.

MR. PATRICK C. KELIHER: Thank you for the presentation; it was very helpful. I'm happy to hear that you don't have any requests for listings. In the state of Maine, obviously we became aware of this issue; as far as the exportation of elvers, a very valuable fishery to the state of Maine, one that we have invested a tremendous amount of time and energy, both from a science, but also for an enforcement standpoint.

A couple points, you had a graph up there that showed CITES and all of your partners around the outside; and it said the states. I'm assuming your interaction with the states is solely through AFWA, is that correct?

MS. NOGUCHI: That's partially correct. In cases where we have species that are listed, paddlefish is a pretty good example, so all sturgeon, all Acipenseriformes are listed under CITES Paddlefish are Appendix 2. There is a fair amount of Paddlefish caviar; and we work directly with the state DNRs, to make a legal acquisition finding in particular. We will go to each individual state.

We need to know what laws they have in place. When we get an application to export, we want to know where was it taken, when was it taken, and we will consult with the state to make sure they have the proper permits, they were fishing in the proper place, their logbooks were up to date that kind of thing. We will work directly with the state governments as well.

CHAIRMAN GARY: Follow up, Pat.

MR. KELIHER: Thank you for that. This is no disrespect to AFWA; because I have complete respect for the organization and the work that you do. But the state of Maine's Department of Resource is not a member of AFWA; and I think it's very important for the Atlantic States Marine Fisheries Commission to be part of that circle, when it comes to sturgeon, eels, and other very valuable species.

The issue around elvers is all about export. We had some issues in the state of Maine regarding what we thought was a fail-proof system of a swipe card; to control chain of custody. People got around it. By going around it that tells us the next weak link is at the airport; with U.S. Fish and Wildlife Service inspections.

Mr. Chairman, at some point I would like to make a recommendation to this Board to send a letter to the U.S. Fish and Wildlife Service; to express our concern about exports in general, as it pertains to elvers. If the U.S. Fish and Wildlife Service is unwilling to inspect a load of eels; other than looking at the paperwork, we have a very weak link.

Major Cloutier could speak to this all night long. If we can't get the U.S. Fish and Wildlife Service to open packages to verify the weight; then there is a breakdown in the system for that export. I think that's going to be very important for all the parties; the state of Maine, ASMFC, AFWA, working with CITES and the U.S. Fish and Wildlife Service, to kind of fix that last bottleneck in the process of exporting live elvers overseas.

MS. NOGUCHI: Just quickly, thank you for that comment. I can't really speak for the Office of Law Enforcement; but I do know that they are very actively engaged in illegal trade in eels, both here in the U.S. and also globally. It's a major global issue. As a matter of fact they offered that they would come, and they would be happy to come and give a briefing on some of the investigations that they have undertaken.

The issue of inspections at the ports, I know that this is a difficult issue. We only have so many inspectors; and it's impossible to inspect everything, right. But targeted inspections and targeted operations definitely can happen. I will certainly take your comments back. But I know that this is something that our Office of Law Enforcement is very focused on now.

CHAIRMAN GARY: Pat, we'll come back to that as an action item and revisit that before the meeting. Senator Watters.

SENATOR DAVID H. WATTERS: Just a comment on an earlier question; and perhaps Laura will correct me, but I do believe sea turtles are included as a CITES species. I did want to mention to my fellow legislators and legislative proxies here, aside from the immediate question of eels, in reference to CITES that I passed wildlife trafficking legislation this year; Senate Bill 451.

While CITES deals with international importation and the federal government deals with interstate. If you want to deal with intrastate possession and sale of CITES listed endangered species, you have to pass the state statute on it. We did a list of about 15 species; yes, Ivory is heavy orientation for that.

We didn't do sea turtles because that wasn't a fishery that we're involved in New Hampshire. But I do encourage you all to take a look at what you might need to do within your state statute, to make sure that loophole in CITES and in controlling this trade of endangered species, including some marine species, is not occurring in your states.

CHAIRMAN GARY: Any other questions? Cheri.

MS. CHERI PATTERSON: I just had a question on if CITES designates American eel under Appendix 2 species; what is the timing involved in complying with any restrictions that might come of that?

MS. NOGUCHI: Listing proposals that are adopted at a Conference of the Parties go into effect 90 days after the close of that meeting of the Conference of the Parties. Sometimes there is a delayed implementation. There was for the sharks, in particular. This was a group of species that had not been regulated before.

There was a feeling that parties needed time to get up to speed on how they were going to do it. But I would imagine with something like eel, because there are already eels in trade, it would probably be the standard is 90 days after the close of the meeting.

CHAIRMAN GARY: Are there any other questions? John Clark.

MR. CLARK: Thanks to your reminders earlier about this issue. Kirby, if you could just review, the FMP in 2000, one of the recommendations was to have American eel listed under Appendix 3 of CITES; and that didn't happen. I was just wondering if you could review how the whole process evolved back then.

MR. KIRBY ROOTES-MURDY: I can speak to what I've communicated to you, John, which is that in the FMP that was passed back in 1999, and came into effect in 2000. There was a recommendation to have American eel listed under Appendix 3. My understanding is that recommendation that was put in the FMP was made on behalf of Fish and Wildlife Service.

Going back through the proceedings to try to see where that landed; there was a note in June of 2000 that Fish and Wildlife was going to move forward with a proposed rule regarding that. But I don't have any other additional information after that. It did not come up in a subsequent proceeding of the Board over the next year or two; specific to an Appendix 3 listing.

MR. CLARK: In that case can the Fish and Wildlife Service, do you know what happened, Laura?

MS. NOGUCHI: I don't actually know the details of that. It's been proposed to use both to list it under the ESA, at least twice. I know there have been 90 day findings and however many year findings; and they've never gone forward with it, and also the Appendix 3 listing. I do not know why we didn't go forward.

If people feel that that is a way that they would like to go, the advantage of it of Appendix 3 is that you can list something or delist it as you wish at any time as a party; but also because it gets directly at the illegal trade. It can help states that have laws in place to implement and enforce those laws; so that is really the benefit of Appendix 3.

CHAIRMAN GARY: Other questions. All right, thank you to Thomas, Laura, and Deb for your presentations today. I think the next question before the Board is; given the fact that we have a situation where it's highly unlikely that a proposal is going to come forward. Does the Board want to take a position?

If so, I would like to hear that feedback now. If not, the next course of action I think is probably to look at where we position ourselves going forward in the CITES process; and potentially look at the stock assessment schedule for American eel. Is there a desire on the Board to take a position on this Appendix 2; in advance of this May meeting coming up? Pat.

MR. KELIHER: I would recommend that we do not take a position in advance of the upcoming meetings; but request that staff, i.e. Kirby, keep a close eye on this and report to the Board as new information comes forward.

CHAIRMAN GARY: I have Lynn and then Cheri.

MS. FEGLEY: Just one quick clarifying question to follow up on Pat's comment. Can these proposals be life stage specific, or is it for the species as a whole?

MS. NOGUCHI: That's another really good question. For Appendix 1 and Appendix 2 it is the entire species; it's all parts and products. Appendix 3 is a little bit different. I don't know about animals, for plants. Plants are also different; you can specify certain parts and products. Animals, it's the whole thing, yes.

CHAIRMAN GARY: Cheri Patterson.

MS. PATTERSON: I think I got this answer from Bob; but for the benefit of the rest of the table here. How long would it take to conduct a stock assessment for American eel?

DR. ANSTEAD: For a benchmark, if it were to be done due in 2021, I would like to get the process started in 2019. It's nice to have two years to start requesting the data; to start getting everybody's schedules aligned. That is not necessarily how long all the work would take; but I think 2019 would be a good notice for our TC members and our data providers to kind of get on the same page with deadlines and work.

CHAIRMAN GARY: Other questions? There is no objection to Pat's comment, then that's the direction we'll take with the Board. At this point, before I come back to Pat's other suggestion; to address the timing of the eel assessment, the stock assessment benchmark. Is there a desire from the Board to proceed to advance the time table; as Kristen just suggested? Lynn.

MS. FEGLEY: I guess I'm wondering, do we have any new information; if we were to start in 2019 to complete an assessment in 2021. Is there any new information that would allow a better assessment? I shouldn't say better, but an assessment that allows us to define whether or not we're overfishing or overfished; and if we don't have that new information is it likely to really be helpful in this sort of case?

DR. ANSTEAD: Yes, I think that's a really good question, and I think that is one that would ideally be posed to the TC or the SAS. I know when we were approaching the update timeline, which was done in 2017, we did ask the TC. You know these research recommendations that you flagged during the benchmark that said should be completed before a next benchmark, has enough work been done?

Ultimately the TC said no. But let's do an update to stay on it. I think we would have to have a similar conversation; but the terminal year of the last benchmark was 2010. There is potential for some new data, maybe some new modeling approaches. But that is really a conversation for the full TC and SAS to have.

CHAIRMAN GARY: Senator Watters.

SENATOR WATTERS: I think that some of the questions that are raised suggest the logic of trying to move forward on the assessment. There is so much we don't know about eels; and also we are going to have to be facing whether climate change is going to have any impacts on their spawning and their habitat. If there is some movement at CITES, if we don't have a stock assessment to anticipate that we won't have the information to argue whether or whether not it is indeed necessary for a listing of endangered, and for us to take a position on that.

CHAIRMAN GARY: Any other further discussion? Put it out to the Board this way, perhaps. Following Kristen comments, is there any opposition to having that dialogue with the Technical Committee and coming back to the Board at a future meeting? Hearing none; perhaps that's the direction that we will go. Now

I'm going to come back and revisit Pat Keliher's comments about advancing a letter. Pat, if you could clarify that for us again.

MR. KELIHER: Laura's comments in regards to the Office of Enforcement with U.S. Fish and Wildlife Service are very accurate. They've done a lot of work with eels; at least that I know of what they've done domestically. Abroad I'm not sure; but I'm certain it's very active. We meet with Northeast Officers on an annual basis; Marine Patrol is very active with them about their cases.

I think potentially having the Board send a letter to the Office of Law Enforcement, expressing our gratitude for the work that they've done; and request their possibly expanded involvement when it comes to importation of eels, working directly with ASMFC Law Enforcement Committee in particular.

I'm not sure if we would go as far as referencing Maine Marine Patrol; but I do know that based on the work that we're going to do this legislative session, where we will have a bill in place to require every exported shipment be inspected by a Maine Marine Patrol Officer during weigh up. Because we will have exactly what is being shipped out of the state of Maine; and it could then be re-reviewed and inspected at the airport again by inspection agents.

I think it's kind of the missing link; because if they are using those shipments to then add to. It's one thing if they're putting them in boxes and shipping them out and saying they're guppies. We don't have any control. But to ensure that this legal activity is not infiltrated with illegal eels; is very important. I think some sort of a letter stating that to the Office of Law Enforcement; and asking for cooperation and giving our cooperation in return, would be prudent at this time.

CHAIRMAN GARY: Before we make a final decision on that Dan.

MR. DAN McKIERNAN: Just a question for Pat. Pat, what airports are we talking about?

MR. KELIHER: J.F.K. is the big shipping airport; but I know some shipments have gone out of Boston as well and possibly even Newark.

CHAIRMAN GARY: Is there any objection to Pat's suggestion of sending a letter from the Board? Hearing none; then we'll proceed with that. We'll work with staff to do such. Laura would like to make a comment.

MS. NOGUCHI: I just appreciate your comments; and I want to say that in addition to a stock assessment and having that understanding of the health of the population. Getting the illegal trade under control is a really big piece. I appreciate that you recognize that. I did read your minutes from the August, 2018 meeting before I came here; and I understand the problems, at least partially the problems that you're facing. But in terms of staving off a CITES listing; getting the illegal trade under control is really key.

REVIEW AND POPULATION OF THE ADVISORY PANEL

CHAIRMAN GARY: The next item on our agenda is the Review and Population of the Advisory Panel; and Tina, you'll be handling that.

MS. TINA BERGER: Good afternoon, thank you. I would present for your consideration and approval Richard Stoughton, commercial fyke net fisherman from South Carolina, and Lawrence Voss, a commercial potter out of Delaware, to add to the American Eel Advisory Panel, thank you.

CHAIRMAN GARY: Robert.

MR. ROBERT H. BOYLES, JR.: I would move that we accept those appointments as presented.

CHAIRMAN GARY: Seconded by John Clark**. Is there any opposition to these AP nominations? Seeing none; passed.**

ADJOURNMENT

CHAIRMAN GARY: That brings us up to our last item on the agenda, Other Business, and is there any other business to bring before this Board today? Seeing none; the American Eel Management Board is adjourned.

(Whereupon the meeting adjourned at 4:40 o'clock p.m. on October 22, 2018)

State of Maine Aquaculture Plan for American Eel Pursuant to Addendum IV to the ASMFC Interstate Fishery Management Plan

Maine Department of Marine Resources
32 Blossom Lane
Augusta, ME 04330

MAY 2019

Photo By American Unagi, LLC

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Background

The Maine Department of Marine Resources (MDMR) supports the development of domestic aquaculture in Maine. With Maine's existing fishery management measures and eel management infrastructure the state is in a good place to implement a domestic aquaculture quota into its current management plan. Connecting Maine's fishery to a domestic aquaculture provides year-round jobs directly in eel grow-out, supports indirect jobs throughout the local seafood and marine-related industries, and produces an eel product grown under the high standards of US aquaculture production.

The MDMR solicited interested parties to participate in this quota request and has selected to work with American Unagi for 2019. Over the course of the last four years, American Unagi has utilized recirculating aquaculture system (RAS) technology, specifically using designs developed and successfully utilized for eels in Europe. This has allowed the company to grow high-value American eels in a controlled environment, certify sustainability and source, and provide a level of product supply to growing customer segments that prefer locally grown/sourced and fully traceable seafood products. Given the success of the last four years of pilot production, American Unagi is scaling production to 240 MT and is requesting a domestic aquaculture quota for the commercial facility.

In October 2014, the ASMFC adopted Addendum IV to the Interstate Fishery Management Plan for American Eel. Addendum IV implemented a provision allowing states and jurisdictions to submit an Aquaculture Plan to allow for the limited harvest of American eel glass eels (hereinafter "glass eels") for use in domestic aquaculture facilities. Specifically, Addendum IV states: "Under an approved Aquaculture Plan, states and jurisdictions may harvest a maximum of 200 pounds of glass eel annually from within their waters for use in domestic aquaculture facilities provided the state can objectively show the harvest will occur from a watershed that minimally contributes to the spawning stock of American eel. The request shall include: pounds requested; location, method, and dates of harvest; duration of requested harvest; prior approval of any applicable permits; description of the facility, including the capacity of the facility the glass eels will be held, and husbandry methods; description of the markets the eels will be distributed to; monitoring program to ensure harvest is not exceeded; and adequate enforcement capabilities and penalties for violations." Pursuant to Addendum IV to the Interstate Fishery Management Plan for American Eel, the MDMR is submitting the following Aquaculture Plan for approval. While only one aquaculture operation, American Unagi, has requested to be included in the Aquaculture Plan for consideration, future plans may consider additional operations.

Pound Requested

American Unagi is requesting 200 pounds for the 2020 fishing year.

Location of Harvest

The Aquaculture Plan proposal requirements have been modified based on the following criteria (as recommended by the Technical Committee):

> States and jurisdictions may develop a Plan for aquaculture purposes. Under an approved Aquaculture Plan, states and jurisdictions may harvest a maximum of 200 pounds of glass eels annually from within their waters for use in domestic aquaculture facilities. Site selection for harvest will be an important consideration for applicants and reviewers. Suitable harvest locations will be evaluated with a preference to locations that have:
> (1) established or proposed glass eel monitoring,
> (2) are favorable to law enforcement and
> (3) watershed characteristics that are prone to relatively high mortality rates.

Watersheds known to have features (ex. impassible dams, limited area of upstream habitat, limited water quality of upstream habitat, and hydropower mortality) that would be expected to cause lower eel productivity and/or higher glass eel mortality will be preferred targets for glass eel harvest. This is not an exclusive requirement, because there will be coastal regions with interest in eel aquaculture where preferred watershed features do not occur or are not easily demonstrated. In all cases, the applicant should demonstrate the above three interests were prioritized and considered.

American Unagi is planning to source the glass eels from several regions in Maine's watersheds to limit the impacts to individual river systems and be consistent with the statewide approach of the exiting fishery. In addition to data for regulatory measures, having full traceability and accountability of the facility's eels is important to the company's end market so the fishermen, volume, and harvest location will be identified for all eels entering the facility.

In 2019, American Unagi obtained glass eels from the Medomak River, Pemaquid River, Megunticook Stream, and Somes Pond outlet. None of these sites have established or proposed glass eel monitoring. The only glass eel monitoring in Maine occurs at West Harbor Pond, where the eel life cycle study is occurring. Removing glass eels from that site would compromise Maine's required study. The four sites listed are commonly fished for glass eels, and are routinely monitored by Marine Patrol Officers. Megunticook Stream has a steep gradient and multiple dams without upstream or downstream passage and Somes Pond is small. These two location would likely not produce a large number of adult eels.

Rates of Harvest

Aquaculture harvest will be limited to the current glass eel fishing season per State of Maine. By law, the elver season occurs between March 22 and June 7 (Appendix A; 12 M.R.S.A. §6575).

Methods of Harvest

A licensed harvester will be required to fish for all eels used for domestic aquaculture. License are issued by the Department of Marine Resources (Appendix A; 12 M.R.S.A. §6505-A, and §6302-A). For the aquaculture quota, one or more individuals will be issued a specialty aquaculture fishing allowance by MDMR Commissioner that permits the harvester to harvest glass eels for aquaculture purposes beyond the limits of their personal harvest quotas.

Glass eels shall be harvested only by dip net or elver fyke net, with size and construction being in compliance with current Maine law (Appendix A; 12 M.R.S.A. §6001). A license issued under this section must identify the number and types of nets that the license holder may use (Appendix A; 12 M.R.S.A. §6505-A). Elver fyke nets must display a tag issued by the Department when they are submerged (Appendix A; 12 M.R.S.A. §6505-B)

Additional harvest measures include a prohibition on fishing in the middle third of any waterway, within 150 feet of a fishway or a dam with a fishway, and specific area closures where fishing for elvers is prohibited (Appendix A; 12 M.R.S.A. §6575-B; §6575-C; §6575-F; §6575-G).

Finally, no person may fish for, take, possess or transport pigmented eels. All catches shall be screened and graded immediately upon harvest, whereas all eels failing to pass through 1/8” bar mesh net, as well as all bycatch will be returned to the water.

Monitoring Program

The Maine glass eel fishery has been managed under a Total Allowable Catch (TAC) established by the Atlantic States Marine Fisheries Commission (ASMFC) since 2014. In 2014, the TAC was 11,749 lbs, which was determined by calculating a 35% reduction from the 2013 Maine landings of elvers. The TAC was subsequently dropped to 9,688 lbs for the 2015-2018 seasons. This TAC was based on the actual Maine landings achieved during the 2014 season. Landings have typically approached the TAC, except for the 2015 season, when poor weather prevented fishermen from filling their quotas. By law, 21.9% of the annual TAC is allocated to the four federally recognized Indian Tribes in the state.

Concurrent with the implementation of the TAC, Maine implemented an individual quota system for state license holders, calculated based on harvester reported landings during the 2011, 2012, and 2013 seasons. The individual quota system is monitored through the use of a “swipe” card.

The swipe card system was created in 2013 to enable Maine to monitor the elver quota. The system was designed to allow dealers to enter data daily and allow MEDMR staff to quickly analyze that data within 24 hours of receipt. Additionally, the swipe card system was developed as the mechanism to monitor the individual fishing quota of harvesters.

Swipe cards are issued annually to each elver license by a Marine Patrol Officer. At that time, the license holder signs an acknowledgement form that indicates their understanding of their individual quota and the penalties associated with exceeding their quota. Harvester sales are checked daily against their quota, and when the harvester's quota is reached or exceeded, the swipe card is deactivated by MEDMR Landings Program staff.

Each elver dealer has a swipe card reader for the permanent facility, as well as all vehicles used to transport elvers. Dealers are required to submit swipe card transaction reports (including negative reports) by 2 p.m. for each day of the elver season (March 22nd to June 7th). If dealers are delinquent with two days' worth of reports the swipe card system will not allow dealers to purchase elvers from harvesters until they submit all outstanding reports or create a negative report for the missing days. A dealer to dealer program was added in 2015. The dealer to dealer program required a card swipe each time dealers moved elvers to another location or dealer. The dealer to dealer program uses the same hardware and software as the harvester to dealer system, and is also subject to daily reporting including negative reports.

For the aquaculture quota, MDMR will issue separate aquaculture account to the assigned harvesters for a total allocation of 200 pounds. When the facility is assigned its quota it will designate the licensed harvesters that will be collecting the 200lbs. The aquaculture facility will be required to hold an elver dealer permit and license its buying station, transport vehicles, and facility. The permitted aquaculture facility will be the only dealer allowed to swipe aquaculture quota cards in addition to regular individual harvester cards. The data collection on these transitions from harvester to facility will include the harvester's name, harvest site, harvest method, date, and pounds. When the 200 pound quota is achieved, cards will be deactivated.

Due to the nature of the production, the facility will also be able to provide a status report to MDMR on glass eel survival when eels are moved from glass eel intake system into production facility at approximately four months from arrival (see facility description for more details).

Penalties for Violation

Since 2012, Maine has made numerous law changes to close any remaining loopholes and create the proper penalties for elver violations. The majority of elver violations were criminalized in 2014, changing from a civil violation, to a Class D crime with a $2000 fine. At the same time, mandatory license revocations were imposed for the second violation of several elver offenses, including untagged gear, fishing out of season, or exceeding the individual fishing quota. In addition to the $2000 fine, individuals who exceed their quota are subject to a "pecuniary gain" fine, where they must pay back to the State the value of any elvers that were taken in excess of their quota. The Department is authorized to deny the renewal of the license of an individual who has failed to pay their pecuniary gain fine in its entirety prior to the following elver season.

Harvester, dealers, and aquaculture facilities may have random inspection of the facility and places of harvest conducted to ensure all rules and regulations under conditions of permit(s) are being adhered to. An aquaculture facility permit would hold to these same penalties and loss of license for violations.

Regardless of specific penalties that may be provided in law, the Commissioner also has the authority to suspend any licenses or certificates issued by the Department if a person is convicted or adjudicated in court of violating any marine resources law or regulation. In addition, the Commissioner may pursue license suspension without criminal conviction or civil adjudication through an administrative process.

Prior Approval of Permits

American Unagi was first approved to hold and grow eels by MDMR in 2014. During the course of operating the pilot facility, American Unagi has worked closely with the State regulators on permitting for its operations. The company holds the necessary permits to buy, culture, and sell American eels.

For purchasing elvers from licensed Maine harvesters, American Unagi holds a MDMR Elver dealer license that is renewed annually. Under this permit, the company has permitted a buying station, transport vehicle, and facility. For sale of grown product, the company holds a MDMR Wholesale Dealer Permit that is renewed annually. Prior to November 1st, all eel aquaculture was permitted under MDMR, but as of November 1, 2017, the state of Maine has shifted the responsibilities for permitting land-based aquaculture facilities from the Department of Marine Resources to the Department of Agriculture, Conservation, & Forestry (DACF). The DACF is underway developing interim guidance for licensing and American Unagi is currently working closely with the State during this transition.

Description of Market (s)

American Unagi has already been supplying domestic outlets for the eel produced in its pilot facility. The company is planning to expands its sale of live and further develop processed products for domestic consumption. For propriety reasons, specific details are not being provided.

Description of facilities (design, capabilities, and technical facts)

The company is building a 240MT commercial scale land-based recirculating aquaculture plant in midcoast Maine. Following the formula for success of eels and RAS, American Unagi engaged a worldwide leader in RAS design in eels to assist in assessing the feasibility of its commercial plant, develop a schematic design, provide detailed operations and equipment costs to develop the plant.

The farm consists two separate systems: a glass eel system and a grow-out system. When glass eels are brought in they will go into the glass eel system which also serves as quarantine area. This recirculated system includes 18 round tanks of 2.25 meter diameter and 100 cm deep. Every 12 minutes the water is filtered and then recycled. The outlet of the fish tank is equipped with a brushing machine, basically a cylindrical screen that is constantly brushed to prevent clogging. The brushing machine is fed with water from the bottom center of the tank, pulling up dead and dying fish and feces. Glass eels are held in this system for 1-4 months as they are acclimated to commercial aquaculture diet. Once the glass eel reach a weight of 3-5 gram they are size graded and moved into the grow-out system. This system has a two series of tanks split into “nursery” and “grow-out”. The first series of nursery tanks hold the eels from 3-

5 grams until around 20 grams. The eels are then moved to the largest series of tanks within the same systems, where they are grown to market size.

Each system has its own filtration equipment. The waste water leaving the tanks is first sieved with a drumfilter; a rotating sieve that is equipped with a sieve cloth with 36-40 micron openings. Once the screen gets clogged with solids it automatically starts a rinsing cycle, spraying the waste into a gutter that is collected and processed. From the drumfilter the water is pumped into a biofilter for the stripping of carbon dioxide and for conversion of ammonia ($NH3$) into the relatively harmless nitrate ($NO3$). The biofilter is a moving bed biological reactors (MBBR's). These are energy efficient, compact, and are more efficient in maintain heat than other biofilters. From the biofilter the water flows by gravity through a MHO oxygen reactor to add pure oxygen and then by gravity back to the fish tanks.

A monitoring /control system is used for guarding pH, temperature and oxygen. All fish tanks are equipped with water level sensors. Together with some pressure sensors these are connected to an alarm system that dials out to cell phones. Additionally, our facility is equipped with video surveillance for both security and monitoring purposes.

During the course of the aquaculture process there is some expected mortalities and the losses are anticipated in the production planning. In American Unagi's experience, the largest period of mortality occurs during weaning process after glass eels first arrive. While the company has seen as little as 1% loss, it anticipates as high as 10% loss into its production planning to accommodate for this expected mortality. Therefore to produce, 240 MT annually the company will stock up to 620 lbs of glass eels, with 200 lbs of this being secured under the domestic aquaculture permit and the remaining 420 thru the standard quota system. Each year when the glass eels are stocked into facility the first one to four months they are kept separate from previous year classes. During the this intake period the company tracks growth, survival, and numbers for the years glass eels that would be available to MDMR for review and tracking.

During the production process the eels are size graded every 6-8 weeks. Given eel is a non-domesticated species there is a very big variance between the performance of different individuals. A fast grower may reach market weight in just 6 months but other fish may still weigh a few grams after one year. As a result of the growth variation the farm population in the grow-out tanks will comprise of 2-3 year classes of eel. As part of operating a successful aquaculture facility, meticulous records of growth, survival, and biomass are a necessary part of the business so during the course of the grow-out the farm maintains records of current eels onsite. In addition to supporting the successful operation of the business, these records are also used to support that best management practices are being followed.

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Jessop, B.M. 2000. Estiamtes of population size and instream mortality rate of American eel elvers in a Nova Scotia River. Transactions of the American Fishereis Sciiety 29: 514-526.

Oliveira, K. and J.D. McCleave. 2000. Variation in population and life history traits of the American eel, Anguilla rostrate, in four rivers in Maine. Environmental Biology of Fishes 59: 141-151.

Maine Revised Statutes Title 12: Conservation

§6001. DEFINITIONS

13-F. **Elver.** "Elver" means a member of the species Anguilla rostrata in that stage of its life cycle when it is less than 6 inches in length.

[1995, c. 536, Pt. A, §1 (NEW) .]

13-G. **Elver fyke net.** "Elver fyke net" means a fyke net that is 30 feet or less in length from cod end to either wing tip, is fitted with netting that measures 1/8-inch bar mesh or less, contains a 1/2-inch or less bar mesh excluder panel that covers the entrance of the net, and consists of not more than one funnel end, one cod end and 2 wings.

[1997, c. 575, §1 (AMD) .]

13-H. **Elver dip net.** "Elver dip net" means a dip net with a hoop of not more than 30 inches in diameter and fitted with netting that measures 1/8 inch bar mesh or less.

[1999, c. 7, §1 (AMD) .]

40-A. **Sheldon eel trap.** "Sheldon eel trap" means a box trap with a netted wing 10 feet or less in length used to intercept and direct elvers into the trap.

§6302-A. TAKING OF MARINE ORGANISMS BY FEDERALLY RECOGNIZED INDIAN TRIBES

1. **Tribal exemption; commercial harvesting licenses.** A member of the Passamaquoddy Tribe, Penobscot Nation, Aroostook Band of Micmacs or Houlton Band of Maliseet Indians who is a resident of the State is not required to hold a state license or permit issued under section 6421, 6501, 6502-A, 6505-A, 6505-C, 6535, 6601, 6602, 6701, 6702, 6703, 6731, 6745, 6746, 6748, 6748-A, 6748-D, 6751, 6803, 6804 or 6808 to conduct activities authorized under the state license or permit if that member holds a valid license issued by the tribe, nation or band or the agent of the band to conduct the activities authorized under the state license or permit. A member of the Passamaquoddy Tribe, Penobscot Nation, Aroostook Band of Micmacs or Houlton Band of Maliseet Indians issued a tribal license pursuant to this subsection to conduct activities is subject to all laws and rules applicable to a person who holds a state license or permit to conduct those activities and to all the provisions of chapter 625, except that the member of the tribe, nation or band:

A. May utilize lobster traps tagged with trap tags issued by the tribe, nation or band or the agent of the band in a manner consistent with trap tags issued pursuant to section 6431-B. A member of the tribe, nation or band is not required to pay trap tag fees under section 6431-B if the tribe, nation or band or the agent of the band issues that member trap tags; [2011, c. 598, §17 (AMD).]

B. May utilize elver fishing gear tagged with elver gear tags issued by the tribe, nation or band or the agent of the band in a manner consistent with tags issued pursuant to section 6505-B. A member of the tribe, nation or band is not required to pay elver fishing gear fees under section 6505-B if the tribe, nation or band or the agent of the band issues that member elver fishing gear tags; and [2011, c. 598, §17 (AMD).]

C. Is not required to hold a state shellfish license issued under section 6601 to obtain a municipal shellfish license pursuant to section 6671. [1997, c. 708, §1 (NEW); 1997, c. 708, §3 (AFF).]

[2013, c. 254, §1 (AMD) .]

2. **Tribal exemption; sustenance or ceremonial tribal use.** Notwithstanding any other provision of law, a member of the Passamaquoddy Tribe, Penobscot Nation, Aroostook Band of Micmacs or Houlton Band of Maliseet Indians who is a resident of the State may at any time take, possess, transport and distribute:

A. Any marine organism, except lobster, for sustenance use if the tribal member holds a valid sustenance fishing license issued by the tribe, nation or band or the agent of the band. A sustenance fishing license holder who fishes for sea urchins may not harvest sea urchins out of season; [2011, c. 598, §17 (AMD).]

B. Lobsters for sustenance use, if the tribal member holds a valid sustenance lobster license issued by the tribe, nation or band or the agent of the band. The sustenance lobster license holder's traps must be tagged with sustenance use trap tags issued by the tribe, nation or band or the agent of the band in a manner consistent with trap tags issued pursuant to section 6431-B; however, a sustenance lobster license holder may not harvest lobsters for sustenance use with more than 25 traps; and [2011, c. 598, §17 (AMD).]

C. Any marine organism for noncommercial use in a tribal ceremony within the State, if the member holds a valid ceremonial tribal permit issued to the tribal member by the Joint Tribal Council of the Passamaquoddy Tribe or the governor and council at either Passamaquoddy reservation, by the Penobscot Reservation Tribal Council, by the Aroostook Band of Micmacs Tribal Council or its agent or by the Houlton Band of Maliseet Indians Tribal Council or its agent. [2013, c. 254, §2 (AMD).]

For purposes of this subsection, "sustenance use" means all noncommercial consumption or noncommercial use by any person within Passamaquoddy Indian territory, as defined in Title 30, section 6205, subsection 1, Penobscot Indian territory, as defined in Title 30, section 6205, subsection 2, Aroostook Band Trust Land, as defined in Title 30, section 7202, subsection 2, or Houlton Band Trust Land, as defined in Title 30, section 6203, subsection 2-A, or at any location within the State by a tribal member, by a tribal member's immediate family or within a tribal member's household. The term "sustenance use" does not include the sale of marine organisms.

A member of the Passamaquoddy Tribe, Penobscot Nation, Aroostook Band of Micmacs or Houlton Band of Maliseet Indians who takes a marine organism under a license or permit issued pursuant to this subsection must comply with all laws and rules applicable to a person who holds a state license or permit that authorizes the taking of that organism, except that a state law or rule that sets a season for the harvesting of a marine organism does not apply to a member of the Passamaquoddy Tribe, Penobscot Nation, Aroostook Band of Micmacs or Houlton Band of Maliseet Indians who takes a marine organism for sustenance use or for noncommercial use in a tribal ceremony. A member of the Passamaquoddy Tribe, Penobscot Nation, Aroostook Band of Micmacs or Houlton Band of Maliseet Indians issued a license or permit under this subsection is exempt from paying elver gear fees under section 6505-B or trap tag fees under section 6431-B and is not required to hold a state shellfish license issued under section 6601 to obtain a municipal shellfish license pursuant to section 6671. A member of the Passamaquoddy Tribe, Penobscot Nation, Aroostook Band of Micmacs or Houlton Band of Maliseet Indians who fishes for or takes lobster under a license or permit issued pursuant to this subsection must comply with the closed periods under section 6440.

[2013, c. 254, §2 (AMD) .]

3. Lobster, sea urchin, scallop and elver licenses; limitations. Pursuant to subsection 1:

A. The Passamaquoddy Tribe and Penobscot Nation may each issue to members of its tribe or nation, as the case may be, up to 24 commercial lobster and crab fishing licenses in any calendar year, including all licenses equivalent to Class I, Class II or Class III licenses and student licenses, but not including apprentice licenses. Licenses issued under this paragraph are subject to the eligibility requirements of section 6421, subsection 5; [2011, c. 598, §17 (AMD).]

A-1. The Aroostook Band of Micmacs or its agent may issue to members of the band up to 10 commercial lobster and crab fishing licenses in any calendar year, including all licenses equivalent to Class I, Class II or Class III licenses and student licenses, but not including apprentice licenses. Licenses issued under this paragraph are subject to the eligibility requirements of section 6421, subsection 5; [2011, c. 598, §17 (NEW).]

A-2. The Houlton Band of Maliseet Indians or its agent may issue to members of the band up to 10 commercial lobster and crab fishing licenses in any calendar year, including all licenses equivalent to Class I, Class II or Class III licenses and student licenses, but not including apprentice licenses. Licenses issued under this paragraph are subject to the eligibility requirements of section 6421, subsection 5; [2013, c. 254, §3 (NEW).]

B. The Passamaquoddy Tribe may not issue to members of the tribe more than 24 commercial licenses for the taking of sea urchins in any calendar year. Sea urchin licenses must be issued by zone in accordance with section 6749-P; [2011, c. 598, §17 (AMD).]

C. The commissioner shall adopt rules authorizing the Penobscot Nation to issue to members of the nation commercial sea urchin licenses if the commissioner determines that sea urchin resources are sufficient to permit the issuance of new licenses. The commissioner may not authorize the Penobscot Nation to issue more than 24 commercial sea urchin licenses to members of the nation in any calendar year; [2011, c. 598, §17 (AMD).]

C-1. The commissioner shall adopt rules authorizing the Aroostook Band of Micmacs or its agent to issue to members of the band commercial sea urchin licenses if the commissioner determines that sea urchin resources are sufficient to permit the issuance of new licenses. The commissioner may not authorize the Aroostook Band of Micmacs or its agent to issue more than 24 commercial sea urchin licenses to members of the band in any calendar year; [2011, c. 598, §17 (NEW).]

C-2. The commissioner shall adopt rules authorizing the Houlton Band of Maliseet Indians or its agent to issue to members of the band commercial sea urchin licenses if the commissioner determines that sea urchin resources are sufficient to permit the issuance of new licenses. The commissioner may not authorize the Houlton Band of Maliseet Indians or its agent to issue more than 24 commercial sea urchin licenses to members of the band in any calendar year; [2013, c. 254, §3 (NEW).]

D. The Penobscot Nation may not issue to members of the nation more than 20 commercial licenses for the taking of scallops in any calendar year, except that the commissioner shall by rule allow the Penobscot Nation to issue additional commercial licenses to members of the nation for the taking of scallops if the commissioner determines that scallop resources are sufficient to permit the issuance of new licenses; [2011, c. 598, §17 (AMD).]

D-1. The Aroostook Band of Micmacs or its agent may not issue to members of the band more than 10 commercial licenses for the taking of scallops in any calendar year, except that the commissioner shall by rule allow the Aroostook Band of Micmacs or its agent to issue additional commercial licenses to members of the band for the taking of scallops if the commissioner determines that scallop resources are sufficient to permit the issuance of new licenses; [2011, c. 598, §17 (NEW).]

D-2. The Passamaquoddy Tribe may not issue to members of the tribe more than 20 commercial licenses for the taking of scallops in any calendar year, except that the commissioner shall by rule allow the Passamaquoddy Tribe to issue additional commercial licenses to members of the tribe for the taking of scallops if the commissioner determines that scallop resources are sufficient to permit the issuance of new licenses; [2013, c. 8, §1 (NEW).]

D-3. The Houlton Band of Maliseet Indians or its agent may not issue to members of the band more than 10 commercial licenses for the taking of scallops in any calendar year, except that the commissioner shall by rule allow the Houlton Band of Maliseet Indians or its agent to issue additional commercial licenses to members of the band for the taking of scallops if the commissioner determines that scallop resources are sufficient to permit the issuance of new licenses; [2013, c. 254, §3 (NEW).]

E. The Penobscot Nation may not issue to members of the nation commercial licenses for the taking of elvers in any calendar year that exceed the following limits:

(1) Eight licenses that allow the taking of elvers with 2 pieces of gear; and

(2) Forty licenses that allow the taking of elvers with one piece of gear.

The commissioner shall by rule allow the Penobscot Nation to issue additional commercial licenses to members of the nation for the taking of elvers if the commissioner and the Penobscot Nation determine that elver resources are sufficient to permit the issuance of new licenses; [2015, c. 391, §3 (AMD).]

E-1. The Passamaquoddy Tribe may issue to members of the tribe commercial licenses for the taking of elvers with one piece of gear; [2015, c. 391, §4 (AMD).]

F. The Aroostook Band of Micmacs or its agent may not issue to members of the band more than 8 commercial licenses for the taking of elvers in any calendar year, except that the commissioner shall by rule allow the Aroostook Band of Micmacs or its agent to issue additional commercial licenses for the taking of elvers to members of the band if the commissioner determines that elver resources are sufficient to permit the issuance of new licenses; and [2013, c. 8, §1 (AMD).]

G. The Houlton Band of Maliseet Indians or its agent may not issue to members of the band more than 16 commercial licenses for the taking of elvers in any calendar year except that the commissioner shall by rule allow the Houlton Band of Maliseet Indians or its agent to issue additional commercial licenses for the taking of elvers to members of the band if the commissioner determines that elver resources are sufficient to permit the issuance of new licenses. [2015, c. 391, §5 (RPR).]

The Passamaquoddy Tribe, Penobscot Nation, Aroostook Band of Micmacs, Houlton Band of Maliseet Indians and Department of Marine Resources shall report on the status of the sea urchin, scallop and elver fisheries to the joint standing committee of the Legislature having jurisdiction over marine resources matters by January 15th of each even-numbered year.

Rules adopted pursuant to this subsection are routine technical rules as defined in Title 5, chapter 375, subchapter 2-A.

§6302-B. ELVER QUOTA FOR FEDERALLY RECOGNIZED INDIAN TRIBES IN THE STATE

If the commissioner adopts an elver individual fishing quota system pursuant to section 6505-A, subsection 3-A, this section governs the allocation of the elver quota to federally recognized Indian tribes in the State. [2013, c. 485, §3 (NEW).]

1. **Annual allocation.** In accordance with section 6505-A, the commissioner shall annually allocate 21.9% of the overall annual quota of elver fishery annual landings to the federally recognized Indian tribes in the State. If the Passamaquoddy Tribe, the Penobscot Nation, the Aroostook Band of Micmacs and the Houlton Band of Maliseet Indians reach an agreement regarding the division of this 21.9% portion of the overall annual quota among them and communicate in writing that agreement to the commissioner prior to March 1st of the year in which the quota is allocated, the commissioner shall allocate that portion of the quota in accordance with that agreement. If no agreement is reached, the commissioner shall allocate that portion of the quota in accordance with the following:

A. To the Passamaquoddy Tribe, 14% of the overall annual quota; [2013, c. 485, §3 (NEW).]

B. To the Penobscot Nation, 6.4% of the overall annual quota; [2013, c. 485, §3 (NEW).]

C. To the Houlton Band of Maliseet Indians, 1.1% of the overall annual quota; and [2013, c. 485, §3 (NEW).]

D. To the Aroostook Band of Micmacs, 0.4% of the overall annual quota. [2013, c. 485, §3 (NEW).]

In making any allocations under this subsection, the commissioner shall reserve a portion no greater than 10% of each allocation in order to ensure that the quota is not exceeded.

[2013, c. 485, §3 (NEW) .]

2. **Individual allocations.** The following provisions govern the allocation of the quotas established under subsection 1 to members of each of the federally recognized Indian tribes.

A. The commissioner may enter into an agreement with a federally recognized Indian tribe in the State that does not provide for individual allocations of the quota established under subsection 1 to members of that tribe, nation or band. If the commissioner enters into an agreement pursuant to this paragraph, the following provisions apply.

(1) An elver transaction card under section 6305 must be issued to each person to whom the tribe, nation or band issues a license under section 6302-A, subsection 3.

(2) The holder of a license issued under section 6302-A, subsection 3 must meet the reporting requirements established by rule pursuant to section 6173.

(3) The quota established under subsection 1 applies to all elvers taken under licenses issued by the tribe, nation or band under section 6302-A, subsection 3.

(4) When the quota established under subsection 1 is reached, the department shall notify the tribe, nation or band. When the quota established under subsection 1 is reached, the holder of a license issued by the tribe, nation or band under section 6302-A, subsection 3 may not thereafter take, possess or sell elvers. Taking, possessing or selling elvers after the quota established under subsection 1 is reached is deemed a

violation by the license holder of the prohibition on fishing in excess of the person's individual quota in section 6505-A, subsection 3-A. [2015, c. 391, §6 (NEW).]

B. This paragraph governs the allocation of the quotas established in subsection 1 to members of a federally recognized Indian tribe in the State when the commissioner has not entered into an agreement with members of the tribe, nation or band under paragraph A that applies to members of that tribe, nation or band.

(1) If there is no agreement under paragraph A between the commissioner and the Passamaquoddy Tribe, the Passamaquoddy Tribe shall allocate to each person to whom it issues a license under section 6302-A, subsection 3, paragraph E-1 a specific amount of the quota allocated to the Passamaquoddy Tribe under subsection 1, paragraph A and shall provide documentation to the department of that allocation for each individual license holder. The Passamaquoddy Tribe shall allocate all of the quota that it has been allocated and may not alter any individual allocations once documentation has been provided to the department.

(2) If there is no agreement under paragraph A between the commissioner and the Penobscot Nation, the Penobscot Nation shall allocate to each person to whom it issues a license under section 6302-A, subsection 3, paragraph E a specific amount of the quota allocated to the Penobscot Nation under subsection 1, paragraph B and shall provide documentation to the department of that allocation for each individual license holder. The Penobscot Nation shall allocate all of the quota that it has been allocated and may not alter any individual allocations once documentation has been provided to the department.

(3) If there is no agreement under paragraph A between the commissioner and the Houlton Band of Maliseet Indians, the Houlton Band of Maliseet Indians shall allocate to each person to whom it issues a license under section 6302-A, subsection 3, paragraph G a specific amount of the quota allocated to the Houlton Band of Maliseet Indians under subsection 1, paragraph C and shall provide documentation to the department of that allocation for each individual license holder. The Houlton Band of Maliseet Indians shall allocate all of the quota that it has been allocated and may not alter any individual allocations once documentation has been provided to the department.

(4) If there is no agreement under paragraph A between the commissioner and the Aroostook Band of Micmacs, the Aroostook Band of Micmacs shall allocate to each person to whom it issues a license under section 6302-A, subsection 3, paragraph F a specific amount of the quota allocated to the Aroostook Band of Micmacs under subsection 1, paragraph D and shall provide documentation to the department of that allocation for each individual license holder. The Aroostook Band of Micmacs shall allocate all of the quota that it has been allocated and may not alter any individual allocations once documentation has been provided to the department. [2015, c. 391, §6 (NEW).]

The department shall issue an elver transaction card under section 6305 to a person licensed by the Passamaquoddy Tribe under section 6302-A, subsection 3, paragraph E-1, the Penobscot Nation under section 6302-A, subsection 3, paragraph E, the Houlton Band of Maliseet Indians under section 6302-A, subsection 3, paragraph G or the Aroostook Band of Micmacs under section 6302-A, subsection 3, paragraph F only upon receipt of adequate documentation specifying the individual quota allocated to that person by the tribe, nation or band under this subsection.

[2015, c. 391, §6 (RPR) .]

3. **Overage.** If the total weight of elvers sold by persons licensed by the Passamaquoddy Tribe, Penobscot Nation, Aroostook Band of Micmacs or Houlton Band of Maliseet Indians exceeds the quota allocated under subsection 1 to that tribe, nation or band, the commissioner shall deduct the amount of the overage from any future allocation to that tribe, nation or band. If the overage exceeds the overall annual quota allocated to that tribe, nation or band for the following year, the overage must be deducted from the overall annual quota allocations to that tribe, nation or band in subsequent years until the entire overage has been accounted for.

[2013, c. 485, §3 (NEW) .]

4. **Emergency prohibition.** The commissioner may adopt emergency rules to prohibit the Passamaquoddy Tribe, the Penobscot Nation, the Aroostook Band of Micmacs or the Houlton Band of Maliseet Indians from fishing for elvers under a license issued under this Title if the commissioner finds that the tribe, nation or band has authorized fishing for elvers in a way that the commissioner determines will cause the tribe, nation or band to exceed the annual allocation set forth in subsection 1.

[2015, c. 391, §7 (NEW) .]

SECTION HISTORY
2013, c. 485, §3 (NEW). 2015, c. 391, §§6, 7 (AMD).

§6505-A. ELVER FISHING LICENSE

(CONTAINS TEXT WITH VARYING EFFECTIVE DATES)

1. **License required.** Except as provided in section 6302-A and section 6302-B, a person may not engage in the activities authorized under subsection 1-A unless the person is issued one of the following elver fishing licenses under this section:

A. A resident elver fishing license for one device; [2003, c. 452, Pt. F, §11 (NEW); 2003, c. 452, Pt. X, §2 (AFF).]

B. A resident elver fishing license for 2 devices; [2003, c. 452, Pt. F, §11 (NEW); 2003, c. 452, Pt. X, §2 (AFF).]

C. A nonresident elver fishing license for one device; [2013, c. 468, §23 (AMD).]

D. A nonresident elver fishing license for 2 devices; [2013, c. 468, §23 (AMD).]

E. A resident elver fishing license with crew for one device; [2013, c. 468, §23 (NEW).]

F. A resident elver fishing license with crew for 2 devices; [2013, c. 468, §23 (NEW).]

G. A nonresident elver fishing license with crew for one device; or [2013, c. 468, §23 (NEW).]

H. A nonresident elver fishing license with crew for 2 devices. [2013, c. 468, §23 (NEW).]

The department may not issue a license under paragraph E, F, G or H until January 1, 2015.

[2013, c. 485, §5 (AMD) .]

1-A. **Licensed activity.** The holder of an elver fishing license or elver fishing license with crew may fish for, take or possess elvers. The holder of an elver fishing license or elver fishing license with crew may transport and sell within state limits elvers that the license holder has taken. The holder of an elver fishing license with crew is liable for the licensed activities under this subsection of an unlicensed crew member assisting that license holder pursuant to subsection 1-B. Only the license holder to whom a tag is issued may empty an elver fyke net.

[2013, c. 468, §24 (NEW) .]

1-B. **License limitations.** An elver fishing license with crew authorizes the license holder to engage in the licensed activities under subsection 1-A. The holder of an elver fishing license with crew may engage one unlicensed crew member to assist the license holder only in certain activities as authorized by rule, and the unlicensed crew member may assist only under the direct supervision of the license holder.

[2013, c. 468, §24 (NEW) .]

1-C. **Elver transaction card issued.** The department may issue an elver transaction card to each license holder under this section and to each license holder under section 6302-A, subsection 3, paragraphs E, E-1, F and G in accordance with section 6302-B. The department may charge each license holder an annual fee for the elver transaction card that may not exceed $35. Fees collected under this subsection must be deposited in the Eel and Elver Management Fund under section 6505-D. The license holder shall use the elver transaction card to meet electronic reporting requirements established by rule pursuant to section 6173. The elver transaction card must include the license holder's name and license number.

[2017, c. 250, §2 (AMD) .]

1-D. **Use of elver transaction card required.** The holder of an elver fishing license issued under this section or section 6302-A, subsection 3, paragraph E, E-1, F or G may not sell or transfer elvers the license holder has taken to an elver dealer licensed under section 6864 unless the holder of the elver fishing license presents to the elver dealer the elver transaction card issued to that person under subsection 1-C.

[2013, c. 468, §24 (NEW) .]

1-E. **Elver transaction card limited.** A person may not possess an elver transaction card unless that person holds a license issued under this section or section 6302-A, subsection 3, paragraph E, E-1, F or G and the elver transaction card was issued to that person pursuant to subsection 1-C.

[2013, c. 468, §24 (NEW) .]

1-F. **Licenses issued.** The commissioner may issue up to 425 elver fishing licenses each year under this section.

[2017, c. 250, §3 (NEW) .]

2. **Eligibility.** An elver fishing license may be issued only to an individual who:

A. [1999, c. 534, §1 (RP).]

B. [1999, c. 534, §1 (RP).]

C. Possessed an elver fishing license in the previous calendar year; [2011, c. 549, §3 (AMD).]

D. [2005, c. 533, §1 (RP).]

E. Did not possess an elver fishing license in the previous calendar year because the commissioner had suspended the person's license privileges for a length of time that included the previous calendar year; or [2011, c. 549, §3 (AMD).]

F. Becomes eligible to obtain an elver fishing license pursuant to the elver lottery under subsection 2-C. [2017, c. 250, §4 (AMD).]

[2017, c. 250, §4 (AMD) .]

2-A. **Elver license lottery.**

[2005, c. 533, §2 (RP) .]

2-B. **Elver lotteries.**

[2017, c. 250, §5 (RP) .]

2-C. **Elver license lottery.** The commissioner shall establish an elver fishing license lottery under which a person may become eligible for that license under subsection 2, paragraph F. An applicant to the lottery must submit a lottery application together with a $35 nonrefundable application fee no later than January 15th of the same calendar year as the lottery. An applicant may not submit more than 5 elver fishing license lottery applications per lottery year. In any year in which a lottery is held, the lottery must be held on or before February 15th.

The commissioner may adopt rules to implement the elver fishing license lottery, including provisions for the method and administration of the lottery. Rules adopted pursuant to this subsection are routine technical rules as defined in Title 5, chapter 375, subchapter 2-A.

Twenty-five dollars of the application fee collected under this subsection must be deposited in the Eel and Elver Management Fund established in section 6505-D and used to fund a life-cycle study of the elver fishery. Ten dollars of the application fee may be used by the department to fund the costs of administering the elver fishing license lottery.

[2017, c. 250, §6 (NEW) .]

3. **Limits on issuance.**

[2013, c. 8, §3 (RP) .]

3-A. **Elver fishing quotas.** The commissioner may adopt rules to establish, implement and administer an elver individual fishing quota system in order to ensure that the elver fishery annual landings do not exceed the overall annual quota established by the Atlantic States Marine Fisheries Commission. Except as provided in section 6575-L, a person issued a license under this section or section 6302-A, subsection 3, paragraph E, E-1, F or G may not take, possess or sell elvers in excess of the weight quota allocated to that person under the quota system. The rules must:

A. Establish an overall annual quota for the State; [2013, c. 485, §7 (NEW).]

B. Establish the amount of the overall annual quota under paragraph A that is allocated to persons licensed under this section and specify a formula to establish individual quotas for persons licensed under this section. The formula may take into account the amount of elvers a person licensed under this section lawfully harvested in previous seasons based on final harvesting reports. The rules must specify the date by which harvester reports are considered final for the purpose of determining individual quotas; and [2013, c. 485, §7 (NEW).]

C. Provide, in accordance with section 6302-B, that 21.9% of the overall annual quota under paragraph A is allocated to the federally recognized Indian tribes in the State and establish the amount of that portion of the overall annual quota allocated to the Passamaquoddy Tribe, the Penobscot Nation, the Houlton Band of Maliseet Indians and the Aroostook Band of Micmacs. [2013, c. 485, §7 (NEW).]

If persons issued licenses under this section collectively exceed the overall annual quota allocated to those persons pursuant to paragraph B, the number of pounds by which the license holders exceeded that overall annual quota must be deducted from the following year's overall annual quota allocated to persons licensed under this section. If the overage exceeds the overall annual quota allocated to persons licensed under this section for the following year, the overage must be deducted from the overall annual quota allocated to persons licensed under this section in subsequent years until the entire overage has been accounted for.

The commissioner may adopt or amend rules on an emergency basis if immediate action is necessary to establish and implement the elver individual fishing quota in advance of the beginning of the elver fishing season.

Rules adopted pursuant to this subsection are routine technical rules as defined in Title 5, chapter 375, subchapter 2-A.

[2015, c. 131, §1 (AMD) .]

4. (TEXT EFFECTIVE UNTIL 1/1/18) **Fees.** Fees for elver fishing licenses are:

A. For a person who is a resident, $205; [2017, c. 250, §7 (AMD).]

B. For a person who is a nonresident, $542; [2017, c. 250, §7 (AMD).]

C. For a person who is a resident with crew, $405; and [2017, c. 250, §7 (AMD).]

D. For a person who is a nonresident with crew, $1,426. [2017, c. 250, §7 (AMD).]

One hundred and fifty dollars of each license fee collected under paragraphs A and B and $300 of each license fee collected under paragraphs C and D accrue to the Eel and Elver Management Fund established in section 6505-D.

[2017, c. 250, §7 (AMD) .]

4. (TEXT REPEALED 1/1/18) **Fees.**

[2017, c. 284, Pt. EEEEE, §31 (AFF); 2017, c. 284, Pt. EEEEE, §7 (RP) .]

4-A. (TEXT EFFECTIVE 1/1/18) **License fee.** Fees for elver fishing licenses are:

A. For a resident elver fishing license for one device, $55; [2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF).]

B. For a resident elver fishing license for 2 devices, $63; [2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF).]

C. For a nonresident elver fishing license for one device, $392; [2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF).]

D. For a nonresident elver fishing license for 2 devices, $400; [2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF).]

E. For a resident elver fishing license with crew for one device, $105; [2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF).]

F. For a resident elver fishing license with crew for 2 devices, $113; [2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF).]

G. For a nonresident elver fishing license with crew for one device, $1,126; and [2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF).]

H. For a nonresident elver fishing license with crew for 2 devices, $1,134. [2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF).]

[2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF) .]

4-B. (TEXT EFFECTIVE 1/1/18) **License surcharge.** In addition to the license fee established in subsection 4-A, the commissioner shall assess a surcharge on each license issued under this section as follows:

A. For an elver fishing license issued under subsection 4-A, paragraphs A to D, $150; and [2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF).]

B. For an elver fishing license issued under subsection 4-A, paragraphs E to H, $300. [2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF).]

The surcharge fees collected under this subsection must be deposited in the Eel and Elver Management Fund established under section 6505-D.

[2017, c. 284, Pt. EEEEE, §8 (NEW); 2017, c. 284, Pt. EEEEE, §31 (AFF) .]

5. **Gear.** A person issued a license under this section may utilize one elver fyke net, one Sheldon eel trap or one dip net to fish for or take elvers without paying the fee required for a first net or trap pursuant to section 6505-B. A license issued under this section must identify the number and types of nets that the license holder may use pursuant to this section , section 6505-B and section 6575-B.

[2015, c. 391, §8 (AMD) .]

5-A. **Possession of elvers.** The holder of an elver fishing license may possess elvers only during the open season established in section 6575 and for up to 6 hours beyond the end of the open season.

[2013, c. 301, §10 (NEW) .]

6. **Minimum age.** A person who is under 15 years of age may not fish for or take elvers.

[2001, c. 421, Pt. B, §28 (AMD); 2001, c. 421, Pt. C, §1 (AFF) .]

7. **Nonresident licenses; reciprocity with other states.** A nonresident is eligible to purchase an elver fishing license only if the nonresident documents to the commissioner that the nonresident's state of residence allows Maine residents to purchase an elver license and fish for elvers in that state.

[1999, c. 7, §5 (NEW) .]

8. **Violation.**

[2013, c. 49, §8 (RP) .]

8-A. **Violation.** A person who violates this section commits a Class D crime for which a fine of $2,000 must be imposed, none of which may be suspended. Violation of this section is a strict liability crime as defined in Title 17-A, section 34, subsection 4-A.

[2013, c. 49, §9 (NEW) .]

SECTION HISTORY
1995, c. 536, §A8 (NEW). 1997, c. 297, §§1,2 (AMD). 1999, c. 7, §§2-5 (AMD). 1999, c. 534, §§1-3 (AMD). 2001, c. 421, §§B27-29 (AMD). 2001, c. 421, §C1 (AFF). 2003, c. 20, §WW7 (AMD). 2003, c. 452, §F11 (AMD). 2003, c. 452, §X2 (AFF). 2005, c. 533, §§1,2 (AMD). 2007, c. 615, §15 (AMD). 2009, c. 213, Pt. G, §6 (AMD). 2011, c. 549, §§3-5 (AMD). 2013, c. 8, §§2, 3 (AMD). 2013, c. 49, §§8, 9 (AMD). 2013, c. 301, §§9, 10 (AMD). 2013, c. 468, §§23-25 (AMD). 2013, c. 485, §§5-7 (AMD). 2015, c. 131, §1 (AMD). 2015, c. 391, §8 (AMD). 2017, c. 250, §§2-7 (AMD). 2017, c. 284, Pt. EEEEE, §§7, 8 (AMD). 2017, c. 284, Pt. EEEEE, §31 (AFF).

§6505-B. ELVER GEAR FEES

1. **Elver fyke net and Sheldon eel trap fee.** A person may not submerge an elver fyke net or a Sheldon eel trap in the waters of the State to fish for or take elvers unless the net or trap owner pays annually the following fees:

A. Fifty dollars per net or trap for the use of an elver fyke net or Sheldon eel trap, except that the fee under this paragraph does not apply to an elver fyke net or Sheldon eel trap a person utilizes pursuant to section 6505-A, subsection 5. [2017, c. 284, Pt. EEEEE, §9 (AMD).]

B. [1999, c. 7, §6 (RP).]

C. [1999, c. 7, §6 (RP).]

[2017, c. 284, Pt. EEEEE, §9 (AMD) .]

2. **Tags for elver fyke net and Sheldon eel trap.** A person may not submerge an elver fyke net or Sheldon eel trap in the coastal waters of the State to fish for or take elvers unless a tag issued by the department is affixed to the shoreside wing of the net or trap and is clearly visible. The department may issue a replacement tag when an owner issued a tag documents that a net or trap has been damaged or lost.

[2001, c. 421, Pt. B, §30 (AMD); 2001, c. 421, Pt. C, §1 (AFF) .]

3. **Dip net fee.** A person may not utilize a dip net to fish for or take elvers without paying a fee of $50 per dip net annually.

This subsection does not apply to a dip net a person utilizes pursuant to section 6505-A, subsection 5.

[2017, c. 284, Pt. EEEEE, §10 (AMD) .]

4. **Payment with license.** The fees required under subsections 1 and 3 must be paid upon application for an elver fishing license under section 6505-A.

[1995, c. 536, Pt. A, §8 (NEW) .]

5. **Disposition of fees.** Fees collected under this section accrue to the Eel and Elver Management Fund established in section 6505-D.

A. [2017, c. 284, Pt. EEEEE, §11 (RP).]

B. [2017, c. 284, Pt. EEEEE, §11 (RP).]

[2017, c. 284, Pt. EEEEE, §11 (AMD) .]

6. **Violation.** A person who violates this section commits a Class D crime for which a fine of $2,000 must be imposed, none of which may be suspended. Violation of this section is a strict liability crime as defined in Title 17-A, section 34, subsection 4-A.

[2013, c. 49, §10 (AMD) .]

SECTION HISTORY
1995, c. 536, §A8 (NEW). 1997, c. 297, §§3-5 (AMD). 1997, c. 575, §2 (AMD). 1999, c. 7, §6 (AMD). 2001, c. 421, §B30 (AMD). 2001, c. 421, §C1 (AFF). 2009, c. 213, Pt. G, §§7-9 (AMD). 2011, c. 549, §6 (AMD). 2013, c. 49, §10 (AMD). 2017, c. 284, Pt. EEEEE, §§9-11 (AMD).

§6505-D. EEL AND ELVER MANAGEMENT FUND

1. **Fund established.** The Eel and Elver Management Fund, referred to in this section as the "fund," is established as a dedicated, nonlapsing fund.

[1995, c. 536, Pt. A, §8 (NEW) .]

2. **Permissible uses.** The commissioner may use the fund to research and manage the State's eel and elver resources, to enforce the laws related to eels and elvers and to cover the costs associated with determining eligibility for elver fishing licenses.

[2011, c. 266, Pt. A, §17 (AMD) .]

3. **Plan required.**

[2011, c. 266, Pt. A, §18 (RP) .]

SECTION HISTORY
1995, c. 536, §A8 (NEW). 1999, c. 309, §2 (AMD). 2011, c. 266, Pt. A, §§17, 18 (AMD).

Article 5: ELVER AND EEL LIMITATIONS

§6575. OPEN SEASON; ELVER HARVESTING

1. **Open season.** It is unlawful for a person to fish for or take elvers within the waters of the State except during the open season from noon on March 22nd to noon on June 7th.

[2015, c. 391, §9 (AMD) .]

1-A. **Federally recognized Indian tribes; violation.** It is unlawful for a person to fish for or take elvers in violation of rules adopted by the commissioner under section 6302-B, subsection 4.

[2015, c. 391, §10 (NEW) .]

2. **Setting nets and traps.** It is unlawful for a person to immerse or leave immersed an elver fyke net or a Sheldon eel trap in any river, stream or brook of the waters of the State at any time other than the open season for elver fishing.

[1999, c. 7, §7 (AMD) .]

3. **Locating nets.** It is unlawful for a person to designate or claim by any means a location in which to set an elver fyke net or a Sheldon eel trap at any time other than the open season for elver fishing.

[1999, c. 7, §7 (AMD) .]

4. **Nets of certain sizes.**

[1999, c. 7, §7 (RP) .]

5. **Violation.** A person who violates this section commits a Class D crime for which a fine of $2,000 must be imposed, none of which may be suspended. Violation of this section is a strict liability crime as defined in Title 17-A, section 34, subsection 4-A.

[2013, c. 49, §11 (NEW) .]

SECTION HISTORY
1995, c. 536, §A9 (NEW). 1995, c. 536, §A13 (AFF). 1997, c. 91, §4 (AMD). 1999, c. 7, §7 (AMD). 2013, c. 49, §11 (AMD). 2015, c. 391, §§9, 10 (AMD).

§6575-A. CLOSED PERIOD; ELVER HARVESTING

(REPEALED)

SECTION HISTORY
1995, c. 536, §A9 (NEW). 1995, c. 536, §A13 (AFF). 1997, c. 575, §3 (AMD). 1999, c. 7, §8 (AMD). 2011, c. 549, §7 (AMD). 2013, c. 49, §12 (RPR). 2013, c. 468, §26 (AMD). 2015, c. 391, §11 (RP).

§6575-B. METHOD OF ELVER FISHING; LIMITS ON GEAR

1. **Gear.** It is unlawful for a person to fish for or take elvers by any method other than by dip net, elver fyke net or Sheldon eel trap.

[1995, c. 536, Pt. A, §9 (NEW) .]

2. **Number of elver fyke nets and Sheldon eel traps.**

[1999, c. 7, §9 (RP) .]

2-A. **Number of nets and Sheldon eel traps.**

[1999, c. 534, §4 (RP) .]

2-B. **Type and amount of gear.** It is unlawful for a person to immerse elver fishing gear other than the types and amounts listed on the person's license pursuant to section 6505-A, subsection 5. A person may not immerse an amount of elver fishing gear that exceeds the amount of elver fishing gear listed on the person's license for the previous elver fishing season. A person may elect which types of gear are listed on the person's license prior to the issuance of the license for that elver fishing season. The commissioner may adopt rules to implement this subsection. Rules adopted pursuant to this subsection are routine technical rules as defined in Title 5, chapter 375, subchapter 2-A.

A. [2015, c. 391, §12 (RP).]

B. [2005, c. 533, §3 (RP).]

C. [2005, c. 533, §3 (RP).]

[2015, c. 391, §12 (AMD) .]

3. **Rebuttable presumption.** It is a rebuttable presumption that an elver fyke net, Sheldon eel trap or elver dip net immersed in any waters of the State at any time of the year is immersed for the purpose of fishing for or taking elvers.

[1999, c. 7, §11 (AMD) .]

4. **Prohibition on fishing from boats.** It is unlawful for a person to set or tend an elver fyke net or a Sheldon eel trap from a boat or to fish for or take elvers from a boat. A person may transport an elver fyke net, a Sheldon eel trap or a dip net by boat.

[1995, c. 536, Pt. A, §9 (NEW) .]

5. **Use of dip nets.** It is unlawful for a person to use a dip net to fish for or take elvers while standing in the coastal waters of the State.

[1997, c. 575, §4 (AMD) .]

6. **Prohibition on fishing from artificial platforms.** A person may not build or use an artificial platform to fish for elvers. This subsection does not prohibit fishing for elvers from piers or floats established for purposes other than elver fishing.

[1999, c. 7, §12 (NEW) .]

7. **Bycatch release.** A person immediately shall return alive into the waters of the State any species other than elver that is caught in an elver fyke net.

[1999, c. 7, §12 (NEW) .]

8. **St. Croix River; use of fyke nets prohibited.**

[2015, c. 391, §13 (RP) .]

SECTION HISTORY
1995, c. 536, §A9 (NEW). 1997, c. 91, §5 (AMD). 1997, c. 575, §4 (AMD). 1999, c. 7, §§9-12 (AMD). 1999, c. 534, §§4,5 (AMD). 2005, c. 533, §3 (AMD). 2013, c. 468, §27 (AMD). 2015, c. 391, §§12, 13 (AMD).

§6575-C. CLOSED AREAS; ELVER FISHING

1. **Dams with fishways.**

[2013, c. 49, §13 (RP) .]

2. **River herring traps.** A person may not fish for or take elvers within 50 feet of a licensed river herring trap.

[2011, c. 598, §25 (AMD) .]

3. **Portion of rivers, streams and brooks.** A person may not:

A. Fish for or take elvers at any time within the middle 1/3 of a river, stream, brook or other watercourse, as measured at mean high tide, within the coastal waters of the State; or [2003, c. 452, Pt. F, §14 (NEW); 2003, c. 452, Pt. X, §2 (AFF).]

B. Obstruct the middle 1/3 of any river, stream, brook or other watercourse, as measured at mean low tide, within the coastal waters of the State. [2003, c. 452, Pt. F, §14 (NEW); 2003, c. 452, Pt. X, §2 (AFF).]

[2003, c. 452, Pt. F, §14 (RPR); 2003, c. 452, Pt. X, §2 (AFF) .]

4. **Dip nets near elver fyke nets.** A person may not fish for or take elvers with a dip net in the mouth of an elver fyke net. For the purposes of this subsection, "mouth of an elver fyke net" means that area within an elver fyke net that is net-side of a straight line that runs from one meshed wing tip of the net to the other meshed wing tip.

[2003, c. 452, Pt. F, §15 (AMD); 2003, c. 452, Pt. X, §2 (AFF) .]

5. **Fyke net placement.** A person may not place or set an elver fyke net or take elvers from an elver fyke net when any portion of the net, including any anchoring device, is located within an imaginary line between the wing ends of another elver fyke net. Cod end anchoring devices may not exceed 10 feet in length and wing end anchoring devices may not interfere with or create a hazard to navigation within the middle 1/3 of a navigable watercourse. A marine patrol officer may open the cod end of a net that is located in violation of this subsection.

[1999, c. 7, §13 (NEW) .]

6. **Obstructing elver fyke nets.** A person may not set an elver fyke net or place an obstruction near an elver fyke net in a manner that interferes with the operation of an elver fyke net.

[1999, c. 7, §13 (NEW) .]

7. **Rulemaking; gear placement.** If necessary to conserve the elver resource, the commissioner may adopt rules pursuant to section 6171 relating to placement of elver fishing gear based on the configuration of specific rivers, streams, brooks or other watercourses. Rules adopted pursuant to this subsection are routine technical rules as defined in Title 5, chapter 375, subchapter II-A.

[1999, c. 7, §13 (NEW) .]

SECTION HISTORY
1995, c. 536, §A9 (NEW). 1997, c. 91, §6 (AMD). 1997, c. 575, §5 (AMD). 1999, c. 7, §13 (AMD). 2003, c. 452, §§F13-15 (AMD). 2003, c. 452, §X2 (AFF). 2011, c. 598, §25 (AMD). 2013, c. 49, §13 (AMD).

§6575-D. MOLESTING ELVER FISHING GEAR

1. **Prohibition.** Except as provided in subsection 1-A, a person other than a marine patrol officer or the license holder issued a tag for an elver fyke net may not utilize, transfer, alter, possess or in any manner handle the net unless that person has been issued a license to fish for elvers with an elver fyke net under section 6302-A, subsection 3, paragraph E, E-1, F or G or section 6505-A or a license to fish for elvers with crew with an elver fyke net under section 6505-A and the license holder issued the tag for the elver fyke net is present and assisting in setting, tending or removing the net.

A. [1999, c. 7, §14 (RP).]

B. [2013, c. 468, §28 (RP).]

[2013, c. 468, §28 (AMD) .]

1-A. **Restriction on emptying net or trap; exception.** A person other than the license holder identified on the tag for an elver fyke net or a Sheldon eel trap may not empty that net or trap unless that person has been issued an elver fishing license for the same gear type and has been issued written permission by a marine patrol officer to tend that net or trap. A marine patrol officer may issue a person written permission for the person to tend the license holder's net or trap only for the purpose of releasing captured elvers into the waters of the State if the license holder is temporarily unable to tend that net or trap because of a disability or personal or family medical condition. If the license holder is unable to tend that net or trap for more than 2 consecutive weeks, the net or trap must be removed from the water.

[2013, c. 468, §28 (NEW) .]

2. Violation. A person who violates this section commits a Class D crime for which a fine of $2,000 must be imposed, none of which may be suspended. Violation of this section is a strict liability crime as defined in Title 17-A, section 34, subsection 4-A.

[2013, c. 49, §14 (AMD) .]

SECTION HISTORY
1995, c. 536, §A9 (NEW). 1999, c. 7, §14 (AMD). 2001, c. 421, §B34 (AMD). 2001, c. 421, §C1 (AFF). 2011, c. 549, §8 (AMD). 2013, c. 49, §14 (AMD). 2013, c. 468, §28 (AMD).

§6575-F. WEST SIDE OF ORLAND RIVER CLOSED TO ELVER FISHING

A person may not fish for or take elvers within the portion of the Orland River between the west bank and the center of the river from the southernmost point of land on Fish Point to the dam in Orland. [1999, c. 18, §1 (NEW).]

SECTION HISTORY
1999, c. 18, §1 (NEW).

§6575-G. DAMS WITH FISHWAYS; ELVER FISHING

1. Dams with fishways. A person may not fish for or take elvers within 150 feet of any part of a dam with a fishway or within 150 feet of a fishway.

[2013, c. 49, §15 (NEW) .]

2. Violation. A person who violates this section commits a Class D crime for which a fine of $2,000 must be imposed, none of which may be suspended. Violation of this section is a strict liability crime as defined in Title 17-A, section 34, subsection 4-A.

[2013, c. 49, §15 (NEW) .]

SECTION HISTORY
2013, c. 49, §15 (NEW).

§6575-H. SALE AND PURCHASE OF ELVERS

1. Sale of elvers. A person may not sell elvers except as follows.

A. A person may not sell elvers except to a person who holds a valid elver dealer's license under section 6864 or a person who, pursuant to section 6864, subsection 9, is an authorized representative of a person holding a license issued under section 6864. [2013, c. 301, §12 (NEW).]

B. A person may not accept payment for elvers in any form other than a check or cashier's check that identifies both the buyer, by whom the landings will be reported, and the seller, each of whom must be a person holding a license issued under section 6864, a person who, pursuant to section 6864, subsection 9, is an authorized representative of a person holding a license issued under section 6864 or a person holding a license issued under section 6302-A, subsection 3, paragraph E, E-1, F or G or section 6505-A. [2013, c. 468, §29 (AMD).]

[2013, c. 468, §29 (AMD) .]

1-A. **Purchase of elvers.** A person who holds a valid elver dealer's license under section 6864 or a person who, pursuant to section 6864, subsection 9, is an authorized representative of a person holding a license issued under section 6864 shall post at the point of sale the price that that buyer will pay.

[2013, c. 485, §8 (NEW) .]

2. **Violation.** A person who violates this section commits a Class D crime for which a fine of $2,000 must be imposed, none of which may be suspended. Violation of this section is a strict liability crime as defined in Title 17-A, section 34, subsection 4-A.

[2013, c. 49, §15 (NEW) .]

SECTION HISTORY
2013, c. 49, §15 (NEW). 2013, c. 301, §12 (AMD). 2013, c. 468, §29 (AMD). 2013, c. 485, §8 (AMD).

§6575-I. ASSISTING IN ILLEGAL HARVEST OF ELVERS

(REPEALED)

SECTION HISTORY
2013, c. 301, §13 (NEW). 2013, c. 468, §30 (RP).

§6575-J. SEIZURE OF ILLEGALLY HARVESTED ELVERS

In addition to any other penalty imposed, elvers that are purchased or possessed that were taken in violation of any law or rule pertaining to elvers are subject to seizure by any officer authorized to enforce this Part. The entire bulk pile containing illegally harvested elvers may be seized. For the purposes of this section, "bulk pile" means all elvers in the possession of a holder of an elver fishing license, an elver dealer's license or an elver exporter's license who fished for, took, possesses or bought elvers in violation of any law or rule regulating elvers under this Part. [2017, c. 250, §8 (AMD).]

SECTION HISTORY
2013, c. 301, §13 (NEW). 2017, c. 250, §8 (AMD).

§6575-K. ELVER INDIVIDUAL FISHING QUOTA

1. **Prohibition on possession or sale of elvers in excess of elver individual fishing quota.** A person may not possess or sell a weight of elvers that exceeds the elver individual fishing quota that person has been allocated for the fishing season pursuant to section 6505-A, subsection 3-A, plus any additional quota the person may be authorized to take under section 6575-L.

[2015, c. 131, §2 (AMD) .]

2. **Prohibition on fishing after elver individual fishing quota has been reached.** Except as provided in section 6575-L, this section applies to fishing after a person's elver individual fishing quota has been reached. A person who has sold a weight of elvers that meets or exceeds that person's elver individual fishing quota may not fish for or possess elvers for the remainder of the season, except that such a person who has been issued a license to fish for elvers may in accordance with section 6575-D assist another person who has been issued a license to fish for elvers who has not met or exceeded that person's elver individual fishing quota as provided in section 6505-A, subsection 3-A. All gear tagged by a license holder who has met or exceeded that person's elver individual fishing quota must be removed. A marine patrol officer may seize the elver transaction card of a license holder who has met or exceeded that person's elver individual fishing quota.

[2015, c. 131, §2 (AMD) .]

3. **Violation.** An individual who in fact violates this section commits a crime in accordance with section 6204 for which a fine of $2,000 must be imposed, none of which may be suspended.

[2013, c. 485, §9 (NEW) .]

SECTION HISTORY
2013, c. 485, §9 (NEW). 2015, c. 131, §2 (AMD).

§6575-L. TEMPORARY MEDICAL TRANSFER

The commissioner may authorize a temporary medical transfer of the elver individual fishing quota allocated to a person under section 6505-A in accordance with this section. The holder of an elver fishing license who requests a temporary medical transfer under this section must maintain a valid elver fishing license during the duration of the temporary medical transfer. [2015, c. 131, §3 (NEW).]

1. **Temporary medical transfer requested prior to March 1st.** Notwithstanding section 6505-A, subsection 3-A, the commissioner may authorize a temporary medical transfer that permits the holder of an elver fishing license issued under section 6505-A to transfer the entire annual quota allocated to that person to another person holding an elver fishing license issued under section 6505-A if the following criteria are met:

A. The transferor reported elver landings in the prior fishing year; [2015, c. 131, §3 (NEW).]

B. The transferor is unable to fish the quota allocated to the transferor because the transferor has experienced a substantial illness or medical condition. The transferor shall provide the commissioner with documentation from a physician describing the substantial illness or medical condition; and [2015, c. 131, §3 (NEW).]

C. The transferor requests a temporary medical transfer in writing before March 1st of the fishing year for which it is being requested, except that the commissioner may adopt rules that provide a method for authorizing a temporary medical transfer requested after March 1st to address emergency medical conditions. [2015, c. 131, §3 (NEW).]

Rules adopted pursuant to this subsection are routine technical rules as defined in Title 5, chapter 375, subchapter 2-A.

[2015, c. 1, §5 (COR) .]

SECTION HISTORY
RR 2015, c. 1, §5 (COR). 2015, c. 131, §3 (NEW).

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

STEPHEN W. MURPHEY
Director

MEMORANDUM

TO: ASMFC American Eel Technical Committee

FROM: Todd Mathes, N.C. Division of Marine Fisheries

DATE: July 10, 2019

RE: Update on N.C. American Eel Aquaculture Plan (May 2017) for the 2019 harvest season

<u>2019 Glass Eel Harvest Activities</u>

In December 2018, the American Eel Farm (AEF) agreed to the aquaculture permit conditions submitted to them by NCDMF. Working under the approved May 2017 N.C. Aquaculture Plan, the AEF fished fyke nets from January 2, 2019 through April 19, 2019 and harvested 13.82 pounds of glass eels (Table 1). Dip nets were only used on one occasion, and Irish eel ladders were not used. The AEF did not receive any citations in 2019.

In June 2019, after successfully raising the eels for three months, the AEF suffered a total loss (100% mortality) of the eels harvested under the N.C. Aquaculture Plan allegedly due to bad food.

<u>2019 Glass Eel Harvest Results</u>

- The AEF fished fyke nets for 14 of 22 weeks during the open season; the AEF started fishing the first week of the glass eel season (open - Jan. 1, 2019) and stopped fishing six weeks prior to the end of the season (close - May 30, 2019).
- Fyke nets were fished 73 out of 129 days available to be fished (56.6%) (In order to create a 48-hour rest period, there was no fishing allowed from 12:01 pm Friday through 12:01 pm Sunday throughout the season).
- Dip nets (2) were only used on one occasion and captured 3.5 pounds of glass eels.
- All fishing effort was in the internal Coastal and Joint waters of creeks and canals surrounding Lake Mattamuskeet (Figure 1).
- 13.82 pounds of glass eels were harvested (Table 1).
- 980 glass eels were released alive (Table 1).
- 186.18 pounds of unused glass eel quota remained.
- 160 elvers were released alive (Table 1).

- The maximum number of fyke nets fished per week was 17, with a mean of 9.7 fyke nets deployed throughout the entire harvest period.
- CPUE data – limited utility due to: 1) changing harvest locations, 2) different net dimensions, 3) gear modifications (crab protection), 4) inconsistent fishing effort, 5) periods of no fishing, and 6) weight includes water.

<u>May 2019 N.C. Aquaculture Plan – Proposal</u> - (2-year plan, 2019/2020 and 2020/2021 harvest seasons)

Table 2 outlines the May 2017 and May 2019 N.C. Aquaculture Plan sections side by side for comparative purposes to better see the modifications that were made.

Table 1. American Eel Farm (AEF) summary catch and effort statistics for the 2019 glass eel harvest season. * No weekly fishing activity, fyke nets were removed on 4/19/2019. † 3.2 pounds came from dip nets (n=2).

	Number of fyke nets deployed			Total number			Total pounds of glass eels		Total number of glass eels		Total number of elvers		Glass eel CPUE (number glass eels/hour)
Week date (Sun - Fri)	Mean	Min	Max	days fished	hours fished	Average number of hours fished (min : max)	harvest	released	harvest	released	released	Glass eel CPUE (pound/hour)	
1-4 Jan	2.5	0	3	3	119.1	39.7 (39.1 : 40.5)	0	*0.02*	0	55	0	0.0002	0.46
6-11 Jan	9.7	4	11	6	1,086.3	98.7 (70.7 : 117.6)	0	*0.07*	0	225	14	0.0001	0.21
13-18 Jan	5.0	0	8	5	496.5	67.1 (44.2 : 90.6)	0	*0.09*	0	280	7	0.0002	0.56
20-25 Jan	4.7	0	11	4	466.0	42.4 (12.6 : 74.1)	0	*0.06*	0	180	11	0.0001	0.39
27 Jan-1 Feb	13.7	0	17	5	1,537.5	90.4 (70.8 : 99.3)	1.10	*0.08*	*3,332*	240	58	0.0008	2.32
3-8 Feb	14.2	0	17	5	1,537.4	61.5 (11.8 : 101.7)	7.15†	0	*21,658*	0	42	0.0047	14.09
10-15 Feb	12	0	16	5	1,397.7	87.4 (75.8 : 98.8)	0	0	0	0	0	0.0000	0.00
17-22 Feb	16	16	16	6	1,798.3	112.4 (107.4 : 118.8)	0.40	0	*1,212*	0	0	0.0002	0.67
24 Feb-1 Mar	11.7	0	14	5	1,375.8	98.3 (97.1 : 100.9)	0.72	0	*2,170*	0	1	0.0005	1.58
3-8 Mar*	-	-	-	-	-	-	-	-	-	-	-	-	-
10-15 Mar	11.7	0	14	5	1,253.5	89.5 (88.9 : 90.5)	1.20	0	*3,675*	0	10	0.0010	2.93
17-22 Mar	14	14	14	6	1,567.4	112.0 (108.6 : 114.9)	0.25	0	*757*	0	0	0.0002	0.48
24-29 Mar	7	7	7	6	873.3	124.8 (123.5 : 126.5)	1.50	0	*4,544*	0	7	0.0017	5.20
31 Mar-5 Apr	7	7	7	6	791.8	113.1 (112 : 114.2)	1.50	0	*4,544*	0	10	0.0019	5.74
7-12 Apr*	-	-	-	-	-	-	-	-	-	-	-	-	-
14-19 Apr	7	7	7	6	865.3	123.6 (123.0 : 124.8)	0	0	0	0	0	0.0000	0.00
21-26 Apr*	-	-	-	-	-	-	-	-	-	-	-	-	-
28 Apr-3 May*	-	-	-	-	-	-	-	-	-	-	-	-	-
5-10 May*	-	-	-	-	-	-	-	-	-	-	-	-	-
12-17 May*	-	-	-	-	-	-	-	-	-	-	-	-	-
19-24 May*	-	-	-	-	-	-	-	-	-	-	-	-	-
26-30 May*	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	9.7	0	17	73	15,165.8		13.82	0.33	41,891	980	160	0.0009	2.827

Table 2. Comparison between the current (May 2017) N.C. Aquaculture Plan and the proposed (May 2019) Aquaculture Plan highlighting the modifications.

Section	Current Aquaculture Plan (May 2017)	Proposed Aquaculture Plan (May 2019)	Comment
Dates of Harvest	January 1 - May 30	November 1 - March 31	change in harvest period
General Conditions	…from 12:01 pm on Friday through 12:01 pm on Sunday fyke nets may remain in the water but the terminal portion of a fyke net cod end shall contain a rigid device...	…from 3:00 pm on Friday through 3:00 pm on Sunday fyke nets may remain in the water but the terminal portion of a fyke net cod end shall contain a rigid device...	change in time when nets must be left open
General Conditions	Catch per unit effort (CPUE) data will be collected for each piece of gear. Information collected will include: approximate time the gear began and ended fishing and the number of glass eels harvested. All CPUE data will be reported to the eel biologist by the 10th of the following month.	Catch per unit effort (CPUE) data will be collected for each piece of gear. Information collected will include: approximate time the gear began and ended fishing and the actual number or weight (includes water weight) to the nearest 0.1 pounds of glass eels harvested, and for dip nets the number used. All CPUE data will be required to be reported to the eel biologist for the previous weeks effort and harvest by 5:00 pm the following Saturday.	- added language to require reporting the actual number of glass eels harvested -added language to require the reporting of the number of dip nets used in the harvest of glass eels - change in CPUE reporting (weekly)
After the Harvest		Require AEF to call-in to NCDMF with the total harvest in pounds (or actual number of glass eels if weighing is impractical) prior to leaving the landing site. Zero pounds shall only be reported if no glass eels are harvested.	requirement added by request of NC DMF Marine Patrol
After the Harvest	Require AEF to call-in or email to NCDMF by 5:00 pm each day the total harvest for the previous day in pounds to the nearest 0.1 lb. of glass eels received (including those days when no glass eel harvest occurred). Zero pounds shall only be reported if no glass eels are harvested and received.	Require AEF to call-in or email to NCDMF by 5:00 pm each day the total harvest for the previous day in pounds to the nearest 0.1 lb. of glass eels (or actual number of glass eels if weighing is impractical) received (including those days when no glass eel harvest occurred). Zero pounds shall only be reported if no glass eels are harvested and received.	added language to require reporting the actual number of glass eels harvested if weighing is impractical

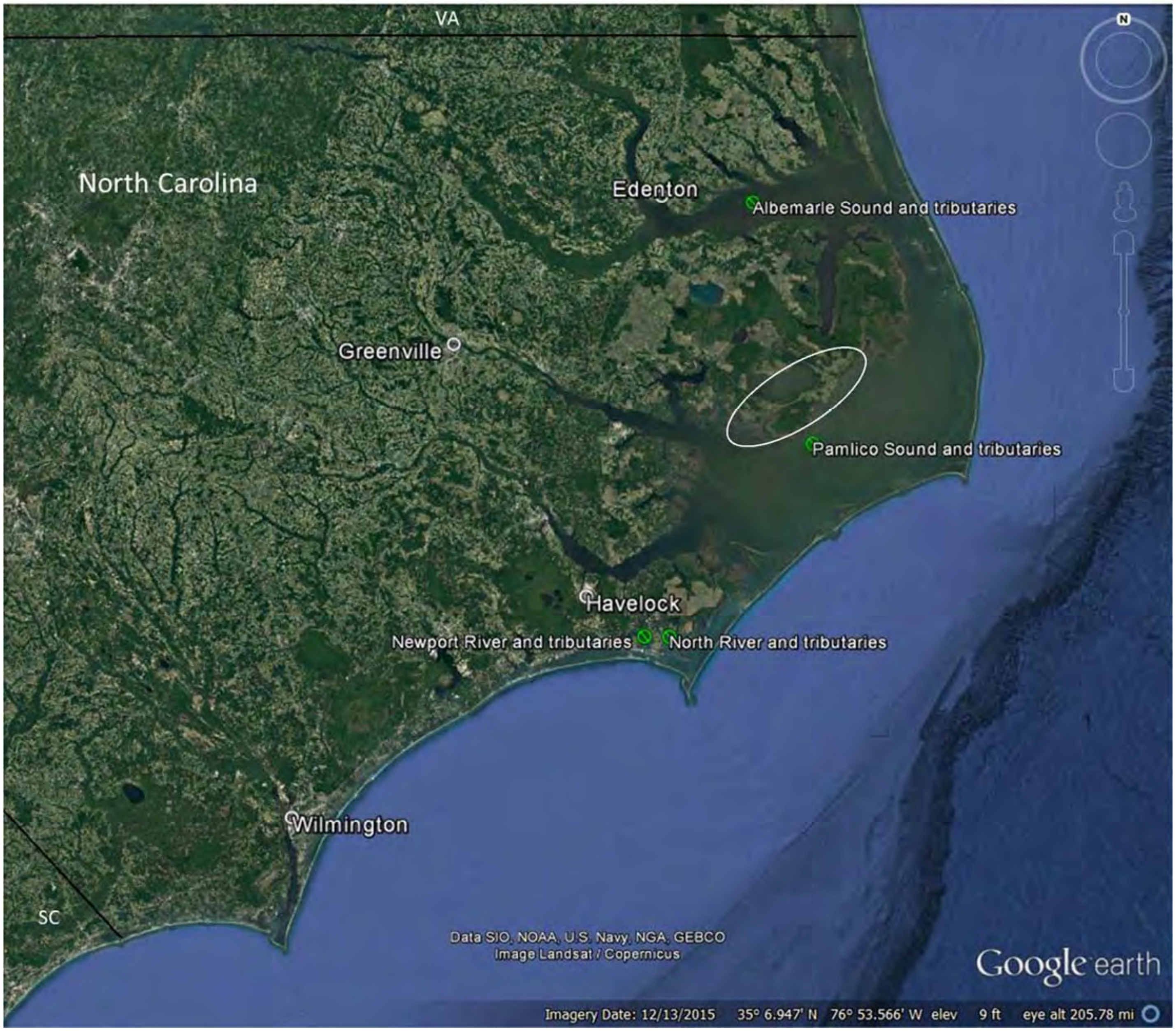

Figure 1. General location of harvest areas (white oval) along the North Carolina coast. All fishing effort in 2019 occurred in the internal Coastal and Joint waters of creeks and canals surrounding Lake Mattamuskeet.

North Carolina Aquaculture Plan for American Eel

Pursuant to Addendum V to the ASMFC Interstate Fishery Management Plan for American Eel

North Carolina Department of Environmental Quality
Division of Marine Fisheries
PO Box 769
Morehead City, NC 28557

Submitted on behalf of the American Eel Farm
Trenton, NC

May 24, 2019

BACKGROUND

Globally, the U.S. is a minor producer of aquaculture products, ranking 15th in a United Nations Food and Agriculture Organization report (FAO 2014). It would be beneficial to expand aquaculture in the U.S. as approximately 91% of seafood (by value) consumed in the U.S. originates overseas. Roughly half of this comes from aquaculture and has driven the U.S. seafood trade deficit to over $11.2 billion annually (NOAA 2016). By passing the National Aquaculture Act of 1980 (and subsequent amendments), Congress put forth that it was in the national interest and the national policy to encourage the development and reduce regulations of aquaculture in the U.S. However, nothing has changed in the past 37. The US is producing about 1% of the annual global production.

In the early 1990s North Carolina was one of several states to impose a 6-inch minimum size limit in part to protect elvers/glass eels for local aquaculture while awaiting recommendations on glass eel/elver fishery development that was expected in the Atlantic States Marine Fisheries Commission fishery management plan for American eel (ASMFC 2000). The April 2000 American eel FMP (Report #36) also shows that the states of New York, Rhode Island, Delaware, Maryland and PRFC also took the same measure to protect aquaculture development between 1992 – 1995.

In January 2019, the ASMFC adopted Addendum V to the Interstate Fishery Management Plan for American Eel (ASMFC 2019);

Addendum V implemented a provision allowing states and jurisdictions to submit an Aquaculture Plan to allow for the limited harvest of American eel glass eels (hereinafter "glass eels") for use in domestic aquaculture facilities. Specifically, Addendum V states:

> *"States and jurisdictions may develop a Plan for aquaculture purposes. Under an approved Aquaculture Plan, states and jurisdictions may harvest a maximum of 200 pounds of glass eels annually from within their waters for use in domestic aquaculture facilities. Site selection for harvest will be an important consideration for applicants and reviewers. Suitable harvest locations will be evaluated with a preference to locations that have (1) established or proposed glass eel monitoring, (2) are favorable to law enforcement and (3) watershed characteristics that are prone to relatively high mortality rates. Watersheds known to have features (ex. impassible dams, limited area of upstream habitat, limited water quality of upstream habitat, and hydropower mortality) that would be expected to cause lower eel productivity and/or higher glass eel mortality will be preferred targets for glass eel harvest. This is not an exclusive requirement, because there will be coastal regions with interest in eel aquaculture where preferred watershed features do not occur or are not easily demonstrated. In all cases, the applicant should demonstrate that the above three interests were prioritized and considered."*

Pursuant to Addendum V to the Interstate Fishery Management Plan for American Eel, the North Carolina Division of Marine Fisheries (NCDMF) is submitting the following Aquaculture Plan on behalf of the American Eel Farm (AEF) for approval. The NCDMF considered preferred watershed features when selecting approved harvest areas and watersheds, however within North Carolina's coastal region this is not easily demonstrated. Only one aquaculture operation, the American Eel Farm (AEF), has requested to be included in the Aquaculture Plan for consideration.

POUNDS REQUESTED

North Carolina requests to harvest 200 lb. of glass eels, the maximum amount allowed under the Aquaculture Plan provision of Addendum IV to the Interstate Fishery Management Plan for American Eel.

DATES OF HARVEST

Glass eels shall be harvested from November 1, through March 31, annually or until 200 lb. of glass eels are harvested, whichever occurs first.

DURATION OF HARVEST

The duration of harvest requested is for a two (2) year period. A renewal plan may be submitted by June 1, 2021 and at that time additional harvest years may be requested along with any modifications deemed necessary to ensure the success and continued approval of the plan. The division will update the Board annually concerning status of and compliance with the plan.

METHOD OF HARVEST

NCDMF will limit the number of individuals authorized to harvest under this plan (3 individuals). Glass eels shall be harvested using either fyke nets, dip nets or Irish eel ladders. Fyke nets shall be constructed as follows:

- Shall be thirty (30) feet or less in length from cod end to either wing tip (net length equals the wing length plus the distance from throat to cod end)
- Shall be fitted with netting that measures 1/8-inch bar mesh or less
- Shall contain a ½-inch or less bar mesh excluder panel that covers the entrance of the net
- Shall have no more than two funnels, one cod end, and two wings

Dip nets shall be constructed as follows:

- Shall be no more than 30 inches wide at the widest point of the net mouth
- Shall be fitted with netting that measures 1/8-inch bar mesh or less

Irish eel ladders:

- Location and construction shall need NCDMF final approval (see Appendix I for design details)

To mitigate the harvest of elvers (fully pigmented eels), all captured eels shall be graded upon capture on the water using a 1/8-inch bar mesh non-stretchable grading screen and any eels that fail to pass through the screen will be immediately returned to the water where captured. Any eels that pass through the screen can be harvested and would then count toward the 200 lb. annual glass eel harvest limit.

THE CURRENT AND PAST STATUS FOR AQUACULTURE PURPOSES

For more than three or four decades, nearly 100% of our nations' natural resource of glass eels have been exported overseas to the Asian markets with most of these eels being placed in Chinese fish farms for grow out. Products are then made (mostly kabiaki unagi) and sent back to the US. There have been many cases over the years where the Food and Drug Administration (FDA) has banned eel products due to unapproved growth hormones as well as other unapproved chemicals being found when tested.

American Eel Farm (formally North Carolina Eel Farm) has been the only exception. Throughout the early to the late 2000's glass eels were purchased from Maine fisherman and brought to the farm for grow out. There was a time when the former owner paid just $60/pound.

Currently, nearly 100% of the glass eels harvested in Maine and South Carolina are exported. Limited grow out data on any commercial level is being collected, limited value-added job opportunities for US employees are realized, and limited US markets are being developed.

MINIMAL CONTRIBUTION

While we have no quantitative data on the abundance of glass eels, it could be argued the harvest of 200 lb. of glass eels is limited enough to have a minimal impact on the spawning stock of American eel (see Appendix II). Natural mortality is thought to be very high during the early life stages (leptocephalus, glass eel, and elver) due to the high fecundity of American eel (ASMFC 2000, 2012). Assuming a mortality rate of ~97-98% of the 200 lb. of glass eels proposed to be harvested, approximately 195 lb. would otherwise perish naturally in the wild.

The American eel has a broad geographic distribution range from the Caribbean to Canada and is found in many US interior states as well. It is well known that globally there is no successful commercial hatchery for the *Anguilla rostrata.* It is also accepted by the scientific community that the species dates well back in history and has the characteristic of panmixia (*Conclusive evidence for panmixia in the American eel, Cote). Anguilla rostrata's* panmictic population allows for all individuals to be a potential partner. This provides for a very large single biomass spanning along the entire eastern seaboard of the US.

ATLANTIC SEABOARD WATERSHED

The **Atlantic seaboard watershed** is a watershed of North America along both:

- The Atlantic Canada (Maritimes) coast south of the Gulf of Saint Lawrence Watershed, and
- The East Coast of the United States north of the watershed of the Okeechobee Waterway. The relatively narrow continental area is demarcated on the south by drainage to the Okeechobee Waterway (which drains both westward to the Gulf and eastward to ocean), the Eastern Continental Divide (ECD) to the west, and the Saint Lawrence divide to the north. US physiographic regions of this watershed are the Atlantic Plain and the Appalachian Mountains & Highlands. Major sub-watersheds of the Atlantic Seaboard are the following (north-to-south):

Sub-watersheds adjacent to the Saint Lawrence divide

- Chedabucto Bay: 2,148 square miles (5,560 km^2)
- Gulf of Maine: 69,115 square miles (179,010 km^2)

- Long Island Sound: 16,246 square miles (42,080 km^2)
- Lower New York Bay: >14,000 square miles (36,000 km^2)

Other notable sub-watersheds

- Delaware Bay: 14,119 square miles (36,570 km^2) — larger than several, but not adjacent to either divide
- Chesapeake Bay: 64,299 square miles (166,530 km^2) — adjacent to both divides (at the Triple Divide point)

Sub-watersheds adjacent to the Eastern Continental Divide

- Albemarle Sound: >14,380 square miles (37,200 km^2)
- Winyah Bay: >7,221 square miles (18,700 km^2)
- Santee River: >4,531 square miles (11,740 km^2)
- Savannah River: 9,850 square miles (25,500 km^2)
- St. Johns River: 8,840 square miles (22,900 km^2)
- Biscayne Bay: >2,800 square miles (7,300 km^2)
- Kissimmee River: >3,000 square miles (7,800 km^2)

The catch data of the American eel shows that the majority of wild caught adults come from the Chesapeake Bay and the Delaware Bay water basins. The figure is about 800,000 pounds per year from both. Catch data also reflects that the overwhelming majority of glass eels are harvested in Maine from the Gulf of Maine watershed. Any harvesting in the North Carolina watershed of Albemarle Sound for glass eels would clearly have little impact on the biomass migrating along the eastern seaboard with help from the Gulf Stream and Labrador currents.

Additionally, it is understood that the voting members of ASMFC took into consideration that all states may have applications for an aquaculture quota and included that language in Addendum IV. The language was revised in Addendum V. That would be a total of 3,000 pounds harvested from the biomass migrating out of the Sargasso Sea. Currently there are only two ASMFC approved aquaculture plans (North Carolina and Maine). Primarily due to the ideal conditions for aquaculture that exist in the southeast and specifically the state of North Carolina.

LOCATION OF HARVEST

North Carolina's internal waters are classified as either inland, joint or coastal fishing waters. The North Carolina Marine Fisheries Commission (NCMFC) and NCDMF have jurisdiction of coastal waters while the North Carolina Wildlife Resources Commission (NCWRC) has jurisdiction of inland waters and both agencies (NCWRC and NCMFC/NCDMF) have authority within joint waters. Other than a few specific regulations, none of which pertain to American eel, commercial activities and recreational activities using commercial gear (devices) occurring in joint waters is under the jurisdiction of the NCMFC/NCDMF. For the purposes of this plan, all glass eel harvest will be restricted to either coastal or joint waters.

GLASS EEL HARVEST SITES

1.) Albemarle Sound and tributaries
2.) Pamlico Sound and tributaries
3.) Newport River and tributaries
4.) North River and tributaries

NCDMF MONITORING PROGRAM

In addition to Aquaculture Operations/Collection General Permit Conditions in rule (NCMFC Rule 15A NCAC 03O .0502) and Aquaculture Operations/Collection Specific Permit Conditions (NCMFC Rule 15A NCAC 03O .0503F), to monitor and regulate the harvest of glass eels, the NCDMF will issue an Aquaculture Collection Permit (ACP) to the AEF with additional permit conditions specific to the N.C. Aquaculture Plan that only apply while engaged in glass eel harvest (ACP) or grow out (AOP) activities authorized under the N.C. Aquaculture Plan for American Eel. To aid in monitoring and enforcement the NCDMF will limit the number of individuals authorized to harvest under the ACP (3 individuals). The permittee listed on the ACP must possess a valid North Carolina Standard Commercial Fishing License (SCFL) or Retired Standard Commercial Fishing License (RSCFL) issued by the NCDMF. The permittee listed on the ACP shall provide names and licensing data for all designees in the harvest of glass eels. Any vessels used for glass eel harvest under the ACP shall have a valid North Carolina Commercial Fishing Vessel Registration (CFVR) issued by the NCDMF. Restrictions will be placed on the ACP requiring certain conditions and procedures to be followed, such as:

GENERAL CONDITIONS

- Glass eels harvested from N.C. coastal fishing waters shall not be exported or sold until they reach the minimum legal size of nine inches total length.
- No more than one (1) permittee and two (2) designees shall be authorized to harvest under the ACP.
- No more than two (2) mates will be allowed to assist the permittee or designees while fishing for glass eels.
- The permittee/designee(s) and any vessel participating in the glass eel harvest must be properly licensed by the NCDMF and abide by all fisheries rules and permit conditions.
- Fyke nets, dip nets, and Irish eel ladders are the only gear authorized to use for glass eel harvest under the ACP.
- No more than thirty (30) fyke nets and/or dip nets and/or Irish eel ladders in any combination may be fished by the permittee/designee(s) under the ACP.
- A fyke net may not be placed within fifty (50) feet of any part of another fyke net.
- November 1 through March 31, fyke and dip nets for glass eel harvest may be fished at all hours during the week. Fyke nets may have their cod ends closed during the day, however from 3:00 pm on Friday through 3:00 pm on Sunday fyke nets may remain in the water but the terminal portion of a fyke net cod end shall contain a rigid device with an opening not less than three (3) inches in diameter and not exceeding eight (8) inches in length that is not obstructed by any other portion of the net and dip nets may not be used. This creates a 48-hour rest period to allow glass eels to migrate up these smaller systems to help minimize the impact to the spawning stock.
- Immediately report to NCDMF if a net is tampered with and location of the net and the date and time it was noticed.
- Report to NCDMF when each fyke net is removed from the water. If a net is moved, the new coordinates must be reported once the net is reset. If multiple nets are moved the same day, coordinates may be provided once all the nets have been reset. If a net(s) is removed and not reset, it must be reported upon returning to the landing site.
- Purchased American eels (glass eels, elvers, or yellow eels) shall be kept separate from eels that were harvested as glass eels within N.C. and grown out to yellow eels.

- All gear and harvest restrictions detailed in the Method of Harvest section will be listed as conditions under the ACP.
- Catch per unit effort (CPUE) data will be collected for each piece of gear. Information collected will include: approximate time the gear began and ended fishing and the actual number or weight (includes water weight) to the nearest 0.1 pounds of glass eels harvested, and for dip nets the number used. All CPUE data will be required to be reported to the eel biologist for the previous weeks effort and harvest by 5:00 pm the following Saturday.

BEFORE HARVEST

Fishermen harvesting glass eels under the ACP shall call-in to NCDMF the following information:

- Daily:
    - o Landing site they will be leaving from and returning to once fishing activity is complete.
    - o Number of fyke nets, dip nets, and Irish eel ladders that will be used and their assigned net ID number (net numbers used may also be reported after the harvest.
    - o Names of individual(s) involved shall be reported at the beginning of the season and any changes or additions would be immediately reported.
    - o Description and registration number of the boat(s) to be used for harvest shall require a one time and report and if any changes occur they would need to be reported.
    - o Description and license plate number of the vehicle(s) to be used for harvest shall require a one time and report and if any changes occur they would need to be reported.

DURING HARVEST

- Require the use of a 1/8-inch bar mesh non-stretchable mesh grading screen to cull the glass eels at the harvest site to limit the harvest of elvers

AFTER HARVEST

Fishermen harvesting glass eels under the ACP shall call-in or email to NCDMF the following information:

- Daily:
    - o GPS coordinates of each net once they are set, if multiple nets are set the same day, coordinates can be provided once all the nets have been set.
    - o Require AEF to call-in to NCDMF with the total harvest in pounds (or actual number of glass eels if weighing is impractical) prior to leaving the landing site. Zero pounds shall only be reported if no glass eels are harvested.
    - o Require AEF to call-in or email to NCDMF by 5:00 pm each day the total harvest for the previous day in pounds to the nearest 0.1 lb. of glass eels (or actual

number of glass eels if weighing is impractical) received (including those days when no glass eel harvest occurred). Zero pounds shall only be reported if no glass eels are harvested and received.

- Require AEF to hold all glass eels that perish during transport to the facility and all eels that perish in the facility for inspection.
- All glass eels that perish during transport will count against the 200 lb. harvest limit.

The above conditions and procedures will allow the NCDMF to limit the effort (amount of gear and number of individuals) involved in glass eel harvest under the Aquaculture Plan. These controls will allow the NCDMF to ensure the glass eel harvest does not exceed what is authorized in the Aquaculture Plan. Any glass eels captured that exceeds the 200 lb. harvest limit shall be immediately returned to the water where captured.

ENFORCEMENT CAPABILITIES AND PENALTIES FOR VIOLATIONS

Violations of the ACP permit conditions will be addressed according to the NCDMF SOP for Permit Violations and suspensions will be carried out in accordance with NCMFC Rule 15A NCAC 03O .0504 (see Appendix III).

All charges for violations will be charged under N.C. General Statute § 113-187 (d) (4): Violating the provisions of a special permit or gear license issued by the Department. All fines will be at the discretion of the court; however, fines may not always be levied for the first offense.

The call-in requirements under the Monitoring Program section will allow enforcement officers to know when and where lawful harvest is occurring. It will also allow for random inspections to take place at the harvest and landing sites to ensure the conditions of the permit and all applicable NCMFC rules and regulations are being followed. Random inspections will also be performed at the aquaculture facility to ensure the proper records are being kept to account for all eels in the facility as required under N.C. General Statute § 113-170.3 and NCMFC Rule 15A NCAC 03O .0502 (8) (see Appendix IV).

SIZE LIMIT EXEMPTION

The intent is to raise the eels as close as possible to the legal minimum size of 9 inches total length prior to sale. Given the difficulty in measuring live eels, prior to sale, all eels shall be graded using a ½-inch by ½-inch non-stretchable mesh grading screen. Any eels that do not pass through the grading screen may be sold and any that pass through the grading screen shall remain in the possession of the AEF until such time as the eels are large enough to not pass through the grading screen. On inspection, a 10% tolerance by number will be allowed for eels that pass through the grading screen.

PRIOR APPROVAL OF PERMITS

The AEF has all necessary permit approvals in place with the exception of an Aquaculture Collection Permit from the NCDMF. This permit will be issued upon approval of the Aquaculture Plan by the ASMFC American Eel Management Board. The permits currently held by the AEF are:

- North Carolina Department of Agriculture Aquaculture Operation Permit valid until 2022
- North Carolina Division of Marine Fisheries Aquaculture Operation Permit renewed annually. To be eligible for an ACP, an Aquaculture Operation Permit is required (see Appendix V: NC Marine Fisheries Commission (NCMFC) Rule 15A NCAC 03O .0501 (e))
- North Carolina Division of Marine Fisheries Standard Commercial Fishing License
- North Carolina Division of Marine Fisheries Dealer License

As noted in NCMFC Rule 15A NCAC 03O .0501 the appropriate licenses from the Division of Marine Fisheries must be held by the permittee. A North Carolina Standard Commercial Fishing license is required to fish commercial gear such as fyke nets, a Commercial Fishing Vessel Registration (CFVR) is required for vessels used to harvest seafood and a Dealer License is required to sell fish taken from the coastal fishing waters.

DESCRIPTION OF THE MARKET

The AEF indicated they have identified clients for food and bait markets domestically as well as overseas. The long-term intent is to develop and expand the US domestic market as much as possible. For proprietary business reasons, specific details were not provided.

DESCRIPTION OF THE FACILITY

American Eel Farm
1633 NC HWY 41 West
Trenton, NC 28585

History, Design, Capacities and Technical Facts

The AEF, located in Trenton, North Carolina, is a state-of-the-art Recirculated Aquaculture System (RAS) which has been operating since 2003

Below are two You Tube links that show videos of the facility:

https://www.youtube.com/watch?v=4YnQn7aivw4

https://www.youtube.com/watch?v=1wUiwmzO-TI

It is a proven Danish system designed overseas by Inter-Aqua Advance for eel grow-out and imported to the US by William Bokolar and Marty Bouw to US into the state of VA. The state of VA granted an 800 kilogram harvester permit for glass eels in 1999 as outlined in the ASMFC American eel April 2000 FMP Report #36 for this facility.

The AEF was initially operated in North Carolina as the North Carolina Eel Farm (corporate filing date May 21, 2002). It was purchased from the original owners by George Koonce and transported to Jones County. The original location suffered hurricane damage and was moved to its current location. The facility has a 15-year operation history in North Carolina. There is no other facility specifically designed to grow out glass eels to yellow eels at a commercial level in

NC. The facility has the capacity to easily grow-out in excess of 900 pounds of glass eels. There is historical proprietary data on a large scale commercial level that no current fish farm, University, or government agency in the US can match.

The facility has three separate closed recirculating systems. The two main systems are identical RAS units each containing twelve (12) 1,000 gallon tanks and independent water treatment systems for both RAS units. Each RAS contains twelve (12) raceway tanks with 900 US usable gallons. Water is purified, restructured and super oxygenated.

Raceway Tanks

Each section contains 12 raceway tanks. The facility has two separate treatment sections and 2 10,000 gal temporary storage tanks with filtration and aeration. Each raceway tank is equipped with a fine screen outlet complete with a tertiary motorized brush system, to keep the mesh clean. In each tank, there are also level switches that give alarm for high water level. These large rectangular fiberglass tanks hold about 1,000 gallons of water. Here is the home of the eels while we are their stewards.

Each tank is outfitted with aeration provided by large Sweetwater pumps and back-up emergency oxygen lines which automatically activate in case of a power outage. Each tank also can be isolated from the system and individually cleaned if necessary without draining the entire system.

There are three automatic feeders for the first three tanks that are ideal for the small eels. As they are graded the larger eels can be fed by hand or additional automatic feeders can be installed.

Monitoring Systems

There is a new Pacific Oxyguard water quality monitoring system that monitors pH, oxygen saturation levels, water levels and temperature. The system can send alarms remotely and is programmed to call a farm manager’s cell phone as well as four other programmed numbers if any levels drop or change as per settings logged into system. The system can be expanded by adding more test probes and programming if desired.

This system design is based on proven *Anguilla anguilla*, *A. mossambica*, *A. bicolor* and *A. marmorata* aquaculture techniques. The systems are technically sound, energy efficient, and easy to operate. The system has been successful with American eels as proven by recorded growth rates, low food conversions and low incidence of disease and mortality.

Mechanical Filtration

Attached to those 24 tanks is a complete water treatment unit equipped with a HydroTech drum filter type 803 / 40-micron mechanical filtration unit. This unit has a max flow of 31,500 gal/hour or 63,000 gal/hour if both sections are in operation. The two drum filters sieve feces and other large particles out of the water. The filters are continuously sprayed (adjustable timing possible) with water to self-clean. The waste water runoff from this event drains into a small channel within the drum filter and then drains into a system pipe which gravity feeds into the main channel in the tank room that runs the full distance from tank #1 to tank #24 where the waste water is then pumped into a small settling pond on the property by a sump pump through a 12 inch PVC drain pipe.

Biological Filtration

After mechanical filtration, water is gravity fed into 2 parallel 18-foot-tall silos (four total for both sections) with patented Inter Aqua Advance (IAA) A/S Moving Bed Bio Reactor (MBBR) technology for biological treatment of the water (removal of ammonia and dissolved organic matter). Each silo has a volume of 1,300 gallons and is 55% filled with IAA bio-curler bio media. This technology is superior to simple trickling filter bioreactors in that the attached blower motors run constantly to keep the media moving. This also acts as a self-cleaning process within the silos and contributes to the CO_2 stripping process. Nitrifying bacteria create a film on the media and converts ammonia to a nitrate. It is safe for the fish and excellent for growing plants.

With an optimum temperature for the growth of the eel at 24 degrees C. or 74 degrees F, the water treatment unit will be able to handle up to 250 lb. dry feed per day per section (500 lb. per day total). After the MBBR water flows by gravity into a common pump sump.

The water can be circulated with 3 separate pumps (per section, 6 pumps total), one 3 HP Low Head main pump and two 3 HP medium pressure pumps with 20 psi into two oxygen-cones (per section 4 total) for supersaturating of liquid oxygen into the water. In total the 3 pumps give a minimum flow capacity of 31,500 gal/hour (63,000 gal/hour total).

CO^2 Stripper

There is a carbon dioxide stripper for tanks #1 - #24 which has counter flow packed tower technology and utilizes structured packing of vacuum formed sheets of PVC. These packings will provide maximum wettability, thereby maximizing the stripping effort.

Ultraviolet Lighting (UV)

Water flows through the center of a cylindrical housing. The water passes through the device and the UV lighting assists in disinfecting the water by destabilizing the DNA of germicidal bacteria The water is surrounded by UV bulbs in special waterproof housings. The DNA in the bacteria is "blown-up". The UV system has recently had the bulbs updated. However, there have been reports that a UV disinfection system is not needed with eels so this system may be reconsidered.

Super Oxygenation

The water is injected through a top mount opening into 10 foot tall oxygen cones (4 total). As it spills into the pool below a vortex is created and splashing occurs. The water is restructured as bubbles are produced. Liquid Oxygen is injected into these bubbles under 20 PSI pressure (PV=nPT). There is a back-up liquid oxygen system tied into the main oxygen source with two air stones per raceway as a safety net. It is serviced simply by attaching the flow meter to a large liquid oxygen tanks. Should there be the need, the main liquid oxygen source would back feed the 26 tanks with 150 PSI automatically.

Water Supply

The system is supported by three deep water wells all of which are operable and are wired with three phase wiring for better conservation as well as on independent breakers so as to always allow for a water source to be actively supplying water. One is about 300 feet deep and the other two about 200 feet deep. Jones County is part of the North Atlantic Coastal Plain aquifer and is conveniently located where the Castle Hayne, Pee Dee and Black Creek aquifers intersect. Additionally, there is public water tied into the facility.

Water Softening System

There is a large commercial grade water softening system that all water passes through prior to entering any portion of the facility. The purpose is to change the molecular structure of the Ferrous Iron from the ground water to prevent it from becoming Ferric Iron once oxidized. The rust colored sediment that can cause operating issues.

Valve System

The facility has many valves which assist in directing water flow. This enables the operator to isolate any section, component or well source.

There is 440 volt electric service at pole. There is a heating system that can heat the water entering from the wells prior to entering the main water source if needed by passing heated water through several tubes mounted in the well reserve tanks for both sections. These well reserve tanks are equipped with automated on/off valves allowing water to be called automatically from the well when the water level reaches a preset level.

The water is distributed back to the raceway tanks via a common pipe manifold situated on the wall at the end of the tanks, with a separate valve to each tank for maintenance. A flow rate of 31,500 gal/hour (per system or 63,000 gal/hour total) will give an exchange rate of 3 to 5 times/hour to maintain self-cleaning and an adequate oxygen level in the raceway.

There is a third system which has two large 9,000 gallon tanks supported by similar filtration, aeration and small bio-reactors. This system is separate from the other two. Total capacity for AEF is about 50,000 gallons with about 40,000 being usable. Additionally, there is plenty of room to expand on the flat 2-acre site on which the facility is located. With 226 days a year of sun and a mean annual temperature of 70 degrees there is also a great opportunity to develop a medium to large scale aquaponics system on site.

In addition to the main tank room and the state-of-the-art water treatment room there is a main office area, sales office area, employee dinning, a furnished residential area, a full bathroom with laundry, a feed room, packaging room, a mechanical room, an electrical room, storage rooms and two large covered exterior areas - one at 15 X 85 feet and the other at 15 X 50 feet. The grounds are gated and there is a security system with 16 infrared cameras capable of being viewed remotely. The facility has cable connections for internet and TV as well as two satellites for backup. The steel building construction is insulated with pressed foam to help minimize temperature fluctuations on hot or cool days. The roof was replaced with a steel roof about six years ago. There is a heating system but it is not necessary to use when system is running due to local climate and the ground water temp of 68 degrees.

With the general geographic location being the Southeast USA along with the well-insulated building the water temperature for maximum growth rate could be efficiently maintained. Trenton, NC has a climate that is very suitable to aquaculture/agriculture in general. The annual average mean temperature is 70 degrees where the ideal temp for grow-out of eels is 74 degrees. There is no snow fall (very rare) and few days below freezing (very rare).

Eel Grow Out

Eels can be stocked in high densities in the raceway tanks. Stocking densities of 300 kg/m^3 or 2(+) lb./gal are often seen in eel farms. It is estimated that juvenile eels have an oxygen demand of 300 mg/kg/hour. The liquid oxygen system at the AEF is sufficient to reduce mortality and sustain eels in high densities. Estimated grow out time from the glass eel phase to 9 inches averages around 210 days. Individual eels grow at different rates so total grow out time will be longer. Due to the varying growth rates, it is estimated that one-third of the eels will be harvested in 5 - 7 months, another group will be harvested at 8 - 10 months, and the rest will be harvested at 11 - 12 months after harvest.

A large mobile stainless-steel grading machine in the main tank room will be used to grade the eels every four to six weeks. A well-managed RAS eel farm can expect a weaning rate of 80 - 90%. Eels feed ratio is greater than 1:1 in most studies depending on the amount of protein in the feed. There are studies in Japan and China that show a faster grow out however this outline is one the AEF is comfortable with.

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FIGURES

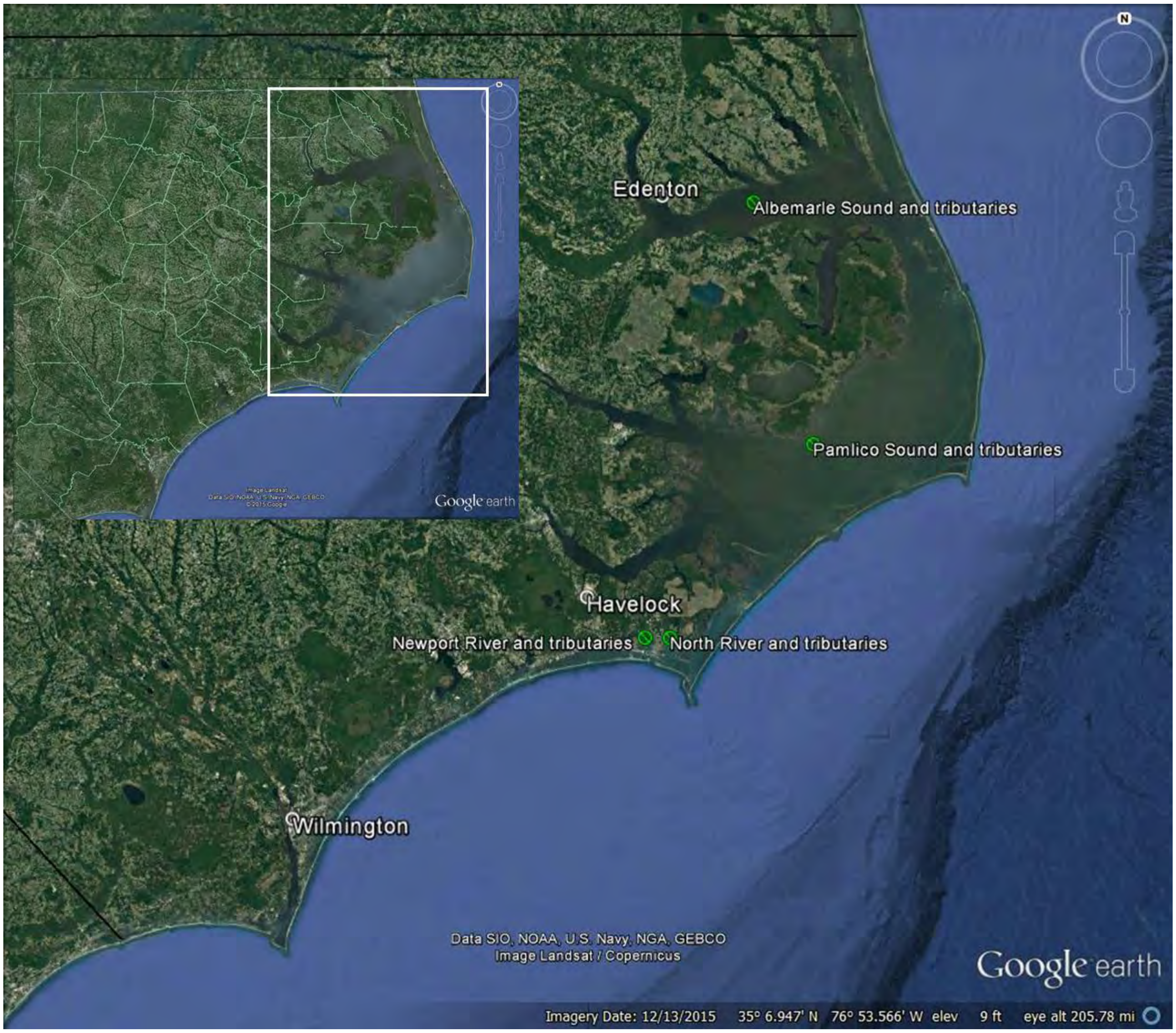
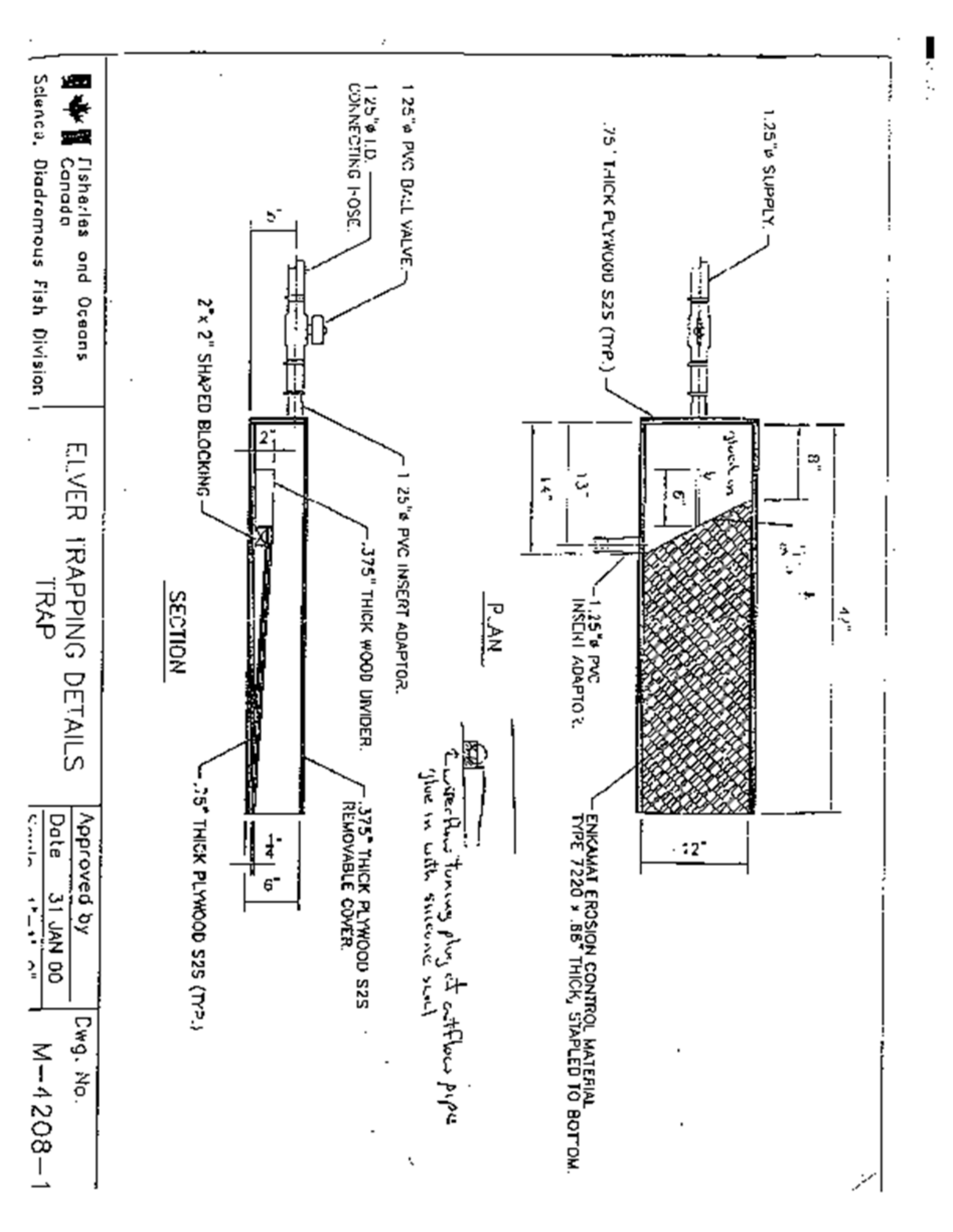


Figure 1. General location of proposed harvest areas (green circles) along the North Carolina coast.

APPENDIX I


1.25"ø SUPPLY.
.75" THICK PLYWOOD S2S (TYP.)
1.25"ø PVC INSERT ADAPTOR.
PLAN
ENKAMAT EROSION CONTROL MATERIAL TYPE 7220 x .66" THICK, STAPLED TO BOTTOM.
12"
8"
13"
14"
1.25"ø PVC BALL VALVE.
1.25"ø I.D. CONNECTING HOSE.
1.25"ø PVC INSERT ADAPTOR.
.375" THICK WOOD DIVIDER.
2"x 2" SHAPED BLOCKING
SECTION
.375" THICK PLYWOOD S2S REMOVABLE COVER.
.75" THICK PLYWOOD S2S (TYP.)
Fisheries and Oceans Canada
Science, Diadromous Fish Division
ELVER TRAPPING DETAILS TRAP
Approved by
Date 31 JAN 00
Dwg. No.
M-4208-1

APPENDIX II

TESTIMONY PRESENTED TO THE COMMITTEE ON MARINE RESOURCES RE: H.P. 137, AN ACT TO RESTRICT THE TAKING OF EELS LESS THAN 6 INCHES IN LENGTH FROM MAINE COASTAL WATERS (EMERGENCY)

by
James D. McCleave
February 23, 1995

INTRODUCTION

The purpose of my testimony is primarily to educate the members of the committee, other legislators and interested persons about the unique life cycle of a truly fascinating and somewhat mysterious fish, the American eel. The unusual life cycle has some important implications for management and conservation of this species, which are different than for most species of fishes. I will present several of these implications. Finally, I do offer an opinion on the soundness of this particular bill.

I am a Professor of Oceanography and a Cooperating Professor of Zoology at the University of Maine, where I have been since 1968. I have conducted research on the biology of the American eel and the European eel since the early 1970s and have published more than 25 scientific papers on them. I also teach about eels in my classes at the University, and I occasionally have participated in workshops on eels with my European colleagues. A copy of my résumé is appended.

I offer this testimony as a friend of the eel, an awesome fish, and as a friend of eel fishers of all types. It is not my intention to support one group of harvesters over another. My conclusions and opinions are biologically based. The economics of the eel fishing and aquaculture industries and the economic consequences of management decisions are left to the realm of other experts.

LIFE CYCLE OF THE AMERICAN EEL

American eels are highly migratory, with spawning and larval development occurring in the ocean, and feeding and growth occurring in estuaries and fresh waters (rivers, streams, ponds, and lakes) [catadromous life cycle].[1] Spawning occurs near the surface over very deep water in a large area of the Sargasso Sea (Figure 1) and only there, meaning there is a single breeding population for the species. The Sargasso Sea is a large portion of the western North Atlantic Ocean east of the Bahamas and south of Bermuda. Spawning occurs in winter. Eggs hatch in a day or two in the warm water, releasing a long-lived larval stage [leptocephalus], which is flattened from side-to-side and shaped somewhat like a willow leaf. The leptocephali drift and swim in the upper few hundred feet of the

How do they know?

[1]My language is intended to be understood by the nonspecialist. However, the appropriate scientific terms are included in brackets for completeness and to allow direct reference later in the document.

ocean for several months, growing slowly to a length of 2-2.5 inches. The leptocephali dramatically alter their shape [metamorphose] to resemble a miniature, transparent eel, called a glass eel, during the subsequent autumn and winter. This metamorphosis occurs at sea, perhaps near the edge of the continental shelf. The glass eels enter estuaries and ascend rivers during winter and spring, earlier at the southern end of their range, later at the northern end. (My research group at the University of Maine has contributed substantially to this knowledge.) It is during the spring ascent that glass eels, sometimes termed elvers, are harvested commercially in Maine. yr later

The glass eels in estuaries and fresh waters rapidly develop rather drab pigmentation in their skin, dark on the back and often yellowish on the belly, leading to the name yellow eel for this stage. Growth is generally slow, and yellow eels spend several years in estuaries and inland waters. Growth and age at maturity are not well known. Males probably remain as yellow eels for 4-6 years or more, and grow to about 12-18 inches or so. Females remain as yellow eels for many more years, probably 6-20 years in New England and the Maritime Provinces. During this growth period, yellow eels are fished commercially in estuarine and fresh waters, using baited traps or pots.

During late summer and early autumn, maturing yellow eels undergo a second metamorphosis in preparation for a migration to sea to spawn. The pigment on the belly frequently becomes an iridescent silvery, leading to the term silver eel. Silver eels migrate from fresh waters and estuaries to sea in late summer and autumn in the northern part of their range, including Maine, and later in the southern part of the range. During this migration in Maine, silver eels are fished commercially in fixed weirs or nets set across streams and rivers.

Silver eels migrate to the Sargasso Sea, *spawn once and die*. Little is known of this migration or actual spawning, but it seems likely that autumn migrants are the spawners of the subsequent winter. Evidence of the timing and location of spawning comes from the distribution in space and time of small leptocephali. (My research group at the University of Maine has contributed substantially to this knowledge.)

The yellow stage of the American eel ranges from the eastern Gulf of Mexico, all along the east coast of the US, through the states and provinces bordering the Gulf of Maine, to the states and provinces bordering the Gulf of St. Lawrence, to Newfoundland and Labrador. Yet all spawning of the resulting silver eels occurs in the Sargasso Sea.

POINTS OF EMPHASIS FROM THE LIFE CYCLE

- There is a single breeding population for the entire species regardless of where the yellow eels resided [panmixis]. All genetic evidence suggests that a female from Maine is as likely to spawn with a male from Georgia as with a male from Nova Scotia.
  - This means there is no 'homing' of offspring from eels of the Penobscot or Kennebec Rivers to those rivers.

- Glass eels entering the Maine rivers are just the same genetically as those entering elsewhere within the range.

- There is a single spawning by a female in her lifetime [semelparity]. An adult female may have to grow for 15 years before reaching maturity and spawning *once*.

- Females develop large numbers of eggs [high fecundity], probably 400,000-3,000,000 eggs per female increasing with female size.

- Nearly all the eggs produced by a female and fertilized by a male will die before reaching maturity [high mortality]. This is natural in fecund species; otherwise the earth would be covered with eels.

- Females are much larger at sexual maturity than males [sexual dimorphism].
  - Most females are larger than 20 inches (50 cm) at maturity.
  - Most males are less than 18 inches (45 cm) at maturity.

- Determination of whether an eel becomes a male or female is not completely under genetic (chromosomal) control, but the process of sexual determination is not fully understood.

HYPOTHESES RELEVANT TO CONSERVATION

There are two hypotheses, for which there is some scientific evidence, which are important to decisions on conservation of the species. Both hypotheses follow logically from an overriding hypothesis that eels encountering more productive waters have a greater tendency to become males, while those encountering less productive waters have a greater tendency to become females. (There is a body of life history theory that supports this different life history strategy for males and females.)

- There is a gradual increase in the proportion of eels that become females from the estuary toward the headwater streams, i.e. increasing up a given drainage. Within a river drainage, more productive waters are generally found in the lower reaches, especially the estuary.
  - If correct, this means that Merrymeeting Bay has a lower proportion of females than the higher waters of the Kennebec River.

- There is a gradual increase in the proportion of eels that become females from the southern part of the range to the northern part of the range [a cline]. Along the range of the eel, more productive waters are generally found to the south, less productive waters to the north, including Maine.

- If correct, this means that Maine is likely to have a greater proportion of female eels within its population than, say, Georgia.

MY OPINION ON EEL MANAGEMENT-CONSERVATION

Because of the wide range of the species, and because the species is a single breeding population, one political jurisdiction alone cannot conserve the species. However, Maine can act responsibly from an understanding of the eel's life history.

I will now argue against this bill. The first line of reasoning is on the basis of prudent interpretation of the implications of the life cycle. The second line of reasoning is on the basis of a scenario for interpretation of the high fecundity-high mortality consequences in this species.

From both lines of reasoning, I am led to the conclusion that *there is no biological basis underlying the restriction of harvest proposed by this legislation*. For certain, in my mind, there is *no emergency*. This is not to state that development of sound management and conservation practices are not needed.

IMPLICATIONS FROM THE LIFE CYCLE

In a one-time spawning [semelparous], fecund species with a long lifetime before that one reproduction, prudent conservation strategy would increasingly protect females the closer they get to reproduction. Mortality is high in a fecund species, but the rate of mortality declines exponentially with size. Mortality rate in leptocephali must be enormous; mortality rate in glass eels must be enormous as well. However, mortality rate in females larger than, say, 15 inches is probably very low. (Here I refer to natural mortality, not mortality from people's activities of fishing, damming, polluting, etc.)

Maine, acting in prudent fashion, might choose to protect preferentially maturing females. I stress females because only females produce young. One male may mate with many females, but only females bear eggs.

If the cline in increasing proportion of females from south to north is correct, Maine and the Maritime Provinces might give increased thought to protecting females. A greater proportion of the reproductive potential may be in the northern part of the species' range.

If there is an increasing proportion of females farther up a drainage, it may be prudent to harvest differentially fewer eels farther up drainages.

Weir fisheries, pot fisheries with mesh-size limits, and eel-size limits all shift the harvest toward a greater percentage of females. Because of the sexual dimorphism, the larger the mesh or the larger the size limit, the greater the pressure is transferred to prereproductive females. Further, because females are longer lived than males, greater fishing pressure is transferred to prereproductive females. This is exactly opposite from the desirable effect. It is more logical, if anything, to place a maximum size limit on the harvest of eels. Such a measure is clearly against conventional wisdom for managing fishes, but this is an unconventional species.

States and provinces that do not allow weir fisheries prudently protect females, whether they know it or not. Only Maine and, to a very limited degree, New York allow weir fisheries for eels.

Likewise, states and provinces that restrict commercial fishing in fresh waters prudently protect females, whether they know it or not. Most states have a substantial or complete restriction on such fishing. Not Maine.

On the other hand, most states and provinces have minimum size limits on commercial eel harvest, generally 4 inches, 6 inches or 8 inches. I do not believe these jurisdictions made those regulations on any basis other than transfer of practices from management of other species, such as trout or bass. In the extreme, Prince Edward Island has a minimum size limit of 18 inches for eels. Other Maritime Provinces are considering similar regulations. This practice would ensure that nearly all harvested eels would be females, a completely counterproductive measure.

Just because other jurisdictions have similar regulation, we should not make the assumption that the regulations have biological basis. Maine should strive gain the information necessary to base regulations in accord with the life cycle of the eel.

IMPLICATIONS FROM MORTALITY RATES

Management of commercial and recreational harvest of fishes (or tolerance of dams and pollution) has always been based on the assumption that there are compensatory mechanisms within the biology of the species, i.e. mechanisms that allow increased survival or increased reproduction of the nonharvested individuals, so the population does not decline. This is the concept of sustainable yield. The key to success of this approach is to understand what the compensatory mechanisms are and when they occur in the life cycle with respect to when harvest occurs.

Again, the eel is unique because of its high-fecundity, high-mortality characteristic. It seems unlikely to me that major compensatory mechanisms are to be found in the oceanic stages of the life cycle. The leptocephali probably have the highest mortality. Food limitation and inability to reach the continental shelf may be the critical factors, neither of which is under control of the leptocephali. Silver eels on migration to the Sargasso Sea to spawn probably have the lowest mortality, and they also have little opportunity for compensating mortality earlier in the life cycle.

In the elver-yellow eel stages, there is high mortality, but there is also the greatest likelihood of compensatory mechanisms for added mortality due to human activities. Because this is the growth phase, competition for food may occur among individual eels, causing starvation or at least slowing the growth. Reduced density of eels *may* result in higher survival, greater growth rate, and perhaps higher fecundity. On the other hand, not all outcomes of reduced density are predictable. Because the mechanisms of gender determination are not known for eels, reduced density could increase the ratio of females to males (a positive compensatory mechanism) or decrease the ratio of females to males (a negative compensatory effect). However, most density-dependent effects are negative and have positive compensatory mechanisms.

I illustrate the subtle effects of compensatory mechanisms with a *hypothetical* numerical example. For the example, assume an average female has a fecundity of 1,000,000 eggs. Only one female and (less than) one male need to survive from those million eggs and reproduce to maintain a stable population. In the first scenario, I assume there is a compensatory mechanism for harvesting that can occur anytime after harvesting, regardless of when the harvesting occurs. In the second scenario, I assume there is a slightly greater compensatory mechanism in the yellow eel stage (likely, as described above).

- Scenario 1. Minor compensatory mechanism any time.
  - Fecundity 1,000,000 eggs produced by average female.
  - Assume 99.9% die at sea as leptocephali, leaving 1,000 glass eels.
  - Assume 99.2% of those die becoming silver eels, leaving 8 to migrate seaward.
  - Assume a <u>harvest</u> of half the migrating silver eels (4), leaving 4 migrants.
  - Assume 50% of those die, leaving 2 successful spawners.

  - Fecundity 1,000,000 eggs.
  - 99.9% die as leptocephali, leaving 1,000 glass eels.
  - <u>Harvest</u> half the migrating glass eels, leaving 500.
  - 99.2% die before becoming silver eels, leaving 4 to migrate.
  - 50% of those die leaving 2 successful spawners.

  - Conclusion: In this scenario, it does not matter when in the life cycle eels are harvested as long as the allowed harvest is set by actual mortality rates, rather than the hypothetical ones used in the examples here. Alternatively, harvest of a combination of life stages is possible, again as long as actual mortality rates are applied.

- Scenario 2. Greater compensatory mechanism in yellow eel stage.
  - Fecundity 1,000,000 eggs.
  - 99.9% die as leptocephali, leaving 1,000 glass eels.
  - <u>Harvest</u> half the migrating glass eels, leaving 500.
  - Now, if there is compensation such that mortality is reduced in the yellow eels stage <u>by only 1%</u>, 98.2% die before becoming silver eels, leaving 9 to migrate seaward.
  - <u>Harvest</u> half the migrating silver eels (4 or 5), leaving 4 to migrate.

- ◇ 50% of those die leaving 2 successful spawners.
- ◇ Conclusion: In this scenario, harvest of glass eels has no effect on the harvest of silver eels because of a compensatory mechanism in the yellow eel stage. Again harvest size needs to be determined with actual mortality rates.

CONCLUSIONS

I conclude from the two previous sections that there is no biological basis for assuming that harvest of glass eels *per se* is detrimental to the conservation of the American eel. Under certain conditions, the harvest of glass eels could have less detrimental effect on conservation than harvest of silver eels. Under certain conditions, the harvest of glass eels could occur while having little or no detrimental effect on harvest of silver eels.

I also conclude that the current regulatory structure for eels in the States and Provinces in the eel's range is not based upon sound biological principles. However, unregulated or unsoundly regulated commercial fishing in Maine and other jurisdictions is distinctly unwise. By testifying in opposition to this bill, I am not implying that there is not cause for concern and for possible regulations on commercial fishing for eels.

SCIENTIFIC RECOMMENDATIONS FOR CONSERVATION AND MANAGEMENT

In the short term for decision making in Maine, the following steps are important.

- Mortality rates and sources of mortality in the glass eel, yellow eel and early silver eels stages need to be determined to allow estimates of how much harvest could be allowed in what stages of life without deleterious effect on the stock.
  - ◇ Determine sources and rates of natural mortality, and determine whether there is density-dependent mortality, which involves determination of food-webs and predator-prey relations.
  - ◇ Determine sources and rates of anthropogenic mortality at different stages, which includes fishing mortality and nonfishing mortality (fish passage at dams, pollution, hydroelectric turbines, etc.).

- Fishing mortality needs to be determined from the activities of the fishing industry.
  - ◇ A licensing system for fresh waters and tidal waters specific to commercial fishing for eels should be instituted.
  - ◇ A reporting system for commercial catches by life-cycle stage or gear needs to be associated with the licensing system.

- Growth rates of males and females and fecundity of females of various sizes needs to be determined to allow assesment of harvest practices on the reproductive potential of the migrants that do migrate to sea to spawn.

- The distribution of sex ratio throughout selected drainages needs to be determined to allow assessment of harvest practices on abundance of females and males.

In the long term for decision making over the geographic range of the eel, the following steps are important.

- The mechanism of gender determination in eels needs to be understood, so effects of harvest practice on sex ratios can be determined.

- The distribution of sex ratio over the geographic range needs to be determined, so harvest practice could be adjusted over the range as appropriate to the life cycle.

APPENDIX III

NC Marine Fisheries Commission Rule 15A NCAC 03O .0504:

15A NCAC 03O .0504 SUSPENSION/REVOCATION OF PERMITS

(a) For violation of specific permit conditions (as specified on the permit), permits may be suspended or revoked according to the following schedule:

- (1) violation of one specific condition in a three year period, permit shall be suspended for 10 days;
- (2) violation of two specific conditions in a three year period, permits shall be suspended for 30 days;
- (3) violation of three specific conditions in a three year period, permits shall be revoked for a period not less than six months.

If the permit condition violated is the refusal to provide information upon request by Division staff, either by telephone, in writing or in person, the Fisheries Director may suspend the permit. Such permit may be reinstated 10 days after the requested information is provided.

(b) All permits will be suspended or revoked when the permittee's license privilege has been suspended or revoked as set out in G.S. 113-171. The duration of the suspension or revocation shall be the same as the license suspension or revocation. In the event the person makes application for a new permit during any period of license suspension, no new permit will be issued during the suspension period. In case of revocation of license privileges, the minimum waiting period before application for a new permit to be considered will be six months.

(c) Permit designees shall not be permitted to participate in a permit operation during any period they are under license suspension or revocation.

(d) Upon service of a notice of suspension or revocation of a permit, it is unlawful to fail to surrender any permit so suspended or revoked.

APPENDIX IV

NC General Statute 113-170.3:

G.S. 113-170.3. Record-keeping requirements.

(a) The Commission may require all licensees under this Article to keep and to exhibit upon the request of an authorized agent of the Department records and accounts as may be necessary to the equitable and efficient administration and enforcement of this Article. In addition, licensees may be required to keep additional information of a statistical nature or relating to location of catch as may be needed to determine conservation policy. Records and accounts required to be kept must be preserved for inspection for not less than three years.

(b) It is unlawful for any licensee to refuse or to neglect without justifiable excuse to keep records and accounts as may be reasonably required. The Department may distribute forms to licensees to aid in securing compliance with its requirements, or it may inform licensees of requirements in other effective ways such as distributing memoranda and sending agents of the Department to consult with licensees who have been remiss. Detailed forms or descriptions of records, accounts, collection and inspection procedures, and the like that reasonably implement the objectives of this Article need not be embodied in rules of the Commission in order to be validly required.

(c) The following records collected and compiled by the Department shall not be considered public records within the meaning of Chapter 132 of the General Statutes, but shall be confidential and shall be used only for the equitable and efficient administration and enforcement of this Article or for determining conservation policy, and shall not be disclosed except when required by the order of a court of competent jurisdiction: all records, accounts, and reports that licensees are required by the Commission to make, keep, and exhibit pursuant to the provisions of this section, and all records, accounts, and memoranda compiled by the Department from records, accounts, and reports of licensees and from investigations and inspections, containing data and information concerning the business and operations of licensees reflecting their assets, liabilities, inventories, revenues, and profits; the number, capacity, capability, and type of fishing vessels owned and operated; the type and quantity of fishing gear used; the catch of fish or other seafood by species in numbers, size, weight, quality, and value; the areas in which fishing was engaged in; the location of catch; the time of fishing, number of hauls, and the disposition of the fish and other seafood. The Department may compile statistical information in any aggregate or summary form that does not directly or indirectly disclose the identity of any licensee who is a source of the information, and any compilation of statistical information by the Department shall be a public record open to inspection and examination by any person, and may be disseminated to the public by the Department. (1997-400, s.5.1; 2001-213, s. 2.)

NC Marine Fisheries Commission Rule 15A NCAC 03O .0502:

15A NCAC 03O .0502 PERMIT CONDITIONS; GENERAL

The following conditions apply to all permits issued by the Fisheries Director:

(1) it is unlawful to operate under the permit except in areas, at times, and under conditions specified on the permit;

(2) it is unlawful to operate under a permit without having the permit or copy thereof in possession of the permittee or his or her designees at all times of operation and the permit or copy thereof shall be ready at hand for inspection, except for Pound Net Permits;

(3) it is unlawful to operate under a permit without having a current picture identification in possession and ready at hand for inspection;

(4) it is unlawful to refuse to allow inspection and sampling of a permitted activity by an agent of the Division;

(5) it is unlawful to fail to provide complete and accurate information requested by the Division in connection with the permitted activity;

(6) it is unlawful to hold a permit issued by the Fisheries Director when not eligible to hold any license required as a condition for that permit as stated in 15A NCAC 03O .0501;

(7) it is unlawful to fail to provide reports within the timeframe required by the specific permit conditions;

(8) it is unlawful to fail to keep such records and accounts as required by the rules in this Chapter for determination of conservation policy, equitable and efficient administration and enforcement, or promotion of commercial or recreational fisheries;

(9) it is unlawful to assign or transfer permits issued by the Fisheries Director, except for Pound Net Permits as authorized by 15A NCAC 03J .0504;

(10) the Fisheries Director, or his agent, may, by conditions of the permit, specify any or all of the following for the permitted purposes:

(a) species;
(b) quantity or size;
(c) time period;
(e) location;
(d) means and methods;
(f) disposition of resources;
(g) marking requirements; or
(h) harvest conditions.

(11) unless specifically stated as a condition on the permit, all statutes, rules and proclamations shall apply to the permittee and his or her designees; and

(12) as a condition of accepting the permit from the Fisheries Director, the permittee agrees to abide by all conditions of the permit and agrees that if specific conditions of the permit, as identified on the permit, are violated or if false information was provided in the application for initial issuance, renewal or transfer, the permit may be suspended or revoked by the Fisheries Director.

APPENDIX V

NC Marine Fisheries Commission Rule 15A NCAC 03O .0501:

15A NCAC 03O .0501 PROCEDURES AND REQUIREMENTS TO OBTAIN PERMITS

(a) To obtain any Marine Fisheries permit, the following information is required for proper application from the applicant, a responsible party, or person holding a power of attorney:

- (1) Full name, physical address, mailing address, date of birth, and signature of the applicant on the application. If the applicant is not appearing before a license agent or the designated Division contact, the applicant's signature on the application shall be notarized;
- (2) Current picture identification of applicant, responsible party, or person holding a power of attorney. Acceptable forms of picture identification are driver's license, North Carolina Identification card issued by the North Carolina Division of Motor Vehicles, military identification card, resident alien card (green card), or passport; or if applying by mail, a copy thereof;
- (3) Full names and dates of birth of designees of the applicant who will be acting under the requested permit where that type permit requires listing of designees;
- (4) Certification that the applicant and his designees do not have four or more marine or estuarine resource convictions during the previous three years;
- (5) For permit applications from business entities:
  - (A) Business Name;
  - (B) Type of Business Entity: Corporation, partnership, or sole proprietorship;
  - (C) Name, address, and phone number of responsible party and other identifying information required by this Subchapter or rules related to a specific permit;
  - (D) For a corporation, current articles of incorporation and a current list of corporate officers when applying for a permit in a corporate name;
  - (E) For a partnership, if the partnership is established by a written partnership agreement, a current copy of such agreement shall be provided when applying for a permit; and
  - (F) For business entities, other than corporations, copies of current assumed name statements if filed and copies of current business privilege tax certificates, if applicable; and
- (6) Additional information as required for specific permits.

(b) A permittee shall hold a valid Standard or Retired Standard Commercial Fishing License in order to hold a:

- (1) Pound Net Permit;
- (2) Permit to Waive the Requirement to Use Turtle Excluder Devices in the Atlantic Ocean; or
- (3) Atlantic Ocean Striped Bass Commercial Gear Permit.

(c) A permittee and his designees shall hold a valid Standard or Retired Standard Commercial Fishing License with a Shellfish Endorsement or a Shellfish License in order to hold a:

- (1) Permit to Transplant Prohibited (Polluted) Shellfish;
- (2) Permit to Transplant Oysters from Seed Oyster Management Areas;
- (3) Permit to Use Mechanical Methods for Shellfish on Shellfish Leases or Franchises;
- (4) Permit to Harvest Rangia Clams from Prohibited (Polluted) Areas; or
- (5) Depuration Permit.

(d) A permittee shall hold a valid:

- (1) Fish Dealer License in the proper category in order to hold Dealer Permits for Monitoring Fisheries Under a Quota/Allocation for that category; and
- (2) Standard Commercial Fishing License with a Shellfish Endorsement, Retired Standard Commercial Fishing License with a Shellfish Endorsement or a Shellfish License in order to harvest clams or oysters for depuration.

(e) Aquaculture Operations/Collection Permits:

- (1) A permittee shall hold a valid Aquaculture Operation Permit issued by the Fisheries Director to hold an Aquaculture Collection Permit.
- (2) The permittee or designees shall hold appropriate licenses from the Division of Marine Fisheries for the species harvested and the gear used under the Aquaculture Collection Permit.

(f) Atlantic Ocean Striped Bass Commercial Gear Permit:

(1) Upon application for an Atlantic Ocean Striped Bass Commercial Gear Permit, a person shall declare one of the following gears for an initial permit and at intervals of three consecutive license years thereafter:

    (A) gill net;

    (B) trawl; or

    (C) beach seine.

    For the purpose of this Rule, a "beach seine" is defined as a swipe net constructed of multi-filament or multi-fiber webbing fished from the ocean beach that is deployed from a vessel launched from the ocean beach where the fishing operation takes place.

    Gear declarations shall be binding on the permittee for three consecutive license years without regard to subsequent annual permit issuance.

(2) A person is not eligible for more than one Atlantic Ocean Striped Bass Commercial Gear Permit regardless of the number of Standard Commercial Fishing Licenses, Retired Standard Commercial Fishing Licenses or assignments held by the person.

(g) Applications submitted without complete and required information shall not be processed until all required information has been submitted. Incomplete applications shall be returned to the applicant with deficiency in the application so noted.

(h) A permit shall be issued only after the application has been deemed complete by the Division of Marine Fisheries and the applicant certifies to abide by the permit general and specific conditions established under 15A NCAC 03J .0501, .0505, 03K .0103, .0104, .0107, .0111, .0401, 03O .0502, and .0503 as applicable to the requested permit.

(i) The Fisheries Director, or his agent may evaluate the following in determining whether to issue, modify, or renew a permit:

(1) Potential threats to public health or marine and estuarine resources regulated by the Marine Fisheries Commission;

(2) Applicant's demonstration of a valid justification for the permit and a showing of responsibility as determined by the Fisheries Director; and

(3) Applicant's history of habitual fisheries violations evidenced by eight or more violations in 10 years.

(j) The Division of Marine Fisheries shall notify the applicant in writing of the denial or modification of any permit request and the reasons therefor. The applicant may submit further information, or reasons why the permit should not be denied or modified.

(k) Permits are valid from the date of issuance through the expiration date printed on the permit. Unless otherwise established by rule, the Fisheries Director may establish the issuance timeframe for specific types and categories of permits based on season, calendar year, or other period based upon the nature of the activity permitted, the duration of the activity, compliance with federal or state fishery management plans or implementing rules, conflicts with other fisheries or gear usage, or seasons for the species involved. The expiration date shall be specified on the permit.

(l) For permit renewals, the permittee's signature on the application shall certify all information as true and accurate. Notarization of signature on renewal applications shall not be required.

(m) For initial or renewal permits, processing time for permits may be up to 30 days unless otherwise specified in this Chapter.

(n) It is unlawful for a permit holder to fail to notify the Division of Marine Fisheries within 30 days of a change of name or address, in accordance with G.S. 113-169.2.

(o) It is unlawful for a permit holder to fail to notify the Division of Marine Fisheries of a change of designee prior to use of the permit by that designee.

(p) Permit applications are available at all Division Offices.

Section	Current Aquaculture Plan	Proposed Aquaculture Plan	Comment
Dates of Harvest	January 1 - May 30	November 1 - March 31	change in harvest period
General Conditions	…from 12:01 pm on Friday through 12:01 pm on Sunday fyke nets may remain in the water but the terminal portion of a fyke net cod end shall contain a rigid device…	…from 3:00 pm on Friday through 3:00 pm on Sunday fyke nets may remain in the water but the terminal portion of a fyke net cod end shall contain a rigid device…	change in time when nets must be left open
General Conditions	Catch per unit effort (CPUE) data will be collected for each piece of gear. Information collected will include: approximate time the gear began and ending fishing and the number of glass eels harvested. All CPUE data will be reported to the eel biologist by the 10th of the following month.	Catch per unit effort (CPUE) data will be collected for each piece of gear. Information collected will include: approximate time the gear began and ended fishing and the actual number or weight (includes water weight) to the nearest 0.1 pounds of glass eels harvested, and for dip nets the number used. All CPUE data will be required to be reported to the eel biologist for the previous weeks effort and harvest by 5:00 pm the following Saturday.	- added language to require reporting the <u>actual</u> number of glass eels harvested -added language to require the reporting of the number of dip nets used in the harvest of glass eels - change in CPUE reporting (weekly)
After the Harvest		Require AEF to call-in to NCDMF with the total harvest in pounds (or actual number of glass eels if weighing is impractical) prior to leaving the landing site. Zero pounds shall only be reported if no glass eels are harvested.	requirement added by request of NC DMF Marine Patrol
After the Harvest	Require AEF to call-in or email to NCDMF by 5:00 pm each day the total harvest for the previous day in pounds to the nearest 0.1 lb. of glass eels received (including those days when no glass eel harvest occurred). Zero pounds shall only be reported if no glass eels are harvested and received.	Require AEF to call-in or email to NCDMF by 5:00 pm each day the total harvest for the previous day in pounds to the nearest 0.1 lb. of glass eels (or actual number of glass eels if weighing is impractical) received (including those days when no glass eel harvest occurred). Zero pounds shall only be reported if no glass eels are harvested and received.	added language to require reporting the <u>actual</u> number of glass eels harvested if weighing is impractical

Atlantic States Marine Fisheries Commission

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MEMORANDUM

July 19, 2019

To: American Eel Management Board

From: American Eel Technical Committee

RE: Technical Committee Review of Aquaculture Proposals

Attendees: Jordan Zimmerman (DE; Chair), Ellen Cosby (PRFC; Vice-Chair), Sheila Eyler (USFWS), Danielle Carty (SC), Patrick McGee (RI), Marty Gary (PRFC), Robert Atwood (NH), Ryan Harrell (GA), Gail Wippelhauser (ME), Wendy Morrison (NOAA), Todd Mathes (NC), Troy Tuckey (VIMS), Kim Bonvechio (FL), Jen Pyle (NJ), Keith Whiteford (MD), Brad Chase (MA), Carol Hoffman (NY)

Public: Sara Rademaker (American Unagi), Fisherman's Voice

Staff: Kirby Rootes-Murdy and Kristen Anstead

The Commission's American Eel Technical Committee (TC) met via conference call on Monday July 15, 2019 to discuss the following items:

1. North Carolina's Aquaculture Proposal
2. Maine's Aquaculture Proposal
3. Update on USGS GIS Project
4. Update on Canada DFO Data Workshop

Call Summary and Recommendations:

1. North Carolina's Aquaculture Proposal for 2020-2021

Beginning with the 2016 fishing year, NC DMF has submitted an application on behalf of NC's American Eel Farm (AEF) to harvest 200 lbs of glass eels for use in aquaculture as allowed under the Aquaculture Plan provisions of Addendum IV (2014) and Addendum V (2018) to the Interstate Fishery Management Plan. Todd Mathes (NC DMF) presented an update on the 2019 fishing season as well as a new two year proposal from AEF to harvest 200 lbs annually. Mathes reported that AEF fishermen fished fyke nets 14 of 22 possible weeks primarily from January 1-March 30, 2019 and ended 6 weeks early. Dip nets were only used on one occasion. Fishing occurred in canals and tributaries surrounding Lake Mattamuskeet. In total, 13.82 lbs of glass eels (approximately 42,000 eels) were harvested and approximately 980 glass eels were released alive. CPUE data was collected but caveats include differences in net dimensions, changing harvest locations, gear modifications, inconsistent fishing effort, periods of no fishing, and recorded weights that included water.

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No citations were given to AEF fishermen in 2019. In June, there was a total mortality event attributed to bad food given to the eels; no eels were raised and brought to market.

For the 2020-2021 proposal, much of the aquaculture plan remains the same from the previous plan (May 2017) with the following updates:

- The proposal changes the start of the fishing year from Jan 1 to Nov 1, ending on March 31 instead of May 30. This would mean the fishing season would overlap two calendar years starting this fall;
- The time when nets must be left open was changed from 12:01 p.m. to 3:00 p.m.;
- Language was added to require reporting the actual number of glass eels harvested and require the reporting of the number of dip nets used in the harvest of glass eels
- Change to weekly CPUE reporting;
- Requirement added for the AEF to call-in to NCDMF with total harvest prior to leaving the landing site; and
- Language was added to require reporting the actual number of glass eels harvested if weighting is impractical after harvest

The TC discussed the proposal and asked Mathes questions to confirm that no American eels made it to market due to the mortality event and glass eels released at the beginning of the season reflected production needs to harvest some minimum amount before starting to bring the eels back to the facility. There were many questions regarding the change of the start date from January 1st, 2020, to November 1st, 2019, for the fishing season. Mathes stated that AEF was interested in exploring the availability of glass eels during November and December based on some indication from South Carolina eel fishermen as well as data from the Beaufort Bridge Ichthyoplankton Sampling Program that glass eels may be present then. Danielle Carty (SC DNR) stated that the peak of harvest for glass eels in SC's commercial fishery is February-April and that they rarely see glass eels before January. There was a minority concern expressed from the TC that starting fishing prior to January 1st fishing could open enforcement considerations despite low potential for NC harvest. Ultimately, the TC approved the proposal as is because the data collected could provide information regarding glass eels in the region during part of winter that has been previously unknown. Additionally the TC indicated it was unlikely AEF would find glass eels at that time of year.

It should be clear that proposal's November 1, 2019 would shift the fishing season to cover two calendar years. If approved, the new proposal could have harvest in one calendar year count towards two separate 200 lb harvest allowances for aquaculture. Addendum IV indicates that aquaculture proposals can propose harvest up to 200 pounds annually; the Board will need to determine whether to accommodate a proposal specifying harvest to a fishing season that occurs over two calendar years.

2. Maine's Eel Aquaculture Proposal for 2020

Sara Rademaker of American Unagi (AU) presented a report to the TC on the 2019 fishing season, which was their first year applying and getting approved, and a proposal for the 2020 season to harvest 200 lbs of glass eels. Rademaker stated that several commercial eel fishermen in Maine were contracted to fish for glass eels for AU, and all of the fishermen worked together to help this program run smoothly. Each fisherman had ten or twenty pound allotments to fish their fyke nets, and they took their catch to a buying station with a swipe card system, as required by ME DMR. It was a slow start to the season due to a cold spring in the region and most of the fishing took place from mid-April through May. AU made the decision to only use 130 lbs of their 200 lbs. quota in 2019 so as to not stress the facility and production in their first year with aquaculture quota. Law enforcement visited the facility and had no issues with the program.

For the 2020 season, Rademaker requested 200 lbs. of glass eels. AU plans on working with licensed commercial fisherman again and believes that they are better equipped to harvest more eels this year.

The TC approved the proposal for the 2020 fishing year.

In regard to both proposals, and any proposals that come to the TC in future years, Brad Chase (MA DMF) recommended the following with full TC support:

1.) To provide more information related to the Addendum V language on "suitable harvest locations", add a table to proposals with information on harvest sites.
Possible table fields if available: watershed name, tributary name, drainage area, average. seasonal discharge, river mile, tidal amplitude, years sampled, presence of hydropower, number and river mile of impassible dams and passible dams.

2.) Add section (1-2 paragraphs with table) on previous year's harvest to annual aquaculture proposals.

3.) Require CPUE reporting for all approved plans that have similar provisions as NC with enhanced reporting by location and set numbers. Include an abbreviated table of this reporting in the annual reporting/proposals. The goal would be to gain standardized fyke net catch and effort information at locations with consistent aquaculture harvest that could augment the state's monitoring of glass eel.

3. Update on USGS GIS Project

Kristen Anstead (ASMFC) updated the TC on a collaboration between ASMFC and USGS. Recently, John Young (USGS Leetown Science Center) approached ASMFC with a proposal to develop a habitat or GIS modelling framework for American eel to address several of the research recommendations from the stock assessment. In the initial phase, the TC compiled a spreadsheet of all available data sets from each respective state and jurisdiction and indicated the level of data available (i.e., environmental variables collected, biosampling data, location data). Young et al. reviewed the data summaries and requested several in raw form to explore some modelling approaches for the Delaware

River basin/Chesapeake Bay drainage area. Anstead has been working with TC members to get the raw data and will continue to keep the TC informed as the project progresses.

4. Report on Canada DFO Data Workshop

Anstead updated the TC on a workshop she and Kirby Rootes-Murdy (ASMFC) attended regarding a range-wide assessment for American eel by Canada's Department of Fisheries and Oceans (DFO). DFO received some funding to compile their fishery-dependent and –independent data across provinces and discuss all available data throughout American eel's range, similar to an ASMFC data workshop. At the workshop, participants discussed data strengths and weaknesses and methods currently used by the ASMFC (i.e., ARIMA, DBSRA) that could be applied in Canada. An assessment workshop will be held in October to review the model development by DFO staff and Laura Lee (Previous Stock Assessment Subcommittee Chair) will represent ASMFC. Anstead and Rootes-Murdy will continue to keep the TC updated on any collaboration between or meetings with DFO.

Atlantic States Marine Fisheries Commission

Horseshoe Crab Management Board

August 6, 2019
2:45 – 3:30 p.m.
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1. Welcome/Call to Order *(M. Rhodes)* 2:45 p.m.

2. Board Consent 2:45 p.m.
   - Approval of Agenda
   - Approval of Proceedings from May 2019

3. Public Comment 2:50 p.m.

4. Consider Management Response to 2019 Horseshoe Crab Benchmark Stock Assessment (*M. Rhodes*) **Possible Action** 3:00 p.m.

5. Other Business/Adjourn 3:30 p.m.

The meeting will be held at the Westin Crystal City, 1800 S Eads Street, Arlington, VA 22202; 703.486.1111

MEETING OVERVIEW

Horseshoe Crab Management Board Meeting
Tuesday, August 6, 2019
2:45 p.m. – 3:30 p.m.
Arlington, Virginia

Chair: Dr. Malcolm Rhodes (SC) Assumed Chairmanship: 10/17	Horseshoe Crab Technical Committee Chair: Jeff Brunson (SC)	Stock Assessment Subcommittee Chair: Dr. John Sweka (FWS)
Vice Chair: Joe Cimino (NJ)	Horseshoe Crab Advisory Panel Chair: Allen Burgenson (MD)	Law Enforcement Committee Representative: Doug Messeck (DE)
Delaware Bay Ecosystem Technical Committee Chair: Greg Breese (FWS)		Previous Board Meeting: October 24, 2018
Voting Members: MA, RI, CT, NY, NJ, DE, MD, DC, PRFC, VA, NC, SC, GA, FL, NMFS, USFWS (16 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from May 1, 2019 Board Meeting

3. Public Comment – At the beginning of the meeting public comment will be taken on items not on the agenda. Individuals that wish to speak at this time must sign-in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Consider Management Response to 2019 Horseshoe Crab Benchmark Stock Assessment (3:00 p.m.-3:30 p.m.) Possible Action
Background • A benchmark stock assessment was recently completed, peer reviewed, and approved for management use at the Spring 2019 meeting (**Briefing Materials**). • The assessment determined the following statuses for regional and coastwide stocks of horseshoe crab: Northeast (RI-MA), Neutral; New York (NY-CT), Poor; Delaware Bay (VA-NJ), Neutral; Southeast (FL-NC), Good; and Coastwide, Neutral. • The Board moved to postpone discussions of any management response to assessment results until the August 2019 meeting.
Board actions for consideration at this meeting • Consider possible management action in response to the 2019 Horseshoe Crab Benchmark Stock Assessment.

5. Other Business/Adjourn

Horseshoe Crab

Activity level: Medium

Committee Overlap Score: Low (SAS overlaps with BERP)

Committee Task List
• TC – Gauge eel and whelk stakeholder interest in alternative bait trials using Kepley Biosystems' OrganoBait • ARM & DBETC – Incorporate Catch Multiple Survey Analysis horseshoe crab population estimates into the ARM model • TC – March 1st: Annual compliance reports due • ARM & DBETC – Fall: Annual ARM model to set Delaware Bay specifications, review red knot and VT trawl survey results

TC Members: Jeff Brunson (SC, TC Chair), Derek Perry (MA), Natalie Ameral (RI, Vice Chair), Deb Pacileo (CT), Catherine Ziegler (NY), Samantha Macquesten (NJ), Jordan Zimmerman (DE), Steve Doctor (MD), Ellen Cosby (PRFC), Adam Kenyon (VA), Jeffrey Dobbs (NC), Eddie Leonard (GA), Claire Crowley (FL), Linda Stehlik (NMFS), Chris Wright (NMFS), Joanna Burger (Rutgers), Gregory Breese (USFWS), Mike Millard (USFWS), Kristen Anstead (ASMFC), Michael Schmidtke (ASMFC)

SAS Members: John Sweka (USFWS, SAS Chair), Linda Barry (NJ), Jeffrey Dobbs (NC), Michael Kendrick (SC), Natalie Ameral (RI), David Smith (USGS), Richard Wong (DE), Kim McKown (NY), Kristen Anstead (ASMFC), Michael Schmidtke (ASMFC)

Delaware Bay Ecosystem TC Members: Greg Breese (USFWS, DBETC Chair), Amanda Dey (NJ), Audrey DeRose-Wilson (DE), Jordan Zimmerman (DE), Steve Doctor (MD), Adam Kenyon (VA), Jim Fraser (VA Tech), Eric Hallerman (VA Tech), Mike Millard (USFWS), Wendy Walsh (USFWS) , Kristen Anstead (ASMFC), Michael Schmidtke (ASMFC)

ARM Subcommittee Members: Jim Lyons (USGS, ARM SC Chair), Larry Niles (NJ), Linda Barry (NJ), Audrey DeRose-Wilson (DE), Steve Doctor (MD), Michelle Klopfer (VA Tech), John Sweka (USFWS), Wendy Walsh (USFWS), Conor McGowan (USGS/Auburn), David Smith (USGS), Jim Nichols (USGS), Kristen Anstead (ASMFC), Michael Schmidtke (ASMFC)

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

HORSESHOE CRAB MANAGEMENT BOARD

The Westin Crystal City
Arlington, Virginia
May 1, 2019

These minutes are draft and subject to approval by the Horseshoe Crab Management Board
The Board will review the minutes during its next meeting

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INDEX OF MOTIONS

1. **Approval of Agenda** by Consent (Page 1).

2. **Approval of Proceedings of October 2018** by Consent (Page 1).

3. **Main Motion**
   Move to accept the 2019 Horseshoe Crab Benchmark Stock Assessment and Peer Review Reports for management use as modified today (Page 22). Motion by Adam Nowalsky; second by Mike Luisi. Motion substituted.

4. **Motion to Substitute**
   Move to substitute to accept the 2019 Horseshoe Crab Benchmark Stock Assessment and Peer Review Reports for management use (Page 26). Motion by Mike Luisi; second by Jim Gilmore. Motion carried (Page 27).

   Main Motion as Substituted
   Move to accept the 2019 Horseshoe Crab Benchmark Stock Assessment and Peer Review Reports for management use.

5. **Move to postpone management response to the 2019 Horseshoe Crab Benchmark Stock Assessment until the August 2019 meeting** (Page 31). Motion by Justin Davis; second by Dan McKiernan. Motion carried (Page 31).

6. **Move to approve the nomination for Nora Blair to the Horseshoe Crab Advisory Panel** (Page34). Motion by Robert Boyles; second by Jim Gilmore. Motion carried (Page 34).

7. **Move to adjourn,** by Consent (Page 34).

ATTENDANCE

Board Members

Dan McKiernan, MA, proxy for D. Pierce (AA)
Raymond Kane, MA (GA)
Sarah Ferrara, MA, proxy for Rep. Peake (LA)
Bob Ballou, RI, proxy for J. McNamee (AA)
David Borden, RI (GA)
Justin Davis, CT (AA)
Bill Hyatt, CT (GA)
Jim Gilmore, NY (AA)
Maureen Davidson, NY, Administrative proxy (AA)
Joe Cimino, NJ (AA)
Tom Fote, NJ (GA)
Adam Nowalsky, NJ, proxy for Sen. Andrzejczak (LA)
Stewart Michels, DE, proxy for D. Saveikis (AA)
Roy Miller, DE (GA)
Craig Pugh, DE, proxy for Rep. Carson (LA)
Michael Luisi, MD, proxy for D. Blazer (AA)
Russell Dize, MD (GA)
Phil Langley, MD, proxy for Del. Stein (LA)
Pat Geer, VA, proxy for S. Bowman (AA)
Chris Batsavage, NC, proxy for S. Murphey (AA)
Jerry Mannen, NC (GA)
Robert Boyles, Jr., SC (AA)
Mel Bell, SC, proxy for Sen. Cromer (LA)
Doug Haymans, GA (GA)
Erika Burgess, FL, proxy for J. McCawley (AA)
Sherry White, USFWS
Chris Wright, NMFS
Martin Gary, PRFC

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Staff

Robert Beal
Toni Kerns
Jess Kuesel
Mike Schmidtke
Kristen Anstead

Guests

Nora Blair, Charles River Labs
Sarah Blick, Assoc. of Cape Cod
Allen Burgenson, Lonza Walkersville, Inc.
Jon Hare, NOAA
Brett Hoffmeister, Assoc. of Cape Cod
Larry Jacobson, Hillsborough, NC
Wilson Laney, NC State Univ.
George Lapointe, Hallowell, ME
Arnold Leo, E. Hampton, NY
Willa Lerner, Blue Star Strategies
Jessica Lindgren, Blue Star Strategies
Mike Millard, USFWS
Samantha Underwood, Assoc. of Cape Cod

The Horseshoe Crab Management Board of the Atlantic States Marine Fisheries Commission convened in the Jefferson Ballroom of the Westin Crystal City Hotel, Arlington, Virginia, Wednesday, May 1, 2019, and was called to order at 3:15 o'clock p.m. by Chairman Joe Cimino.

CALL TO ORDER

CHAIRMAN JOE CIMINO: Okay we'll get started here. Good afternoon everyone; my name is Joe Cimino. I'll be filling in for the current Chair, Dr. Malcolm Rhodes. I have with me Doctors Anstead, Sweka, Schmidtke, and Jacobson. If that is not enough doctors to get us through this agenda, I think we'll need a TARDIS.

APPROVAL OF AGENDA

CHAIRMAN CIMINO: We'll start with Board consent. Are there any changes to the agenda?

APPROVAL OF PROCEEDINGS

CHAIRMAN CIMINO: Seeing none; you all have had a chance to review the approval of the proceedings from the October, 2018 meeting. Are there any edits or changes there? Okay seeing none we'll consider it approved by consent. This is the time traditionally for public comments on items not on the agenda.

What we will do is allow at a later point in time public comment on the stock assessment or the Peer Review of the stock assessment after those presentations are given. I realize we do have one signed up speaker for that. Just to let you know, we will do that after the presentations take place.

2019 HORSESHOE CRAB BENCHMARK STOCK ASSESSMENT

CHAIRMAN CIMINO: Okay, so we'll get into the Benchmark Stock Assessment. We have our first presentation by, as I said, Dr. Sweka.

PRESENTATION OF STOCK ASSESSMENT REPORT

DR. JOHN A. SWEKA: Before I begin, I just wanted to thank all the other members of the Stock Assessment Subcommittee that are listed here, who have put in a tremendous amount of work over the past year, year and a half on this, also the Technical Committee, ARM Subcommittee, Delaware Bay Ecosystem Technical Committee, the Advisory Panel as well as the Management Board.

A little history of our Horseshoe Crab Stock Assessment, I kind of liken it to climbing a mountain. Back in 1998, we started off with a benchmark assessment that merely just had some trend analysis to it. In 2004, we continued with that trend analysis and then some regional meta-analyses. By 2009 that benchmark assessment, things got improved.

We had trend analysis, regional meta-analyses, auto regressive integrated moving average models, preliminary catch survey model, surplus production model was attempted and this was the beginning of the multi-species modeling for the Delaware Bay. However, in 2013, after the peer review of the 2009 assessment, we had to drop back a little bit.

The 2013 update just included trend analysis, regional meta-analysis, and the ARIMA models again. But here we are in 2019 now. I think we've come back up that mountain, adding to continued trend analysis with ARIMA a new catch multiple survey model, which is an extension of the Catch Survey Analysis. We've added discard estimates and we've now included estimates of biomedical mortality. Back in 2009, we did not have a formal set of reference points adopted by the Horseshoe Crab Management Board. We did see increased abundances in the southeast region and Delaware Bay regions but still declining abundances in New York and New England regions.

During the 2013 update, New England and New York still had declining abundances but we saw positive trends in the southeast and some also in the Delaware Bay. We realized we needed to start including biomedical mortality in our assessment, you know, and ideally at the regional level, which brings into question data confidentiality and the issues associated with that.

In this Benchmark Assessment we include biomedical mortality but we've also added something we've never looked at before, and that was discard estimates from other fisheries. We still have our usual bait landings. We've also attempted more modeling approaches and a regional assessment for the Delaware Bay using a catch multiple survey analysis.

Management of horseshoe crabs began in 1998 with the fisheries management plan. And, over the ensuing decade a series of addendums that had essentially made a restricted bait harvest of horseshoe crab, more and more with each added addendum, or continued previous addendums. In 2012, Addendum VII was adopted by the Management Board.

This adopted the ARM framework for management within the Delaware Bay. Recommendations from the ARM framework were first implemented in 2013. This Adaptive Resource Management model takes into consideration horseshoe crab abundance as well as red knot abundance as input data.

The model ultimately results in the recommendation of one of five agreed upon harvest packages for management within the Delaware Bay. These harvest packages range from a full moratorium on both sexes to a maximum of 630,000 crabs at a two-to-one ratio as the most liberal harvest package.

Since 2013, since the ARM framework was first implemented, we've been recommending and implementing a harvest quota that had been 500,000 male-only harvest crabs in the Delaware Bay region. Current quotas along the coast and, you know, this table shows them, and in many cases voluntary state quotas are actually less than the ASMFC quota from 2017. In particular Massachusetts, New York, their state mandated quota is less than what ASMFC prescribed.

As far as biomedical harvest goes, there are no fisheries management plan limits on harvest. There are some state specific daily, annual, or seasonal restrictions. But, monitoring requirements were part of Addendum III and are annually reported to ASMFC in state compliance reports.

These requirements specify monthly and annual harvest percent mortality up to the point of release. Harvest methods, sex ratios of collected and bled crabs, and disposition of bled crabs and the condition of the holding environment of the bled crabs prior to their release. We have divided our stock assessment up into four different regions; and this has been consistent with previous stock assessments. We have the northeast region spanning from Maine down through Rhode Island, the New York region going from Connecticut down to the New York Bight, encompassing Long Island Sound. The Delaware Bay region from New Jersey down to Virginia, and then the southeast region everything from North Carolina southward.

Our regional breakdown is supported based upon genetic analysis of horseshoe crabs, as well as tagging information in the coastwide tagging database. This table here just illustrates how the majority of tagged and recaptured crabs are recaptured in the same general area as they were released but you do have some movement among regions.

Also, with the tagging estimates and the tagging analysis, we used those to come up with estimates of annual survival within a region. From this Cormack-Jolly-Seber model, we see estimates of apparent survival within a region. From this Cormack-Jolly-Seber model we see estimates of apparent survival vary across the regions.

It's highest in Delaware Bay at 76 percent annual survival, and it was lowest in the coastal New York, New Jersey areas at 62 percent. We get into coastwide bait landings. This is for the entire coast through the time series. You can see through management, horseshoe crab harvest for bait has greatly decreased through time.

The bars on this graph represent the breakdown between male and female harvest. In a lot of cases not all reporting in the landings was sex specific and that's why there is that gap between the bars and the solid line. You'll notice in recent years since 2013, the harvest has been predominantly males.

That is due to the implementation of the ARM framework within the Delaware Bay area that selects just for males. By region through time, when we parse this out among our four regions, we still see that Delaware Bay contains the greatest amount of harvest relative to the other regions. The southeast is very little bait harvest. New York and the northeast region fall in between.

Here is a graph showing the Delaware Bay bait landings and again, you know we've definitely decreased through time as more addenda have been added. Again, you can see here in the most recent years from 2013 on very low numbers of female crabs are harvested. The females that are harvested as part of the bait landings come from Maryland and Virginia because not all of their crabs are of Delaware Bay origin, so there is some allowance there.

Moving on, one of the big things that we looked at within this assessment was biomedical mortality. Historically horseshoe crab management has assumed a 15 percent biomedical bleeding mortality rate on those crabs that are bled and then released. What we did was we scoured the literature of available studies that have looked at biomedical bleeding mortality.

From those published studies, we took all of their treatments and sample sizes and made a bootstrap simulation that randomly pulled values from these studies respective distributions of mortality, weighted by the sample size within each one of these studies. Through that bootstrap simulation process, we generated a new distribution of what the possible biomedical mortality rate could be. It just so happened coincidentally that it worked out that the mean of that distribution also ended back at 15 percent. But at least now we could also put some uncertainty on that. The rate, 95 percent confidence limits of that distribution range from 4 to 30 percent.

Along with the biomedical mortality, something that we examined was tagging information of those biomedically-bled crabs. We did a Cormack-Jelly-Seber analysis to look at survival of bled versus unbled crabs. The assumption going into this analysis was that due to bleeding there may be a decrease in long-term survival of the crabs that are bled.

Low and behold, we actually found the exact opposite of that, in that the bled crabs had a greater survival than the unbled crabs. This was particularly the case for female horseshoe crabs, so it was kind of a counter-intuitive finding that we found. Most likely the reasons for this is that the biomedical industry will select and only bleed crabs that appear to be in very good condition. Perhaps the reason for these results is the crabs that were bled are crabs that would have otherwise had a higher survival anyway, whereas the non-bled crabs were crabs reflecting both good and poor condition crabs within the entire population.

This graph, I'm sure you've seen this on the ASFMC's website. It just puts in comparison coastwide, the commercial bait landings compared to biomedical collections of horseshoe crabs and estimated biomedical mortality, applying a 15 percent bleeding mortality rate. As we see, between 2004 and 2011, the number of crabs that were collected for the biomedical industry, as well as the number of crabs that died because of the biomedical industry, you know, showed a steady increase.

But since 2011 it has stayed relatively constant. In terms of total mortality it's roughly about 70,000 since 2012 onward. Discards, this is another source of removals that was never really examined by the Stock Assessment Subcommittee in previous assessments. Horseshoe crabs aren't taken as bycatch in other fisheries; but they hadn't been quantified up until this point.

The Northeast Fisheries Observer Program, it's run by the Northeast Fisheries Science Center, collects data on harvested and discarded catch, gear, effort, and species and lengths and weight. This survey runs from Maine to North Carolina. It began in 1989, and horseshoe crab data actually within this survey began in 2004.

Horseshoe crab landings were very minimal in this data from several states, so our analysis of the discard data focused mainly on the Delaware Bay area, and was mainly used for input to the catch multiple survey analysis. Here are some estimates of total discards and then dead discards. We can see the total discards in other fisheries increased through time as well, obviously, as dead discards.

I would like to say there is a lot of uncertainty in these data and it's something that we need to keep looking at to refine these estimates. One of the reasons why there has been an increase in the number of discarded horseshoe crabs is because harvest restrictions have become more and more stringent through time. On vessels commercial fishermen can't keep the horseshoe crabs they may catch as bycatch, they have to go back. This increase is really an artifact of our current management.

Moving on to fishery-independent data sources, we had a lot of data that we looked at. We tried to screen these data through a few criteria. Number one here you have a time series. Ideally we would like to have a time series of fisheries-independent data that goes for at least 20 years to accommodate the life cycle and life span of horseshoe crab. But, sometimes a 20-year period isn't available for many of our surveys so we recommended a survey for inclusion in any analyses to have at least ten years of data. Survey design, we tried to stick with surveys that had some sort of a statistical design, such as surveys with random stratified sampling. Gear, we included surveys that used gear that was set and operated in a space and time when they would likely catch horseshoe crabs and gear that were capable of catching crabs. Likewise with the spatial and temporal coverage. Methodology, we eliminated surveys whose methodology may have changed during the course of their time series.

This is a big list of all the surveys up and down the coast that we examined. This table is in the report and it gives an indication whether that particular survey was accepted for use or if it was rejected, and what reason it might have been rejected. Once we decided which surveys we would use, we pursued several different approaches as to how we would standardize the data.

We explored nominal geometric means, GLM standardization of the raw survey data. We attempted to break apart surveys into stage or sex if we could. You know this was especially needed for the catch survey model, which I'll talk about later. The problem with these approaches was that in many of our surveys we have a high proportion of zero tows in most surveys, which made standardization very difficult.

In the end we decided to use a delta distribution for the mean and variance of each survey for each year. This sort of method is also used by the Virginia Tech Trawl Survey in the Delaware Bay. The use of the delta method can lead to more efficient estimators of the mean and variance, because zero tows, zero catches are treated separately, and positive observations are drawn from a log normal distribution. The final estimate or index of abundance are obtained from the product of the proportion and mean for non-zero tows.

In the analysis of trends we had two approaches: one is a method by Conn 2010, and the other was what we've been using as autoregressive integrated moving average models.

In the Conn method several abundance indices are combined into a single composite index using hierarchical modeling and this assumes that each index samples relative abundance, but is subject to both observation and process errors. The autoregressive integrated moving average models or ARIMA models. These derived fitted estimates of abundance over the time series for each survey individually. This minimizes the measurement error and ultimately we can estimate the probability of being less than some index-based reference point. The index-based reference points we've chosen, and we've used them in previous assessments, were the 25th percentile of the fitted index values, and also the 1998 fitted index value. The reason for using 1998 as a reference point was because that was when the FMP was put in place. It kind of tells us where we stand relative to when active management began.

Moving on, here I'll show a series of graphs for each region. Just depicting the ARIMA fits, and on each one of these graphs, the blue horizontal line represents the 1998 index-based reference point, and the red horizontal line represents the 25th percentile reference point. Here for the northeast, a few surveys.

The Massachusetts DMF Trawl Survey north versus south of Cape Cod, the north survey doesn't show much of a trend, and that survey also rarely catches horseshoe crabs. You can see a lot of zero values in there. South of Cape Cod we do see an increase over the last five-year period, to where it's actually above the 1998 index-based reference point.

The New Hampshire spawning surveys for males and females, they don't extend to 1998, but have shown somewhat of a decline. Then, a conflicting survey is the Rhode Island Monthly Trawl Survey in and around Narragansett Bay has shown a rather steady decrease through the time period.

If we combine all these surveys into the Conn Index, or the two trawl surveys, you know we see very wide confidence intervals on that index coming from the Conn model. This is because we have two conflicting surveys that show opposite trends. Moving down to New York, the results are a little more consistent across surveys and, in general, all of our surveys in New York show a declining trend except the NEAMAP in the fall.

But the NEAMAP time series doesn't extend very far back into time. But the Connecticut/Long Island Sound Trawl Survey, Seine Surveys in Jamaica, Little Neck and Manhasset Bay's all decline, as well as the Peconic Bay Trawl Survey have all declined and continue to decline. As we combine all these surveys into the Conn Index, we can see kind of a steady decline through time.

On Delaware Bay is where we have the majority of our fisheries independent surveys. This slide looks at the Delaware 30-foot Trawl Survey that is conducted within Delaware Bay and we see in both the fall and the spring for males and females. We saw a declining trend through the 1990s. It kind of bottomed out in the mid-2000s and in the last five to ten years it has been steadily increasing.

Other surveys include the Delaware Bay, or the New Jersey Surf Clam Dredge Survey. That survey has shown an increasing trend consistently through time since the early 2000s. Unfortunately this survey has ended, and changed methodologies in 2012. That is why we don't have more recent data.

Along Maryland's coastal bays, things have just kind of been going up and down without a consistent trend and the NEMAP Survey from the fall doesn't have that many years of data, and we don't see a definitive trend in that. New Jersey's Ocean Trawl Survey, kind of conflicting trends whether you look at the data from that survey, whether it's in the fall versus the spring. The spring version of that survey shows an increase since 2010 in both males and females. However, the fall showed a declining trend and then kind of a leveling off throughout the time period.

The reason the bottom two figures here for spring female and spring males from the New Jersey Ocean Trawl Survey don't have a blue line for the 1998 reference point is because this survey didn't start partitioning sexes until 1999.

Here we have the Virginia Tech Survey, which is the only survey along the coast that actually targets horseshoe crabs. We've seen some ups and downs through 2010. Then from 2012 to 2015 the survey lost funding so there is actually a gap in data over that time period. Then it began again in 2016. We've seen some ups and downs but in the most recent years it's much higher than that 25th percentile reference point. The Delaware Bay Index from the Conn Model, when you combine all of these we generally see the declining trend through the 1990s, a low point in the mid-2000s, and then somewhat of an increasing trend towards the end of the time series with fairly wide confidence intervals on it as well.

Moving down to the southeast region finally, various surveys from Georgia, North Carolina, South Carolina, well what we saw here is fairly consistent with previous assessments was an increase in the early part of the time series, and then somewhat of an increase or a stabilization in more recent time.

That is kind of reflected also in the Conn Index for the southeast. You can see an increase in the mid to late 2000s, or 2010, and perhaps even a leveling off or somewhat of a decrease in the most recent years. To kind of summarize the ARIMA models, we considered those surveys that had a terminal year in 2016 or 2017, the residuals from their ARIMA fits were normally distributed and combined sex surveys, because we didn't want to summarize based on surveys that were split into male versus female, to try to avoid double counting a particular survey.

What we're looking at here is the probability of an index-based reference point being either less than the 1998 fitted value, or the 25th percentile of the fitted values, and if that probability is greater than 50 percent. If it's greater than 50 percent that's good. That means that survey is fairly likely to be less than the reference point.

In New England we have one out of two surveys less than the '98 reference point. New York, things don't look very good. All four out of four surveys were less than the 1998 value, Mid-Atlantic, which would be Delaware Bay, two out of five and the southeast, zero out of two that fit these criteria for inclusion in this summary.

Then we also had the corresponding number relative to the Q-25 reference point. Some other assessment methods that we looked into and applied, the first one was a surplus production model using ASPIC from the Northeast Fisheries Science Center toolbox, and also an index method. Now from the previous 2009 assessment, one of the recommendations from the Peer Review Panel was to develop an operating model to make some simulated datasets and to test the surplus production model. We did that and found that the surplus production model just did not adequately account for the complex life history of a species like horseshoe crab; that has a late age maturity and lives a long time. That one was abandoned and the Index Method, we had high hopes for this. It's a relative F method that can ultimately give you some reference points to target your fishery at. We also tested that with the operating model and found that it couldn't accommodate the complex life history of horseshoe crab, so it was abandoned as well.

Now the operating model was used to generate some simulated data which was ran through the catch multiple survey analysis and it worked. That model accommodates the life history of horseshoe crab so we then moved forward with running the catch multiple survey analysis for Delaware Bay female crabs only. The underlying model for the catch multiple survey analysis is shown here and it takes into account the number of fully recruited animals or multiparous females and the number of newly recruited females, or primiparous females.

The way you can tell the difference between a primi and a multi parous female is just by looking. They're both sexually mature, both possess eggs, but a multiparous female will have marks from where it had previously spawned, when the male is in amplexus with it the previous spawning season.

Within this model we have the number of multiparous and primiparous females, natural mortality, the catch and it just gets decremented from one year to the next. We ultimately end up with an estimate of the multiparous animals in a given year. Just two graphs with some of the input data going into the catch multiple survey analysis.

These are the removals. The top graph here shows the bait harvest of female crabs within Delaware Bay, and how that has changed through time, and you see it has greatly decreased through time and in recent years, and then also our estimates of dead discards for Delaware Bay. Now again, this is female only.

The interesting thing is, because of our active management in Delaware Bay that targets only male harvest the dead discards are actually a greater removal than what the bait harvest is for females. The bottom graph illustrates the removals due to biomedical bleeding and you'll note that for confidentiality reasons I've left the Y axis off of this graph.

I won't say much more about that other than the trend has increased since 2004, when reporting of biomedical became mandatory to ASMFC. The fishery independent surveys that went into this were the Virginia Tech Swept Area Estimates, which are broken down by primiparous versus multiparous animals.

You can see, you know, it's fluctuated through time. But, once the survey came back online you know we see an increase from 2016 and 2017 relative to where it was when the survey ended in 2012. Other surveys that were included as tuning indices were the New Jersey Ocean Trawl, and the Delaware Bay 30-foot Trawl from the spring. Base model parameters are given there. We assume the natural mortality of 0.274, which was based upon our tagging results that showed, this is an instantaneous rate, our tagging results showed a corresponding survival in Delaware Bay at 76 percent annually. Then model weights, these came from the Conn Analysis that we did. One aspect of the Conn Analysis is that it can give certain surveys a given weight, you know, depending on how much variability it explains in the survey.

The Virginia Tech Survey carried the greatest weight. Starting values were 2 million recruits, or primiparous females, 3.6 million multiparous females, and then some starting values for the catchability of the Delaware and New Jersey Trawls, and then S was the selectivity between Delaware and New Jersey.

We assumed that there was equal catchability for pre-recruits versus fully recruited animals. Then our base model was run assuming a 15 percent biomedical bleeding mortality. Fits to the individual surveys. The individual fits weren't great. They captured the general trends that we see, so they weren't great but they weren't terrible either and they do capture the general trends.

Ultimately in the end, these two graphs depict what we estimate for instantaneous fishing mortality and number of adult females within the Delaware Bay population. You'll note again for data confidentiality reasons I've left off the Y axes on both of these graphs. I will say that fishing mortality has decreased through time on Delaware Bay females and abundance has increased, especially in the most recent years.

One thing you'll note is the very large confidence intervals from 2013 through 2015 in our abundance estimates. The reason why we had these large confidence intervals is because we were missing the data from Virginia Tech during those years. This also illustrates the importance of that Virginia Tech Survey in our assessment to gain better estimates of abundance.

I will mention to that if we just look at the raw Virginia Tech data, the minimum swept area estimate was 8.6 million total female in 2018. We did a lot of sensitivity runs of the catch multiple survey analysis varied starting values of R, N, and Q, looked at our assumptions about natural mortality, the survey weights, survey CVs, the primiparous, the multiparous selectivity, percent biomedical mortality.

We varied that all the way from zero up to our 95th percent confidence limit of 30 percent bleeding mortality. We looked at the inclusion versus exclusion of dead discards. Also, the inclusion or exclusion of years when the Virginia Tech Trawl Survey did not operate. Due to confidentiality issues I can't show all of the sensitivity results but I will say, in general, the model outputs were very robust.

Biomedical mortality bleeding rate had very little effect on the outputs. The greatest sensitivity of the model was to freely estimating Virginia Tech Survey catchability, and also the weights that we had prescribed to each one of the surveys. This graph just shows you a retrospective analysis, again with the Y axis left off.

You see for the most part we don't have any retrospective pattern except during the years when the Virginia Tech Trawl Survey did not occur. Otherwise, the retrospective pattern looks great. Reference points, one of our terms of reference tasked us with developing reference points. We tried to develop reference points for the Delaware Bay. One method was based on a theoretical population projection model and this was to try to estimate a number at MSY and an F rate at MSY. Then, we also looked at yield and egg per recruit models for the Delaware Bay. Both of these methods were ultimately considered not suitable for management.

The yield in egg per recruit models gave us reference points that just did not make biological sense; and the big reason for that, you know, the problem with horseshoe crabs is that the adults have a greater mortality than the juveniles, and that's because natural mortality increases once the adults start to come up on the beach. You know they're subject to being overturned, subject to more avian predation. That kind of basically wrecks any kind of a per-recruit analysis; and also the fact that once a crab is mature it has a terminal molt and does not gain in size anymore. If it doesn't grow in size any more than its fecundity isn't increasing; or its weight is not increasing, which is problematic for both yield and egg per recruit models.

The population projection model reference points, you know, the Peer Review Panel thought that they may be biased because they were developed outside of our actual assessment model, and recommended that we don't do a direct comparison between the catch survey analysis results and output numbers of abundance or fishing mortality estimates. But the Peer Review Panel said that they could be useful for other management purposes, perhaps to put things into context. The ultimate management recommendations for the use of reference points is to use the 1998 index based reference point from the ARIMA models to determine stock status.

In doing this, you know again, that summary that I showed from the ARIMA results, we looked at the time series of surveys that had a time series that extended back to 1998, combined sex surveys, residuals from the ARIMA fits were normally distributed, and the terminal year of that survey was either 2016 or 2017.

We came up with a rule kind of a stoplight approach to determine status, based on the percentage of surveys within a region having a greater than 50 percent probability of their terminal years fitted value being less than the 1998 index-based reference point. A poor status was given to a region if greater than 66 percent of the surveys fit those criteria.

A neutral status was 34 to 65 percent and a good status was less than 33 percent. In the end, if we look at the column on the far right or the two columns on the far right for 2019, in the northeast we have a neutral status. In the New York region we have a poor status, Delaware Bay a neutral status, and the southeast a good status, overall for the coast a neutral status.

You know, if we apply these same criteria to the results from the 2009 benchmark assessment and the 2013 update assessment just for relative comparisons through time. One thing you'll note is the numbers of surveys included in each one of these assessments has changed. Earlier in 2009, we included every sort of survey that we did, whether that individual survey was split by sex and stage and so on. There is probably some double counting of a survey within a region. We've also changed the actual data that was used in the ARIMA model because before we just used whatever index a particular state calculated for a survey. This time we standardized them all using the delta method. But we still show these just for comparison and a thing to note on this is, you know, New York is the problem here. It started out green, went to yellow, and now it's down into red.

Taking a closer look at the individual surveys that were included in this summary, I show here the most recent five and ten year trends for each survey within each region. In the northeast, you know, we have conflicting trends between the Massachusetts Trawl Survey and the Rhode Island Trawl Survey. One is going up, one is going down.

In New York very consistent trends, especially over the past ten years, all of these surveys are trending downward. Delaware Bay, individual surveys are either trending upward or are stable and, likewise in the southeast, things are either trending up or at least stable in the last five to ten year period.

One of the other terms of reference we had to address was a comparison of this stock assessment to the adaptive management framework within Delaware Bay. Really it's kind of comparing apples and oranges. I put this table together to try to illustrate this. You know the bottom line is there are different management objectives.

You could use a coastwide stock assessment, single species, you know, to ultimately arrive at a maximum sustainable yield or to try to stay greater than the 1998 index-based reference point. Whereas, in the adaptive resource management model, we also want to maximize yield, but maintain ecological function.

Ultimately we are constrained by the needs of shorebirds. The model types, you know, the coastwide assessment we can work with a single species model just for horseshoe crabs; under the ARM it's a multispecies model that has theoretical models of both horseshoe crab dynamics as well as red knots.

Management triggers, you know, we could have our typical FMSY, BMSY, or index-based reference points under the coastwide stock assessment, whereas under the ARM we have threshold values that change what we might do. These threshold values are based on red knot abundance of 81,900 birds, or female horseshoe crab abundance of 80 percent of a theoretical carrying capacity, which equals 11.2 million.

Under the ARM framework the harvest of female horseshoe crabs doesn't have any value or utility until these threshold values are met. Our status conclusions, you know, under a typical coastwide stock assessment, you would want to ultimately come up with not overfished or overfishing is not occurring.

In this case because we're using the 1998 index-based reference points, we would say for Delaware Bay it's a neutral status. Under the ARM the thresholds for each species aren't met, therefore female harvest is not valued. Management recommendations, depending on reference points, female harvest could increase in Delaware Bay; whereas under the ARM we would still be at a continued male-only harvest. I also put a big question mark there if female harvest could increase. Like all stock assessments, at the end we have a number, a myriad of future research recommendations. I'll just summarize those here, broken down into future research, data collection, and assessment methodology.

For future research we would like to have some more information on life history, movement, habitat associations of horseshoe crabs. You know, what effects climate change may have on population dynamics, and then better evaluation of spawner surveys and how we might improve those to be used in future assessments. Data collection, it would be nice if more surveys had standardized stage-based methods of bio-sampling.

It's easy enough to look at horseshoe crab and tell whether it's a primi or a multiparous animal. We also need some more gear efficiency studies for the Virginia Tech Trawl Survey; expand surveys out beyond Delaware Bay that have similar methodology and gears to the Virginia Tech Trawl Survey, and you know, some continued evaluation of biomedical mortality.

Future assessment methods include further development of the catch multiple survey analysis, continued tagging analyses, and a possibility of once we have enough data, perhaps moving or including or exploring a delay difference model. Ultimately, we think that we would recommend the ARM use of the catch multiple survey analysis population estimates.

Our overall conclusions from this assessment, the catch multiple survey analysis provides the most accurate estimates of abundance to use as input to the ARM for the Delaware Bay. We should definitely maintain and continue to pursue funding for the Virginia Tech Trawl Survey because really that survey drives the catch multiple survey analysis.

We should consider management action in New York; given its poor status and continued declining trends. It seems each time we look at the New York region, you know, each one of our assessments paints a worse and worse picture. We should also continue to monitor in the northeast. We don't have much data in the northeast and we have conflicting trends, you know between that Massachusetts Trawl Survey and Rhode Island Trawl Survey, so continue to take a close look at that area.

Then ultimately the population impacts of biomedical bleeding are probably minimal, given the sensitivity analyses that we ran with the catch multiple survey model, and you know, the robustness to changes in our biomedical assumptions within that model. It really had no impact on output values.

Finally discard mortality may be a significant factor, you know, and it could be greater than bait harvest in recent years for the Delaware Bay, at least for females it looks like it might be. That is something that we need to get a better handle on. This is the first attempt at it. We need to get a better handle on discards and continue to improve our estimation of discard mortality.

The next assessment on the SAS recommended an update in five years and a benchmark in ten years. The Peer Review Panel recommended a benchmark in five years due to the potential for improved discard estimation and model updates that could significantly affect the stock assessment.

PEER REVIEW REPORT

DR. SWEKA: With that I think we'll move to the Peer Review Panels.

CHAIRMAN CIMINO: Go ahead, Dr. Jacobson, and thank you, John.

DR. LARRY JACOBSON: Well my Momma told me, she said Larry whenever you're going to give a presentation make sure you show some leg. Here it is; and I hope that helps. It gets me right to my joke. Lying in bed last night I get a phone call and there is a voice on the other end that says; this is a voice that sounds like John Sweka.

He said make sure you wear shorts tomorrow; no jacket, and a dirty tee shirt. He said it's very informal. I said, I just did the laundry, sorry no tee shirt but I can handle the rest. I hung up and went to bed, got dressed and came in this morning. The moral of the story is the smart presenter is the guy with the long pants.

I chaired the Horseshoe Crab Stock Assessment Review Report and I chaired the Committee. As you know, you know everything on this slide. The Horseshoe Crab Technical Committee and Stock Assessment Subcommittee reviewed their stock assessment then we had a review meeting. Our scientific review was focused just on the science, data inputs, model results and so forth.

We had terms of reference and we tried to follow them quite closely. We had no interest in policy or any other controversies. We had access to all of the data, so the review panel was not limited to the publicly available data. We had access to all the data, including the details from the biomedical industry and we saw the actual catches, the landings, all of it.

There were three of us and it was a good team, a good review team, myself excepted. We had myself, we had two other people, we had Ruth Carmichael, who is a very well-known and very well respected horseshoe crab biologist, as well as many other things, and we had Matt Cieri, who works at the Maine Department of Marine Resources, and he's a widely experienced stock assessment biologist, does a lot of review work.

I used to work at NMFS. I was a Chair of the Invertebrate Subcommittee and worked there for about 30 years. Basically, from our point of view it was a sound assessment. It provides the best available information. It should be used by managers. The information is sound. It doesn't go beyond what it can justify, and so forth.

We were pretty happy with it after some discussion. We thought the assessment team was also a very fine team. They were all capable but even more important they were cooperative, and they worked really diligently to improve the assessment. The assessment work was well documented. We appreciated that.

Here are our first terms of reference. We were supposed to consider whether all potential data sources were considered, evaluated, and selected correctly and we believe they were. In particular, as John described, the process for including or admitting surveys was clear and satisfactory and reasonable. It appears that the biological sampling for horseshoe crab, sex, length, things like that in the commercial fisheries and the other fisheries is less than you would find in most other fisheries. But it was adequate for the assessment at hand; because very little could be done with the catch data, given that there was so little information about discards. But in the future it may be important to have more information about the biological characteristics of the catch.

We believe that the analysis that was done supports that 15 percent bleeding rate. As a result of that 15 percent bleeding rate, you know to get the biomedical losses, the dead crabs due to biomedical harvest, you have to take the biomedical collection; I think they like to call it, which you guys don't get to see, multiply it times 15 percent, which is the fraction that died, and then you get the number of crabs that may have died in the biomedical end by sort of multiplication. Consequently, when you do that, you see that the biomedical losses based on that 15 percent mortality rate are always less than 13 percent of the bait harvest.

Now, maybe they've got the biomedical harvest mortality rate wrong by a factor of two and 30 percent of them die. Even so, you would still have biomedical mortality of less than 26 percent. But we're comfortable with the 15. We're comfortable with the idea that the losses, in terms of dead crabs to the biomedical industry is about 13 percent, never more than 13 percent of the bait harvest.

We're going to suggest that this bleeding mortality stuff is no longer a major uncertainty. It seemed to us that there was too much time devoted to it in the assessment but, of course, you didn't have the results of the assessment when you formulated the terms of reference. The bleeding mortality is no longer a major uncertainty, given the relatively small biomedical take, the 13 percent and the comparison to bait landings, in particular discards.

Now it is discards I'm going to hit over and over and over again. The discard estimates were made for the first time; there were questions about how they were done. There was some more work done at the meeting and so forth and most attention was focused on Delaware Bay for discards. But it's potentially, it's possible, that the discards are as large as the combined mortality in any of the other fisheries.

All of the other fisheries put together could be higher than that or could be lower than that. There is a lot of uncertainty but it could be a major source of uncertainty, a major source of mortality. I think that is probably where you could devote whatever energy you have for horseshoe crabs in the near term in terms of research and so forth.

This is a slide that shows, that is meant to make the point about the biomedical losses relative to bait. The top slide shows for the whole coast in actual numbers, millions of horseshoe crabs. It shows the bait landings, it shows the biomedical collection, which is green, and then if you apply the 15 percent mortality rate to the collections, you get the biomedical mortality.

That is the little red knobs going along the bottom. You can see they're small relative to the bait landings; and that's not to criticize the bait landings, it's really only to say that it appears the biomedical stuff isn't that important. The bottom slide shows the dead discards estimated for the Delaware Bay region, just the Delaware Bay region, and you can see that it's got confidence intervals. The confidence intervals are pretty wide. But who knows what's going on anywhere else?

Here are our review findings: Recommendation 1, estimate those discards. See if you can estimate discard mortality too. We've got the discards, which have to be estimated based on fishery observer data, the so called NEFOP data. Then you've got to estimate the discard mortality rate, which we worked on here, and probably didn't need to make it into the slide. But we like to do it on a regional and a whole stock basis if we can.

Recommendation 2 is to add discard estimation experience to the Assessment and Management Teams. Now this discard estimation stuff is an art. You have to understand the fishery, you have to understand the horseshoe crab fishery, horseshoe crabs, you have to understand the fisheries that might intercept horseshoe crabs, and you have to understand the data bases. You have to understand the history of the databases. You really do want to get some experience in doing it into the Horseshoe Crab Assessment and Management Teams. I think that it would be reasonable to allow the ASMFC staff to access the discard databases directly. That would be very efficient if you can manage. It would be a good idea to provide them with some training to shave a few years off of the process of learning to do this discard estimation and to do it more accurately.

Back to the TOR, evaluate the methods and models. The ARIMA model as used here and was actually used previously, are good models for horseshoe crabs under the circumstances. They may appear simple to you but they are objective. There is not much to argue about in connection with them. They are well grounded statistically, and they make best use of the available data, which are the surveys. They are robust to uncertainties about catch because they don't use them. No estimates of natural mortality involved and so forth. I think a practical business person working in their own interest would not hesitate to use information like this to track what's going on with their business.

We like the catch-multiple-survey analysis. We believe that they provide the best available estimates of abundance in F and they provide reasonable estimates for Delaware Bay females only. However, there weren't any comparable reference points available in order to do a sort of overfishing/overfished determination for just the Delaware Bay. We recommended not doing it. It didn't seem necessary because we had the ARIMA models to fall back on and the ARIMA models were being used elsewhere.

There were some other reasons as well, and I'll go into them if you would like. But it seemed fine to us to use the Collie-Sissenwine model the CMSA estimates for other purposes besides comparison to reference points. There was a theoretical population model that John alluded to and it was a nice piece of work, but it wasn't comparable to any of the other models we had either. We didn't make much use of it. However, there was one major result and it seemed to estimate that FMSY was less than 0.1 that is to say low, which would indicate that the horseshoe crabs are not really resilient to much in the way of fishing. You know, with an FMSY of less than 0.1, so less than 10 percent per year to get maximum sustained yield.

Recommendation 3: calculate the reference points and projections within the Collie-Sissenwine model, I'm sorry, the Catch Multiple Survey Analysis model or other assessment model for comparability. You should compare apples to apples. The reference points should come from the same model that you used to compute the stock status, you know, the abundance or the fishing pressure. That goes for projections too. If you're going to do projections, do the projections inside the model that you're using for the rest of the work. That way you don't get into an "apples to orange" comparison when you're making the estimate in 2018 based on one set of assumptions, and doing the projections based on another. We believe you should continue to improve that catch and multiple survey analysis. We thought it was a big step forward and particularly for use in other regions and for both sexes, because remember we've only used it for females in Delaware Bay.

TOR 3, does this work? Can you guys hear me okay? I feel myself turning away.

Evaluate the diagnostic analyses performed, including sensitivity and retrospective analysis. There was no shortage of sensitivity and diagnostic analyses. We had residual analyses, identified poor ARIMA model fits, and they did some historical analysis to demonstrate that the ARIMA was pretty stable between assessments. It inspired more confidence than uneasiness. It appeared to be a good way to go. They did a historical retrospective with that new 33 percent/66 percent status method that he showed you; and there were some changes over time in the number of stocks that were below the 1998 reference point, but they seemed reasonable, those changes seemed quite reasonable given the trends in the surveys and so forth, and the changes in the number of surveys that might have been used in each assessment. They did a lot of sensitivity analyses with the CMSA; and they were robust, no retrospective patterns to speak of and so forth.

Recommendation 5 goes back to the CMSA and this is something that John alluded to. One of the reasons the CMSA model in Delaware Bay is so stable is because they assumed that the Virginia Tech Survey catches 100 percent of the crabs in the path of the net. It's probably a pretty good assumption for that survey because it's a net, and it's a survey designed for horseshoe crabs. But it's probably not quite 100 percent. It would be a good idea to go back and do some field experiments, go out there and drag that net over the heads of a bunch of horseshoe crabs, and see exactly what fraction you actually do collect. That would be worth doing.

However, even with that criticism we were comfortable with the estimates from the Catch Multiple Survey Analysis, the CMSA. All right, what else have we got here? Evaluate methods used to characterize uncertainty in model estimates. This is all fine. The ARIMA model fits used standard statistical approaches; which are quite good. You can eliminate that second bullet. Well the first part of it is true. The nice thing about the ARIMA proposal and the business about using the reference point from 1998 is that you automatically include uncertainty in both the estimated trend, and also where the reference point is. If something is done to make the survey run high, the reference point goes high, too, because they're linked together. That is why you like to take them from the same model. They move up and down together and if there is any bias they sort of cancel.

The Catch Multiple Survey Analysis, standard sensitivity analysis and standard variance calculations, it's all fine. Recommend the best estimates of stock biomass, abundance and exploitation from the assessment for use in management. We say use the relative abundance from the ARIMA models, the 1998 reference point and the 33/66 percent method to determine stock status.

As it happens, we can't calculate exploitation measures from the ARIMA model or from any other approach; short of the tags, because of all that uncertainty about discards. You know until you get the discard numbers nailed down, the discard estimates nailed down, it's very difficult to say anything about how much fishing pressure there is or what the trends in fishing pressure have been like.

We don't believe the CMSA should be used for status determination at this point; for the reasons I alluded to. But they are suitable for use for other purposes, like that ARM model. The only other thing is that even though we don't want you to make a comparison of the CMSA to the reference points, for example from some other model.

It was pretty clear to us looking at the CMSA results, these are results that you can't see that the fishing mortality levels are very low there. It's extremely unlikely, I think extremely is fair, extremely unlikely that there is overfishing occurring in the Delaware Bay area in the FMSY sense. What I'm saying is it is very likely that fishing mortality, particularly for those females, is lower than FMSY, probably quite a lot lower.

Evaluate the choice of reference points and methods used to estimate them; recommend stock status determination. Panel conclusions, use relative abundance in 1998 from the ARIMA models as abundance reference points, and then use that 33/66 status method to combine results from multiple surveys at regional and whole stock levels.

The multiple surveys, for example in the Delaware Bay area, you might see that as a disadvantage. It is certainly more convenient for stock assessment people; when you can treat any survey anywhere in a region of being a replicate of the other ones. However, for horseshoe crabs it seems to us that there probably are different population dynamics in different bays and areas within a region.

It just isn't necessarily a good idea to assume that they are all the same. We see it as sort of a strength in this assessment that it really does include the realism of different trends and different regions. Recognizing the need to combine these surveys a little bit to get enough data to actually do something. We think that this apparently primitive looking technique is probably quite reasonable under the circumstances. Review and prioritize research recommendations. Estimate discards and discard-mortality rates by gear. Make discard data and expertise more available to plan and assessment teams, that is our biggest take-home. The second one and this is not a small point either is that there are a lot of surveys. What we think is that it would be good to take some of those survey programs, and if it's feasible, do a better job of collecting data from the horseshoe crabs that are taken.

In other words, count them, measure them, sex them, and do it sort of consistently and on a routine basis so that, over a certain period of time, we might collect better data for the stock assessment and might make it easier to apply these catch multiple survey analyses and so forth and so on.

There is a lot of survey work out there. There are a lot of surveys in this assessment. But they don't all track horseshoe crabs equally well. Perhaps the people in charge could get together and decide to regularize the collection protocols or something. That is one thing we think you guys should do as a matter of some priority. In other words, coordinate collection across survey programs.

Continue that Virginia Tech Horseshoe Crab Trawl Survey. They managed to bring it through with those three years of missing survey data. But if they had been any closer to the end of the survey series they might not have; things might have become too imprecise. We think you should keep that survey going and operated on an annual basis if possible.

Then keep up the good work on the stock assessment models and so forth. Timing of the next assessment, from our point of view, and this is one of the two areas where we had some discussion and a little bit of disagreement, at least initially with the Assessment Team. We would see, ideally, another benchmark stock assessment in five years because of the discard questions.

It seems possible to us that the information about discards might be such that you would want to consider different management approaches, particularly to manage to reduce discard. It might be that the discard is occurring in certain fisheries at certain times of the years in certain areas, for example. It might be that the actual fishery-induced mortality is twice what you think it is.

Maybe that will help explain what's going on in New York. That kind of work is more along the lines of a five-year timeframe. We also think, and of course this is none of our business, it's yours, that it would be prudent though to start work on the discards soon, because you know you'll start talking to the NEFOP people.

The NEFOP people are short on resources. They'll start arguing with you about whether it's the best use of available resources. You'll go back and forth. You'll come to some sort of a compromise. It may be that the protocols that are used to collect the observer data will need some adjustment and that will take some negotiation too.

You know, John Hare will have to talk to folks and so forth. It will take a little time for the discard question to percolate into the culture, into the horseshoe crab culture. Maybe display some of the biomedical mortality questions. You know we've got to get people sort of thinking along a new track, at least for a little while. If you were going to do an assessment in five years, considering the cultural change that's required, considering there may be training involved to bring the team staff up to speed, to get use to the databases, to make changes to the data collection protocols that we think it would probably be a good idea to start on the discard estimation soon. I think that's my last slide. Have you guys got any questions for John?

CHAIRMAN CIMINO: Okay let's get started. Roy Miller.

MR. ROY W. MILLER: Thank you Dr. Jacobson and Dr. Sweka for your fine presentations. I have a question concerning the discard loss. I don't remember if you mentioned the sources of potential discard mortality, but in Delaware Bay you have a gillnet fishery, you have a conch dredge fishery, you have a crab dredge fishery.

Other than that, the only other source of discard loss, if you want to call it that, might be commercial dredging operations from main channel deepening. Do you have any feeling for the relative importance of those potential sources of discard mortality relative to each other?

DR. KRISTEN ANSTEAD: I will answer that question. As part of the NEFOP dataset we did have the commercial trips in the Delaware Bay states for all fisheries and if they kept horseshoe crabs, if they discarded horseshoe crabs what the gear was, what the state was. We could look at that and the discard estimates were actually performed by gillnets, midwater trawl, and bottom trawl, and dredge separately.

Those estimates were made separately for each of the three gears and different mortality rates were applied to each of those gears. We used 50 percent for trawl and gillnets and 5 percent for dredges and the scale of the discards from those fisheries did vary by gear and by state. That was all taken into consideration as part of those estimates, but certainly more work can be done to fine tune that as Dr. Jacobson has indicated.

CHAIRMAN CIMINO: Follow up, Roy.

MR. MILLER: Please. Of those sources do you have a feeling at this point in time which one might be the most important source of discard mortality in Delaware Bay, considering the volume of course of each of those activities?

DR. ANSTEAD: I hesitate to point the finger at one thing because the dataset isn't designed to capture horseshoe crab discards. Dr. Jacobson has indicated that maybe we need to kind of talk with NEFOP about how we could get this dataset to be better for horseshoe crab but there were some years of just massive dredge catches.

But we only assigned a 5 percent discard mortality to the dredges, thinking that the horseshoe crabs might sustain being caught in a scallop dredge, for example. Some of those peaks that you see in the discard are just a really large haul in one year of horseshoe crabs in a dredge fishery. But I think consistently the trawls maybe caught the most. But again the dataset is not designed for that. We need to do some work around it.

CHAIRMAN CIMINO: Okay, Jim Gilmore.

MR. JAMES J. GILMORE: I've actually got two questions but the first one is for John. Are there any conclusions or even speculation as to why we are seeing this rather odd thing, where we have a decline in New York but either stable or increasing things around us? The second question then I'll just put it out. I'm not sure who could answer it. But when did the New Jersey moratorium, what year did it start?

DR. SWEKA: To your first question. Yes, it is very odd that New York continues to see a decline. You know, your allowed quota from ASMFC has declined. Then at the state level you take less than half of that. There is no biomedical collection or mortality going on in New York. The two hypotheses that could still explain the continued decline are one, either what little bait harvest is allowed is still too excessive, or their habitat has changed.

That would take some additional research into the areas around New York to see if the amount of available spawning habitat has changed, if water quality has changed. But it is strange that given the reductions in harvest and no biomedical, it's hard to point the finger at that as the leading cause. To your second question, when New Jersey's moratorium went into effect, it was 2007.

DR. JACOBSON: John, there is the discard hypothesis, too. Intense fishing in a variety fisheries around the New York region, plenty of discard and so forth.

MR. GILMORE: Just a follow up, and I think there is a fourth reason and it might be illegal harvest. Just so we have that on the table. We've seen quite a bit of enforcement action on this fishery because of the supply and demand issue with once we get closures in other states the price goes up and the supply goes down. Demand goes up, price goes up. Anyway, we're thinking that has something to do with it also.

CHAIRMAN CIMINO: We've got Mike Millard, Adam Nowalsky, and then Dan McKiernan.

DR. MIKE MILLARD: Thank you gentlemen for both of your very thorough reports. It's hard to believe we've been at this horseshoe crab thing over two decades now. John, a question for you, a comment and a question about the biomedical mortality, I guess the take-home message from both of your reports is that it is essentially insignificant.

I think back as a TC member. Our relationship with the biomedical folks has been colorful, to say the least about the use of their data and access to their data. Given that though, and I think it's a fact that their estimated bycatch or estimated discard mortality has exceeded the cap in the plan six out of the last seven years, or something like that.

This Board has never forwarded a motion, either accepted or defeated, to cap or limit the biomedical harvest. I'm sure there have been many reasons we've not taken that up, given they violated the cap. But, I guess a charitable interpretation now is that we had the wisdom to see that the juice wasn't worth the squeeze anyway; because it is an insignificant harvest. I understand the confidentiality issue and you redacted the Y axes on many of your drafts. But is there some context you can give us just to help me wrap my head around just how insignificant that estimated mortality is?

DR. SWEKA: Sure Mike. I mean, the numbers in the reports represent the coastwide biomedical mortality because, then, by reporting the coastwide we don't violate any confidentiality issues. If we wanted to make a very, very extreme estimate of what biomedical mortality might be, perhaps you could take the coastwide numbers that are bled, which in 2017 was over 440,000.

If you make the assumption that every one of those crabs was a female, and all of those crabs also came from Delaware Bay. To put that in kind of context, you know, the coastwide bleeding mortality relative to say just the Delaware Bay only population. If we assume they're all from Delaware Bay, all females, and we would assume that 30 percent of them die after bleeding, which is on the upper end of our estimates of bleeding mortality.

That would be 139,000 crabs dying because of the biomedical industry. Relative to the female population in Delaware Bay at the same time in 2017, which was 7.6 million crabs coming just from the Virginia Tech minimum swept area estimates of abundance, which we know are probably an underestimate, because it's not 100 percent catchability.

If you just divide those two alone, you know biomedical mortality would represent 1.8 percent of that population and that would be in a very extreme upper limit, assuming the worst case scenario for everything. Even that, and then take into account, the natural mortality of adult female horseshoe crabs, which we estimate as 24 percent per year. You're comparing 1.8 percent versus 24 percent. That kind of puts it in as an absolute maximum extreme impact of the biomedical industry on Delaware Bay alone.

DR. JACOBSON: John, wasn't it also the case, there is a table in the Confidential Report that showed coastwide biomedical deaths, assuming the 15 percent mortality rate in comparison to bait landings, and it was always less than 13 percent. The mortalities lost to the biomedical were always less than 13 percent of bait landings; so that is a comparison to landings. You just did a comparison available to biomass. I think you can go at it both ways.

DR. SWEKA: Yes, and we have done that in the past, looked coastwide what the estimated coastwide biomedical harvest was relative to bait landings and it's always been fairly low. It's not insignificant. We realized back after the 2013 stock assessment update. It's not insignificant where we can completely ignore it, but it is still low compared to bait.

DR. JACOBSON: I think the 13 percent was in a year prior to the institution of regulations and so forth too; so in most years it was much lower than 13 percent.

CHAIRMAN CIMINO: Adam Nowalsky.

MR. ADAM NOWALSKY: I was going to ask for a response to a comment in materials that were submitted to us after the assessment. ASMFC apparently did not conduct a detailed analysis of biomedical mortality or its impact on the Delaware Bay spawning population and, specifically female crabs which produce eggs. I think I just heard that detailed analysis. Unless there is anything else to add, I think I'm comfortable that my question was answered. Thank you.

CHAIRMAN CIMINO: Dan McKiernan.

MR. DANIEL McKIERNAN: In the document is the discards enumerated by say gear type and area that we could look at?

DR. ANSTEAD: Yes in the document there are the total discard estimates by gear before they're combined, and then attributed dead, and then the attributed dead to females in Delaware Bay.

MR. McKIERNAN: But what about some of the other regions like New York or the northeast? Is it there too?

DR. ANSTEAD: No. When I got the dataset from NEFOP they go from you know most of the coastal states. But the dataset wasn't as robust outside of the Delaware Bay, so the confidence intervals were even larger. That's why we really focused on the Delaware Bay. For example, in New York they are very low bycatch values in that dataset, and I don't know if that's because of the way that the data is collected, or if that is true.

There were just too many questions outside of the Delaware Bay states to really zero in on that. Massachusetts had pretty good data actually from the NEFOP that could be looked at further but we really focused on that because we wanted it as an input for the catch survey, and that's where the data seemed the most complete.

MR. McKIERNAN: My last question is, I wonder at some point if there is going to be a discussion about a preferred method to manage horseshoe crab fisheries sustainably. In my state we benefit from something that was opposed years ago but lives on and that is the refuge closure at Monomoy.

We've got the National Park in parts of Cape Cod as well, and those areas are off limits to harvest. I think we might be the beneficiary of sort of that kind of management strategy even though Massachusetts didn't institute it. I think it represents a pump for recruitment and maybe protection of adults.

I guess I wonder about how things seem to be declining elsewhere, and I don't know if there are some recommendations. We did adopt the Rhode Island lunar closures; which seemed like a good idea, and I just wonder at some point might there be an assessment of good management strategies for this species.

DR. SWEKA: I guess I would say that's kind of a difficult question to answer. I mean obviously there are a lot of different avenues that if the Management Board considered a management action. You know a lot of different things that you could possibly do with seasonal closures, lower harvest limits.

You know, more refuge area, perhaps around New York. We didn't do any sort of and I don't think we have the data. We don't have the data to really do a management strategy evaluation. It would be nice if we had population estimates in these other regions like we have in Delaware Bay. Perhaps on down the line if we can somehow get some hard population estimates, say around the problem area of New York. Then maybe we could start modeling some of the dynamics there and do a management strategy evaluation to look at alternative management there, more than just reductions in bait harvest alone.

CHAIRMAN CIMINO: We will be considering management responses so, if in that discussion there is a task to either the Technical Committee or if we're going down the line of starting a PDT, I think we can continue that discussion there. I have Stew Michels next and then Bob.

MR. STEWART MICHELS: Excellent, excellent assessment and review. The picture of that mountain that you showed is certainly not steep enough to reflect the accomplishment that you guys made here. I had a question regarding the discard conversion factors that were used. They seem a little light to me, like by about half. I was just wondering where those data came from.

DR. ANSTEAD: Sure, we used the ratio estimator. They were scaled up to ACCSP landings for those states; all species landings for the same gear. That's one of the challenges of this dataset as well, is the NEFOP gear is the same as the ACCSP gear, but it's not necessarily categorized the same way, so sometimes it can be hard to compare those two datasets to each other.

It is a crude estimate at this point. We have the NEFOP data to do the ratio of horseshoe crabs discarded to species landed. Then it's scaled up by the ACCSP all species landed for the similar gears and states. Does that answer your question?

MR. MICHELS: That does answer another question I had but the actual estimates for the weight of a male versus the weight of a female for the conversion.

DR. ANSTEAD: Yes, the bio-sampling in NEFOP for horseshoe crab is also quite thin. With the exception of the trawl gear, we had some bio-sampling from that and so we could use annual bio-sampling to do some of those conversions. Otherwise we looked to the state conversion factors to get between the weights and the numbers.

Traditionally, what is used is one pound for a male and then 2.67 pounds for a female. They can be controversial conversion factors but that is generally what is used and so, at that crude level with about a 46 percent female, I believe is the ratio we used for that in those weights. That is how those conversions were made.

MR. MICHELS: Okay, that is probably something that we should take a look at when we delve into those discards. If I may, Mr. Chairman, the use of the Delaware Bay Spawning Survey, I'm kind of curious as to why it was not used as an index of relative abundance. I understand in the ARM model the sex-ratio data is used. But I wonder if you could speak to that.

DR. SWEKA: Yes Stew, part of the problem with that is you know we believe it's a gear saturation issue, in that you can only fit so many crabs within a square meter, you know the square 1 x 1 meter quadrant on the beach. It doesn't show the same sorts of trends that some of the trawl surveys are showing, because you fill up that quadrant and that's all the more crabs that you can fit in that space. You know perhaps if there was somewhat of a redesign of the survey that accounted for more longitudinal distance along a beach; you know that takes into account more of the spreading out of horseshoe crabs. Maybe that would make it a slightly better survey. It has been used, you know, Dr. Dave Smith has used it in some analyses to see how crabs have spatially redistributed through time across Delaware Bay. It's still useful for that and it's also like you've mentioned, we use it in the ARM framework to look at the sex ratio of males per females.

MR. MICHELS: Then Dr. Jacobson, you mentioned that and I probably misunderstood, but the catch multiple survey analysis, recommended its use for the ARM model would be appropriate. But then I thought I heard you say for females only.

DR. JACOBSON: The model as it was run for females only; because it takes advantage of some aspects of the reproductive biology. At this point it should only be used for females only. But we look forward to extensions or developments or more work that might make it possible to do it for males also, and also, for males and females in other areas. Does that address your question?

MR. MICHELS: I think that does. But then how do we accommodate the male harvest packages by only incorporating the female component into the model?

DR. JACOBSON: I'll probably let the Assessment Team answer that but I think that, in Delaware Bay there is enough information, even if it's not complete, to split the total landings into males and females. Of course I think most of the landings have been females recently, but John.

DR. SWEKA: I'll just back up and state why we didn't try to estimate male abundance within the CMSA. The reason why was because there are some years. You know the nature of that model, it always assumes that there is going to be more multiparous individuals than primiparous individuals.

For whatever reason, sometimes with the males you end up with more primiparous than you do multiparous individuals in a given year. It seems like there is a little more interannual variation and those ratios between multi and primi don't stay consistent through time. The problem there was when we tried running it in the model, the model just would not converge. To the second point then, you know, what do we use in the ARM model for males?

That is obviously something we would have to discuss within the ARM Subgroup. Just off the top of my head right now, if we're getting an estimate of females that we're confident in. From the trawl survey itself we have the ratio of total males to females. We could apply a sex ratio to that or get the sex ratio from the trawl and apply that to the female estimates of abundance, and then use that as our estimate of male abundance, you know for input to the ARM. That is one quick possibility off the top of my head.

CHAIRMAN CIMINO: Stew, you good? Bob Ballou.

MR. BOB BALLOU: I'm interested in the blending of the Massachusetts and Rhode Island surveys into a single regional index and, because the Mass survey is trending up and the Rhode Island is trending down, they sort of cancel each other out and you end up with a neutral status. Then juxtapose with the New York situation where they're all trending down and showing up as bright red. As a Rhode Islander, I'm not sure if that leaves me feeling lukewarm or lukecold. I am wondering whether there was any thought given to differentiating Rhode Island as a standalone. The survey that Rhode Island conducts appears to have warranted its inclusion as a contributor to the assessment.

But again, because we were blended together with Massachusetts, it puts us in this kind of interesting juxtaposition between a trending up status to our east and a trending down status to our west, and a Rhode Island survey that's trending down. I'm wondering if you could speak to that issue a little bit. Thank you.

DR. SWEKA: Yes, we definitely thought a lot about Rhode Island. You know, which region it should be in. Should it be lumped in with New York? Should it be in with Massachusetts and the rest of New England or the northeast? It's hard to say. Yes, the trends are more like the New York area, but where the Rhode Island Survey is conducted is awfully close geographically to where the Massachusetts Trawl Survey south of Cape Cod.

It is interesting how geographically close the Rhode Island survey is to Massachusetts and yet we see completely different trends in the two. I don't have a good answer for you other than that we did have many, many long debates, not only in this assessment but in previous assessments. Where do we fit Rhode Island? Where should we really break the New York versus New England?

Also, even with the rest of New England, once you go up around north of the Cape then that survey just kind of bounces around without a consistent trend or lots of zero tows out of there too. There is certainly, you know that's why in the end one of our conclusions is we need to keep looking at New England. It shows a neutral trend but it's based on two surveys with conflicting trends of each, so continue to watch and examine that.

CHAIRMAN CIMINO: Mike Millard.

DR. MILLARD: Thank you, Mr. Chair, for a second go-round. Dr. Jacobson, it occurs to me that the development of reference points outside of the assessment model framework is not without precedent yet you said several times it's a bad idea. Is there something about the horseshoe crab in particular that makes it a bad idea or is it just in your opinion a bad idea across the board?

DR. JACOBSON: It's viewed I think the technical consensus is that it's a bad idea across the board and some of the reasons stem from experience with real uncertain assessments where you are pretty sure of the trend but the biomass may be 100 or 200, off by a big amount between models. The difference between two models may be substantial and unexplainable, even though they show the same trends.

If you were to take a reference point from one and compare it to the say a biomass estimate from another, the difference, the ratio may be due more to different assumptions in the model, than to the real status of the stock. When you take the reference point and the status measure from the same model, you take any relative bias in the two and it's the same on both sides. If one is high by 50 percent, the other one is high by 50 percent, when you divide them, take the ratio you've got the status measure, the biomass on the top and the reference point on the bottom. The 50 percent biases cancel out. If you have two models, one of them may be high by 50 percent the other may be low by 50 percent.

Depending on which one you take the reference from, 0.1, and which one you take the biomass from. You'll come out with a number that is off by a factor of 2 or 50 percent, depending on which way you flip them. It's just from a technical point of view in general, and a consensus technical point of view I think, viewed as not a great idea. But, we tried to be responsive and we tried to be as helpful as we could and we think that there was real information in John's theoretical model. The theoretical information is that the FMSY is probably lower than 0.1.

If you look at the results from the Collie-Sissenwine model you see that the mortality estimates for the most recent years from it were very low, you know very low, even low relative to 0.1. We're comfortable saying that it's pretty unlikely that fishing pressure exceeds FMSY at this time in the Delaware Bay area, but we drew the line at actually making the comparison. It's just bad practice in our view.

CHAIRMAN CIMINO: Adam Nowalsky.

MR. NOWALSKY: I would like to make a motion if you're ready. I move to accept the Benchmark Stock Assessment and Peer Review Report for management.

CHAIRMAN CIMINO: We have a whole bunch of seconds. Well okay, Mike Luisi. We did promise to allow the public to have a chance, and we do have one individual that signed up to speak. I didn't know, Mike and I were thinking that we would like to hear their questions before a Board vote if that's all right.

PUBLIC COMMENT

MR. BRETT HOFFMEISTER: Want me to go ahead and make the comments now?

CHAIRMAN CIMINO: Yes. Brett Hoffmeister if you can come up, we have a public microphone at the end of the table here. Hopefully I got your name right, but if you state your name and affiliation.

MR. HOFFMEISTER: Yes indeed, you did get my name right; thank you, it's not easy to do. Thank you for the opportunity to speak. This is a great opportunity. As you said my name is Brett Hoffmeister; I'm the LAL Manager at Associates of Cape Cod. I also am Vice Chair of the Horseshoe Crab Advisory Committee; two roles I take very seriously.

I've got a couple comments today regarding the assessment and some of the assessment process. First off, I would like to say that I've had the opportunity to be in attendance for some of the meetings. It was really something to watch. I would personally, and my Company ACC would like to thank them for the work and the effort they put into this assessment.

I personally have a new found respect for the painstaking process of analyzing this data from so many different sources. This was by no means an easy task as it was a privilege to watch these ladies and gentlemen work. The team did so thoughtfully, skillfully, and professionally. I would also like to thank the team for their efforts in maintaining our privacy in matters protected by confidentiality laws.

It was very clear to me that this was a priority for the team and ACC recognizes that this made a tough job tougher and we sincerely appreciate those efforts. That said, I did pore over the draft assessment and I do take issue with one certain aspect of the assessment, and if you allow me a few minutes to describe that I will make it quick.

ACC has a 45-year history of conservation efforts that began with the catch and release model, size limits. We've worked with the state to prohibit bait fishing in some embayments. We participate in the rent-a-crab program, utilizing the resource officially and most recently instituted a project that uses in vitro fertilization to restock the wild population.

The takeaway from that is that our Company does care, and always has cared, and always will care for these horseshoe crabs. This is a resource that we depend on for our business. It is for that reason we were distressed to see the inclusion. We didn't talk about it here today, but Section 4.2.2. There is a section called sublethal effects of biomedical bleeding. In this section they specifically reference two papers, the Anderson paper and the Owings paper from 2013 to 2017, respectively, coming from the University of New Hampshire.

I'm familiar with these papers. I've read them, and I went over them again as part of this comment section. I would like to make it abundantly clear to everybody in this room that the processes described in these papers does not reflect our longstanding industry practices as they repeatedly claimed to do. For the benefit of those who haven't read these papers, please allow me to read from them. This is from the Owings Paper.

The bleeding process replicating industry standard processes, took a total of three days. From the get go they are inaccurate. The 60 gallon barrels of the treatment animals were placed outside in direct sunlight for four hours or next to a space heater in the greenhouse; depending on the temperature of ambient sunlight during the selected day to replicate duration of time spent on the deck of a boat prior to transport to biomedical facilities. The average temperature the crabs experienced during this time was 32 degrees Celsius; plus or minus 2.7 degrees.

For the benefit of those here that's about 90 degrees Fahrenheit. After the first four hours the barrels were placed in the back of a car and driven around for an additional four hours; to simulate time spent in the truck traveling to the bleeding facility. Temperature here was about 23.2 plus or minus 1.7 degrees Celsius (that's about 75 degrees Fahrenheit).

After these four hours the barrels were placed indoors for another 16 hours to simulate the time spent overnight in a bleeding facility. These were held at about 70 degrees Fahrenheit. After the 16 hour of sitting time, hemolymph was extracted as below. They go into a description of how the process was done; and then they go on to say that the bled animals remained in their barrels overnight for another 24 hours to replicate a second night at the bleeding facility, again at 70 degrees Fahrenheit. Then the barrels were placed in the back of a car for four hours to simulate transportation back to the dock where they would eventually be loaded on vessels and returned to their capture location. The fact of the matter is that before Ms. Owings even began her bleeding process, ACC would have taken crabs from the supplier, bled them, and returned them to their natural surroundings; so before she even got started.

Whereas she still had in comparison the crabs that were enduring the process and enduring the conditions that they cite here had another 36 hours to go. Claiming that this process is industry standards is simply wrong; and much can be said about the Watson paper, much the same can be said about the Watson paper.

It says Cape Cod is well aware of the relationship between hypoxia, hemocyanin levels and stress on the animal's well-being and we have been for decades. The fact that exposing these crabs to inhumane conditions that might result in high mortality an altered behavior should not be a surprise to anybody in this room. I think we all can acknowledge that.

I understand the author's good intentions but claiming that the treatment in these studies is accurate and mimics those of our longstanding practices is wrong. It's disappointing that the ASMFC is giving credibility to that claim by publishing the results and the conclusion from these experiments as representative in this industry, in both this assessment and back in the September issue of the Fisheries Focus.

What can be and should be acknowledged is that the good results come from good treatment. This is something that we've known for decades. This is something my colleagues in the biomedical industry have known and this is something that this Commission knows, and documented in the 2011 best practices.

Every paper reviewed by the Stock Assessment Subcommittee has demonstrated similar results with crabs that are treated well. Often those numbers are overlooked. Focusing on the results of extreme and poor handling condition only misinforms and that is not the purpose of this Commission.

To state that these are the effects of biomedical bleeding is simply wrong, and I believe has no place in this assessment. I don't mean my criticism to undermine the good work that was done because there was some very good work done here, and I was witness to it. But I want to make it abundantly clear that the claims that these papers make that this is an accurate description of what happens in the biomedical industry is completely wrong and I thoroughly believe there is no place for this in this assessment.

Just to finalize again. I do want to thank you for the good work that was done by the Subcommittee. I have to give a nod to Massachusetts DMF, who I think is doing an excellent job maintaining and managing the horseshoe crab fishery. We've seen the benefit of some of their management actions. I would like to thank you all for taking my comments today.

CHAIRMAN CIMINO: I wanted the Board to have a chance to hear any public comments or questions for either the Peer Review or the Stock Assessment folks. We do have a motion on the floor that has been seconded. Adam Nowalsky.

MR. NOWALSKY: I hate to belabor it but those are some pretty strong comments. Is there any response from staff with regards to this, because unless there is something otherwise, I'm inclined to with the consent of this body modify that motion to remove 4.2.2?

DR. ANSTEAD: I can respond to that a little bit. Just to back up a couple steps with how we approach this biomedical issue for the stock assessment in all of those studies we looked at. We did portion those studies out by region and had a representative from the SAS evaluate each of those studies by region, as part of the appendices in the report.

They all concluded that for the most part many of those studies are not in line with practices that they're aware of in their respective regions; and that is reflected in the appendices of the stock assessment. Additionally, we had a TOR to evaluate sub-lethal effects of biomedical bleeding and those were the only two studies we're aware of.

I'm not pushing back on you. I'm happy to remove it if that is the will of the Board, but it was one of our TORs, and so we were only limited in our capacity of those two papers to address that TOR that was assigned to us. Certainly, I don't think that section says that we believe that is how biomedical is operating. Those are just the two studies that have evaluated sub-lethal effects of bleeding; not necessarily the practices of the facilities.

CHAIRMAN CIMINO: Dan.

MR. McKIERNAN: The question that comes to mind is it cited a Master's Thesis. Was that Master's Thesis work published in a Peer Reviewed Journal?

CHAIRMAN CIMINO: I don't think we have the answer.

MR. McKIERNAN: Consistent with Adam's comment, is it possible to remove that reference if it wasn't published in a journal?

DR. ANSTEAD: Yes. We can remove that study if that addresses your comments, Adam. How about the Anderson study though?

MR. McKIERNAN: Brett, do you have a comment on the Anderson study?

MR. HOFFMEISTER: Only to say that similar conditions. I mean in the Anderson study these crabs were put on, I guess the aquatic equivalent of a hamster wheel. To get a baseline they put them in water for two weeks and then bled again. In that study they were looking specifically at sublethal effects, and they took a lot of blood out of some crabs and not so much out of others.

The groups that didn't get a lot of blood taken out of them fared pretty well and, I think that during the mortality studies that was evidence in these studies. But similarly these crabs were exposed to conditions that were not even close to what we do. I don't know how else to say that. These are extreme conditions and it's bothersome that they claim that this is the biomedical procedure when it is not. If they want to claim that this is what they did that's fine, that's what they did. It's not what we do. I think that needs to be acknowledged somewhere.

CHAIRMAN CIMINO: We also have another member of the public that would like to speak, I'm assuming it's to this issue.

MR. ALLEN BURGENSON: Hi everybody, and thanks for allowing me to speak at this meeting. My name is Allen Burgenson; I am the Chair of the Advisory Panel for the horseshoe crabs, and I can echo pretty much everything that Brett said. Now several years ago when there was first an excursion of the threshold we all got together at ASMFC Headquarters, all the manufacturers and our State Representatives, to come up with best management practices.

We all developed them, we all agreed to them, and we all practice them. There has been some comment that these practices are just guidelines and voluntary and we don't have to follow them. That is incorrect. We have taken the best management practices, put them into standard operating procedures, and this is what we follow.

We are also regulated by the U.S. Food and Drug Administration; who can audit us at any time all the way from horseshoe crab collection all the way to the final product manufacture. These are something that they are not just guidelines; they are hard coded into what we do. As far as my company Lonza, I can tell you, we go out at night after 9:00 o'clock at night, so it's dark.

If anybody has been out on the water at night, you know it could be 80, 90 degrees on the land, but it's going to be pretty cool out on the water. When we collect crabs, you guys were right before, we don't use the term harvest, we collect. Those horseshoe crabs are collected and they're put into insulated totes and then they're brought back to shore and put into an air-conditioned vehicle. They are then that same night brought to our bleeding facility, put into an air conditioned facility, and we try to approximate air temperature.

Then they're brought into the bleeding facility, which is kept at about 65 degrees F, because all of our bleeders are wearing Tyvek suits, and if you've ever worn a Tyvek suit you know how hot you get. After they're bled they are put back into the tote and they are put back into our bins, which are then returned with the next trip out.

Our total time out of water is less than 24 hours. All of those articles that say that they reflect what we do, they are wrong. Unfortunately, a lot of those articles are the data that is used to determine our mortality rate. Of course if you take all those papers all along you're going to come to 15 percent.

But, none of those papers follow our practices, and those practices have been audited by all the companies here, as well as our DNR representatives who go out with the fishermen to see what happens when they collect the crabs. The FDA has seen what we do. Our mortality, we've been arguing this for years and years. But we don't even agree with the 15 percent; it's much lower. That's pretty much it. Thank you.

CONSIDER ACCEPTANCE OF BENCHMARK STOCK ASSESSMENT AND PEER REVIEW REPORT FOR MANAGEMENT USE

CHAIRMAN CIMINO: Thank you, and Adam before I turn this back over to you, one thought that was expressed here is that removal of this entire section from the document may not lay out that this was at least looked at, whether or not.

MR. NOWALSKY: My proposed way forward to that Mr. Chairman, is I would like to see all references to the Owings Thesis removed from the document; leave 4.2.2 in with the first paragraph, but add a sentence or a paragraph that notes that the study protocols referenced are different than industry best practices. That would be my proposed way forward.

CHAIRMAN CIMINO: I look to the seconder of the motion.

MR. MICHAEL LUISI: I will agree with my colleague from New Jersey if it helps things move along here.

MS. TONI KERNS: Could I help you guys instead of having to write out all of this stuff that we say as modified today based on the comments on the record, or to that degree. Is that all right, Adam?

CHAIRMAN CIMINO: Seeing nods, but we also have a hand. Robert Boyles.

MR. ROBERT H. BOYLES, JR.: Parliamentary inquiry Mr. Chairman. I understand what we're trying to do and I appreciate the comments from industry. We're editing a Stock Assessment and a Peer Review with this motion, correct? Is that the net effect of what we're doing? If that is the case I'm a little uncomfortable with that.

CHAIRMAN CIMINO: Yes, the answer is since this is the approval of the Peer Review and the Assessment document that we're talking about an edit to the Assessment Document. We have several hands. Start with Emerson Hasbrouck.

MR. EMERSON HASBROUCK: Well, I appreciate what the motion is trying to do, I have to agree with Robert Boyles. Are we going to start editing stock assessments now? I think that's a dangerous path to start to go down, where management boards are going to start to edit and change stock assessment reports. I'm not comfortable with that.

CHAIRMAN CIMINO: I've got Erika Burgess.

MS. ERIKA BURGESS: I would vote against this motion based on the fact that I do not feel it's the responsibility of the Board to edit Peer Reviewed Stock Assessments that come before it. I've read Section 4.2.2. I understand the speakers and the AP member's concern about the findings of this research.

However, I find nothing inflammatory in that section and I appreciate staff's clarification that the Stock Assessment Subcommittee or Committee, looked at biomedical mortality at an individual stock level basis, and addressed that specifically in the appendices, and that satisfies my concerns.

CHAIRMAN CIMINO: Mike, do you still want to?

DR. MILLARD: Sure I will quickly. I also would have a problem with this motion. I think it's a slippery slope for the Board to start judging the validity of papers referenced in stock assessments. That could go a long way.

CHAIRMAN CIMINO: Stew Michels.

MR. MICHELS: Yes, I agree with my colleague's comments and I would just like to point out that there is a number of Master's Theses cited in the documents that we typically use in our actions here at the Board.

CHAIRMAN CIMINO: Mike Luisi.

MR. LUISI: That's the last time I second a motion by Adam. It seemed very, very simple when we started**. I would move to substitute to accept the 2019 Horseshoe Crab Benchmark Stock Assessment and Peer Review Reports.**

CHAIRMAN CIMINO: Second, Jim Gilmore; comments, Adam Nowalsky.

MR. NOWALSKY: Is there an alternative here whereby there is some action we could take that this could be looked at again by the SAS and/or Peer Review, and bring it back to us modified, so we're not modifying anything, they're modifying it and giving it back to us. Is there some pathway for that?

MS. KERNS: In trying not to edit the document, we could take the information that is already in the appendix that says that this does not reflect the best practices sentence; and bring that into the main part of that section. That would be maybe a compromise of the Board and not really editing, and as Stew said before many of our assessments has gray literature, as well as master's thesis. It's not uncommon to have that in a document.

CHAIRMAN CIMINO: Robert Boyles.

MR. BOYLES: I would suggest for the Board's benefit that we've noted the public comment. We've noted the concerns that have been expressed. We've had rather extensive discussion about this now. I think that's on the record and we can move on. Thank you.

CHAIRMAN CIMINO: Well, before we do I'll have to point out that I did need to bring in another doctor, so we got that far. Dan.

MR. McKIERNAN: I really like Toni's suggestion that if we could bring a statement from another part of the document and embed it into that section; that reflects something that's already in the document. At least the reader is going to be left with a more accurate depiction of these studies. Is there something, Mike that you could amend your motion to endorse Toni's suggestion?

DR. ANSTEAD: I'm happy to make those changes along with some other minor edits that we have found before it gets published in the spirit of what we've talked about today, to soften that language and make it clear that these studies do not follow best practices that this was a TOR, this was what was available. But it's not part of the biomedical practices.

CHAIRMAN CIMINO: I'm going to agree with Robert that we've had a healthy discussion on this, so I'm going to ask if with the motion and second that we have right now if there is any objection to this motion.

MR. McKIERNAN: Well as long as the motion includes amendment as we just discussed during this and it's not on the board.

MS. KERNS: I think it's on the record unless you need us to change the motion, we will make those changes.

MR. McKIERNAN: I trust the staff.

CHAIRMAN CIMINO: With that I'll take it that we have, we now have a main motion. I'll ask the question again. Is there any objection to the now main motion? Okay, good then, with that consent our next agenda item is Consideration of Management Response.

Sorry, the motion is; move to accept the 2019 Horseshoe Crab Benchmark Stock Assessment and Peer Review Reports for management use. Subtitle with edits. This motion was by Mike Luisi; second by Jim Gilmore.

CONSIDER MANAGEMENT RESPONSE TO 2019 HORSESHOE CRAB STOCK ASSESSMENT

CHAIRMAN CIMINO: With that I'm going to turn it over to Mike and he'll give a presentation. Then we will open it up for consideration of Management Response.

DR. MIKE SCHMIDTKE: Given the time that we're at I'll try to keep this a brief as possible. I wanted to lay out for the Board some of the recommendations from the assessment that could lead to a management response as well as some of the previous discussions or actions that have been postponed until after the assessment.

Specific actions or motions don't necessarily need to be made today but, if any of these or other items want to be taken up or further discussed, and require staff or committee work, Board direction on what tasks need to be completed would be helpful for doing that. First, I'll highlight two of the assessments conclusions that have management implication throughout the presentation.

What would be necessary to initiate any of these responses is shown in bold. The assessment review indicates that the catch multiple survey analysis population estimates are the most accurate estimates of abundance to use as an input for the ARM in Delaware Bay. The only thing that would be required to start using these population estimates in the ARM model would be Board guidance to do so. It doesn't change anything inherent of the model as written in Addendum VII, so we would just need that Board guidance.

Next, the assessment concluded that the New York region, which includes New York and Connecticut, has a poor status due to continued declining trends in abundance indices for that region. Whether and what type of work would be necessary to respond to this recommendation would really depend on how the Board wants to respond. It may need a management document, it may need state action. It really depends on some discussion that may occur today. Now, moving on to some of the previous actions and discussions that have been delayed, first of all draft Addendum VIII that was proposed and eventually postponed in October of 2016, that was initiated to address incorporation of biomedical mortality in the ARM model, as well as bait harvest packages that would allow for female harvest in the Delaware Bay.

This, obviously, is an addendum would be required to carry this out. This will need to be taken up, not necessarily in this meeting but at some point, because it was postponed until after the assessment and we are now after the assessment. The biomedical mortality incorporation options that were involved here, we had two different options.

One of which could actually be done without an addendum, if the biomedical mortality was incorporated as an additional source of mortality within the ARM model and the harvest packages were maintained. There was some work done in the meantime since this action was postponed.

In October of 2017 that information was presented to the Board and showed that neither of these methods for incorporating biomedical mortality altered the harvest package recommendations that have come to the Board. Additionally there has been discussion about the incorporation of new or altered harvest packages that would allow different levels of female harvest in the Delaware Bay.

One point that has continued to be said and is relevant to this, is that unless the female population of horseshoe crabs exceeds that 80 percent carrying capacity threshold, there will not be any female harvest recommended by the ARM model, regardless of any additional harvest packages. That is something for the Board's consideration when thinking about draft Addendum VIII.

Finally, Addendum VII describes the use of a double-loop process, which includes the iterative process that we conduct every year when we set our harvest specifications. Then, there is also a set-up phase that is in the Addendum, set to be reviewed every three to four years. This is done to update the model assumptions, stakeholder information, monitoring information, and things of that nature. This type of a review has been characterized in two forms: a long-term review, which could be expected to take up to two years, and a short-term review that could be done in six to eight months.

The last review conducted in 2016 was a short-term review. Given the considerable amount of information from the new assessment, the Board may want to consider conducting another review in the future. As part of this, it would be helpful also to migrate the software platform from ASDP, which is the current program that is not a very widely used program, to something that is more useable and can be housed in house and run potentially by staff or other scientists on the ARM Subcommittee. To conduct this review in either form, and especially to migrate that platform, would require a significant amount of time and money. That is something for the Board's consideration, and depending on the recommendations from the review, a management document may have to follow as well. With that, I can take questions as the Board needs them on these types of processes. I do want to reiterate that final decisions are not necessary today but, if the Board desires any type of work to be done between now and the next meeting in achieving any of these tasks, guidance on that would be helpful.

CHAIRMAN CIMINO: Stew Michels.

MR. MICHELS: Mike, the long term look at the double-loop process. I think the slide indicated that it was going to be costly. Do we have a source of funding available for that or are we soliciting funding sources for that?

DR. SCHMIDTKE: I am not aware of a funding source for that. Really, one part of that if we're going to be migrating the platform that's been talked about a couple times before, and that is something that would take potentially a graduate student or postdoc, somebody like that. Half a year or year's-worth of time to do. That could bring in some cost as well as paying for whatever workshops need to be done to do the review itself.

CHAIRMAN CIMINO: Roy Miller.

MR. MILLER: I just wanted to quickly bring up one thing that was not mentioned in Mike's presentation and it was stressed by Dr. Sweka, the value and importance of the Virginia Tech Trawl Survey. I understand our funding is available for this survey through 2019. I'm uncertain as to whether there is funding available beyond that. If not then I just want it on the record that that should be a priority for our organization would be to help secure funding if possible to continue that Virginia Tech Trawl Survey.

CHAIRMAN CIMINO: Thanks Roy. I'm going to turn to Bob Beal.

EXECUTIVE DIRECTOR ROBERT E. BEAL: Summer flounder stole my voice. We do have money for '19 and '20, Roy; so we've got a couple years in the bank, so to speak. Anytime we put in our appropriation request and Commission priorities this survey is one of the high priorities. We're going to keep working on it.

Having a couple years funding is good to have but it's not the long-term funding source that we would like to have. I think we're just going to have to piecemeal it, you know year by year, and the good news is we're two ahead right now so we'll just keep making sure the appropriators know this is a priority for the Commission and the importance of that survey for the Horseshoe crab management.

CHAIRMAN CIMINO: Yes, go ahead Jim.

MR. GILMORE: I'm not sure if this is a charge to look at yet but let me lay it out, and then maybe I'll see if there is some work they've been doing. It's getting back to my question about the reason for the decline in New York. This goes along with what Dan McKiernan said before, it's like looking at different things we can do. New York has already reduced their harvest from 360,000 to 150,000. We have spawning area closures already. We've got this massive monitoring system going, not a scientific one, plus we have a volunteer-based one, and they filled my conference room last week with all the volunteers we have going on. We're essentially doing all this and then the suggestions we have moving forward would be to do more quota reduction, or whatever. But that doesn't seem to be where the problem is. Here are some other facts that are starting to come together:

The New Jersey harvest, I'm sorry moratorium, started ten years ago and all your data shows a steady decline over ten years right when that moratorium was put into place. In addition, from our monitoring in New York, we have better survival in the Peconics. The further you get away from New Jersey the higher the survival goes.

Jamaica Bay has got the lowest survival. It's starting to look like we've got the issue of what we were concerned with all along, is that that New Jersey shut down their horseshoe crab bait fishery but they didn't close down their whelk and their eel fishery. The demand for bait still exists. What I'm suggesting are two things:

I would like to know is overharvest the reason, illegal harvest going on that we don't know about that's not coming up in any of the assessments? Are there some things that maybe we could suggest; or maybe Jersey does and looks into it, for instance an artificial bait requirement or getting into the male-only fishery, some things along those lines?

Because we're just going to eventually close our fishery, it looks like. Then we're going to drive the issue further to the east, and now we're going to have Rhode Island and Massachusetts population going down. It seems like maybe that's not the right way to be doing this. I want to get that looked at but I don't know if it's actually a specific charge, or can we focus in on why we have this very strange thing going on in New York.

From a biological standpoint it doesn't seem like it's maybe the biology. It seems like it is maybe illegal harvest. The other thing and I'll add we're working with Connecticut right now to put a size limit on our whelk fishery. Hopefully that will reduce demand. But I still don't think that is going to be enough unless we address the problem of maybe there is no harvest in New Jersey, but there is still a demand.

CHAIRMAN CIMINO: Well, I'm not going to assume it's something that we would be tasking a Technical Committee with, but it may be a question for our Law Enforcement group, if that's something that's on their radar currently. I have a couple hands up. I saw Mike Luisi first, Tom Fote and then you, Justin.

MR. LUISI: Mike, could you go back one slide to the slide that has Addendum VIII on it? Maybe one more, yes that's the one. If you're looking for some advice, if you go down to the second to last bullet there, the additional or altered harvest that would allow for females in the Delaware Bay sounds like something I would have suggested maybe a couple years ago.

At the time, I think we were looking to explore alternative ways of coming up with a way that the state of Maryland or those harvesting in the Delaware region could harvest a few females. Now, given the fact that it's understood that until we reach some certain threshold level exceeding 80 percent carrying capacity, or 11.2 million females, we're not going to be able to develop something to get there. I would say if you're looking for advice, that if it was advised to continue with this draft Addendum, that you could eliminate that part of it from any further consideration. If the other portions of the Addendum were to be explored further then that would be fine with me.

CHAIRMAN CIMINO: Tom Fote.

MR. THOMAS P. FOTE: We also looked, I think, and talked about it years ago about the sea level rise and the rise in the bays and estuaries, which we lost all the sandy beaches where the horseshoe crab spawn. I don't know if that contributes to the decline or not. I don't know that we have ever surveyed. I don't know how it is in New York after the results of Sandy. We've seen the Bay is much higher than it's ever been before; and we lost some of the areas that they spawned on.

CHAIRMAN CIMINO: Justin Davis.

DR. JUSTIN DAVIS: I have a motion if you're ready for that. I don't know if we're done with discussion.

CHAIRMAN CIMINO: One more, Chris Wright.

MR. CHRIS WRIGHT: Given that the Peer Review and the Stock Assessment folks brought up discard mortality, I would like to have the TC evaluate what kind of studies we would need, and get a cost estimate of what they would cost, because if we have five years, we need to start addressing that sooner than later.

CHAIRMAN CIMINO: Agreed, thanks. Okay if no others I will turn it back to Justin.

DR. DAVIS: I move we postpone consideration of management response to the 2019 Horseshoe Crab Benchmark Stock Assessment until the August, 2019 ASMFC meeting.

CHAIRMAN CIMINO: A second, Dan McKiernan. Discussion, go ahead Justin.

DR. DAVIS: I think we've had a very robust discussion today about the stock assessment and the issues around horseshoe crab management. I think the hour is getting kind of late. I want to echo some of the comments made by Jim Gilmore when it comes to the New York region and Connecticut. Our fishery is pretty small scale.

Landings have been low; around 20,000 crabs and stable for a number of years. Over time we've taken measures to restrict harvest; we have closed areas. I sort of feel the same way that while I'm concerned about the results that came out of the stock assessment. I don't feel that further harvest restriction is necessarily the path forward.

I'm interested in taking a really broad look at all the factors that might be affecting horseshoe crab abundance in the New York region. I feel like at least from my standpoint; I would benefit from an opportunity to have some more discussions with my partners in the region about what we might want to task the Technical Committee or the PDT with investigating for a potential management document. I just sort of feel like at least from the standpoint of the New York region from Connecticut, I'm not ready today to lay out all the things we might want to have in a draft management document. That was my reason for asking for postponing.

MR. CIMINO: Sounds fair. Any additional comments? Stew.

MR. MICHELS: Just a clarification perhaps. Does that include incorporation of that CMSA model into the ARM model? Would you include that or can we make a recommendation for the Committee to pursue that?

DR. DAVIS: I would be fine with that recommendation being made today.

MR. CIMINO: Right, we won't need a motion specifically for that. Maureen Davidson.

MS. MAUREEN DAVIDSON: Hi, speaking as Jim Gilmore's proxy. Thank you. I agree with Justin. I think that we would be able to benefit if we had some additional time to look at where we can make management changes to see what's happening to our horseshoe crabs, try to determine where our loss is. Whether it is attributed to mortality or they're not there they are leaving, and other sources of our horseshoe crab loss. I think we would just benefit with a little more time.

CHAIRMAN CIMINO: If we don't have any opposition to this motion I will consider it approved by consent. Also, making note that there were no objections to including the catch survey estimates.

RECOGNITION OF DR. JAMES COOPER

CHAIRMAN CIMINO: Last item on the agenda is to review and populate the Advisory Panel membership but, before we do that I would like to recognize a longstanding member who is stepping down, Dr. Jim Cooper, who also wanted to provide some comments to us. First, I'll turn it over to Bob Beal for recognition; and then over to Robert Boyles to provide Dr. Cooper's comments to us.

EXECUTIVE DIRECTOR BEAL: Great, thank you, Mr. Chairman. Just very briefly, I wish Jim Cooper was here, but he couldn't make it today. I just wanted to, you know on behalf of the Commission and the Commissioners and the Board thank Dr. Cooper for two decades of service to the Horseshoe Crab Management Program. He was here at the very beginning when Horseshoe Crab was separated from American eel management; and Tom O'Connell from Maryland was the drafter of the plan, and also to those things.

He's been here from the very beginning and provided a great perspective from the biomedical community to the Board. He also chaired the Advisory Panel for a decade at least, if not a little bit more. Just, he's been a great part of this process and a really valuable advisor to the Management Board. I just want to thank him for his couple decades of service that he gave us. Thank you, Dr. Cooper.

CHAIRMAN CIMINO: Absolutely, thank you, and Robert.

DR. BOYLES: I would like to echo our Executive Director's remarks about remarkable Dr. Cooper. He regrets that he could not be here today on his final day as a member of the Advisory Panel. Mr. Chairman, I would seek unanimous consent of entering Dr. Cooper's written remarks, which were sent to the Board as part of the supplemental materials.

Enter those into the record verbatim please, with unanimous consent, recognizing the hour is late, but at the same time I did get a note from him. He did not intend necessarily to read these comments himself, but I think it's certainly worthy of recognizing his many contributions to the Commission, to our family, and to these resources.

I'm thanking him for his stalwart leadership and support of the Commission and his leadership in the biomedical industry, and helping us sort through some challenging times as Bob said from the beginning. Mr. Chairman, I would seek unanimous consent to enter those remarks into the transcript of the meeting if it pleases the Board, and again, recognition and thanks, and my gratitude as a South Carolinian to Dr. Cooper for his leadership and service to the Commission.

CHAIRMAN CIMINO: Not seeing any objections, we'll assume that. Thank you.

DR. JAMES F. COOPER: "Mr. Chairman, Board Members and guests,

It has been an honor and privilege to work with the Commission and a remarkable group of marine resource managers and scientists for the past 28 years to conserve the Atlantic horseshoe crab, *Limulus polyphemus*. Upon my last day as a member of the Advisory Panel, I offer a tribute to the Commission and individuals who created the remarkable HSC Fishery Management Plan (FMP) with their initiative, vision, dedication and hard work.

While searching for horseshoe crabs for my new LAL firm in Charleston, I discovered that truck-loads of crabs were being collected and transferred to Virginia for the bait market. After calling this matter to the attention of our SCDNR director, Robert Boyles, he led his staff and my wife in an effort to draft and find sponsors for a bill prohibiting out-of-state transport and for conserving this resource; the bill passed the SC Senate in 1991. Our bill became a model for conservation.

At the same time, biologists near Delaware Bay were responding to overharvesting for bait. The Univ. of Delaware sponsored a forum in February 1996 that drew 81 stakeholders for the first coordinated effort to address the crisis. The following issues were addressed by notable scientists and resource leaders:

- Carl Shuster discussed HSC exploitation and abundance;
- Robert Loveland and Mark Botton presented HSC life history and commercial use;
- Stu Michels addressed stock assessment;
- Tom O'Connell described Maryland's crab fishery;
- Peter Himchak described HSC resource monitoring and management in New Jersey;
- Benjie Swan discussed spawning survey activities; and
- Jim Cooper gave an overview of the new LAL industry.

Focused leadership was urgently needed to create an FMP. In response to harvest reduction measures in NJ and DE, MD State leadership expressed support for an Atlantic coast Interstate Fisheries Management Plan via ASMFC. The Commission lacked the staffing and financial resources at that time, so the MD Department of Natural Resources offered one of its Fisheries Service employees, Tom O'Connell, to serve as the Commission's Horseshoe Crab FMP Coordinator. ASMFC agreed, and Tom moved into this role with his salary covered by MD DNR.

Tom continued to serve for several years, coordinating the development and approval of the HSC FMP, Addendum 1 that established state-by-state harvest quotas and survey requirements. The FMP was accepted in October, 1998. Carrie Selberg took on Tom's duties at ASMFC in 2001. My recent interview with Tom provided the following details about the FMP development.

Plan Development Team (PDT): The success of the PDT that drafted the FMP and Addendums was due to the following individuals, who brought different skill sets to this team:

- Tom O'Connell, for his organization, interpersonal and planning/coordination skills;

- Eric Schrading (US FWS) for his biological knowledge and writing skills;

- Stew Michels (DE DNREC) and Peter Himchak (NJ Marine Fisheries Division) for their biological insight and technical knowledge of HSC and population surveys; and

- Paul Perra (NOAA NMFS) for his ASMFC experience and strong partner relations.

Technical and Stock Assessment Committees:

- Dr. Dave Smith, US Geological Survey, Leetown Science Center, for his survey design, statistical analysis and decision support skills. Dave was a lead author of the Adapative Resource Management framework for horseshoe crabs, and member of the HSC SAC;

- Dr. Jim Berkson (VA Tech Univ) for his ability to work with technical experts and limited data to design a horseshoe crab stock assessment framework. At an early meeting at VA Tech, Jim was credited for laying out a vision of a framework to assess horseshoe crabs that was accepted and implemented by the SAC;

- Dr. Mike Millard (US FWS) for his leadership and technical skills; and

- Carl Shuster, Benjie Swan, Stew Michels, Pete HImchak, Joanna Burger, Mark Botton, Robert Loveland and many other state biologists for their early technical contributions.

- (Stock Assessment Report No. 98-01 was published February 1999.)

Advisory Panel:

- Dr. Jim Cooper and Robert Munson for co-chairing the AP and working with a very diverse group of stakeholders, and for representing their views even when in disagreement.

Tribute is also paid to Roy Miller who skillfully chaired the Horseshoe Crab Board during the contentious early period of development and implementation of the FMP, when watermen and environmentalist vigorously argued their positions. Roy recently said that the biggest disappointment of his era was failure to find a suitable bait alternative, a view we all share.

A personal tribute is also paid to Robert Boyles, SCDNR Director, who exemplified how industry and marine resource managers can work together for the best use of public resources. Robert always had a skillful and cheerful way to manage the most challenging problems. Thank you, Robert.

As indicated by the recent Stock Benchmark Assessment, the implementation of the FMP, the prudent use and conservation practices of the LAL industry and the continued work of marine scientists has secured the sustainability of the Atlantic horseshoe crab.

Finally, as your LAL resource, I have some comments about the future of LAL. The Chinese horseshoe crab is threatened because of habitat loss, overfishing for human consumption, and production of TAL (*Tachypleus* amebocyte lysate). In the absence of a return-to-sea policy, TAL crabs are subject to 100% mortality, a vivid reminder that a similar fate could have befallen our horseshoe crab without the protection of LAL practices in the US.

Cooper and Levin applied a return policy for LAL production from the outset of our biomedical-use discovery in 1970. TAL firms produce about 15% of the amebocyte lysate global market. They will turn to using LAL as their crab population is exhausted. Some TAL firms will purchase LAL directly from US firms while others may attempt to establish bleeding facilities in the US; ASMFC member states need to anticipate their response to this possibility.

Mortality does not occur during the LAL-related bleeding process of donor crabs, which is analogous to human blood donation. Rudloe (1983) studied the impact of bleeding on a large number of crabs in a Florida bay and estimated that bleeding increased the risk mortality by about 10%. The SAS considers this number trivial in comparison to other HSC threats.

Only older HSC, which have thinning shells and are heavily laden with a vast array of parasites and other organisms, are susceptible to the stress conditions of bleeding. The tagged crab found at Moore's Beach, NJ, is evidence that bleeding does not discourage spawning activity. In closing, I express my sincere appreciation for the opportunity to participate in Commission activities that conserve our horseshoe crab. It has been a truly rewarding experience. I consider it 28 years well spent! Respectfully submitted, James F Cooper, PharmD".

REVIEW AND POPULATE HORSESHOE CRAB ADVISORY PANEL MEMBERSHIP

MS. TINA L. BERGER: Yes hi, I would like to present for the Board's consideration and approval Nora Blair as South Carolina's newest member to the Horseshoe Crab Advisory Panel. She replaces Dr. Cooper.

CHAIRMAN CIMINO: Do we have a motion? Robert.

MR. BOYLES: I move to approve the nomination for Nora Blair to the Horseshoe Crab Advisory Panel.

CHAIRMAN CIMINO: **Second by Jim Gilmore. Is there any objection, approved by consent?**

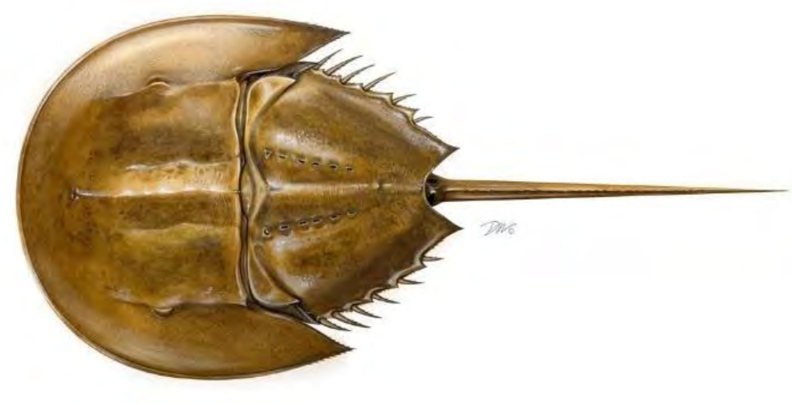
OTHER BUSINESS/ADJOURN

Okay, with that in other business, the Board had asked about updates on development of LAL alternatives. There is an update but in recognition of the late hour, and I already lost my promise to Mike Millard that I was going to get us out of here much earlier. The AP Chair does have information on that but we will be getting that out to the Board by e-mail. Thank you, and if we have a motion to adjourn, Justin Davis, thank you, so moved.

(Whereupon the meeting adjourned at 5:40 o'clock p.m. on May 1, 2019)

Atlantic States Marine Fisheries Commission

2019 Horseshoe Crab Benchmark Stock Assessment and Peer Review Report



Approved for Management Use by the Horseshoe Crab Management Board May 1, 2019

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

ACKNOWLEDGEMENTS

The Atlantic States Marine Fisheries Commission thanks all of the individuals who contributed to the development of the horseshoe crab stock assessment, specifically the ASMFC Horseshoe Crab Technical Committee and Stock Assessment Subcommittee members who developed the consensus stock assessment report as well as the Atlantic Coastal Cooperative Statistics Program staff Heather Konell for validating landings. Thank you to Josh Newhard (USFWS) for additional help on the tagging data and Mike Wilberg (UMCES) for support with the CMSA modelling in ADMB.

ASMFC Horseshoe Crab Stock Assessment Subcommittee

John Sweka (Chair), U.S. Fish and Wildlife Service
Natalie Ameral, Rhode Island Division of Fish and Wildlife
Kristen Anstead, Atlantic States Marine Fisheries Commission
Linda Barry, New Jersey Division of Fish and Wildlife
Jeffrey Dobbs, North Carolina Division of Marine Fisheries
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2019 Horseshoe Crab Benchmark Stock Assessment Peer Review Report

Conducted on
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Arlington, Virginia

Prepared by the
ASMFC Horseshoe Crab Stock Assessment Review Panel

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ACRONYMS

ARIMA	Auto-Regressive Integrated Moving Average (stock assessment model)
ARM	Adaptive Resource Management
B_{MSY}	Biomass at maximum sustainable yield
CMSA	Catch Multiple Survey Analysis (stock assessment model)
CV	Coefficient of Variation
F	Annual fishing mortality rate
F_{MSY}	Fishing mortality rate at maximum sustainable yield
MSY	Maximum Sustainable Yield
N_{MSY}	Abundance at maximum sustainable yield
NEFOP	Northeast Fisheries Observer Program
TOR	Term of Reference

EXECUTIVE SUMMARY

The assessment splits the range of horseshoe crabs into four regions; Northeast (Maine, Massachusetts, Rhode Island), New York (Connecticut, New York), Delaware Bay (New Jersey, Delaware, Maryland, Virginia), and Southeast (North Carolina, South Carolina, Georgia, Florida).

The Panel recommends using horseshoe crab trend estimates for females and males combined from Autoregressive Integrated Moving Average (ARIMA) models fit to survey data for stock status determination, relative to abundance in 1998. Examination of results from multiple surveys within individual regions is necessary. Stock status was based on the proportion of surveys above or below their 1998 reference point when ASMFC management began. Stock status was considered poor if 33% of the surveys were below their reference point (red), good if 66% were above their reference point (green), and neutral (yellow) otherwise.

Stock status differs among regions based on the recommended 1998 reference point and ARIMA-based relative abundance estimates (see Figure 1 in Advisory Report). Based on this recommended approach, horseshoe crab relative abundance in the Northeast and Delaware Bay regions are in a neutral condition, New York is in a poor condition, and the Southeast is in a good condition. On a coastwide basis, horseshoe crab relative abundance is likely in a neutral condition.

ARIMA and Catch Multiple Survey Analysis (CMSA) model estimates were both available for female horseshoe crabs in the Delaware Bay region. The Panel recommends CMSA results when abundance and fishing mortality estimates are required, such as in the Adaptive Resource Management (ARM) model used by managers (Note the ARM model was described during review discussions but not reviewed by the Panel). CMSA results were not used for status determination because comparable reference points were not available. However, given the increasing survey trends, low landings, and CMSA results of low fishing mortality and relatively high abundance, overfishing and an overfished status are unlikely for female horseshoe crabs in the Delaware Bay region.

The magnitude of horseshoe crab discards in the targeted horseshoe crab fishery and other fisheries is potentially the most important uncertainty and highest priority research recommendation identified in the assessment to improve abundance estimates. Preliminary results show discard mortality may be comparable to or greater than combined mortality from other sources.

The stock assessment could not determine overfished stock status in terms of B_{MSY}, N_{MSY} or proxy reference points because biomass, abundance estimates and MSY reference points were not available. Trend-based relative abundance reference points were used instead, following common practice in many fisheries.

The stock assessment could not determine if overfishing is occurring in terms of F_{MSY} for horseshoe crabs as mortality estimates and suitable reference points were not available. It was not possible to determine if overfishing was occurring based on trends because discards are uncertain.

It is important to continue survey data collection for horseshoe crabs (particularly the Virginia Tech survey), promote consistent survey sampling among locations, and expand survey data collection to include size, sex, and information on female reproductive condition (primiparous vs. multiparous).

COMMENTS BY TERMS OF REFERENCE

1. **Evaluate the thoroughness of data collection and the presentation and treatment of fishery-dependent and fishery-independent data in the assessment, including the following but not limited to:**
    a. **Presentation of data source variance (e.g., standard errors).**
    b. **Justification for inclusion or elimination of available data sources,**
    c. **Consideration of data strengths and weaknesses (e.g., temporal and spatial scale, gear selectivities, ageing accuracy, sample size),**
    d. **Calculation and/or standardization of abundance indices.**

The Review Panel examined a number of different fishery-dependent and fishery-independent data sources. Data used for ARIMA models and the Delaware Bay region were sufficient to support the analysis presented. The Panel noted the ARIMA approach was better than the Conn (2010) method in application to horseshoe crabs because of spatial variation in population dynamics within regions. Review efforts were therefore focused on the ARIMA approach.

Fishery-independent data included survey information and stock abundance from multiple different surveys (see Table 33 of Assessment Report), which are the primary data for ARIMA models. The assessment team presented the data clearly and handled the data appropriately. However, many surveys did not identify primiparous (first time female spawners) or multiparous individuals (repeat female spawners) nor record sex. This deficiency will hamper future assessment efforts, and a recommendation to add sex and maturity sampling was made by the Review Panel (see TOR 8).

Fishery-dependent data included bait landings, biomedical collection, and discards. Biological sampling for the bait fishery and biomedical collection seemed adequate given the limited use of commercial data in the assessment, although the assessment team did highlight several improvements from past stock assessments. Discards are a substantial uncertainty (see below). The development and use of bait bags may have reduced bait harvest numbers by 50-75% in the early years of management (when benchmark was set). The assessment team should provide a description of this change in the overview of the history of the stock (e.g., Fisher and Fisher 2006; Gerhart 2007).

The assessment team presented data and analysis on the proposed 15% biomedical mortality rate, which appears to be a robust estimate determined by a simple and fairhanded approach based on the best available data. The Review Panel agreed with the assessment team's approach, but noted some covariates such as season of harvest, size/condition of crabs, and location that are worth investigating. However, additional data and analyses are not likely to significantly alter assessment results due to the modest magnitude of biomedical mortality. As such, while an uncertainty, the biomedical mortality rate should receive less focus in future assessments.

By far the largest source of data uncertainty was regional and coastwide discards and the associated mortality of discarded horseshoe crabs. Losses due to discards may be similar or greater than losses from bait harvest and biomedical collection combined. The Review Panel highlights the importance of discard mortality for assessment and management of horseshoe crabs.

With respect to discards, the Review Panel recommends:

1) Expanding the analysis of discards to the entire stock unit, beyond the Delaware Bay region.
2) Further examination of discard mortality rates by gear, area, and season. This effort should include a literature review as well as field studies as time allows.
3) Stratification of observer data by season, area, and fleet is critical in discard estimation and it will be important to develop and test approaches for horseshoe crabs. It is important to exclude fleets incapable of harvesting horseshoe crabs (i.e., offshore fisheries, midwater or raised foot rope trawls). These tasks will require thorough examination of data from the Northeast Fisheries Observer Program (NEFOP) data and state at-sea observer programs.
4) Future assessment teams should include an analyst who has direct access to the NEFOP database and the experience necessary to conduct discard analyses. In addition, it would be useful to provide data training and access to ASMFC analytical staff.

2. Evaluate the methods and models used to estimate population parameters (e.g., F, biomass, abundance) and biological reference points, including but not limited to:

   a. Evaluate the choice and justification of the preferred model(s). Was the most appropriate model (or model averaging approach) chosen given available data and life history of the species?

   b. If multiple models were considered, evaluate the analysts' explanation of any differences in results.

   c. Evaluate model parameterization and specification (e.g., choice of CVs, effective sample sizes, likelihood weighting schemes, calculation/specification of M, stock- recruitment relationship, choice of time-varying parameters, plus group treatment).

Models and modeling decisions for stock status determination were appropriate and acceptable. ARIMA models were the primary modeling technique used in this and the last two assessments to estimate relative stock abundance and define limit reference points based on trends for horseshoe crabs (Helper et al. 2002). The models were fit to selected survey data for males and females combined in each stock region and are intended to smooth the data, reduce noise, and estimate underlying trends in stock size. ARIMA models with three lags are well-suited for horseshoe crabs because: the statistical approach is objective, the model complexity is reasonable given the length and noise in the survey data, the method accommodates years with missing data, and results can be used to estimate stock status and reference points that are comparable. One attribute of the method is that it estimates multiple trends (one for each survey) instead of a single trend for each region. Conn (2010) models produce a single trend for each region and were evaluated for horseshoe crabs but rejected in favor of ARIMA models. The assumption with Conn models of identical trends in each survey was sometimes violated, likely due to heterogeneous population dynamics within regions.

Estimates from a Catch Multiple Survey Analysis (CMSA) model are the best available estimates of abundance and fishing mortality for female horseshoe crabs in the Delaware Bay region. The CMSA estimates may be biased low, however, due to the assumption of 100% capture efficiency in the Virginia Tech trawl survey. Other uncertainties include missing years of Virginia Tech survey information (2012-2015), lack of a stock recruitment relationship, short time series of data, and discards. For these reasons, and as indicated in the assessment report, the Panel notes uncertainty in model results. The Panel further recommends caution in using this model to interpret stock status or develop management reference points at this time. However, the CMSA results are based on multiple survey time series, with data for some surveys available for all years. The model takes advantage of the ability to define new recruits in terms of primiparous individuals and the high probability that catchability is equivalent between primiparous and multiparous horseshoe crabs. Of note, the Virginia Tech survey is specifically designed for horseshoe crab collection and has a higher capture efficiency than other surveys (see research recommendations). The Panel agrees the CMSA model estimates are suitable for input to models such as the Adaptive Resource Management (ARM) model.

The Panel reviewed a theoretical simulation model used to estimate MSY-based reference points from a published density dependent relationship, including improved estimates of natural mortality. A similar method for making short-term stock abundance forecasts was also reviewed. Earlier versions of the reference point model were used in ARM management. The Panel agreed the new estimates of natural mortality and other changes were improvements that could be considered in the ARM framework. However, the reference points from the simulation approach should not be directly compared to abundance and fishing mortality estimates from the CMSA for status determination because calculations between the two models may not be comparable (see below). For the same reasons, the forecast model should not be used to make short-term stock size projections based on CMSA results. It is wiser to use the CMSA itself for short-term projections to ensure comparability and because variances for the predictions can be directly calculated. The theoretical population model and reference points may provide useful information in other circumstances.

There was considerable discussion about comparing stock estimates from one model to reference points calculated in another. The Reviewer's advice to avoid this practice is based on the possibility of errors in status determination that can be reduced or avoided using a single model to calculate stock size and reference points. As an example, if we ignore random estimation errors and say the stock size estimate from the first model is $B' = gB$ where B is the true biomass and g is a multiplicative bias due to model misspecification and data errors. The stock size and B_{MSY} reference point estimates from the second model are $B''=hB$ and $B_{MSY}''=hB_{MSY}$ where B_{MSY} is the reference point and h is the bias. The status determination ratio B'/B_{MSY}'' based on two models is in error by the factor g/h which might amount to substantial over- or underestimation. In contrast, using stock size and reference point from just the second model, for example, gives $B''/B_{MSY}'' = hB/hB_{MSY} = B/B_{MSY}$ which is likely more accurate because the bias h in the numerator and denominator cancels out.

3. **Evaluate the diagnostic analyses performed, including but not limited to:**
   a. **Sensitivity analyses to determine model stability and potential consequences of major model assumptions**
   b. **Retrospective analysis**

Residuals from ARIMA models used for status determination were normally distributed and had acceptable temporal patterns. Retrospective patterns generally are not a problem in ARIMA models. Historical analyses demonstrated that the ARIMA models were stable from one assessment to the next.

There was no evidence of retrospective patterns in CMSA results and the model fit to survey data was acceptable. Extensive sensitivity analysis demonstrated that the CMSA model was robust to assumptions about catchability, selectivity, natural mortality, and survey variance. The stability was due to assumptions that primiparous and multiparous females had the same catchability in the Virginia Tech survey and that the survey, which was designed for horseshoe crabs, captures nearly 100% of the horseshoe crabs in its path between the trawl sweeps. Sensitivity analysis showed the two assumptions were compatible because results were similar when one of the assumptions was eliminated.

4. **Evaluate the methods used to characterize uncertainty in estimated parameters. Ensure that the implications of uncertainty in technical conclusions are clearly stated.**

The uncertainty in ARIMA model fits was displayed graphically in terms of confidence intervals. Uncertainty in status determination based on ARIMA model results considered the uncertainty in both the stock status measure and the reference point. The criterion used to identify stocks below their reference point was relatively stringent (50% probability of being less than the reference point with 80% confidence), but appropriate and consistent with Helser and Hayes (1995).

Variance and CVs for CMSA results were estimated using the delta method in AD-Model Builder for presentation in the final report. The assessment authors were asked to depict CMSA results using asymmetric confidence intervals and to provide CVs for estimates in tables. The variances for recruitment estimates in years with missing Virginia Tech survey data were large, as expected, but variances for total stock size were reasonable.

5. **If a minority report has been filed, review minority opinion and any associated analyses. If possible, make a recommendation on current or future use of the alternative assessment approach presented in minority report.**

No minority reports were submitted.

6. **Recommend best estimates of stock biomass, abundance, and exploitation from the assessment for use in management, if possible, or specify alternative estimation methods.**

The Panel recommends using horseshoe crab trend estimates for females and males combined from ARIMA models fit to survey data for stock status determination, relative to abundance in 1998. Examination of results from multiple surveys within individual regions is necessary due to the lack of comprehensive, consistent survey methods through time. Stock status was based on the proportion of surveys above or below their 1998 reference point when ASMFC management began. Stock status was is considered poor if 33% of the surveys are below their reference point (red), good if 66% are above their reference point (green), and neutral (yellow) otherwise.

ARIMA and Catch Multiple Survey Analysis (CMSA) model estimates were both available for female horseshoe crabs in the Delaware Bay region. The Panel recommends CMSA results when abundance and fishing mortality estimates are required, such as in the Adaptive Resource Management (ARM) model used by managers. CMSA results were not used for status determination because comparable reference points were not available. However, given the increasing survey trends, low landings, and CMSA results (low fishing mortality and relatively high abundance), overfishing and an overfished status are unlikely for female horseshoe crabs in Delaware Bay.

Exploitation estimates were available for females in the Delaware Bay region only. Simple catch/survey, catch/ARIMA and catch/swept area abundance exploitation rates were not calculated because of difficulties in estimating catch including discards.

7. **Evaluate the choice of reference points and the methods used to estimate them. Recommend stock status determination from the assessment, or, if appropriate, specify alternative methods and measures.**

For the coastwide and regional assessments using ARIMA models, the Review Panel endorses the use of reference points for each stock region based on relative abundance in 1998, when

ASMFC management commenced. A second alternative of using quartiles was examined but was not favored given the short timeframe of the indices.

Further, the Panel recommends using horseshoe crab trend estimates for females and males combined from ARIMA models fit to survey data for stock status determination relative to abundance in 1998. Examination of results from multiple surveys within individual regions is necessary. Stock status is based on the proportion of surveys above or below their 1998 reference point when ASMFC management began. Stock status is poor if 33% of the surveys are below their reference point (red), good if 66% are above their reference point (green), and neutral (yellow) otherwise. The color code system is useful in tables that summarize stock status results.

To help managers determine if changes in harvest practices or other population pressures have affected horseshoe crabs in recent years, the Review Panel requested a table comparing regional status results in the current and previous stock assessment.

For the Delaware Bay region, the Panel reviewed a reference point approach based on a theoretical population model, which was used to estimate N_{MSY} and F_{MSY}. The modeling indicated F_{MSY} for Delaware Bay is below 0.1 and population growth occurs slowly, over decades. While informative, the reference points from the theoretical approach should not be directly compared to abundance and fishing mortality estimates from the CMSA for status determination because calculations in the two models may not be comparable. Alternative, history-based reference points could be explored, but given the short time series, the Review Panel and assessment team expressed concern about the historical approach. Ultimately, the Review Panel did not make any recommendations on Delaware Bay region-specific reference points.

8. **Review the research, data collection, and assessment methodology recommendations provided by the TC and make any additional recommendations warranted. Clearly prioritize the activities needed to inform and maintain the current assessment and provide recommendations to improve the reliability of future assessments.**

RESEARCH RECOMMENDATIONS

The Review Panel commends the assessment team for development of a thorough set of research recommendations under the categories of future research, data collection, and assessment methodology. In contrast to the recommendation of the SAS, however, the Review Panel recommends that a benchmark stock assessment be considered in five years. The potential for improved discards estimation and associated model updates to significantly affect horseshoe crab stock assessment was the primary reason for this recommendation. Also the Review Panel supports the assessment team's plan to remain proactive about maintaining surveys and research programs particularly focused on three main areas: 1) refining estimates of bycatch and discard mortality through literature review and experimentation, 2) better defining the constraints of existing trawl surveys, and improving the efficiency and consistency of surveys among locations and through time, particularly to include data on both primiparous and multiparous females whenever possible, and 3) improving the assessment methodology to support future model applications.

The Panel also noted there is a meaningful need for data on the juvenile and subadult components of this stock that are not well captured in either trawl or spawning surveys. While trawl surveys are likely to continue to serve as the primary basis of tracking abundance through time, it is important to continue to support research to better define these poorly understood stock components such as natural mortality and recruitment.

The Review Panel cautions the assessment team to avoid broad-brushing when discussing survey results. Remember that surveys are necessarily an index of change based on specific locations and segments of each population.

Climate change is already likely affecting horseshoe crab populations, habitat, and food resources in undefined ways. While not as much of a priority for study as discard estimates, the Review Panel appreciated the assessment team’s inclusion of research recommendations on this topic and thinks the concept must be a consideration in all ongoing and future research. Of particular importance are the effects of temperature and sea level rise on the extent of available spawning and foraging habitat.

To improve data analyses and subsequent assessment, the Review Panel noted some constraints that could be improved for future assessments:

1) In some cases, additional data needed to address questions were available, but not readily accessible to the ASMFC assessment team. The Review Panel recommends ensuring that existing resources such as fisheries observer (discard) and NEFOP data be made directly available to the assessment team.
2) The inability to publicly show regional biomedical collection and mortality data and derivative stock assessment results presents a material constraint to fully explaining the stock assessment results. The assessment team could consider alternative approaches to share mortality data such as by reporting biomedical and bycatch estimated mortality together. Efforts should be made to improve data access and use however possible.
3) Given the evidence of links (as yet poorly defined) between the Atlantic coast and Gulf coast horseshoe crab populations, which will likely increase if the effects of climate change prompt large-scale alteration of habitat or animal movement, and the likelihood of future harvest pressure in the Gulf, the Review Panel encourages the assessment team to enhance communication with Gulf States Marine Fisheries Commission and encourage data collection in anticipation of future need.

The Review Panel prioritized the following research recommendations from the assessment report:

Data Collection

- Better characterize discards, landings, and discard mortality by gear. This effort could be accomplished through a combination of literature research for other commercial species such as blue crabs and other invertebrates and experimentation.
- Continue biosampling for sex and weight, particularly by primiparous and multiparous, and expand where possible, using standardized protocols across regions and surveys.
- Continue to fund and operate the full Virginia Tech Trawl Survey annually.
- Conduct a gear efficiency study of the Virginia Tech Trawl Survey given the importance of using swept-area estimates of abundance in modeling the Delaware population.
- Determine the sampling constraints of all surveys used in horseshoe crab stock assessment, particularly better defining the area and type of habitat represented by each survey and the portion of the population sampled (by size, sex, maturity status to the extent possible). This could be done at the cost of staff time only.
- Define the features among existing trawl surveys and compare them to the demographics of the sampled populations to determine which survey approaches (timing, gear type or size, etc.) are effective to encourage consistent and most effective sampling methodology among locations. This could be done at the cost of staff time only.
- Expand coastwide tagging studies to better define movement (extent of range), population mixing among regions (including greater tag and recapture effort in the Gulf of Mexico), mortality and maximum age. Mortality estimates from tagging are particularly important when other estimates are not available, and they should be emphasized in future assessments. These data will support use of the MARK and JSC models outside of Delaware Bay and inform applicability of management zones.

Assessment Data and Methodology

The configuration of the Northeast region, which includes the Rhode Island and Massachusetts surveys, should be reconsidered in the next assessment. Declining trends in the Rhode Island survey are like trends in the New York region to the south and markedly different from the increasing trend in the more northern Massachusetts survey. In addition, the small Rhode Island survey has a disproportionate effect on status determination for the much larger Northeast region.

Some potential improvements to the CMSA model should also be considered. Survey data are weighted in aggregate based on standardized variances from preliminary Conn models and then individually based on estimated annual CVs. Sensitivity analyses showed that model results were robust to configuration of weights. However, it is not clear whether uncertainties were double counted or that the product of the two types of inverse variance weights (one standardized the other not) is appropriate. The assessment team should consider whether these conventions and assumptions affect the delta method variances for abundance and fishing mortality estimated in the model.

Survey data for primiparous horseshoe crabs in the Virginia Tech trawl survey are important in CMSA for estimating recruit abundance. The Virginia Tech survey is the only survey that distinguishes between primiparous and multiparous horseshoe crabs. The survey was not conducted during 2012-2015. Therefore, the variance of model recruitment estimates is very large for these years. Alternate approaches to estimating recruitment and more realistically appraising its variance should be considered. For example, a spawners-recruit formulation or a random walk model that assumes similar recruitment in adjacent years might be appropriate. It might be advantageous to individually weight recruitment deviations to control problematic estimates. Fortunately, as demonstrated by sensitivity runs, the uncertainty of recruitment estimates in years with missing survey data had very little effect on total stock abundance estimates because the recruitment estimates in adjacent years tend to be negatively correlated such that an underestimate in year *t* results in an overestimate in year *t+1* that cancels the potential error in total abundance. The changes suggested could increase the realism of the estimated recruit time series but would probably have little effect on the overall abundance estimates.

If use of the CMSA model continues or is expanded, then it should be modified to include short-term projection capabilities so that projections and historical model estimates are guaranteed to be comparable. It is easy to calculate the variance of projected estimates, including uncertainty in recruitment, terminal stock size, catchability, etc. Also, it would be good to compute any new reference points directly in the CMSA to ensure comparability of reference points and stock status measures.

CMSA models for male horseshoe crabs in Delaware Bay and other areas should be developed. The best approach may be to use a two-sex version of the model so that combined male and female abundance can be compared to catch and surveys with no sex data.

The CMSA for horseshoe crabs took advantage of aspects of female horseshoe crab biology (terminal molt at maturity) and the Virginia Tech survey carried out in Delaware Bay which distinguishes between primiparous (newly mature = recruits in CMSA) and multiparous crabs (post-recruits in CMSA). Unfortunately, primiparous and multiparous crabs are not distinguished in other surveys and the methods used for Delaware Bay are not applicable elsewhere. Other approaches to tracking abundance of new recruits (e.g. cohort slicing) could be tested so that the model can be applied to other areas and sexes.

If the CMSA model is too difficult to apply in other areas, then a two sex and length-based (or possibly age based counting age from recruitment to the fishery) approach should be considered. Alternately, and considering data and staff limitations, it may be best to continue using the robust and simple ARIMA model approach.

9. **Recommend timing of the next benchmark assessment and updates, if necessary, relative to the life history and current management of the species.**

The Review Panel recommends that a benchmark stock assessment be considered in five years given the potential for improved discard estimates and associated model updates to significantly improve the horseshoe crab stock assessment.

Special Comments

To facilitate communication, the Review Panel recommends using consistent and accurate terminology such as N_{MSY} rather than B_{MSY} when referring to counts as opposed to biomass data. Similarly, the Panel suggests, to the extent possible, displaying comparable data on the same axis range (or scale) to facilitate data interpretation.

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ADVISORY REPORT

A. Status of the Stock: Current and Projected

Based on the recommended modeling approach (see below), horseshoe crab in the Northeast and Delaware Bay regions are in a neutral condition, New York is in a poor condition, and the Southeast is in a good condition (Table 1). On a coastwide basis, horseshoe crab relative abundance is likely in a neutral condition.

Fishing pressure was estimated for female horseshoe crabs in the Delaware Bay region but not for males or horseshoe crabs in other regions because discard mortality in the horseshoe crab and other fisheries is unknown and may be substantial.

B. Stock Identification and Distribution

The Atlantic States Marine Fisheries Commission (ASMFC) manages the horseshoe crab stock from Maine to eastern Florida (Figure 1). Genetics, isotope analyses, and tagging data suggest the horseshoe crab population is comprised of multiple units, some distributed across multiple states and others embayment-specific that are linked to varying degrees. Due to varying levels of data at these levels, the assessment splits the range of horseshoe crabs into four regions; Northeast (Maine, Massachusetts, Rhode Island), New York (Connecticut, New York), Delaware Bay (New Jersey, Delaware, Maryland, Virginia), and Southeast (North Carolina, South Carolina, Georgia, Florida). This was a pragmatic decision that balances data availability and biological realism.

C. Landings

Since the mid- to late-1900s, horseshoe crabs have been harvested commercially primarily for use as bait and for use in the biomedical industry (Figure 2). Bait harvest is used primarily in the conch and American eel pot fisheries. The biomedical industry uses crabs to manufacture Limulus Amebocyte Lysate (LAL) which is used to test pharmaceuticals for the presence of gram-negative bacteria.

Early harvest records should be viewed with caution due to potential under-reporting. Between the mid-1800s and mid-1900s harvest ranged from approximately 1 to 5 million crabs annually, then dropped to between 250,000 and 500,000 crabs annually in the 1950s. About 420,000 crabs were harvested annually during the early 1960s.

Commercial landings declined after 1998 when ASMFC management began and then fluctuated around an average of 753,000 crabs from 2004-2017. The 2017 harvest level was the largest harvest since 2003 but still over 500,000 crabs less than the coastwide quota of 1.587 million crabs.

Biomedical losses are modest (<13% of bait landings assuming 15% bleeding mortality) but are not shown due to confidentiality concerns.

D. Data and Assessment

Relative abundance trends were estimated by fitting ARIMA models to survey data for horseshoe crabs taken during multiple research surveys in each of the four regions. Relative abundance in 2017 was compared to relative abundance during 1998 when ASMFC management began where the estimates for 1998 and 2017 were both from ARIMA models.

Additional information about abundance and exploitation are available for female horseshoe crabs in the Delaware Bay area from a CMSA model. The results were not used for status determination but are recommended for use where biomass and fishing mortality estimates are required for management.

E. Biological Reference Points

The recommended biological reference point for horseshoe crabs is the relative abundance of male and female horseshoe crabs during 1998 from ARIMA models. Stock status is based on the proportion of surveys in a region or coast wide that are above or below their 1998 reference point. Stock status is poor if 33% of the surveys are below their reference point (colored red in tables), good if 66% are above their reference point (green), and neutral (yellow) otherwise (Table 1).

F. Fishing Mortality

CMSA results indicate low fishing mortality for female horseshoe crabs in Delaware Bay in recent years (Figure 3). It was not possible to develop trend based or other measures of fishing pressure on males in Delaware Bay or for other areas due to uncertainty about discards.

G. Recruitment

CMSA model estimates for female horseshoe crabs indicate roughly average recruitment during 2017-2018 but the estimates are uncertain due to missing Virginia Tech survey data for 2013-2016 (Figure 4). No other direct information about recruitment is available.

H. Spawning Stock Abundance

Based on CMSA estimates, female spawning biomass in Delaware Bay is relatively high (Figure 5). No other direct estimates of spawning stock abundance are available.

I. Bycatch

The assessment provided the first estimates of discard mortality in the horseshoe crab and other fisheries. Preliminary results are uncertain but suggest that discard mortality may be comparable to or greater than mortality from other sources (bait landings plus biomedical collection). The magnitude of horseshoe crab discards in the horseshoe crab and other fisheries is the most important uncertainty and research recommendation identified in the assessment.

J. Other Comments

It is important to continue survey data collection for horseshoe crabs (particularly the Virginia Tech survey), determine how current survey methods differ (and implications for assessment across sites), define which methods are most effective to promote consistent survey sampling among locations, and to expand survey data collection to include size, sex, and female reproductive condition (primiparous vs. multiparous) information.

K. Tables

Table 1. Stock status determination for the coastwide and regional stocks based on the 1998 index-based reference points from ARIMA models.

Region	2009 Benchmark	2013 Update	2019 Benchmark	2019 Stock Status
Northeast	2 out of 3	5 out of 6	1 out of 2	Neutral
New York	1 out of 5	3 out of 5	4 out of 4	Poor
Delaware Bay	5 out of 11	4 out of 11	2 out of 5	Neutral
Southeast	0 out of 5	0 out of 2	0 out of 2	Good
Coastwide	7 out of 24	12 out of 24	7 out of 13	Neutral

L. Figures

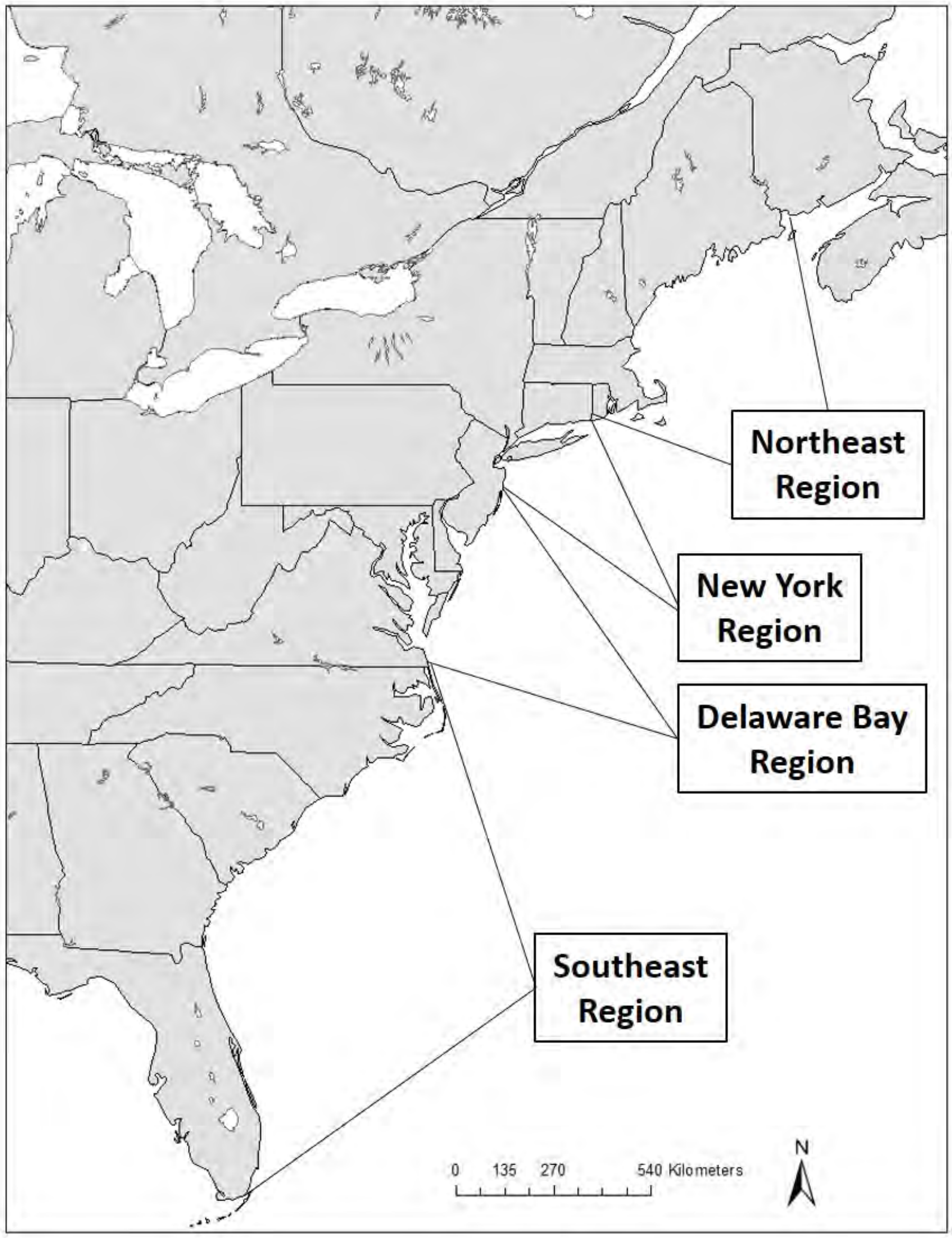


Figure 1. Map of the Atlantic coast showing the regions for horseshoe crab assessment.

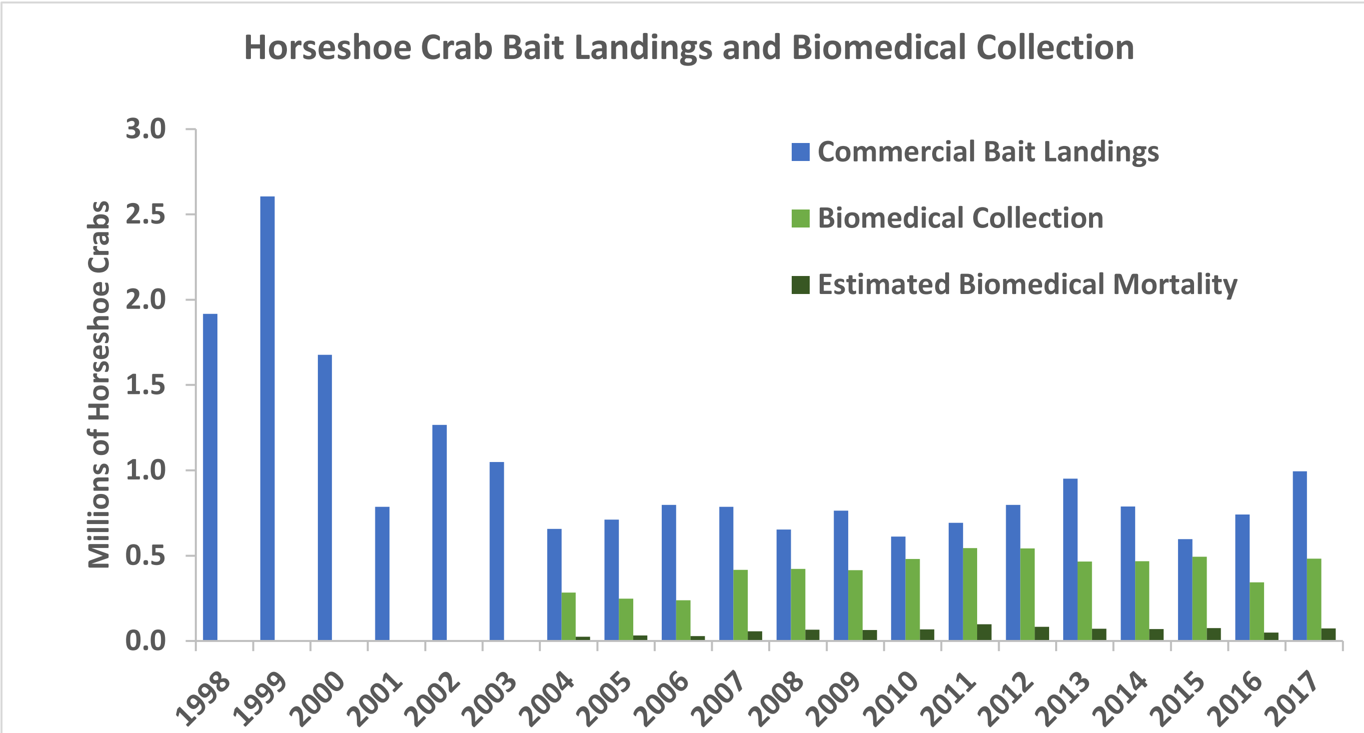


Figure 2. Coastwide horseshoe crab bait landings, biomedical collection, and estimated mortality attributed to the biomedical industry. Biomedical data has been reported to ASMFC since 2004 and a 15% rate is applied to the number of horseshoe crabs bled and released alive to estimate mortality from the industry.

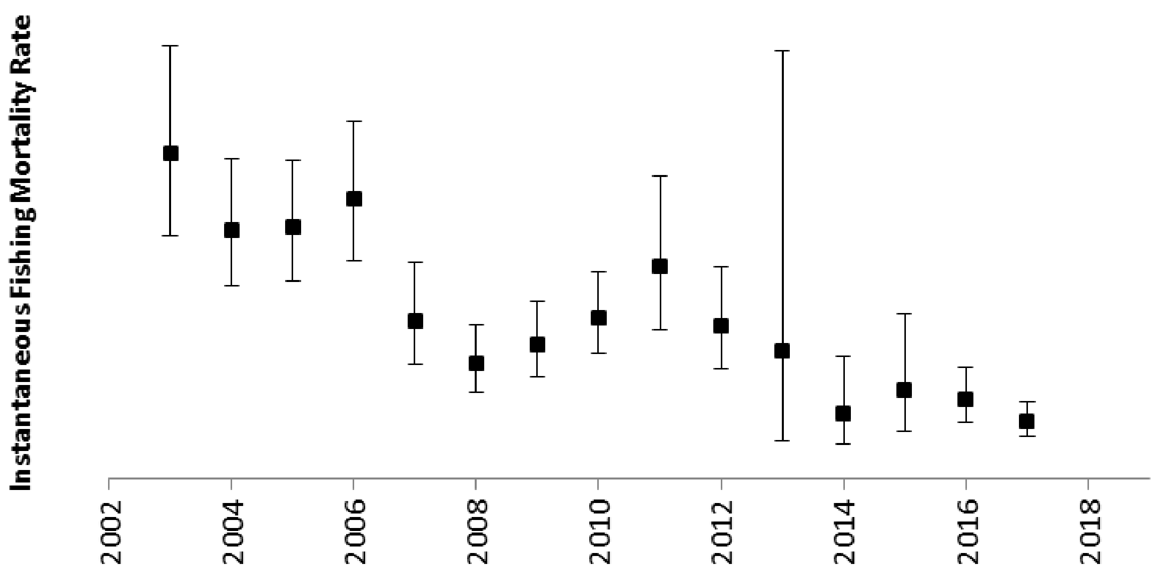


Figure 3. CMSA model estimated instantaneous fishing mortality rate F with lower and upper 95% confidence limits. Y-axis values have been removed due to CONFIDENTIAL data.

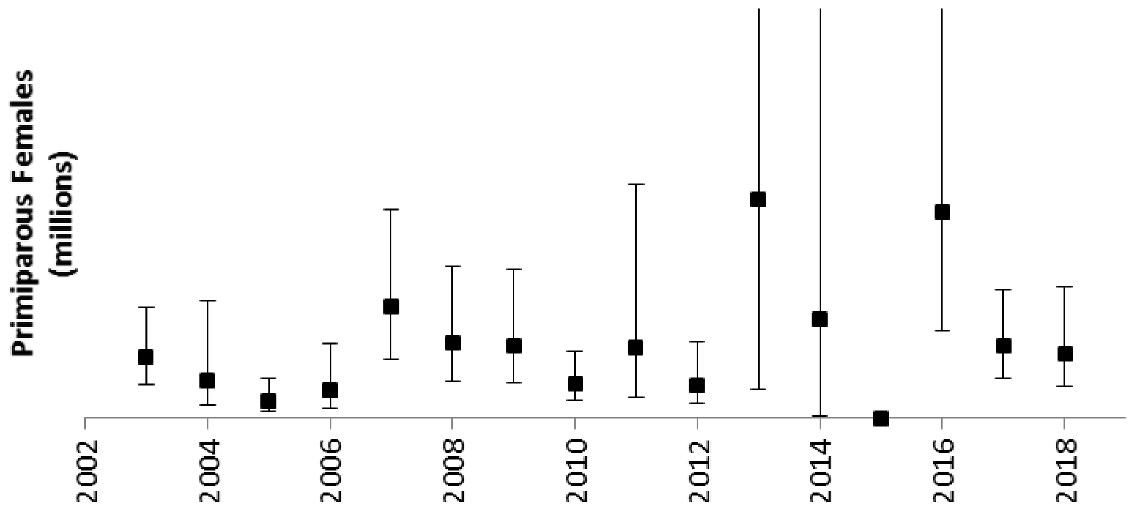


Figure 4. CMSA model estimated primiparous female abundance with lower and upper 95% confidence limits. Upper confidence limits for 2013, 2014, and 2016 extend beyond y-axis with values of CONFIDENTIAL. Y-axis values have been removed due to CONFIDENTIAL data.

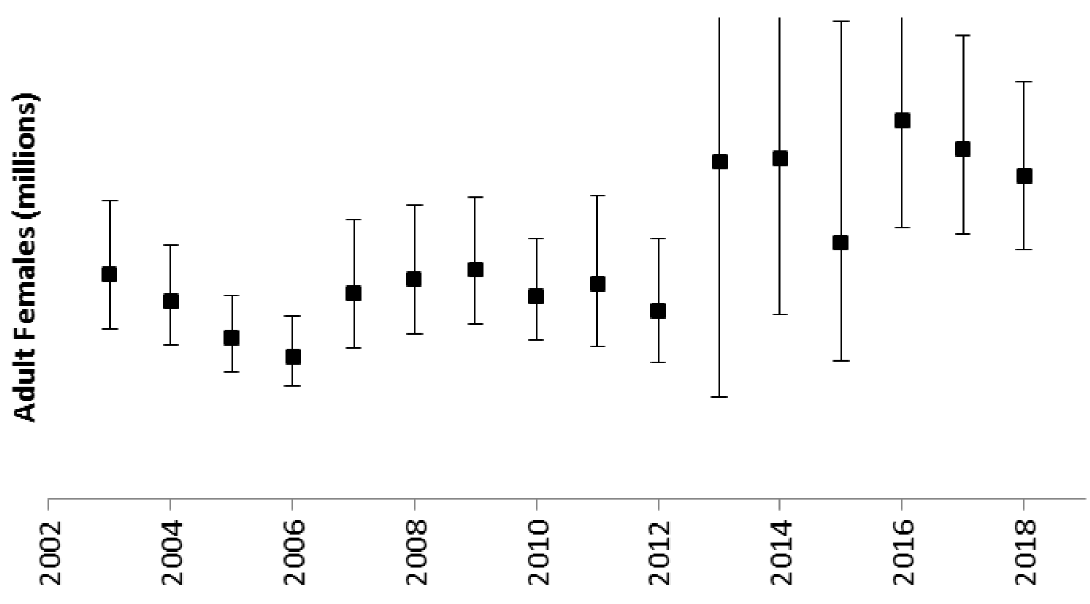
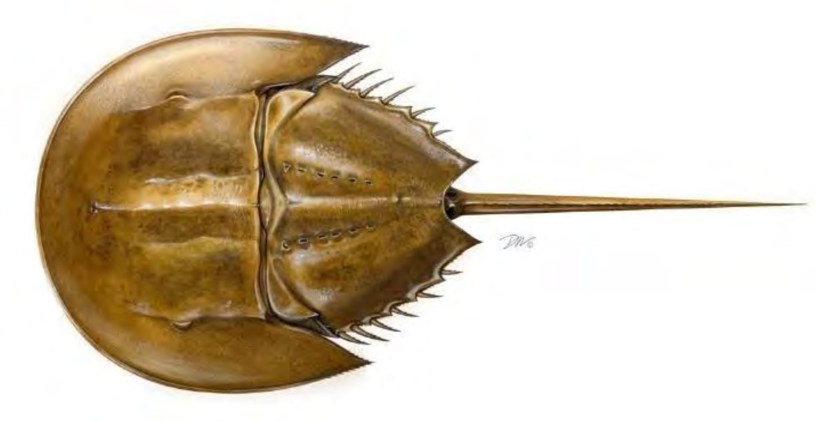


Figure 5. CMSA model estimated adult (primiparous + multiparous) female abundance with lower and upper 95% confidence limits. Upper confidence limits for 2013, 2014, and 2016 extend beyond the y-axis with values of CONFIDENTIAL. Y-axis values have been removed due to CONFIDENTIAL data.

Atlantic States Marine Fisheries Commission

2019 Horseshoe Crab
Benchmark Stock Assessment Non-Confidential Report



Prepared by the
ASMFC Horseshoe Crab Stock Assessment Subcommittee

John Sweka (Chair), U.S. Fish and Wildlife Service
Natalie Ameral, Rhode Island Division of Fish and Wildlife
Kristen Anstead, Atlantic States Marine Fisheries Commission
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Jeffrey Dobbs, North Carolina Division of Marine Fisheries
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Kim McKown, New York State Department of Environmental Conservation
Michael Schmidtke, Atlantic States Marine Fisheries Commission
Dave Smith, U.S. Geological Survey
Rich Wong, Delaware Division of Fish and Wildlife

STATEMENT REGARDING CONFIDENTIAL DATA

Note: The stock assessment and peer review was conducted with the inclusion of biomedical data, which is confidential. Much of the report that details confidential data has been redacted for this public report and noted as **CONFIDENTIAL**. Results have been summarized when data was removed. Confidential data are data such as commercial landings, including biomedical harvest, which can be identified down to an individual or single entity. Federal and state laws prohibit the disclosure of confidential data, and the Atlantic States Marine Fisheries Commission abides by those laws. In determining what data are confidential, most agencies use the “rule of 3” for commercial catch and effort data. The “rule of 3” requires three separate contributors to fisheries data in order for the data to be considered non-confidential. This protects the identity of any single contributor. In some cases, annual summaries by state and species may still be confidential because only one or two dealers process the catch. Alternatively, if there is only one known harvester of a species in a state, the harvester’s identity is implicit and the data for that species from that state is confidential.

EXECUTIVE SUMMARY

The purpose of this assessment was to evaluate the current status of horseshoe crab (*Limulus polyphemus*) along the U.S. Atlantic coast. Data from a variety of fisheries-dependent and –independent sources were reviewed and used to develop bait landings, commercial discard estimates, indices of abundance, and biomedical collection and mortality estimates as well as perform trend analyses, survival estimates, and a catch survey model.

Stock Identification and Management Unit

The Atlantic States Marine Fisheries Commission (ASMFC) manages the horseshoe crab stock from Maine to eastern Florida. Genetics, isotope analyses, and tagging data suggest that the horseshoe crab population is comprised of multiple units, some distributed across multiple states and others embayment-specific. Due to varying quantity and quality of data at these levels, for the purpose of this assessment, horseshoe crabs are evaluated on a coastwide and regional level consisting of the Northeast, New York, Delaware Bay, and the Southeast.

Commercial Fisheries

Horseshoe crabs are primarily harvested commercially as bait for the commercial American eel and whelk/conch fisheries along the Atlantic coast. Since 1998, states have been required to report annual landings to ASMFC through the compliance reporting process and bait landings were validated from Maine to Florida for 1998-2017 for this assessment. The majority of horseshoe crab harvest comes from the Delaware Bay region, followed by the New York, the Northeast, and the Southeast regions. Trawls, hand harvests, and dredges make up the bulk of commercial horseshoe crab bait landings. In recent years, the Delaware Bay region has been limited to male-only harvest through an adaptive management process that constrains the value of horseshoe crab harvest based on the needs of shorebirds. Horseshoe crab landings for 1998-2017 peaked in 1999 at 2.6 million horseshoe crabs and have decreased since the late 1990s. Landings have remained under 1 million horseshoe crabs since 2003 and from 2004-2017 average landings were 752,886 horseshoe crabs.

Horseshoe crabs are also collected by the biomedical industry to support the production of Limulus amebocyte lysate (LAL), a clotting agent that aids in the detection of endotoxins in patients, drugs, and intravenous devices. Blood from the horseshoe crab is obtained by collecting and extracting a portion of their blood. Most crabs collected and bled by the biomedical industry are, as required by the FMP, released alive to the water from where they were collected; however, a portion of these crabs die from the procedure. Crabs harvested for bait are sometimes bled prior to being processed and sold by the bait industry; these crabs are counted against the bait quota. Biomedical use has increased since 2004, when reporting began, but has been fairly stable in recent years. Previous assessments and management documents have applied a mortality rate of 15% to the number of horseshoe crabs bled and released alive to estimate the number of crabs that die each year during the process and this assessment maintains the 15% mortality rate based on an updated meta-analysis of available literature on this topic.

Horseshoe crabs are also encountered in several other commercial fisheries. Discard mortality occurs in various dredge fisheries and may vary seasonally with temperature, impacting both mature and immature horseshoe crabs; however, the actual rate of discard mortality is unknown. Commercial discards were estimated for the Delaware Bay region as part of this assessment with data from the NMFS' Northeast Fisheries Science Center's Northeast Fisheries Observer Program. Estimates indicate a significant amount of horseshoe crabs are captured and discarded in other fisheries, although a large amount of uncertainty is associated with the estimates.

Indices of Relative Abundance

There are spawning beach surveys available to monitor horseshoe crab spawning activity and one trawl survey designed to directly measure horseshoe crab abundance in the Delaware Bay region. These surveys were used to develop indices of relative abundance for the species. Additionally, several other fishery-independent surveys along the Atlantic coast that encounter horseshoe crabs were used to develop abundance indices. Many of these data sets had a high proportion of zero catches per tow in the survey and therefore all indices were developed using the delta distribution for the mean and variance for each year of a survey to specifically take into account the number of zero catches.

Assessment Methods

Tagging data from the USFWS horseshoe crab database were explored by region to estimate survival. The highest survival rates were in Delaware Bay and coastal Delaware-Virginia regions. The lowest were in coastal New York-New Jersey and the Southeast.

The horseshoe crab population was primarily evaluated using autoregressive integrated moving average models (ARIMA) on the coastwide-level and a catch multiple survey analysis (CMSA) for the Delaware Bay region. The CMSA modelling approach could only be developed in the Delaware Bay region due to the availability of the Virginia Tech Trawl Survey that collects stage-based data.

The results of ARIMA indicated that, in general, the Northeast surveys had conflicting trends, New York surveys showed decreasing trends, Delaware Bay surveys indicated increasing or neutral trends, and the Southeast showed increasing or neutral trends.

The CMSA indicated that adult abundance in the Delaware Bay was stable from 2003-2012 and then began increasing considerably in the last few years. This finding is consistent with stock rebuilding due to a period of significantly reduced commercial landings and tight management controls on the fishery beginning in the early 2000s in this region. Recruitment is less stable throughout the time series due to the missing years of data from the survey.

Prior to this assessment, biomedical data were not included in the modeling efforts as a source of harvest. For this assessment, the CMSA was run with and without the biomedical and discard estimates to evaluate the contribution of these other sources of mortality. Population estimates were largely unaffected by the estimated biomedical or discard numbers. Omitting biomedical harvest resulted in a decrease of fishing mortality (*F*) by a small number that did not affect stock status. Commercial discards had a larger effect on *F* and omitting the discard estimates decreased *F* by more than omitting the biomedical data. Commercial discards are likely a larger source of removals than biomedical mortality although much uncertainty is associated with the estimates. Sensitivity runs around varying levels of biomedical mortality rates and the discard estimates indicate that harvest in the region, including biomedical, bait, and discard estimates, appear to be sustainable at current levels and management strategies.

Stock Status

To date, no overfishing or overfished definitions have been adopted by the Management Board. For this assessment, biological reference points were developed for the Delaware Bay horseshoe crab population using a theoretical model and comparing to CMSA estimates. The comparison approach was not endorsed by the Peer Review Panel for use in management. Stock status was determined on coastwide and regional stocks based on the results from the ARIMA and in comparison to similar analysis in past assessments. The current stock status indicates that the Northeast region, which has two surveys with conflicting results, is in a neutral state whereas the horseshoe population in the New York region is poor and has been declining in status from previous assessments. Based on ARIMA results, the Delaware Bay region is in a neutral state and the Southeast region is in a good state.

Region	2009 Benchmark	2013 Update	2019 Benchmark[1]	2019 Stock Status
Northeast	2 out of 3	5 out of 6	1 out of 2	Neutral
New York	1 out of 5	3 out of 5	4 out of 4	Poor
Delaware Bay	5 out of 11	4 out of 11	2 out of 5	Neutral
Southeast	0 out of 5	0 out of 2	0 out of 2	Good
Coastwide	7 out of 24	12 out of 24	7 out of 13	Neutral

[1] The number of surveys below the index based 1998 reference point in the terminal year from ARIMA modeling

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TERMS OF REFERENCE REPORT SUMMARY

Terms of Reference for the Horseshoe Crab Assessment

1. Define population structure based on available data. If alternative population structures are used in the models (e.g., coast-wide, regional, sub-regional or estuary-specific), justify use of each population structure.

2. Characterize precision and accuracy of fishery-dependent and fishery-independent data, including biomedical data, that are used in the assessment, including the following but not limited to:
   a. Provide descriptions of each data source (e.g., geographic location, sampling methodology, potential explanation for outlying or anomalous data)
   b. Describe calculation and potential standardization of abundance indices.
   c. Discuss trends and associated estimates of uncertainty (e.g., standard errors)
   d. Justify inclusion or elimination of available data sources.
   e. Discuss the effects of data strengths and weaknesses (e.g., temporal and spatial scale, gear selectivities, aging accuracy, sample size) on model inputs and outputs.

3. Develop models used to estimate population parameters (e.g., F, biomass, abundance) and biological reference points, and analyze model performance.
   a. Describe stability of model (e.g., ability to find a stable solution, invert Hessian)
   b. Justify choice of CVs, effective sample sizes, or likelihood weighting schemes.
   c. Perform sensitivity analyses for starting parameter values, priors, etc. and conduct other model diagnostics as necessary.
   d. Clearly and thoroughly explain model strengths and limitations.
   e. Briefly describe history of model usage, its theory and framework, and document associated peer-reviewed literature. If using a new model, test using simulated data.
   f. If multiple models were considered, justify the choice of preferred model and the explanation of any differences in results among models.
   g. State assumptions made for all models and explain the likely effects of assumption violations on synthesis of input data and model outputs.
   h. Incorporate biomedical data into the models used. Reassess associated mortality of bled crabs coast-wide, or regionally if possible.

4. Characterize uncertainty of model estimates and biological or empirical reference points.

5. Perform retrospective analyses, assess magnitude and direction of retrospective patterns detected, and discuss implications of any observed retrospective pattern for uncertainty in population parameters (e.g., F, SSB), reference points, and/or management measures.

6. Recommend stock status as related to reference points (if available). For example:
   a. Is the stock below the biomass threshold?
   b. Is F above the threshold?

7. Other potential scientific issues:
   a. Compare trends in population parameters and reference points with current and proposed modeling approaches, including the results of the ARM model for the Delaware Bay. If outcomes differ, discuss potential causes of observed discrepancies.
   b. Evaluate the sub-lethal effects of biomedical bleeding on horseshoe crabs.
   c. Compare reference points derived in this assessment with what is known about the general life history of the exploited stock. Explain any inconsistencies.

8. If a minority report has been filed, explain majority reasoning against adopting approach suggested in that report. The minority report should explain reasoning against adopting approach suggested by the majority.

9. Develop detailed short and long-term prioritized lists of recommendations for future research, data collection, and assessment methodology. Highlight improvements to be made by next benchmark review.

10. Recommend timing of next benchmark assessment and intermediate updates, if necessary relative to biology and current management of the species.

Terms of Reference for the Horseshoe Crab Peer Review

1. Evaluate the thoroughness of data collection and the presentation and treatment of fishery-dependent and fishery-independent data in the assessment, including the following but not limited to:
   a. Presentation of data source variance (e.g., standard errors).
   b. Justification for inclusion or elimination of available data sources,
   c. Consideration of data strengths and weaknesses (e.g., temporal and spatial scale, gear selectivities, aging accuracy, sample size),
   d. Calculation and/or standardization of abundance indices.

2. Evaluate the methods and models used to estimate population parameters (e.g., F, biomass, abundance) and biological reference points, including but not limited to:
    a. Evaluate the choice and justification of the preferred model(s). Was the most appropriate model (or model averaging approach) chosen given available data and life history of the species?
    b. If multiple models were considered, evaluate the analysts' explanation of any differences in results.
    c. Evaluate model parameterization and specification (e.g., choice of CVs, effective sample sizes, likelihood weighting schemes, calculation/specification of M, stock-recruitment relationship, choice of time-varying parameters, plus group treatment).

3. Evaluate the diagnostic analyses performed, including but not limited to:
    a. Sensitivity analyses to determine model stability and potential consequences of major model assumptions
    b. Retrospective analysis

4. Evaluate the methods used to characterize uncertainty in estimated parameters. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

5. If a minority report has been filed, review minority opinion and any associated analyses. If possible, make recommendation on current or future use of alternative assessment approach presented in minority report.

6. Recommend best estimates of stock biomass, abundance, and exploitation from the assessment for use in management, if possible, or specify alternative estimation methods.

7. Evaluate the choice of reference points and the methods used to estimate them. Recommend stock status determination from the assessment, or, if appropriate, specify alternative methods/measures.

8. Review the research, data collection, and assessment methodology recommendations provided by the TC and make any additional recommendations warranted. Clearly prioritize the activities needed to inform and maintain the current assessment, and provide recommendations to improve the reliability of future assessments.

9. Recommend timing of the next benchmark assessment and updates, if necessary, relative to the life history and current management of the species.

10. Prepare a peer review panel terms of reference and advisory report summarizing the panel's evaluation of the stock assessment and addressing each peer review term of reference. Develop a list of tasks to be completed following the workshop. Complete and submit the report within 4 weeks of workshop conclusion.

1 INTRODUCTION

1.1 Brief Overview and History of the Fisheries

Historically, horseshoe crabs (*Limulus polyphemus*) were harvested commercially for fertilizer and livestock feed. Between the mid-1800s and mid-1900s harvest ranged from approximately 1 to 5 million crabs annually (Shuster 1960; Shuster 1982; Shuster and Botton 1985; Finn et al. 1991). Harvest numbers dropped to between 250,000 and 500,000 crabs annually in the 1950s (Shuster 1950) and 42,000 crabs were reported annually by the early 1960s (Finn et al. 1991). Early harvest records should be viewed with caution due to potential under-reporting. The period between 1950 and 1960 is considered the lowest period of horseshoe crab abundance. The substantial commercial-scale harvesting of horseshoe crabs ceased in the 1960s (Shuster 1996).

Since the mid to late 1900s, horseshoe crabs have been commercially harvested primarily for use as bait and to support a biomedical industry. Horseshoe crabs are commercially harvested primarily for use as bait in the conch (*Busycon* spp.) and American eel (*Anguilla rostrata*) pot fisheries, although they are also harvested to a lesser extent for use as bait in the catfish (*Ictalurus* spp.) and killifish (*Fundulus* spp.) fisheries. The biomedical industry uses crabs, most notably, for the manufacture of Limulus Amebocyte Lysate (LAL), a product used to test pharmaceuticals for the presence of gram-negative bacteria. Since 1998, horseshoe crabs have been managed under the Interstate Fishery Management Plan (FMP) for Horseshoe Crab (1998) and its subsequent addenda (Addenda I-VII) by the Atlantic States Marine Fisheries Commission (ASMFC).

Commercial harvest information prior to 1998 is available through the National Marine Fisheries Service and the previous ASMFC stock assessments (ASMFC 2009a, 2013). Commercial landings from 1998-2017 were validated through the Atlantic Coastal Cooperative Statistics Program (ACCSP) by the states during this assessment process, and non-validated landings were not used in any models or analyses. Shortly after establishment of the Interstate Fishery Management Plan (FMP) for Horseshoe Crab in 1998, commercial landings declined until approximately 2004, after which they fluctuated without a long-term directional trend around an average of 753,000 crabs from 2004-2017 (Table 1, Figure 1). A notable increase in coastwide harvest occurred in 2017, with the largest harvest since 2003. However, this harvest was still over 500,000 crabs less than the coastwide quota established by the FMP (1.587 million crabs).

Horseshoe crabs from the Delaware Bay region (New Jersey-Virginia) have been of particular concern due to their relationship with red knots (*Calidris canutus*), a shorebird species currently listed as Threatened by the US Fish and Wildlife Service (USFWS). In 2012, the Adaptive

Resource Management (ARM) model was approved for use, beginning with the 2013 fishing season. The ARM model determines bait harvest levels for the Delaware Bay using population estimates of horseshoe crabs and red knots in that region. Prior to the ARM model's use, New Jersey enacted a commercial harvest moratorium (2006) and Delaware instituted regulations allowing commercial harvest of male crabs only (2008) through state laws. Since use of the ARM model began, the model has recommended and the Horseshoe Crab Management Board (Board) has annually specified harvest package 3 (500,000 male-only crabs) for the Delaware Bay. This regional quota has been allocated among states or areas where crabs of Delaware Bay origin are harvested (New Jersey, Delaware, Maryland, and Virginia east of the COLREGS line). Although they receive a share of the Delaware Bay quota, the commercial moratorium in New Jersey remains in effect.

1.2 Management Unit Definition

The fishery management unit includes the horseshoe crab stock(s) of the Atlantic coast of the United States (Maine to eastern Florida). The coastwide stock is currently managed on state by state, multi-state (e.g., Delaware Bay region), and embayment levels. See section 2.1 Stock Definition for more information.

1.3 Regulatory History

1.3.1 Interstate Management

Prior to 1998, horseshoe crab harvest was unregulated in most states. The Horseshoe Crab Management Board approved the Horseshoe Crab FMP in October 1998. The goal of the FMP is "management of horseshoe crab populations for continued use by: current and future generations of the fishing and non-fishing public (including the biomedical industry, scientific and educational research) migratory shorebirds; and other dependent fish and wildlife (including federally listed sea turtles)" (ASMFC 1998a). The FMP outlined a comprehensive monitoring program and maintained controls on the harvest of horseshoe crabs put in place by New Jersey, Delaware, and Maryland prior to the approval of the FMP. These measures were necessary to protect horseshoe crabs within and adjacent to the Delaware Bay, which is the epicenter of spawning activity along the Atlantic coast. However, subsequent increased landings in other states largely negated these conservation efforts.

In April 2000, the Management Board approved Addendum I to the Horseshoe Crab FMP (ASMFC 2000a). This Addendum established a coastwide, state-by-state annual quota system to further reduce horseshoe crab landings. Through Addendum I the Board recommended to the federal government the creation of the Carl N. Schuster Jr. Horseshoe Crab Reserve, an area of nearly 1,500 square miles in federal waters off the mouth of Delaware Bay that is closed to horseshoe crab harvest. In May 2001, the Board approved Addendum II, which established criteria for voluntary quota transfers between states (ASMFC 2001). In March 2004, the Board approved Addendum III to the FMP (ASMFC 2004a). This addendum sought to further the conservation of horseshoe crab and migratory shorebird populations in and around the Delaware Bay. It reduced harvest quotas, implemented seasonal bait harvest closures in New Jersey, Delaware, and Maryland, and revised monitoring components for all jurisdictions.

Addendum IV was approved in May 2006 (ASMFC 2006a). It further limited bait harvest in New Jersey and Delaware to 100,000 crabs (male only) and required a delayed harvest in Maryland and Virginia. Addendum V, adopted in September 2008, extended the provisions of Addendum IV through October 31, 2009 (ASMFC 2008a). Through a vote, the Board extended the provisions of Addendum IV through October 31, 2010. Addendum VI further extended Addendum IV provisions through April 30, 2013. It also prohibited directed harvest and landing of all horseshoe crabs in New Jersey and Delaware from January 1 through June 7, and female horseshoe crabs in New Jersey and Delaware from June 8 through December 31 (ASMFC 2010). Addendum VI also mandated that no more than 40% of Virginia's annual quota may be harvested east of the COLREGS line in ocean waters. It also requires that horseshoe crabs harvested east of the COLREGS line and landed in Virginia must be comprised of a minimum male to female ratio of 2:1.

Addendum VII was approved in February 2012 (ASMFC 2012). This addendum implemented the Adaptive Resource Management (ARM) Framework for use during the 2013 fishing season and beyond. The Framework considers the abundance levels of horseshoe crabs and shorebirds in determining the optimal harvest level for the Delaware Bay states of New Jersey, Delaware, Maryland, and Virginia (east of the COLREGS). The Board annually reviews recommended harvest levels from the ARM Subcommittee, who run the ARM model, and specifies harvest levels for the following year in New Jersey, Delaware, Maryland, and Virginia. Since initial implementation in 2013, the ARM model has recommended harvest package 3, and the Board has acted in accordance with this recommendation, specifying annual Delaware Bay harvests of 500,000 male-only horseshoe crabs in every year. State quotas throughout the Atlantic coast, with regards to the interstate FMP, have been specified through 2019 (Table 2) and have generally remained the same since 2013. In accordance with the FMP, any overages of quotas set by the FMP have been accounted for through Board-approved quota transfers between states or by a crab-for-crab quota reduction for the state with the overage in the following year.

1.3.2 State Management

Summaries of state-specific horseshoe crab management regulations are provided below. These summaries are not intended to be comprehensive. For complete sets of regulations, please reference states' marine fisheries agencies.

1.3.2.1 Massachusetts

Massachusetts is issued an annual bait harvest quota of 330,377 crabs, but voluntarily imposes a more restrictive quota of 165,000 crabs. The biomedical fishery is not subjected to an annual quota. There are two permits under which horseshoe crabs can be harvested, a limited entry fishery regulated permit endorsed for horseshoe crab bait harvest, or a biomedical harvest permit. A permit is not required to harvest or possess six or fewer crabs per day. Licensed pot fishermen may possess more than six crabs without a regulated horseshoe crab permit as long as the source of the crabs is a documented permitted wholesale or bait dealer.

After they are bled, crabs collected under the biomedical harvest permit are required to be released back in to the waters from which they were collected. Mobile gear fishermen harvesting with a permit endorsed to harvest horseshoe crabs for bait are subjected to a possession and landing limit of 300 crabs per calendar day or fishing trip (whichever is longer). Non-mobile gear bait harvesters are prohibited from landing or possessing more than 400 crabs per day. Biomedical harvest permit holders are prohibited from landing or possessing more than 1,000 crabs per day. Regardless of permit type, there is a 7-inch minimum legal size. The import of Asian horseshoe crabs is prohibited.

Bait harvesters can only sell to bait dealers, and biomedical harvesters can only sell to biomedical dealers. However, bait dealers can loan bait crabs to biomedical dealers in what is known as the "rent-a-crab" program, where crabs intended for the bait market can be sold to biomedical dealers, bled, and then returned to the bait dealer. Rent-a-crabs are counted against the bait quota.

Permit restrictions are issued annually through a letter of authorization (LOA) to those permitted to receive crabs for biomedical purposes. This LOA states that crabs collected by the biomedical fishery must be returned in good condition to the embayment in which they were collected. All bled horseshoe crabs must be marked after bleeding with a distinct marking (changing each year) to avoid re-bleeding within a season. Crabs with the current year's marking cannot be re-bled during the same year. Crabs also must be transported in temperature-controlled trucks set to between 50-60 F˚, and temperature in lab and holding areas cannot exceed 70 F˚. Containers holding crabs cannot be more than 2/3 full to reduce the chance of crushing crabs at the bottom of a container. Crabs also must be kept moist. Horseshoe crabs cannot be harvested during five-day lunar closures, starting two days prior and ending two days after the new and full moons from mid-April through the end of June. In addition, those using mobile gear cannot harvest on Fridays or Saturdays during the summer flounder season (beginning June 10th and lasting until the summer flounder quota is reached). Pleasant Bay, located in Eastern Cape Cod has been closed to bait harvest since 2007.

1.3.2.2 Rhode Island

Commercial harvest of horseshoe crabs in Rhode Island is currently managed using seasons, quota, and mandated reporting. In addition to possessing either a Rhode Island Multipurpose license or a Principal Effort/Commercial fishing license with a non-lobster crustacean endorsement, commercial harvesters must also obtain a horseshoe crab permit approving their participation in either bait, biomedical, or both fisheries. As of the 2017 season, commercial bait harvest has been closed during the month of May and restricted to 60 crabs per day when open. The commercial biomedical harvest is closed from two days before to two days after new and full moons (a five-day closure) during the month of May and does not entail a daily possession limit. Reporting of commercially harvested crabs is required via phone call to the Department of Marine Fisheries every Monday for the previous calendar week's landings and monthly via paper report delivered no later than 15 days after the close of the month being reported. Minimum size limit remains at seven inches in prosomal width.

1.3.2.3 Connecticut

All horseshoe crab harvest from Connecticut waters requires a commercial license, and directed hand harvest of horseshoe crabs also requires an additional Horseshoe Crab Endorsement. All applicable license types are restricted to those with previous history, although license transfer is allowed under specific conditions. When taken under a commercial horseshoe crab trawl license, the possession limit is 25 crabs per vessel per trip or per day, whichever is the longer period of time. No transfer at sea is allowed. When taken under a commercial horseshoe crab hand-harvest license, the possession limit is 500 crabs per license holder per 24-hour period that begins at 12:00 pm. No person taking horseshoe crab under a hand-harvest license shall use any tool, except that gloves may be worn by the license holder. Any person that does not hold a commercial hand-harvest license and an endorsement letter is prohibited from entering the water to assist a licensee. Such unlicensed or unendorsed persons are not prohibited from carrying crabs that have been placed on the beach by the license holder to a storage container or vehicle or taking crabs from a license holder for storage while remaining in a boat. Since December 2000, hand-harvest of horseshoe crabs is not allowed from three closed areas; (1) Menunketesuck Island in Westbrook; and (2) the area known as Sandy Point in West Haven; and (3) the area known as Milford Point in Milford.

Connecticut's quota is 48,689 crabs, as set by Addendum IV in 2001. From 2001-2006 the open harvest season included only June, and since 2007 it extends from May 22 through July 7, exclusive of weekends. Since 2000, all commercial license holders have been required to report horseshoe crab landings (numbers of crabs) monthly by gear type and fishing area. All harvest is recorded as commercial landings regardless of whether it is sold for any purpose or kept for personal use.

1.3.2.4 New York

To commercially harvest horseshoe crabs for bait a person must have a commercial crab permit and a commercial horseshoe crab permit. Five or less horseshoe crabs may be harvested for personal use without a commercial bait permit. To harvest horseshoe crabs for biomedical purposes a person must have a biomedical harvester permit and must sell to a company that has a biomedical user permit. A person must have a valid commercial crab license to be eligible for a biomedical harvester permit. A person must be approved by the FDA to produce LAL to be eligible for a biomedical user permit. Biomedical user permit holders must ensure all horseshoe crab used in the production of LAL are either returned to the location of harvest as soon as possible after the bleeding process or sold as bait and reported as bait harvest. A person may only apply for and hold one horseshoe crab permit type in a calendar year.

The total annual commercial fisheries bait harvest of horseshoe crabs may not exceed the amount annually allocated to New York State by ASMFC pursuant to the FMP (currently 366,272 crabs). For more than a decade New York has voluntarily limited the commercial harvest quota to 150,000 crabs. The Department of Environmental Conservation (DEC) is authorized to set seasonal quota caps and daily trip limits.

Commercial bait harvest permit holders must file monthly harvest reports, except during May, June, and July, when harvest reports must be submitted weekly. Biomedical harvest permit holders must file monthly harvest reports. In addition, they must notify the DEC 24 hours in advance with details on the planned harvest. Biomedical user permit holders must file monthly reports. In addition, they must notify the DEC 24 hours in advance of releasing horseshoe crabs back into the water.

Horseshoe crabs may only be taken for commercial and biomedical purposes by: hand harvest, pound net, trap net, gill net, otter trawl, seine or dredge. Dredges used to harvest horseshoe crabs shall not be greater than six feet in width. Except during the months of September and October, dredges may not be used to harvest horseshoe crabs in the Atlantic Ocean. The possession or landing of horseshoe crabs from any vessel having a dredge onboard is also prohibited while the dredge fishery is closed.

The DEC may establish closed areas for commercial hand-harvest of horseshoe crabs if it determines that the area receives significant use by spawning horseshoe crabs or shorebird species for which horseshoe crab eggs are an important food source. The DEC may also close harvest in areas managed by a local, state, or federal agency or governing body as public recreation areas, at the request of that agency or governing body.

1.3.2.5 New Jersey

A moratorium is in place on the harvest of horseshoe crabs and horseshoe crab eggs for an indeterminate period of time. The law prohibits the possession of horseshoe crabs and horseshoe crab eggs except for those individuals in possession of a scientific collecting permit, allowing them to possess horseshoe crabs or horseshoe crab eggs for research or educational purposes only. Those fishermen utilizing horseshoe crabs as bait must provide adequate documentation that the horseshoe crabs in their possession were not harvested in New Jersey. For those commercial fishermen in possession of horseshoe crabs, documentation shall include a receipt or bill that provides the name, address, and phone number of the person or company that provided the horseshoe crabs, the permit or license number of the person or company named, and the state and, if possible, the location where the horseshoe crabs were harvested.

1.3.2.6 Delaware

Delaware's annual horseshoe crab harvest is determined in accordance with the annual sex-specific allocations identified in Addendum VII to the FMP. Harvest is required to be reported by phone to the Delaware Department of Natural Resources Division of Fish and Wildlife (DNREC DDFW) on a daily basis. Upon reaching 95% of the annual allocation, DNREC establishes a date and time to close the fishery, based on recent fishery performance and landings. Any overages incurred are subtracted from the following year's horseshoe crab quota allocation.

Two methods of harvest are permitted and employed in Delaware's horseshoe crab fishery. Hand harvest licenses were capped in 1998, although transfer of licenses between qualified individuals is lawful. Individuals that have a current commercial eel license are also allowed to harvest horseshoe crabs for personal bait use. Harvest by eel licensees may not be sold or commingled with any other commercial harvest of horseshoe crabs. Annual hand harvest may not begin until June 8 and ends upon reaching the quota allocation. No more than 300 cubic feet of horseshoe crabs may be collected in a 24-hour period. If the quota has not been reached by June 30, five horseshoe crab dredge permits are issued via lottery, if more than five applications are received. Only current holders of oyster harvesting licenses are eligible for horseshoe crab dredge permits. Dredge harvest is limited to 1,500 horseshoe crabs per day. No harvest, by any method, is allowed to occur between sunset and sunrise.

Delaware has prohibited the use of more than one-half of a female horseshoe crab or one male horseshoe crab as bait in any type of pot on any one day. Bait saving devices are mandatory in all whelk pots employed in the state. Possession of Asian horseshoe crabs or parts thereof are prohibited without written authorization from the Director of the Division of Fish and Wildlife.

1.3.2.7 Maryland

The annual quota of male horseshoe crabs for the commercial fishery is 255,980 male crabs. There is no female harvest permitted. Harvest is subject to daily catch limits, determined by whether the harvester has a valid landing permit. Non-permitted harvesters may not land more than 25 horseshoe crabs per day. Permitted harvesters may not land more than 150 horseshoe crabs per day from May 1-July 9. From July 10-November 30, permitted harvesters are subject to daily limits as designated on their respective permits.

The bait fishery is subject to seasonal restrictions. From May 1-July 9, horseshoe crabs from outside one mile of the Atlantic coast or from Maryland's coastal bays and tidal tributaries may be caught and landed, but crabs may not be caught within one mile of the Atlantic Coast or the Chesapeake Bay and its tidal tributaries. From July 10-November 30, horseshoe crabs from the state tidal waters may be caught and landed. From December 1-April 30, horseshoe crabs may not be caught or landed in Maryland.

Horseshoe crabs used for scientific purposes (including biomedical use) must be collected by individuals with scientific collection permits. These permits are only granted with proof that collected crabs are being supplied to a facility approved by the US Food and Drug Administration (FDA). Only male crabs may be collected from January 1-June 6. Crabs must be transported in a refrigerated truck and returned within 48 hours. A chain of custody form must follow the crabs from collection to release, and an annual report detailing use of horseshoe crabs is due to the state by January 31 of the following year.

1.3.2.8 Potomac River Fisheries Commission (PRFC)

Potomac River commercial watermen are required to keep an accurate and complete daily account of their catches and releases and submit these reports to the PRFC on a weekly basis.

1.3.2.9 Virginia

Virginia allocates its quota annually among five different harvest gear types including trawl, dredge, pound nets, by-hand, and by other gear. Each one of these gear types is limited entry and requires a gear-specific harvesting permit to participate in the fishery. The harvest of horseshoe crabs in Virginia requires a Commercial Fishing Registration License as well as a gear-specific horseshoe crab harvesting permit. The daily landing limits for each gear-specific license are 2,500 crabs by Trawl Permit, 2,500 crabs by Class A Dredge Permit, 1,000 crabs by Class B Dredge Permit, 500 crabs by Hand Harvest Permit, 500 crabs by Pound Net Permit, and 250 crabs by General Category Permit.

Daily harvest of horseshoe crabs in Virginia must be reported to the agency on a monthly basis through the Virginia Mandatory Reporting Program. Individuals also must call in daily harvests of horseshoe crabs to the agency each day. Each dealer must obtain a Horseshoe Crab Buying Permit in order to buy horseshoe crabs in Virginia. These permitted buyers must supply daily reports of all horseshoe crabs bought on a monthly basis.

The landing of horseshoe crabs in Virginia by trawl is prohibited from January 1 through June 7 of each year and is limited to male only harvest. Virginia prohibits the harvest of horseshoe crabs within 1,000 feet in any direction of the mean low waterline from May 1 through June 7 of each year. Individuals must obtain a Scientific Collection Permit from the Virginia Marine Resources Commission in order to harvest horseshoe crabs for biomedical purposes.

1.3.2.10 North Carolina

Commercial harvest regulations are set by proclamation of the Division of Marine Fisheries Director as stated in North Carolina Marine Fisheries Commission Rule 15A NCAC 03L .0207. The current harvest season is January 1 to April 30 each year with a 50 crab per day limit. An additional opening can occur later in the year if sufficient quota remains uncaught.

Biomedical use crabs are subject to the same harvest regulations as the commercial harvest. Additionally, a biomedical use permit is required as outlined in North Carolina Marine Fisheries Commission Rule 15A NCAC 03O .0503 (a) pursuant to the ASMFC Horseshoe Crab FMP.

1.3.2.11 South Carolina

Taking or possessing horseshoe crabs is unlawful except under permit granted by the South Carolina Department of Natural Resources (SCDNR). Horseshoe crabs may be possessed for educational purposes or for use in LAL production, with appropriate permits. There is no commercial harvest or sale of horseshoe crabs in South Carolina.

Educational permits allow harvest and possession of no more than 25 horseshoe crabs or parts of horseshoe crabs taken in South Carolina state waters.

Horseshoe crabs from which blood is collected for production of LAL may be held in facilities approved by the SCDNR and must be handled so as to minimize injury to the crab. Horseshoe crabs collected must be returned unharmed to state waters of comparable salinity and water quality as soon as possible after bleeding unless subsequent retention is permitted. Horseshoe crabs must be collected by hand outside of restricted areas. Facilities permitted to use horseshoe crabs for LAL production are required to submit monthly reports of collection activity and any mortality that occurs while crabs are possessed.

1.3.2.12 Georgia

All Georgia salt waters are closed to the taking of horseshoe crabs for bait except during those times when the salt waters or portions thereof are opened to the taking of shrimp, whelk, or blue crab by trawling. All horseshoe crab harvest by gear other than a trawl requires a commercial license with a horseshoe crab endorsement. Harvest by trawl requires a commercial trawl license.

It is unlawful for any person taking horseshoe crabs to take or possess more than 25 horseshoe crabs at any one time or for there to be on board the boat used for the taking more than 75 horseshoe crabs at any one time, whichever is less. The taking or catching of horseshoe crabs incidentally during legal fishing operations of other marine species is not a violation of this Rule if the horseshoe crabs so taken in excess of the limits are immediately returned to the water from which they were taken without being intentionally or negligently harmed by the taker or the equipment being used. Horseshoe crabs landed in other states may be imported with appropriate documentation.

Collections of crabs for biomedical use must be conducted by harvesters licensed by the Georgia Department of Natural Resources (GADNR). Individuals that possess crabs for biomedical use must also have a license from GADNR. There are no restrictions on the number of horseshoe crabs that may be taken for biomedical use. Crabs collected for biomedical use are to be returned unharmed to state waters of comparable salinity and water quality as soon as feasible after blood extraction.

1.3.2.13 Florida

Harvest, possession, and sale of horseshoe crabs within Florida state waters requires a current Saltwater Product License (SPL), and no recreational harvest is allowed. Horseshoe crabs must be harvested by hand or gig; all other gear and methods are prohibited. Those possessing a current SPL, can harvest 25 crabs per day. An SPL holder with a Marine Life endorsement can harvest 100 crabs per day, and SPL holders with a permit to harvest eels commercially in freshwater may harvest 100 crabs per day. Harvesting crabs for biomedical purposes require a Horseshoe Crab Biomedical Collecting Permit. This permit has no bag or possession limits if the crabs are maintained and released alive in the area where collected. Biomedical permits are valid for one year and require an activity report detailing the number of crabs collected, areas of collection, and percent mortality up to the point of release, to be submitted by May 1 each year.

1.4 Assessment History

1.4.1 Previous stock assessments

The initial stock assessment for horseshoe crab was completed and peer reviewed in 1998 (ASMFC 1999; ASMFC 1998b). A new assessment framework was proposed in 2000 (ASMFC 2000b), and an internally peer-reviewed assessment was produced in 2004. The most recent externally peer-reviewed benchmark stock assessment was completed in 2009 (ASMFC 2009a) and updated in 2013 (ASMFC 2013).

The ARM model currently used to provide management advice for horseshoe crab in the Delaware Bay region (ASMFC 2009b). Since the first year of implementation of the ARM, the model is renewed annually to set harvest specifications in the region.

1.4.2 Summary of Previous Assessment Models

1.4.2.1 Model Description

The 2013 stock assessment update consisted of trend analyses using autoregressive integrated moving averages (ARIMA). In previous assessments (ASFMC 2004b, 2009a), linear trend analyses were also conducted and a meta-analysis (Manly 2001) was used to evaluate consensus among trends. The peer-review panel for the 2009 assessment concluded that the ARIMA modeling was a good advancement in trend analysis and superseded other trend analyses (ASMFC 2009a, 2009c).

The 2009 benchmark stock assessment also included the application of a surplus production model (Prager 1994) and a catch-survey model (Collie and Sissenwine 1983) for the Delaware Bay region. Those models were not included in the 2013 stock assessment update because of improvements that needed to be made as per peer review comments which could be addressed only as part of a benchmark stock assessment. Previous application of these models to the Delaware Bay region did not include mortality due the biomedical industry – an oversight.

Multispecies models have been developed to support adaptive management of horseshoe crab harvest and recovery of the migratory shorebird populations that rely on horseshoe crab eggs in Delaware Bay (primarily Red Knot). The predictive horseshoe crab models are stage-based models based on Sweka et al. (2007). The ARM Framework is described in separate reports developed by the ARM workgroup and reported through the Delaware Bay Ecosystem Technical Committee. The ARM Framework, established through Addendum VII (2012), incorporates both shorebird and horseshoe crab abundance levels to set optimized harvest levels for horseshoe crabs of Delaware Bay origin and is fully described in ASMFC 2009b. This model is updated annually to set harvest specifications and operates outside of the ASMFC benchmark and update stock assessment processes.

1.4.3 Results of the Previous Assessment

No overfishing or overfished definitions have been adopted by the Management Board. Models that could be used in determining overfishing and overfished status were not run as part of the stock assessment update in 2013, the last time the stock was assessed. The 2013 stock assessment update found that horseshoe crab abundance trends varied regionally/sub-regionally based on the ARIMA results. Positive trends were observed in the Southeast and for some indices in Delaware Bay regions. In the Southeast region there was evidence that abundance has remained stable or continued to increase since the 2009 stock assessment. In Delaware Bay, there was evidence for demographic-specific increases in abundance through the time series of data, but trends have been largely stable since the 2009 stock assessment. An exception was the continued sharp increase in abundance indices from the New Jersey Surf Clam Dredge Survey. Declining abundance was evident in the New York and the Northeast regions. These declines were evident in the previous 2004 and 2009 stock assessments, and trends have not reversed. The status of horseshoe crabs in the Northeast region appeared worse in 2013 than what it was during the 2009 stock assessment, with more indices likely less than their Q_{25} and 1998 reference points.

1.4.4 Previous Peer Review Comments

The 2009 peer review panel commended the SAS on advances they made during the benchmark stock assessment including the development of the ARM model and the use of ARIMA. They encouraged the continued development of the catch survey analysis (CSA) and made several recommendations during the 2009 benchmark stock assessment for the application of trend analyses, ARIMA, the surplus production model, and the CSA for future assessments (ASMFC 2009c).

2 LIFE HISTORY

Horseshoe crabs are characterized by high fecundity, high egg and larval mortality, and low adult mortality (Botton and Loveland 1989; Loveland et al. 1996). They breed in late spring on low-energy coastal beaches along the Atlantic and Gulf of Mexico coasts, laying eggs in nests buried in the sand. Larvae hatch from the eggs within 2-4 weeks, although some larvae may overwinter within nests and hatch out the following spring (Botton et al. 1992). Planktonic larvae typically settle within one to two weeks of hatching and begin molting. Juvenile crabs remain in the intertidal flats, usually near breeding beaches. Older individuals move out of intertidal areas to deeper waters (Botton and Ropes 1987). Crabs are thought to mature around 10 years of age and may live up to 20 or more years.

2.1 Stock Definitions

This stock assessment is for the Atlantic coast horseshoe crab populations that range from Gulf of Maine to Florida. The species range extends into the Gulf of Mexico from Florida west into Louisiana and south to the Yucatán Peninsula. The species is considered to be absent from Texas to Tabasco, México.

Ecological processes, genetic patterns, and tagging analyses suggest a regional or sub-regional population structure. Botton and Loveland (2003) examined abundance and dispersal of horseshoe crab larvae in Delaware Bay. They found a strong tendency for larvae to stay close to spawning beaches. This finding suggests that larval dispersal is not the mechanism for mixing populations (Botton and Loveland 2003). Studies revealing high genetic diversity among populations allow assessments of sex-specific gene flow patterns, which indicate that males disperse at higher rates than females (Pierce et al. 2000, King et al. 2005). This sex-biased dispersal of sexually mature individuals implies that if a population becomes extirpated, gene flow alone may not be sufficient to repopulate an area due to limited larval dispersal potential (Botton and Loveland 2003) and female migration (Swan 2005) among embayments (King et al. 2005).

King et al. (2005), with the intent to account for the genetic structure at a scale relevant to conservation and management, suggested that the distribution of the American horseshoe crab is comprised of multiple population units divided among large geographic regions. Based on the major zones of discontinuity in the genotypic patterns of nDNA, Smith et al. (2017) structured a rangewide risk assessment into the following regions and then integrated the regional assessments to the species level. The transnational genetically-informed regions were:

- Gulf of Maine (USA), including embayments from Great Bay estuary in New Hampshire and north into Maine
- Mid-Atlantic (USA), including all embayments south of New Hampshire to and including North Carolina
- Southeast (USA), including embayments in South Carolina and Georgia, but note that the Georgia population extends into northern Florida
- Florida Atlantic (USA), including embayments along the Atlantic coast of Florida south of the Georgia population
- Northeast Gulf of Mexico (USA), including embayments along the Gulf coast of Florida, Alabama, barrier islands of Mississippi, and easternmost barrier island of Louisiana.
- Yucatán Peninsula (México), including embayments on the western, northern, and eastern portions of the peninsula (the Mexican states of Campeche, Yucatán, and Quintana Roo) and Mexican portion of the Caribbean Sea.

Also, tagging data indicate that a majority of adult crabs remain within local regions and some overwinter in local embayments (ASMFC 2004; James-Pirri et al. 2005; Swan 2005; Smith et al. 2006; Moore and Perrin 2007). Tag release and recapture data from the United States Fish and Wildlife Service horseshoe crab tagging database was used to examine patterns in release and recapture location. Tag recaptures after more than three months at large were examined for the following regions: Northeast, coastal New York-New Jersey, coastal Delaware-Virginia, Delaware Bay, Chesapeake Bay, and Southeast (Table 3 and Table 4).

More than 93% of recaptures were within the region of release except for those released in the coastal Delaware-Virginia. Among those released in coastal Delaware-Virginia, 66% were recaptured in coastal Delaware-Virginia and 31% were recaptured in Delaware Bay. These results are consistent with a regional horseshoe crab population structure. Rutecki et al. (2004) argued for management to consider harvest rates and population abundances possibly down to the embayment level.

Evidence of regional differences are further supported by stable isotope analyses, which indicate adult crabs are loyal to local feeding grounds (Carmichael et al. 2004; O'Connell et al. 2003). Trends in horseshoe crab abundance and population dynamics differ among regions (ASMFC 2004; Smith et al. 2017). Smaller sized populations such as those in Cape Cod waters may be localized based on spawning densities, size structure, and movement patterns (Carmichael et al. 2003; James-Pirri et al. 2005).

Finally, different embayments and regions are subject to different types and levels of harvest for different purposes. Since different types of harvest (bait, biomedical, or scientific) select for different size and sex segments of the population, different populations may experience different harvest pressures due to their location-specific population dynamics (Rutecki et al. 2004). Widener and Barlow (1999) studied a population of horseshoe crabs that appeared to be a local one. They concluded, "Harvesting large numbers of animals from such a local population would have significant impact on its size" (Widener and Barlow 1999). In Delaware Bay waters, commercial harvest is conducted by hand and dredge (Kraemer and Michels 2009), while in areas such as Cape Cod most harvest is conducted by hand from local beaches (Rutecki et al. 2004). In Delaware Bay, the majority of harvested crabs are collected for bait. In contrast, among Cape Cod populations, the primary purpose for which crabs are harvested (bait, biomedical, or scientific) varies by embayment (Rutecki et al. 2004) with bait harvest predominating except in Pleasant Bay where only biomedical harvest is permitted (A. Leschen, personal communication). Since mortality associated with each harvest type varies, the extent of harvest pressure and depletion by overharvest also necessarily varies among embayments (Widener and Barlow 1999; Rutecki et al. 2004). Hence, there is strong support for local management based on regional or sub-regional population structure and harvest pressures.

For purposes of this assessment, the coastwide stock of horseshoe crabs was divided into four geographic regions based on genetic analysis, data availability, and state boundaries. These four regions include: 1) Northeast – Maine south to Rhode Island; 2) New York – Connecticut south to northern New Jersey; 3) Delaware Bay – northern New Jersey south to Virginia; and 4) Southeast – North Carolina south to the Florida Keys (Figure 2).

2.1.1 Genetics

A range of molecular genetic techniques applied across multiple studies has been used in attempts to assess population structure (stock identification) in horseshoe crabs. These studies now include the first range-wide surveys of nuclear DNA variation in any horseshoe crabs (King et al. 2015). King et al. (2003, 2005, 2015) found that the correlation of genetic and geographic distance among horseshoe crab populations sampled along the Atlantic coast suggests isolation by distance as the driving force behind population structure. The more recent findings (King et al. 2005, 2015) suggest the presence of similar levels of genetic diversity and variation among the collections, punctuated with a series of genetic discontinuities of varying "depth" across the species' range that could indicate demographic independence or regional adaptation, and reflect vicariant geographic events. Populations sampled within these regional groupings exhibit shallow but statistically significant differentiation. Moreover, populations at the ends of the range are more differentiated from nearby populations than are populations in the middle of the range from their neighbors. A separate study showed possible subdivision between collections from the upper Chesapeake Bay and near the entrance of Delaware Bay (Pierce et al. 2000). However, this finding is in contrast to what King et al. found. Pierce et al. (2000) also suggest that the samples from the upper Chesapeake Bay show a resident population. In addition, based on electrophoretic evidence, gene flow does occur between widely separated populations, although considerable genetic variation exists within and between populations of horseshoe crabs (Selander et al. 1970). Saunders et al. (1986) found no evidence for genetic divergence between New England and middle Atlantic populations based on mitochondrial DNA analysis.

2.1.2 Morphometric Information

Shuster (1979) suggested that each major estuary along the coast had a discrete horseshoe crab population, which could be distinguished from one another by adult size, carapace color and eye pigmentation. Differences between the morphologic characteristics of discrete populations were seen among geographically distinct populations (Riska 1981). Larger animals and populations are reported in the middle of the species' distribution (Maryland to New York), while smaller animals and populations are found in the southern and northern extent of its range (Shuster 1982). However, based on morphometric data collected in South Carolina the greatest mean adult size occurs in the South Atlantic Bight and decreases in size north and south (Shuster 1950; Thompson 1998). Thompson (1998) hypothesized that larger individuals occur in the South Atlantic Bight due to optimal temperature and salinity for horseshoe crab development in this region.

Due to their morphological similarity to mid-Mesozoic taxa, horseshoe crabs are considered to be evolutionarily static (Kin and Błażejowski 2014) and have been referred to as phylogenetic relics (Selander et al. 1970). However, close inspection has revealed the presence of considerable morphological and genetic variability (Shuster 1979; Riska 1981; Selander et al. 1970; King et al. 2005; Faurby et al. 2010). Recent genetic studies (King et al. 2015), reveal a pattern of genetic variation that is consistent with patterns of morphological variation identified previously (Shuster 1979; Riska 1981).

2.1.3 Tagging Information

Tagging data from the USFWS horseshoe crab database were analyzed by region to estimate survival and evaluate the dataset for movement analysis. The regions identified in the database are Northeast, coastal New York-New Jersey, Delaware Bay, coastal Delaware-Virginia, Chesapeake Bay, North Carolina, Southeast, and Gulf (Table 3). The Northeast, Delaware Bay, Southeast, and Gulf showed high rates (>93%) of within-region recaptures (Table 4).

Survival analysis was conducted using program MARK (White and Burnham 1999) which showed regional variation in annual survival rate (Table 5). The Jolly-Cormack-Seber (JCS) model was fit to all data. Releases were sufficient to support survival analysis for the Northeast, coastal New York-New Jersey, Delaware Bay, coastal Delaware-Virginia, and the Southeast. The numbers of years of release varied by region. Models were fit for each region separately and then combined for the years 2009-2017, which are the years that all regions had in common. The survival analysis showed that models with regional and time-specific survival and probability of capture fit best based on AIC (Table 5). The highest survival rates were in Delaware Bay and coastal Delaware-Virginia regions. The lowest were in coastal New York-New Jersey and the Southeast.

Movement rates that were estimated by fitting multi-state models in program MARK (Lebreton et al. 2009) showed significant exchange between coastal areas and Delaware Bay (Table 6). Multi-state models have been used to estimate within-region movement for Long Island populations (J. Bopp, SUNY, personal communication). Problems with convergence were encountered and further analysis is needed. However, results for the Delaware Bay region under constant rate model are shown in Table 6.

2.2 Migration Patterns

The current understanding of horseshoe crab migratory patterns is that juveniles move from shallow estuarine waters to deeper estuarine or ocean waters as they grow and mature, reaching sexual maturity either in their natal estuary or ocean waters (Baptist et al. 1957; Shuster 1979; Shuster and Botton 1985; Botton and Ropes 1987; Botton and Loveland 2003; Smith et al. 2009). After maturation, adults migrate annually from the deeper estuary or ocean waters to spawn on estuarine beaches. It is currently unclear why some horseshoe crabs remain within natal estuary waters to mature while others migrate to ocean water to mature. The vast majority of horseshoe crabs from Delaware Bay, for example, migrate to the continental shelf to grow and mature (Botton and Ropes 1987; Smith et al. 2006; Hata and Hallerman 2008), but this population may exhibit some sex-specific migratory patterns. While all juveniles tend to remain within the Bay. Smith et al. (2009) showed that at about eight years of age, females were more likely than their male counterparts to migrate to the continental shelf to mature and males tended to reach sexual maturity without leaving the bay.

While the continental shelf is an important area for maturing horseshoe crabs from the Delaware Bay population, horseshoe crabs from other regions appear to remain within local embayments while maturing (Botton and Ropes 1987; James-Pirri et al. 2005; Swan 2005; Smith et al. 2006; Moore and Perrin 2007; Beekey and Mattei 2009; Schaller et al. 2010; Beekey and Mattei 2015). The importance of local embayments to horseshoe crabs was shown by Landi et al. (2015), who found that spawning locations within Long Island Sound tended to be close to offshore locations where adults had been caught in trawl surveys. Stable isotope analyses also show that adult crabs are loyal to their local feeding grounds (O'Connell et al. 2003; Carmichael et al. 2004). In addition, acoustic telemetry has demonstrated that many animals remain year-round within one bay or estuary (Rudloe 1980; Ehlinger et al. 2003; Beekey and Mattei 2009; Schaller et al. 2010; Watson et al. 2016). The annual migration of mature horseshoe crabs from deeper waters to estuarine spawning beaches appears to be triggered, at least in part, by the onset of warm water temperatures (Smith and Michels 2006; Watson et al. 2009).

Microsatellite genotyping has shown the presence of distinct regional populations for horseshoe crabs, as well as evidence for some gene flow among these regional populations (King et al. 2005; Smith et al. 2017). A low level of gene flow among regional populations is also supported by an analysis of USFWS tagging database showing that horseshoe crabs may migrate significant distances as mature crabs. Crabs tagged in the Gulf of Mexico, for instance, were later recorded from the Southeast and Delaware-Virginia regions while horseshoe crabs tagged in the Southeast region have been documented along the Atlantic coast up to the Northeast region. In addition, horseshoe crabs tagged in the Northeast region have been documented in the Southeast, and horseshoe crabs tagged in New York and New Jersey have also been documented to move towards the Southeast region. Additional genotyping analysis within the southeastern population showed no evidence of genetic structuring across the study area and indicated significant gene flow was occurring across multiple estuaries in South Carolina (Cushman et al., *in review*). While the vast majority of horseshoe crabs appear to stay within or near their natal estuaries, genetic and tagging data highlight the importance of movement within and among regional populations of horseshoe crabs. Because the boundaries separating regional populations of horseshoe crabs may not align with state-level management zones, it is important to understand how horseshoe crab movement might affect horseshoe crab populations in different management zones. As such, further research is needed to better understand the movement patterns of horseshoe crabs both within and among areas of distinct management jurisdiction.

Adult horseshoe crabs are known to be important predators of a variety of benthic macrofauna (Carmichael et al. 2004, 2009; Botton 2009). Primary prey for adult horseshoe crabs are blue mussels (*Mytilus edulis*) and surf clams (*Spisula solidissima*; Botton and Haskin 1984, Botton and Ropes 1989). Horseshoe crabs serve as prey for endangered sea turtles (Keinath 2003; Witherington and Witherington 2015), and their eggs are consumed by migrating shorebirds (Haramis et al. 2007). Their burrowing activities are a form of bioturbation that affects the habitat available for other species (Gilbert and Clark 1981; Kraeuter and Fegley 1994), and predatory activities affect the intertidal and subtidal meio- and macrofaunal communities (Wenner and Thompson 2000; Ehlinger and Tankersley 2009).

2.3 Age

No reliable method is available to directly age horseshoe crabs. Botton and Ropes (1988) and Grady et al. (2001) used epifaunal *Crepidula fornicata* (shell length / shell weight) on the crab's prosoma to indirectly determine age. Shuster (2000) developed criteria for assigning approximate age based on carapace color and the extent of carapace wear. Hata and Berkson (2003) used shell wear, color and structural changes of the pedipalps (males) to stage horseshoe crabs by maturity in conjunction with the Virginia Polytechnic Institute and State University's horseshoe crab trawl survey. Smith et al. (2009) used shell wear, color, size, structural changes of pedipalps and egg presence to characterize maturity and approximate age. Several researchers have proposed the use of ommatidia (units that compose the compound eye) to age juvenile horseshoe crabs, but funding sources are necessary to more formally investigate this possibility. Research using lipofuscin for aging has not been shown to be reliable (Smith et al. 2009). Estimating age by length/width measurements, at least over a wide geographical range, is complicated by the apparent latitudinal differences in size (Shuster 1954; Botton et al. 1992).

Indirect aging methods have provided estimates of longevity. Botton and Ropes (1988) estimated that Delaware Bay horseshoe crabs live at least 17 to 19 years using *C. fornicata*. Swan (2005) found a similar range for Delaware Bay horseshoe crabs based on tagging data. Grady et al. (2001) estimated that Pleasant Bay, New Hampshire, crabs live at least 17 years using *C. fornicata*. Ropes (1961) estimate longevity at 14 to 19 years using tagging data from Pleasant Bay. Shuster and Sekiguchi (2003) reported that horseshoe crabs may live for 20 years in the northern part of their range. Recent tagging data have shown adult crabs at large for up to 17 years before recapture (D. Smith, personal communication), indicating an individual at least 27 years of age.

2.4 Growth

Horseshoe crabs undergo stepwise growth, with females typically attaining larger sizes than males. Smith et al. (2009), reviewing several studies, reported the average prosomal width growth increment for all instars was 1.28 (range: 1.15 – 1.52). Growth is relatively rapid during the first several years progressing through stages I-V in the first year, stages VI – VII the second year, stages VII – IX the third year, with a single molt per year until reaching maturity (Shuster 1982). Shuster (1950) citing "different" sources and a series of exuviae from a captive specimen, approximated that it took 9 to 12 years for horseshoe crabs to reach sexual maturity. Sekiguchi et al. (1982) concluded that male horseshoe crabs molt 16 times and mature in their ninth year; females molt 17 times and mature in their tenth year. Smith et al. (2009) found that males in Delaware Bay tended to mature at age 10 and 11, while females tended to mature at ages 10, 11, and 12.

Carmichael et al. (2003) concluded that male and female horseshoe crabs may continue to molt upon maturation and that males and females had differential growth rates with females also molting more times than males. Female exuviae from crabs of a mature size with amplexus scars have been encountered (G. Breese, G. Gauvry, and C. Shuster, personal communication; Carmichael et al. 2015), further supporting the conclusions of Carmichael et al (2003). The steeply decreasing tag return rates among older adult crabs, and shiny shells with possible tag scars found in a tagging study conducted by Schaller and Dorsey (2011) provide more evidence for this conclusion. However, Smith et al. (2009) examined the hypotheses of differential maturity, differential growth and indeterminate molting and also concluded that females did not grow at a faster rate than males, but rather underwent an additional molt. Although they could not confirm or rule out post-amplexus molting, they did find that it is likely uncommon (<1% of population) and had no discernable population-level effect within the Delaware Bay population.

To test how prosomal width-to-weight relationships vary by sex and region, width and weight data were separated by sex, and split into four regions; Northeast (Maine, Massachusetts, Rhode Island), New York (Connecticut, New York), Delaware Bay (New Jersey, Delaware, Maryland, Virginia), and Southeast (North Carolina, South Carolina, Georgia, Florida).

Graham et al. (2009) established a log-transformed prosomal width-to-weight relationship using the form

$$log_e(Wt) = log_e(PW) * \alpha + log_e(b)$$

where Wt = weight of a horseshoe crab (kg); PW = prosomal width (mm); α = slope; and b = y-intercept.

Linear regressions were used to determine the regional and sex-specific slopes and y-intercepts for the width-to-weight relationships. Two-way ANCOVAs were used to test whether sex specific and regional differences existed in the prosomal width-to weight relationship. The ANCOVAs revealed a significant difference by sex (P<0.001). Male prosomal width-to-weight relationships showed no significant difference when specific regions were compared to a coastwide aggregate relationship, although the Northeast region was significantly different from the Southeast (*P*=0.021), Delaware Bay (*P*<0.001), and New York (*P*=0.004) regions when compared region-to-region. Females showed no regional differences.

Regional and sex specific width-to-weight relationships were calculated to be;

Coastwide, female:	$\log_e(Wt) = \log_e(PW) * 2.8659 - 15.1802$
Northeast, male:	$\log_e(Wt) = \log_e(PW) * 2.8357 - 15.1309$
Southeast, Delaware Bay, New York, male:	$\log_e(Wt) = \log_e(PW) * 2.4381 - 12.9439$

2.5 Reproduction

Warming spring temperatures often provide a cue for adult horseshoe crabs to move from deep bays and shelf waters that serve as overwintering habitat to the intertidal zone of beaches where spawning occurs (Shuster 1982; Moore and Perrin 2007; Watson et al. 2009; Schaller et al. 2010; Cheng et al. 2015). In the Gulf of Mexico, spawning extends from February until October, with peaks in March or April (Rudloe 1980; Brockmann et al. 2015). In south Florida, spawning can occur throughout the year (Ehlinger and Tankersley 2007) whereas spawning activity in Georgia and South Carolina occurs from March to July (Thompson 1998). In the Delaware Bay area the crabs spawn from April through at least July, with peak spawning occurring in May and June (Shuster and Botton 1985, Michels et al. 2008; Smith and Michels 2006) and in Long Island Sound, spawning generally begins in May (Beekey and Mattei 2009). In Cape Cod, Massachusetts, spawning begins in May and continues into July (Barlow et al. 1986; Widener and Barlow 1999; James-Pirri et al. 2005), although Carmichael et al. (2003) reported the spawning season in Pleasant Bay, Massachusetts may span from late March through mid-July, based on observations of pairs of horseshoe crabs in amplexus. Variability in the timing of horseshoe crab spawning migrations is associated with water temperature (Smith et al. 2017). Because the current warming trend of estuarine and ocean temperatures is expected to continue, it will be important to understand how increases in water temperatures will affect the timing of horseshoe crab migrations and spawning activity. As such, further research is necessary to understand how temperature sensitivity might vary regionally and how climate warming will affect the timing and magnitude of annual horseshoe crab migrations.

Horseshoe crabs prefer to spawn during high tides, using changes in water depth as a cue (Chabot et al. 2008; Chabot and Watson 2010; Chabot et al. 2011). Some researchers have also reported that peak spawning is associated with the highest tides of the month on the new and full moons (Rudloe 1980, Shuster and Botton 1985, Barlow et al. 1986, Smith et al. 2002a). Lunar period, however, may not always be a valid predictor of horseshoe crab spawning. For example, Leschen et al. (2006) and James-Pirri et al. (2005) found similar levels of spawning activity during all daytime high tides regardless of lunar phase in the vicinity of Cape Cod. Similarly, in Great Bay Estuary, New Hampshire, temperature was shown to be an important determinant of spawning activity with little relationship with lunar phase or time of day (Watson and Chabot 2010; Cheng et al. 2016). The higher of the two daily tides can also be related to spawning activity (Barlow et al. 1986; Rudloe 1980; Chabot and Watson 2010; Brockmann and Johnson 2011). In Delaware, however, the highest levels of spawning activity occur during the evening high tides (Shuster and Botton 1985; Smith et al. 2010). In microtidal areas, wind-blown surge can have a greater effect on water level than tides. Under these conditions, wind-blown surge can strongly influence the numbers of spawning horseshoe crabs (Brockmann and Johnson 2011).

Males are known to locate females using both visual and chemoreceptive cues (Brockmann 2003a; Saunders et al. 2010) and female crabs often arrive at the spawning beach with a male attached to the opisthosoma (Cohen and Brockmann 1983; Loveland and Botton 1992; Brockmann 2003a; Shuster 1982; Cheng 2014). Often several satellite males accompany the attached pair on the beach (Cohen and Brockmann 1983; Brockmann and Penn 1992). Males in amplexus are not shown to differ in size from satellite males, but males in amplexus are generally in better condition, more active, have a higher sperm concentration, remain attached longer and are more recently molted into the adult phase than males not in amplexus (Cohen and Brockmann 1983; Brockmann and Penn 1992; Loveland and Botton 1992; Brockmann 2002; Duffy et al. 2006; Sasson et al. 2012). The males externally fertilize the eggs as they are being deposited. Although a single attached male can fertilize all of a female's eggs, satellite males, when present, may fertilize a majority of eggs (Brockmann et al. 1994, 2000).

Female horseshoe crabs prefer to lay their eggs in well-drained sandy beaches that are protected from surf, although they are also known to spawn in cobble, mud, and peat. It is currently unclear how important these non-sandy habitats are to the reproductive potential of horseshoe crabs across their range. On a single tide, females can excavate a pit and deposit from two to five clusters of about 1000 – 4000 eggs at depths from 5 to 20 cm (Rudloe 1979; Brockmann 1990; Leschen et al. 2006; Brockmann 2003b). However, estimates of eggs per cluster vary: Shuster and Botton (1985) reported 3,650 to 4,000 eggs per cluster and Weber and Carter (2009) reported an average of 5,786 ± 2,834 eggs per cluster. Egg cluster size was 1,644 – 1,739 eggs/cluster in Florida (Johnson and Brockmann 2010), 2,365–5,836 eggs/cluster in Delaware Bay (Shuster and Botton 1985; Weber and Carter 2009), 3,741 eggs/cluster in Long Island Sound (Beekey et al. 2013), and 640–1,280 in Cape Cod, Massachusetts (Leschen et al. 2006). There does not appear to be a relationship between cluster size and female size (Brockmann 1996; Leschen et al. 2006), but larger females carry more eggs and lay more clusters per spawning season than smaller females. Leschen et al. (2006) found a correlation between female size and the number of eggs laid by horseshoe crabs in Pleasant Bay, Massachusetts. Overall, much of the variability in horseshoe crab fecundity appears to be related to female size and latitude (Botton et al. 2010; Smith et al. 2017). Because female size can vary with latitude, more research is needed to understand how latitude, and thus temperature, interacts with female size to affect fecundity in horseshoe crabs.

Female horseshoe crabs typically complete their spawning activity during one tidal cycle (5 days of high tide around new or full moon; Brockmann and Penn 1992; Brousseau et al. 2004; Smith et al. 2010; Beekey and Mattei 2015). In Florida, females return to beaches to nest on average 3.4 times and most spawn during only one tidal cycle (Brockmann 1990). Female horseshoe crabs in Delaware Bay were shown to spawn over two to five consecutive nights, remaining within 50 to 715m of their established spawning beach before moving away from the beaches several days after the new moon (Brousseau et al. 2004; Smith et al. 2010). In Long Island Sound, females were found returning to the same beach up to six days after their initial appearance (Beekey and Mattei 2015). Significant beach fidelity over successive years, however, has not been demonstrated.

Egg development is dependent on temperature, salinity, moisture, and oxygen content (Vasquez et al. 2015b). Larval horseshoe crabs, termed trilobites, generally hatch from the eggs within 2–4 weeks, with a small proportion of larvae overwintering within nests and hatching the following spring (Botton et al. 1992; Shuster 1950). Hatching of eggs is triggered by environmental cues related to high water conditions including hydration, physical disturbance, and hypoosmotic shock, which facilitate survival of newly-hatched larvae (Ehlinger and Tankersley 2003; Botton et al. 2010). Trilobite larvae do not appear to be strong swimmers, relying on vertical movements to take advantage of selective tidal stream transport. Larvae that become planktonic settle to benthic habitats within approximately one week of hatching (Shuster 1982). Larval and juvenile crabs appear to show little dispersal because they remain in the intertidal flats near breeding beaches (Botton and Loveland 2003; Cheng et al. 2015). After approximately two weeks as larvae, they molt to the juvenile (second instar) stage where the telson is formed. As they grow, the older juveniles move out of intertidal areas (Botton and Ropes 1987).

2.6 Natural Mortality

Two field studies have published direct estimates of survival rates of horseshoe crabs. Botton et al. (2003) reported only 3 of 100,000 trilobite larvae were found as fourth instars on adjacent tidal flats by the end of their first summer in New Jersey. Carmichael et al. (2003) calculated annual survival rates for juvenile and adult horseshoe crab stages based on size-based cohort progressions in Pleasant Bay, MA. Very low mortality was reported on juvenile horseshoe crabs after instar 7 (age 1) through the sub-adult stage (age 8), with increasing mortality on adult stages (Table 7) (Carmichael et al. 2003). No significant difference in mortality rates were seen between adult males and females. A natural mortality rate schedule based on these survival estimates along with an assumed 20-year lifespan has been employed in subsequent horseshoe crab operational models (Sweka et al. 2007), stock assessments (ASMFC 2009a), and adaptive resource models (McGowan et al. 2011) (Table 7).

Horseshoe crab egg predation/consumption by shorebirds is well documented (Botton 1984; Botton et al. 1994; Haramis et al. 2007; Botton 2009; Beekay et al. 2013). Despite significant shorebird predation on eggs, such activity probably has little impact on the horseshoe crab population since consumption is mostly relegated to surface eggs, which would not survive regardless of predation (Botton et al. 1994; Botton 2009). Egg burial depths (>5 cm) in Delaware Bay generally outreach the bill penetration of shorebirds (Loveland et al. 1996; Weber and Carter 2009), while successive horseshoe crab spawning and wave action produce high levels of naturally exhumed eggs unrelated to predation (Jackson et al. 2005; Smith 2007; Botton 2009).

Eggs and trilobite larvae are also preyed upon by numerous surf zone fishes and crustaceans including eels, catfish, juvenile striped bass, white perch, killifish, weakfish, Atlantic silversides, bluefish, sand shrimp, blue crabs, spider crabs, and hermit crabs (*summarized in:* Botton 2009). In Delaware Bay, eggs or trilobites were found in stomachs of 95% of killifish (*Fundulus heteroclitus*) and 96% of Atlantic silverside (*Menidia menidia*) (Botton and Loveland unpublished).

Evidence of post-larval horseshoe crabs has been found in stomachs of bluefish (*Pomatomus saltatrix*) (Friedland et al. 1988) and bonnethead sharks (*Sphyrna tiburo*) (Cortes et al. 1996). Horseshoe crabs can be a major (>40%) component in the diet of loggerhead turtles (*Caretta caretta*) (Seney and Musick 2007). Botton and Loveland (1993) also observed direct predation on adult horseshoe crabs by Herring Gulls and Great Black-backed Gulls in Delaware Bay. Abundant numbers of durophagous, benthic, and large opportunistic predators are found in Delaware Bay with horseshoe crabs, such as black drum, cownose rays, bullnose rays, spiny dogfish, smooth dogfish, sandbar sharks, sand tiger sharks (McElroy 2009), various skate species, striped bass, Atlantic sturgeon, blue crabs, summer resident sea turtles, bullnose rays (Szczepanski and Bengtson 2014). Some predation by these species is likely, but to what extent has not been studied in Delaware Bay. American eel and whelks are also potentially significant predators on the Delaware Bay population, given the importance of horseshoe crabs as the preferred bait in these commercial fisheries.

A major source of adult natural mortality is related to spawning, as excessive energy expenditure, stranding, desiccation, and predation are elevated during mating and egg-burying behaviors. Botton and Loveland (1989) estimated nearly 200,000 mortalities related to stranding on New Jersey beaches in 1986. They believed this could be responsible for up to 10% of the adult population in Delaware Bay, although this is likely an overestimation based on a very conservative population estimate. The population estimate of 2.3 to 4.5 million individuals was based on scaled-up NMFS trawl survey catches that admittedly lacked sufficient sampling in inshore strata containing highest densities of horseshoe crabs (Botton and Ropes 1987). Botton and Loveland (1989) suggested this stranding percentage likely varies among estuaries due to population density, weather and tidal conditions, and beach geomorphology. The condition of the individual, which is probably age-related, is also a factor in stranding-related mortality (Penn and Brockmann 1995). Natural and man-made impingements are also factors that affect stranding-related mortality. The reTURN The Favor program implemented by The Wetlands Institute has rescued over 197,000 horseshoe crabs in the 5 years since its establishment. Of these rescued horseshoe crabs, it was found that approximately 3.7-7.2% of crabs were entrapped in natural impingements and 14-20% of crabs were entrapped by man-made impingements over the years (Ferguson et al. 2017).

Recent mark-recapture analyses (summarized in Section 2.1.3) produced annual survival rates of adult horseshoe crabs ranging from 59% to 79% across various embayments (D.R. Smith, unpublished). In Delaware Bay, the instantaneous natural mortality rate (M) was M=0.274 (from the estimate of survival 76%), which is considerably lower than the adult M=0.47 employed in modeling to-date (Table 7). A lower M (e.g. <0.47) is supported by the empirical ratio of multiparous to primiparous females (ratio=3.8) observed in the Virginia Tech Trawl Survey. Given its biology, newly mature primiparous females will spawn in the upcoming year and exhibit multiparous indicators thereafter, generally occurring between ages 9 and 10. Given a longevity of 20 or 27 years, M would need to be 0.215 or 0.231 to produce a 3.8 multiparous (ages 10+) to primiparous (age 9) ratio.

Protracted at-large durations were also noted in the mark-recapture analyses (up to 17 years), which sheds new light on potential longevity. A mark-recapture duration of 17 years suggests a longevity of roughly 27 years given a minimum age-at-tagging of nine to 11 (based on onset of maturity (Shuster 1950)). Maximum age has heretofore been assumed to be 20 years (Ropes 1961; Botton and Ropes 1988; Swan 2005).

Greater longevity changes the understanding of natural mortality. Indirect estimates of age-invariant, constant, M based on a maximum age of 27 years would range between M=0.11 and M=0.17 (depending on selected mortality model), as opposed to a range of 0.15 to 0.22 given a maximum age of 20 years (Hoenig 1983; Hewitt and Hoenig 2005). Other indirect estimates of constant M can be generated from models that incorporate von Bertalanffy (LVB) growth parameters and environmental information (Pauly 1980; Jensen 1996) (Table 8 and Table 9), although these estimates appear too high to allow for the population to reach maximum ages of 20 plus years.

Von Bertalanffy (LVB) parameters were fit to Carmichael et al.'s (2003) sub-adult growth trajectory, with the assumption of asymptotic size occurring at instars 18 and 20 for males and females. These instars correspond to ages 9 and 11 for males and females, consistent with longstanding expectations about maturity and terminal molting (Shuster 1950; Botton and Ropes 1988; Schuster and Sekiguchi 2003). Stockpiling of males and females also occurred at these instar stages in Pleasanton Bay (Carmichael et al. 2003), further supporting the timing of growth cessation. Asymptotic sizes of adult stages were based on average carapace widths of adult horseshoe crabs (males=203 mm and females=245 mm) observed in the Delaware Division of Fish and Wildlife 30-foot trawl survey from 1966-2018 (M. Greco unpublished data).

Age-variable mortality models allow for M to vary inversely with size (Peterson and Wroblewski 1984; McGurk 1986; Lorenzen 1996; 2000; Gislason et al. 2010). Age-based mortality schedules, utilizing von Bertalanffy parameters and width:weight relationships (Graham et al. 2009), were calculated using Lorenzen (1996) and Gislason et al. (2010) models (Table 10).

These mortality schedules did not accommodate higher adult mortality rates caused by excessive spawning mortality. Replacing the size-based mortality rates for adults (ages ≥10) with mortality estimates (Z=0.238 to 0.528) from recent mark and recapture analyses of adult tagged crabs (D.R. Smith, unpublished) is an option that would better describe mortality in adult age classes.

However, both models, the Lorenzen (1996) model especially, generate mortality rates that appear too high to suit the life history and extended longevity of horseshoe crabs. The extremely elevated early stage mortality rates do not allow for enough survival for the population to reach maturity (age 10) or its maximum age (20-27 years). Extremely high Age 0 mortality (*M*=8, 11) from the Gislason et al. model does correspond well with Botton et al.'s (2003) field estimate of *M*=10.4. Other Age 0 estimates of *M*=4.6 (equivalent to 99% mortality) in Pleasant Bay, MA (Carmichael et al. 2003) and *M*=3.6 in Delaware Bay (R. Wong, unpublished) mesh well with the Lorenzen (1996) model. Future work is needed to better understand size and age-based natural mortality rates for horseshoe crabs.

2.7 Sex Ratio

Two types of sex ratios are useful for understanding horseshoe crab ecology and informing management decisions. The population sex ratio is the ratio of males to females among individuals in the population. The operational sex ratio is the ratio of males to females among adults that are actively spawning. While juveniles show a balanced population sex ratio (Shuster and Sekiguchi 2003; Smith et al. 2009), the population sex ratio among adults has been observed to be somewhat skewed toward males in Delaware Bay (2.2:1 M:F; Smith et al. 2006) and Pleasant Bay, MA (2.3:1 M:F; Carmichael et al. 2003). This difference has been attributed to higher fishing or natural mortality among adult females compared to males, but also might be due to males maturing earlier than females and living as long as females (Smith et al. 2009). The operational sex ratio of horseshoe crabs on the spawning beaches is highly skewed toward males because of behavior and population demographics (Brockmann and Smith 2009). One male attaches to a female in amplexus prior to spawning. During fertilization, however, the amplexed pair is often surrounded by unattached (i.e. satellite) males (Brockmann and Penn 1992). Hence, the operational sex ratio on spawning beaches is expected to be male biased compared to the population sex ratio among adults.

A population sex ratio over 1 is likely to be required among adults to ensure that reproduction is not limited by sex ratio. Brockmann (1990) found that female horseshoe crabs will tend not to nest unless they are in amplexus with a male, and that satellite males are not needed to fertilize eggs. Some males (approximately 30%) are not capable of amplexus because of their condition (Brockmann and Smith 2009). Thus, there needs to be an excess of males in the population to ensure a sufficient number of males capable of amplexus to pair with the females ready to spawn. In the Delaware Bay population, the operational sex ratio averaged 3.8 M:F (SD = 0.51) over 1999 to 2008 (Michels et al. 2008). In contrast, the population sex ratio averaged 2.0 M:F (SD = 0.19) over 2002 to 2008 (Hata and Hallerman 2008). Thus, on average, the operational sex ratio is 1.88 times (SD = 0.19) the population sex ratio for the Delaware Bay population (Hata and Hallerman 2008; Michels et al. 2008).

Sex ratios in estuarine habitats sampled in the Delaware Bay Adult Trawl Survey for the 1990-2017 time period were significantly different for the spring and fall seasons averaging 1.27 and 2.2 M:F in the spring and fall, respectively (Paired t-test; $P<0.001$; Table 11). The seasonal difference in sex ratios for the Delaware Bay Adult Trawl Survey indicates that the relative abundance of females in estuarine habitats is greater during the spring, compared to the fall. This finding is broadly consistent with previous research showing that female horseshoe crabs are more likely than their male counterparts to migrate out of estuarine waters (Smith et al. 2009). While the Delaware Bay Adult Trawl Survey shows seasonal differences in sex ratio, the

New Jersey Ocean Trawl Survey that samples coastal habitats showed no significant difference between seasons with sex ratios of 1.13 and 1.03 in the spring and fall, respectively (Paired t-test; P=0.20; Table 11). The presence of seasonal shifts in sex ratios for the Delaware Bay, but not for the New Jersey Ocean Trawl Survey, could reflect differences in habitat where sex-specific migration patterns may be more likely to occur within estuarine habitats such as Delaware Bay. Annual average sex ratio in offshore habitats sampled in the New Jersey Surf Clam Survey was 0.51 M:F, much lower than sex ratios for the Delaware Bay and New Jersey Ocean Trawl Surveys. It is unclear why the New Jersey Surf Clam survey has lower sex ratio compared to other surveys. Together, these data provide further evidence for sex-specific migration patterns in horseshoe crabs that warrant further study in order to better understand behavior and migration patterns of male and female horseshoe crabs.

Temporal trends in sex ratios for surveys used in this assessment were conducted using Mann-Kendall analysis for the New Jersey Surf Clam Survey as well as both the spring and fall surveys of the Delaware Bay Adult Trawl and the New Jersey Ocean Trawl. Only one of the fishery-independent surveys analyzed showed a significant temporal trend in sex ratio with the available data (Table 11). A significant increase in the sex ratio for the spring season (March-August) of the Delaware Bay Adult Trawl Survey from 1990 – 2017 was documented (Table 11; Figure 3). These data show a sex ratio for the spring of 1990 of 0.76 M:F (CL: 0.30-1.23) increasing to 2.0 M:F (CL: 1.31-2.68) in the spring of 2017 (Table 12). While Mann-Kendall analysis found significant increases in sex ratio in these data (τ=0.39, P=0.004, sen-slope=0.033), breakpoint analysis was also conducted to assess shifts in the stability of the linear relationship. Breakpoint analysis fits linear models to sections of the data and detects locations of breaks in the relationship by minimizing residual sums of squares and determines the optimal number of breaks by minimizing information criterion (Bai and Perron 2003; Zeileis et al. 2003). This breakpoint analysis indicated the presence of a single breakpoint at the year 2006 for the spring season of the Delaware Bay Adult Trawl survey. This breakpoint year is consistent with the regulatory change that reduced the total harvest of horseshoe crabs in Delaware Bay and implemented male-only harvest for portions of Delaware Bay. Mean sex ratio for this survey from 1990-2006 was 0.94 M:F, whereas mean sex ratio from 2007-2017 was 1.79 M:F.

Significant increases in the M:F sex ratio were also observed in some of the fishery-dependent data, specifically, the Virginia off-shore waters and Virginia landings data (Table 11, Table 12). These changes in the sex ratio are not necessarily representative of the population, but rather, reflect changes in the regulations concerning collection and harvest of horseshoe crabs in these regions.

3 HABITAT DESCRIPTION

3.1 Brief Overview of Habitat Requirements

Essential habitat is defined as those waters and substrate necessary for fish spawning, breeding, feeding, or growth to maturity. Habitat requirements change throughout the horseshoe crab life cycle, extending from intertidal beach fronts and tidal flats in coastal embayments for eggs and larvae, to the edge of the continental shelf for adults. Limulus has been described as an ecological generalist (Sekiguchi and Shuster 2009) able to tolerate a wide range of environmental parameters throughout its distribution. Various environmental tolerances have been documented for horseshoe crabs in several areas; however, Sekiguchi and Shuster (2009) suggest that individual sub-populations may have a narrower tolerance than the species.

3.1.1 Spawning, egg, larval habitat

Spawning adults prefer sandy beach areas within bays and coves that are protected from wave energy (Shuster and Botton 1985; Smith et al. 2002b; Jackson et al. 2002; Landi et al. 2015). Nests are primarily located between the low tide terrace (tidal flat) and the extreme high tide water line (Penn and Brockmann 1994; Weber and Carter 2009). Weber and Carter (2009) found that 85% of nests were deposited between the tidal flat and the nocturnal high tide wrack line on the western shore beaches of Delaware Bay. Penn and Brockmann (1994) found similar results in Delaware Bay, but noted that nest deposition occurred in a narrower band within the beach front on Seashore Key, Florida. The differences in nest site selection between Florida and Delaware can be explained by differences in beach morphology, particularly sediment grain size, and its effect on interstitial conditions (Penn and Brockmann 1994). In Massachusetts, New Jersey, and Delaware, beaches are typically coarse-grained and well drained, as opposed to Florida beaches which are typically fine-grained and poorly drained. Spawning is sometimes observed on offshore sandbars and oyster bars (Wenner and Thompson 2000). In Long Island Sound, nests can be found on beaches ranging from coarse-grained and well drained to cobble-dominated substrates to fine grained and poorly drained muddy substrates (Beekey and Mattei 2009).

Beach habitat also must include a sufficient depth of porous, well-oxygenated sediments to provide a suitable environment for egg survival and development (Botton et al. 1988). Nest depth on the western shore of Delaware Bay generally ranged between 3.5 and 25.5 cm (mean 15.5, SD 3.5), although nest depth may be affected by wave energy, bioturbation, or other factors after deposition (Weber and Carter 2009). These results are similar to those found by previous investigators on Delaware Bay beaches (e.g., Hummon et al 1976; Penn and Brockmann 1994; Botton et al 1994). Sediment grain size, in particular, can influence spawning site selection as environmental conditions in the sand affect development (moisture, temperature, and oxygen gradients) (Penn and Brockmann 1994; Jackson et al. 2005). Previous studies suggest that females avoid laying eggs in eroded beaches that are high in hydrogen sulfide and where sediment pore water is low in oxygen, factors that are known to affect development (Botton et al. 1988; Penn and Brockmann 1994, Vasquez et al. 2015).

Rate of egg development is dependent on interstitial environmental parameters including temperature, moisture, oxygen, and salinity (French 1979; Jegla and Costlow 1982; Laughlin 1983; Penn and Brockmann 1994) and disturbance (bioturbation) from external forces (Jackson et al 2005). Placement of nests in the intertidal zone subjects horseshoe crab eggs to a wide range of environmental parameters, making it necessary for eggs and larvae to have wide tolerance ranges; however optimum egg development occurs within a much narrower range of conditions. Studies have shown that optimal development occurs at salinities between 20 and

30 ppt (Jegla and Costlow 1982; Laughlin 1983), although populations from microtidal lagoon systems that often experiences high salinities (>50 ppt) had an optimal range of 30 to 40 ppt, with hatching occurring at salinities as high as 60 ppt (Ehlinger and Tankersly 2004). Egg development occurs most readily at temperatures ranging from 25 to 30°C (Jegla and Costlow 1982; Laughlin 1983; Penn and Brockmann 1994; Ehlinger and Tankersly 2004), with temperatures of 20 and 40°C showing little to no development (Laughlin 1983; Ehlinger and Tankersly 2004). Penn and Brockmann (1994) found optimal development of horseshoe crab eggs from Delaware and Florida to occur at oxygen concentrations between 3 and 4 ppm and moisture content between 5 and 10%.

In addition to the influences of interstitial microhabitat on nest site selection, Thompson (1998) found that preferentially selected spawning sites were located adjacent to large intertidal sand flat areas, which provide protection from wave energy and an abundance of food for juveniles. Most nesting beaches have nearby nursery habitats for juveniles (Botton and Loveland 2003). Geographic differences in nest site selection can be explained by differences in wave energy, beach morphology, and geochemistry (Botton et al. 1988; Penn and Brockmann 1994; Smith et al. 2002a; Beekey and Mattei 2009; Landi et al. 2015).

Horseshoe crab spawning areas are limited by the availability of suitable sandy beach habitat. For example, based on geomorphology, Botton et al. (1992) estimated that only 10% of the New Jersey shore adjacent to Delaware Bay provided optimal horseshoe crab spawning habitat. However, spawning may occur along peat banks if there is sand in the upper intertidal regions and along the mouths of salt marsh creeks (Botton 2009). Shuster (1996) stated that spawning may occur along muddy tidal stream banks, but not on peat banks because adults are sensitive to hydrogen sulfide and anaerobic conditions. Subtidal spawning has been reported, but the extent to which this occurs is unknown. A Habitat Suitability Index model was developed for horseshoe crab spawning habitat within the Delaware Bay (Brady and Schrading 1996).

After hatching, some larvae delay emergence and overwinter within beach sediments, emerging the following spring (Botton et al. 1992). Larvae typically settle in shallow water areas to molt (Shuster 1982).

3.1.2 Juvenile and adult habitats

Nearshore, shallow water, intertidal flats are considered essential habitats for development of juvenile horseshoe crabs (Botton 2009). Juveniles usually spend their first two years on intertidal sand flats (Rudloe 1981; Sekiguchi and Shuster 2009). Thompson (1998) also found significant use of sand flats by juvenile horseshoe crabs in South Carolina. Prime spawning habitat is widely distributed throughout Maryland's Chesapeake and coastal bays, including tributaries. Horseshoe crabs are restricted to salinities that exceed 7 parts per thousand. In the Chesapeake Bay, spawning habitat generally extends to the mouth of the Chester River, but can occur farther north during years of above normal salinity levels. Prime spawning beaches within the Delaware Bay consist of sand beaches between Maurice River and the Cape May Canal in New Jersey and between Bowers Beach and Lewes in Delaware.

Older juveniles and adults are exclusively subtidal, except during spawning. Second and third year instars remain in the vicinity of the spawning beach but move just offshore into shallow subtidal water (Sekiguchi and Shuster 2009), with each succeeding stage moving toward deeper water. In the Delaware Bay, females begin to leave the Bay and move to continental shelf waters around age 7 to 8 to mature in the ocean (Hata and Hallerman 2009a, 2009b, 2009c; Smith et al. 2009). Smith et al. (2009) provide evidence that males remain in the Bay until maturity (age 9), but Hata and Halllerman (2009a, 2009b, 2009c) found evidence of significant numbers of immature males on the shelf one to two years prior to reaching maturity (Hata and Hallerman 2009a, 2009b, 2009c).

The diet of juveniles is varied, including particulate organic matter from algal and animal sources (Gaines et al. 2002; Carmichael et al. 2004). As horseshoe crabs mature, the diet composition shifts to larger prey, and horseshoe crabs are known to be important predators of benthic meiofauna (Carmichael et al. 2004; Carmichael et al. 2009; Botton 2009).

Delaware Division of Fish and Wildlife's 16-foot bottom trawl survey data indicated that more than 99 percent of juvenile horseshoe crabs (<16 cm prosomal width) were taken at salinities >5 parts per thousand.

As ecological generalists living in a shallow water environment over a wide geographic range, *Limulus* is subject to, and therefore adapted to, a wide range of environmental conditions. Specific requirements for adult habitat are not known, but it has been suggested that individual sub-populations may have a narrower tolerance than the species as a whole (Sekiguchi and Shuster 2009). Adult horseshoe crabs range from 21 N to 44 N and 68 W to 90 W (Sekiguchi and Shuster 2009), and have been found as far as 35 miles offshore at depths greater than 200 meters; however, Botton and Ropes (1987) found that 74 percent of the horseshoe crabs caught in bottom trawl surveys conducted by the National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center were taken in water shallower than 20 meters. They are observed in a wide range of salinity regimes, from low salinity (< 10 pp) areas such as the upper Chesapeake Bay, to the hypersaline (>50 ppt) environments of the Indian River Lagoon in Florida. During the spawning season, adults typically inhabit bay areas adjacent to spawning beaches. In Delaware Bay, horseshoe crabs are active in the Bay area at temperatures above 15°C (Sekiguchi and Shuster 2009; Smith et al. 2010), while crabs in Great Bay, NH increase activity at temperatures above 10.5°C (Watson et al 2009). In the fall, adults may remain in bay areas or migrate into the Atlantic Ocean to overwinter on the continental shelf.

Sekiguchi and Shuster (2009) have identified four possible large-scale factors that limit horseshoe crab distribution and habitat, including geomorphology, thermal tolerance, tidal regimes, and currents. Indo-Pacific species of horseshoe crab span the equator, but *Limulus* does not, perhaps due to limited availability of embayments with suitable spawning habitat, or the lack of a broad continental shelf to provide a migratory route. The northern extent of all horseshoe crab species may be limited by duration and severity of winter temperatures. The lack of horseshoe crab populations in the western Gulf of Mexico, which has suitable beach spawning habitat, is thought to be a result of the local tidal regime. Nearly all horseshoe crab populations occur in areas with semi-diurnal tides of moderate amplitude, but tides of this type are not observed in the western Gulf of Mexico.

Habitat degradation is likely an important component of the population dynamics of horseshoe crabs. Groins and bulkheads adversely impact horseshoe crab spawning habitat. Bulkheads may block access to intertidal spawning beaches, while groins and seawalls intensify local shoreline erosion and prevent natural beach migration. An estimated 10 percent of the New Jersey shoreline adjacent to the Delaware Bay has been severely disturbed by shoreline protection structures (Botton et al 1988). Rip-rap and revetments also adversely impact horseshoe crabs by minimizing potential spawning sites and by entrapping and stranding them. A contributing factor in the decline of horseshoe crabs in the Delaware Bay between 1871 and 1981 may be the increased number of jetties and residential development (Shuster and Botton 1985). The Wetland Insitute's reTURN The Favor program records data and information on the locations of impingements that are found while working at New Jersey beaches. Of the 22 beaches that are covered, almost all are affected by structures of variable severity that inhibit the ability for horseshoe crabs to spawn or survive. This data is used to identify beaches that are in need of small-scale restoration projects (Ferguson et al. 2017).

Shoreline erosion combined with shoreline development results in the loss of suitable and potentially suitable spawning beaches. Beach migration is a coastwide phenomenon, where beaches move landward associated with erosional events. However, hard structures (e.g., bulkheads, seawalls, revetments) associated with beach development interfere with the natural beach migration causing habitat loss. Beaches along the New Jersey shore of the Delaware Bay have generally eroded at varying rates ranging from 1 to 12 feet per year for the last 100 years (U.S. Army Corps of Engineers 1997). Erosion rates from 1 to 26 feet per year, averaging approximately 3 to 5 feet per year and the existence of hard structures limiting beach migration have resulted in a decline in Delaware beaches (U.S. Army Corps of Engineers 1991). McCormick and McCormick (1998) report the annual rate of erosion in the Chesapeake Bay averages 1 foot per year. Shoreline areas with high concentrations of silt or peat are less favorable to horseshoe crabs because the anaerobic conditions reduce egg survivability. Horseshoe crabs may detect hydrogen sulfide (which is produced in the anaerobic conditions of peat substrates) or low oxygen conditions, and actively avoid such areas (Botton et al 1988). Erosion affects spawning by influencing beach characteristics that are most important in site selection, such as beach topography, sediment texture, and geochemistry (Botton et al 1988).

Adult horseshoe crabs are known to be important predators of a variety of benthic macrofauna (Carmichael et al. 2004, 2009; Botton 2009). Botton and Haskin (1984) and Botton and Ropes (1989) found that the primary prey for adult horseshoe crabs are blue mussels (*Mytilus edulis*) and surf clams (*Spisula solidissima*). Recent declines in surf clam in the mid-Atlantic are being attributed to climate-change induced increases in water temperatures during late-summer and fall (E. Powell, personal communication). The effects of a declining prey base, in general, and of surf clam populations on horseshoe crab population carrying capacity is unknown.

In summary, horseshoe crabs are an important part of the ecology of the coastal systems in which they are found (Botton 2009). They are prey for endangered sea turtles (Keinath 2003, Witherington and Witherington 2015), and their eggs are consumed by migrating shorebirds (Haramis et al. 2007). Their burrowing activities affect the habitat available for other species through bioturbation (Gilbert and Clark 1981; Kraeuter and Fegley 1994), and predatory activities affect the intertidal and subtidal meio- and macrofauna (Wenner and Thompson 2000; Ehlinger and Tankersley 2009).

4 FISHERY DEPENDENT DATA SOURCES

Commercial fisheries for horseshoe crab consist primarily of directed trawls, hand harvest, and dredge fisheries for use as bait and are the major source of fishery-dependent data for the stock. Landings for horseshoe crabs have been reported since 1970 and fishery-dependent data of the catches have been collected since 1998. Horseshoe crabs are also commercially collected for use in the biomedical industry.

4.1 Commercial Bait Fishery

The commercial bait fishery consists primarily of trawl, hand harvest, and dredge fisheries. State and federal governments collected the fishery-dependent data included in this summary. Since 1998, ASMFC has compiled landings by state in the annual FMP review report. The horseshoe crab fishery supplies bait for the American eel, conch (whelk) and, to a lesser degree, catfish (Ictaluridae) fisheries. The American eel pot fishery prefers female horseshoe crabs to males, while the conch pot fishery uses both male and female horseshoe crabs. The conch fishery uses horseshoe crabs more frequently than the American eel fishery, with eel baits using blue crabs or fish more often than horseshoe crabs (ASMFC 2017).

Most fishing effort for horseshoe crabs is concentrated within the mid-Atlantic coastal waters and adjacent federal waters. However, Massachusetts and New York have also supported a significant fishery. The hand, trawl, and dredge fisheries accounted for 86% of the of the 2017 commercial horseshoe crab bait landings coastwide (by weight) by reported gear type (ASMFC 2018). This pattern is consistent with the distribution of landings by gear since the 1970s. During the past 25 years, the proportion of horseshoe crabs caught by the hand fishery has increased and now accounts for the largest of any reported harvest, while the proportion caught by the trawl fishery has decreased during the same timeframe (ASMFC 2018).

Previous to 1998, commercial landings data for horseshoe crab were collected by the National Marine Fisheries Service (NMFS) by state, year, and gear type. Data were obtained from dealers, logbooks, and state agencies that require fishermen to report landings; however, NMFS records are often incomplete. In addition, the conversion factor used to convert numbers landed to pounds landed has been quite variable among the states and NMFS. Since 1998, states have been required to report annual landings to ASMFC through the compliance reporting process. Landings used in this assessment for 1998 through 2017 were validated by state agencies through ACCSP. Reported landings data show that commercial harvest of horseshoe crabs was high in the late 1990s, declined, and have been relatively stable from 2004 through 2017 (Table 1, Figure 1). Older landings, collected by NMFS, were not incorporated into any models in this assessment due to questionable accuracy of the data.

4.1.1 Data Collection and Treatment

4.1.1.1 Survey Methods

Commercial horseshoe crab landings data collection is a joint state and federal responsibility. The cooperative state-federal fishery data collection systems obtain landings data from state mandated fishery or mollusk trip-tickets, landings weigh-out reports provided by seafood dealers, federal logbooks of fishery catch and effort, shipboard and portside interviews, and biological sampling of catches. State fishery agencies are usually the primary collectors of landings data, but in some states NMFS and state personnel cooperatively collect the data. Statistics for each state represent a census of the horseshoe crabs landed, rather than an expanded estimate of landings based on sampling data. Although the NMFS reports landings in pounds, adoption of the Interstate Fishery Management Plan for Horseshoe Crab (FMP) in 1998 required states to collect and report all horseshoe crab harvest by numbers, pounds, sex, and harvest method (ASMFC 1998a). All states with an operating fishery require mandatory reporting. Horseshoe crab landings reported after 1997 were expressed as numbers of crabs and were obtained directly from the states.

Commercial sampling intensity varies from state to state. Most jurisdictions have implemented mandatory monthly or weekly reporting. Reporting compliance has substantially improved since adoption of the FMP, with all required states (those with landings >5% of the coastwide total) now providing landings by sex each year in compliance reports. In years initially following the adoption of the FMP, some sex information was missing.

4.1.1.2 Biological Sampling Methods

Under the 1998 FMP, states are required to characterize a portion of the commercial catch based on prosomal width and sex. Though many states implemented this compliance component, sampling intensity has been inconsistent among states and between years.

Prosomal width measurements and some sex data from commercial biosampling programs are available from Massachusetts, New York, Delaware, Maryland, Virginia, and North Carolina. These data were included in the growth (Section 2.4) and sex ratio (Section 2.7) analyses for this assessment.

4.1.2 Commercial Bait Landings

The adoption of the FMP in 1998 improved harvest monitoring through mandatory reporting. The adoption of Addendum I to the FMP established reference period landings for the bait fishery that allowed for the implementation of quotas and served as a benchmark to evaluate subsequent bait landings. Addenda III (2004), IV (2006a), and V (2008a) further reduced harvest quotas, implemented seasonal bait harvest closures, and mandated male-only fisheries in some or all of the states in which harvest impacted the Delaware Bay population of horseshoe crabs (New Jersey, Delaware, Maryland, and Virginia).

Commercial bait landings for each state were validated through ACCSP. Inconsistencies between landings in the ACCSP data warehouse and annual compliance reports resulted in a second validation with most of the Atlantic states. For the Delaware Bay Region, ACCSP also validated 2017 landings to support the regional models. Outside the Delaware Bay, landings for 2017 were pulled from compliance reports. Landings previous to 1998 could not be validated by ACCSP and are not included in this assessment or any of the analyses. The coastwide bait landings of horseshoe crabs in Table 1 represent the best data available. Horseshoe crab landings for 1998-2017 peaked in 1999 at 2.6 million horseshoe crabs and have decreased since the late 1990s (Figure 1). Landings have remained under 1 million horseshoe crabs since 2003 and from 2004-2017 landings have averaged 752,886. Sex data were not available for all states, but based on the data available the sex ratio has shifted to predominantly male horseshoe crabs being caught in the bait fishery due to the implementation of the ARM Framework and resulting male-only harvest in the Delaware Bay. At a regional level, on average, commercial bait harvest of horseshoe crabs is predominantly from the Delaware Bay, followed by the New York region, then the Northeast (Table 13, Figure 4). The Southeast historically and presently harvests the smallest number of horseshoe crabs as part of the bait harvest.

Bait landings for the Delaware Bay states was developed to support the catch survey model for that region. Horseshoe crab landings from New Jersey and Delaware are considered to be 100% Delaware Bay origin (i.e., has spawned at least once in Delaware Bay) whereas 51% of Maryland's harvest and 35% of Virginia's are believed to be Delaware Bay origin based on genetic data and analysis (ASMFC 2012). These percentages were applied to the Delaware Bay states' bait harvest. Horseshoe crabs that were not sexed were portioned into males and females based on sex ratios in order to determine how many female horseshoe crabs were harvested in the commercial bait fishery in order to support modeling efforts (Table 14). Similar to the coastwide bait landings, bait landings of Delaware Bay origin were the highest in the late 1990s and have decreased since (Figure 5). The implementation of the ARM Framework through Addendum VII (ASMFC 2012), female harvest in the region has been restricted and this can be seen in the sex ratio of the catch.

4.1.3 Commercial Bait Catch Rates (CPUE)

Commercial catch rates are available from Delaware via the state's compliance report for 2017 (Figure 6). Delaware commercial catch rates were calculated by state employees by dividing the number of horseshoe crabs landed in the dredge and hand fishery by the respective number of trips for each fishery. The commercial CPUE in Delaware's dredge fishery peaked in 1996 and were the lowest in 2003, although there are several years since then when there was no dredge fishery. For the hand harvest CPUE, the highest value was in the terminal year of 2017 and the lowest was in 2013.

Interpretation of the Delaware catch rates are complicated by the imposition of regulations after 1997. For example, after 1997 trip limits were established on the dredge fishery of 1,500 crabs per day and the hand fishery was restricted to 300 ft^3 per day. In addition, the dredge fishery, which was capped at five permits issued annually to fishermen that had traditionally harvested using this gear became subject to a lottery that included non-traditional participants.

These non-traditional fishermen tended to be less efficient while they learned various gear nuisances and locations of horseshoe crab concentrations. Further harvest restrictions were imposed from 2004 and on.

No other state provided sufficient information for this assessment or through their 2017 compliance reports to calculate commercial CPUE. The SAS therefore relied entirely on fishery-independent data to characterize regional and coastwide trends for this assessment.

4.2 Commercial Biomedical Fishery

Research on horseshoe crabs for use in the biomedical industry began in the early 1900s (Shuster 1950). Scientists have used horseshoe crabs in eye research, surgical suture wound dressing development, and detection of bacterial endotoxins in pharmaceuticals (Hall 1992). The current major biomedical use of horseshoe crabs is in the production of LAL. LAL is a clotting agent in horseshoe crab blood that makes it possible to detect endotoxins in patients, drugs, and all intravenous devices. The LAL test was commercialized in the 1970s (J. Cooper, personal communication), and is currently the worldwide standard for screening medical equipment for bacterial contamination.

Blood from horseshoe crabs is obtained by collecting horseshoe crabs, extracting a portion of their blood, and typically releasing them alive. Crabs collected for LAL production are typically collected by hand or trawl. Crabs are inspected to cull out damaged or moribund animals, and transported to the bleeding facility. Following bleeding, most crabs are returned near the location of capture; however, some states allow facilities to bleed crabs caught by the bait industry prior to these crabs going to the market for sale (ASMFC 2004). Bled crabs that are caught and sold by the bait industry are counted against that state's bait harvest quota.

There are six companies along the Atlantic coast that extracted horseshoe crab blood during the time period examined by this assessment, 1999-2017: Associates of Cape Cod (MA), Limuli Labs (NJ), Lonza (MD, formerly Cambrex Bioscience), Wako Chemicals (MD, previously VA), Heptest Labs (VA), and Charles River Endosafe (SC). Addendum III requires states where horseshoe crabs are collected for biomedical bleeding to collect and report total collection numbers, crabs rejected, crabs bled (by sex) and to characterize mortality.

Estimates of biomedical harvest prior to 2004 are uncertain due to lack of standardized reporting; however, estimates from several sources are consistent, lending some credence to the estimates. The FDA estimated medical usage increased from 130,000 crabs in 1989 to 260,000 in 1997 (D. Hochstein, personal communication). This was consistent with other estimates ranging between 200,000 and 250,000 crabs per year on the Atlantic coast (B. Swan, personal communication; Manion et al. 2000). A survey of biomedical companies conducted by the Horseshoe Crab Technical Committee (TC) in 2001 indicated that about 280,000 crabs were bled in 1998 and 2000.

Since 2004, ASMFC has required states to monitor the biomedical use of horseshoe crabs to determine the source of crabs, track total harvest, characterize pre- and post-bleeding mortality, and determine fate (bait or release) of crabs used for biomedical purposes. As reported in annual compliance reports, the total number of crabs delivered to biomedical facilities has increased from 335,501 crabs in 2004 to 575,760 crabs in 2017 which includes crabs harvested as bait (Table 15).

Since 2011, biomedical companies along the Atlantic coast operate under a set of Best Management Practices (BMPs). These BMPs were a product of a collaboration between the LAL companies and ASMFC (Appendix A).

4.2.1 Biomedical Mortality Rate

For previous assessments and the annual compliance reports, mortality in the biomedical fishery (bait crabs excluded) was calculated in two steps. First, pre-bleeding mortality was determined from harvest and use reports provided by the biomedical harvesters. Second, a 15% mortality rate was applied to all bled crabs to determine the post-bleeding mortality. The two values were summed to provide a coastwide estimate of mortality from the harvest, transport, handling, and bleeding of horseshoe crabs used for biomedical purposes.

The 1998 FMP (ASMFC 1998a) established a biomedical mortality threshold of 57,500 crabs which, if exceeded, triggers the Management Board to consider action. The threshold has been exceeded every year since 2007 with the exception of 2016, although no management action has occurred. At the Management Board's request, the TC reviewed available literature and other information on mortality associated with the biomedical fishery (ASMFC 2008b). Despite limitations in study methodology and regional differences in results, the TC endorsed the use of a constant 15% mortality rate at that time.

The SAS developed a Biomedical Workgroup (WG) to review all available literature per region where biomedical facilities operate in order to reassess the 15% mortality rate for bled and released crabs. Each member assessed the studies in terms of how similar they were to the way the biomedical facilities in the region handle crabs and their adherence to the BMPs. The WG presented the results to the SAS, and the SAS also reviewed two additional submissions from Dr. James Cooper and Benjie Swan summarizing the literature, previous mortality rates, and a history of biomedical practices. The reports from the WG members as well as the additional submissions can be found in Appendix A.

The SAS discussed how to determine a biomedical mortality rate at length but with the paucity of long-term studies or studies that collaborate with biomedical facilities to mimic their procedure, it remained a challenging task. Despite having multiple studies and opinions from the SAS and some biomedical representatives on which studies should be considered, the SAS decided to expand Swan's approach from her submission of averaging among all biomedical studies without assigning any value to the studies (i.e., which are more in line with biomedical facilities and which are not) but apply a more rigorous statistical analysis than just a calculated mean.

In order to determine what mortality should be applied to crabs that were bled by the facility and released alive, the SAS compiled all the mortality rates and sample sizes (Table 16). Some studies had multiple rates from multiple treatments and each were treated independently. The rates and samples sizes were analyzed used R Markdown where an overall mortality rate distribution was found by simulating each reported rate as a separate random variable with its own binomial distribution. Then the expected values of the quantiles across the separate studies were calculated to determine a biomedical mortality of 15% with a 95% confidence interval of 4-30%. Therefore, the mortality rate of 15% remains unchanged for this assessment.

4.2.2 Sub-lethal Effects

There are few studies regarding the sub-lethal effects of bleeding horseshoe crabs. Anderson et al. (2013) evaluated the behavioral and physiological impact of biomedical harvest on 28 female horseshoe crabs. The results showed similar mortality rates as previous bleeding studies (18%) but also showed that bleeding decreased the horseshoe crabs activity levels, changed the expression of circatidal rhythms, and altered the amounts of hemocyanin in their blood which may have immune function implications. The study concluded that bleeding horseshoe crabs may decrease female fitness, but it did not follow Best Practices currently used by biomedical facilities and may not reflect sub-lethal effects of the industry.

A University of New Hampshire master's thesis by Owings (2017) focused on determining the effects of bleeding on the behavior of horseshoe crabs, impacts on activity and hemocyanin levels, and reduction of the effects by using a food supplement. Comparing 14 bled and 14 control horseshoe crabs, the study found that bled crabs mated less post-release. Additionally, the author noted that awareness of the overall health and hemocyanin levels of individual horseshoe crabs and avoidance of bleeding already-stressed or sick horseshoe crabs decreases mortalities. It should be noted that the Best Practices agrees and stipulates that horseshoe crabs should be sorted during collection so that unhealthy crabs are returned to the water on site (Appendix 12.1). The thesis concludes by suggesting the industry consider using a dietary supplement before or after bleeding to improve the effects of altering the horseshoe crabs physiological status and survivorship. Similar to Anderson et al. (2013), this thesis did not follow Best Practices currently used by the biomedical facilities and may not reflect sub-lethal effects of the industry. Further research should be done to consider sub-lethal effects of biomedical bleeding that adhere to Best Practices.

4.2.3 Biomedical Effect on Survival

The SAS wanted to examine potential differences in recapture rates and survival rates of bled and unbled horseshoe crabs. Current biomedical companies that participate in the US Fish and Wildlife Service's cooperative horseshoe crab tagging program include Lonza and Wako Chemicals. For the tagging study, both companies catch crabs off the coast of Maryland and Virginia mainly via trawl. While most of the other tagging partners tag crabs as they are spawning on beaches, there are additional trawl-caught crabs that are tagged (Table 17). The tagging programs that have captured horseshoe crabs with a trawl include: Maryland Dept. of Natural Resources (MDDNR), North Carolina Cooperative Research Cruise (NCCRUISE), New York Department of Environmental Conservation (NYDEC), Sacred Heart University (SHU), and Virginia Tech (VATECH).

The SAS explored two approaches for preliminary analyses of bleeding effects based on tagging data. For the first approach, the SAS summarized trawl captured and tagged crabs, in order to reduce bias of capture and/or resight probabilities that may occur between hand-captured and trawl-captured horseshoe crabs (Table 17 and Table 18). When horseshoe crabs are recaptured, their disposition is either alive, dead, or unknown. Unknown disposition occurs when a tag is found and it is not attached to a horseshoe crab carapace. Comparisons were made for the percent of reports for alive, dead, and unknown dispositions for bled and unbled, male and female crabs based on the number of years at large (YAL) for the individual crab. Only years where there were greater than 10 total recaptures were included (Table 19 and Table 20).

For the second approach, Cormack-Jolly-Seber (CJS) capture recapture models were fit for the subset of data tagged and released in the coastal region of Delaware, Maryland, and Virginia from 1999 to 2017. All observations regardless of capture and disposition were included in the capture history matrix. This allowed for sufficient data to fit the complex models while controlling for geography because nearly all tagged and bled crabs were released in the coastal Delaware, Maryland, and Virginia geographic area. There were 77,436 tagged animals with known sex and bleeding status: 8,449 unbled females, 20,435 bled females, 14,998 unbled males, and 33,554 bled males. Models, which were fit using RMark, included covariates for sex, bleeding status, and time for apparent survival (Phi) and capture probability (p).

4.2.3.1 Results

4.2.3.1.1 Trawl Captured and Tagged Crabs

There was a higher proportion of unbled horseshoe crabs reported as alive over time for both males and females (Figure 7). The greatest difference in recapture rates appears to be within the first year of release (0 YAL), as the rates generally become more similar with time. This trend also occurred with horseshoe crabs reported as dead (Figure 8). Again, it appears the effect of bleeding may be greatest within the first year of release, as the number of dead reports sharply declines between zero and one year at large, after which there is a steady increase over time for both bled and unbled horseshoe crabs.

There may also be a difference between sexes, as males appear to be captured alive at a higher rate than females (Figure 7), regardless if those males or females were bled. Males are also reported as dead at a lower rate than females (Figure 8).

Bled crabs (both male and female) are reported as unknown at a higher rate than unbled crabs (Figure 9). As time at large increases, the rate of bled female crabs reported as unknown increased from 27% (0 YAL) to 65 % (8 YAL). Bled males reported as unknown also increased, albeit at a lower rate than bled females. There was not much change in the number of unbled crabs reported as unknown for either males or females (Figure 9). It is likely that unknown reports are a combination of both tag loss and mortality.

4.2.3.1.2 Cormack-Jolly-Seber Model

The best fitting models included group-level effects on apparent survival due to bleeding and sex (Table 21). Survival also varied with time; however, year-specific survival was not estimable for many of the years. Thus, years were binned into periods defined by 2, 3, or 4 consecutive years and estimated average survival over the multiple year periods. The model with the binned 3-year periods fit best (Table 21). The estimated apparent survival was higher in most time intervals for crabs that had been bled, particularly for females (Table 22). On average, females had a lower survival rate than males, but the difference was higher for unbled crabs (70% for females and 73% for males) then for bled crabs (75% for females and 76% for males).

4.2.3.2 Discussion and Recommended Next Steps

Preliminary analysis presents some evidence for a short-term reduction in survival due to bleeding based on first year returns. In contrast, annual survival considering multiple years does not indicate a reduction in survival due to bleeding. Rather the multiyear estimates indicate higher survival for bled crabs compared to unbled crabs tagged and released in the coastal Delaware, Maryland, and Virginia geographic area. The pattern of higher survival for bled crabs could be due to confounding factors related to local harvest pressure on unbled crabs tagged on coastal beaches in the fishery or due to the culling of biomedical catches for selection of high condition individuals. Biomedical culling could result in biomedically tagged individuals representing a healthier subset of the overall population and thus having higher survival, all else equal.

These are preliminary analyses, and the SAS recommends continued evaluation of the tagging data by fitting capture-recapture models that include a short-term (1 year) bleeding effect, account for spatial distribution of harvest pressure, account for capture methodology, and account for disposition of recaptured tagged individuals. Potential methodological approaches include use of time-varying individual covariates to indicate which crabs are 1 year from bleeding and use of hierarchical models to estimate interannual variation in survival within time periods defined by major regulatory changes.

4.2.4 Biomedical Data Estimation

For this assessment, the SAS was tasked with evaluating the biomedical collection and mortality by region and use the mortality associated with biomedical bleeding in the modelling approach. In order to use the data regionally (by sex in some cases), consider the full range of biomedical mortality, and extend the time series, some estimation from the data set had to be performed prior to inclusion in analysis. When assessing the biomedical harvest by region, as opposed to coastwide, the data becomes confidential (*see Statement, page iv*) and therefore some information has been removed from this public document.

4.2.4.1 Methods

Data for the biomedical use of horseshoe crabs is reported to the Commission annually in state compliance reports. Under Addendum III, states are required to report biomedical collections by month and sex, along with the number or percent of observed mortality up to the point of release, collection method, disposition of bled crabs, and condition of holding environment of bled crabs prior to release (ASMFC 2004b). Clarity of reported information has improved throughout the years, and the information is now requested using a standardized template for data entry. To include the most extensive and accurate information possible, states were requested to resubmit biomedical data, including years prior to reporting as required in Addendum III, as available. This also gave states the opportunity to confirm or update information that may have been preliminary at the time of submission for past compliance reports. Discrepancies with previous reports were confirmed by the states in coordination with biomedical facilities.

Data on biomedical use of horseshoe crabs were available for 1999-2017, but the amount, quality, and completeness varied. Within this timeframe several facilities had years of missing information on collections, observed mortality, number of crabs bled, and sex ratio of crabs caught and released solely for biomedical use (biomedical-only), i.e. those that did not enter the bait market after being bled. Mortality of crabs that entered the bait market after being bled is included in bait landings, not in biomedical mortality. To extend the time series of all facilities and account for biomedical mortality in as many years as possible, missing years were estimated based on available data. Biomedical company representatives and state permitting records were consulted to confirm whether and which facilities were operating during years without data.

To account for potential annual trends in the biomedical market as a whole, annual collections of biomedical-only crabs from states with incomplete time series from 1999-2017 were regressed against those with complete time series. Regressions were only conducted for relevant years, when data were reported and had the same facility or facilities operating as years requiring estimation. One state requiring estimation only had two years of data relevant to the missing years, thus a regression could not be conducted and values for missing years were estimated as the mean of the two years of relevant, available data. Relationships between facilities or averages of available years were only used to estimate collections of horseshoe crabs used solely for biomedical use. They were not used to estimate numbers observed dead, bled, or sex ratios when such information was missing. These estimates were made based on state-specific data as described below.

Annual state percentages of collected biomedical-only crabs that were observed dead during the biomedical bleeding process (capture to release) were calculated for all years when such data were available. Years when these data were not available were estimated as state averages of relevant reported annual percentages observed dead multiplied by reported or estimated collection numbers.

Annual state percentages of collected biomedical-only crabs that were bled were calculated for all years when such data were available. Years when these data were not available were estimated as state averages of relevant reported annual percentages bled multiplied by reported or estimated collection numbers.

Annual state sex ratios of biomedical-only crabs collected were calculated for all years when such data were available. Sex-specific collections for unreported years or crabs reported as unknown sex were estimated as relevant state average annual sex ratios multiplied by unsexed, reported or estimated collection numbers. Sex ratios estimated for collections are assumed to also be reflective of later stages and data for the biomedical process (e.g. crabs bled, observed mortality, post-bleeding mortality).

4.2.4.2 Results

Collection data were available for 101 (89%) of the 114 state-year combinations considered (Table 23). Sex, bleeding, and observed dead proportions were more available later in the time series. Sex was not reported for every stage of the biomedical process. Thus, all collection, bled, observed dead, and total mortality numbers are assumed to have the same sex ratio within each state-year combination.

Two significant relationships were observed for collection numbers of states requiring imputation with those of states with full time series of data from 1999-2017 (Figure 9). These relationships were used to estimate collections in missing years when collections were known to have been conducted.

Annual biomedical collections trend up early in the time series to a peak in 2011 (Figure 11). From approximately 2010 through 2017 collections have been fairly stable, outside of a significant, single-year decrease in 2016. This decrease was due to known, temporary changes in production. More typical collection numbers resumed in 2017.

The average annual proportion of collected crabs observed dead during the biomedical process and proportion bled had little variation by state and facility (Table 24). All facilities observed mortalities less than 10% while crabs were in their possession, with all currently operating facilities observing mortalities less than 4%. Most states/facilities bled over 90% of crabs collected.

The bleeding mortality estimate from the meta-analysis of bleeding studies (15%) was applied to numbers of bled crabs to estimate bleeding mortality. This was added to the number of crabs observed dead during the biomedical process to estimate the total mortality attributable to biomedical use (Figure 12). As Delaware Bay was the only region in which sex-specific mortality information was used to model the population, these mortality estimates are specified in Figure 12. These mortality estimates include apportioning of Virginia and Maryland crabs, with 35% and 51% of crabs from each state, respectively, being of Delaware Bay origin. These percentages are based on genetic population structure findings (ASMFC 2012).

4.2.5 Biomedical Biological Data

Sex ratios varied considerably among facilities (Table 25). These sex ratios are likely not representative of population sex ratios in collection areas, as gear selectivity and culling of crabs less likely to be selected for bleeding would alter these ratios. Some facilities have size-based criteria that exclude smaller individuals, making females, the larger of the sexes, more likely to be bled. Additionally, some facilities collect crabs by hand, which allows greater ability to select for large females than other gears, such as a dredge or trawl. Time series of sex ratios indicate greater use of male crabs more recently than in the past.

4.2.6 Biomedical Data to Support Modelling Efforts

The bleeding mortality estimate and 95% confidence limits from the meta-analysis of bleeding studies (15%; [4%, 30%]) were applied to numbers of bled crabs to estimate bleeding mortality. Bleeding mortality was added to the number of crabs observed dead during the biomedical process to estimate the total mortality attributable to biomedical use (Figure 12, Table 26). Biomedical mortality accounted for less than 20% of coastwide mortality resulting from directed (bait and biomedical) use of horseshoe crabs in all years (Table 27). The percent of mortality attributed to the biomedical industry did vary by region, but is **CONFIDENTIAL** (Table 28). Annual sex-specific mortalities were estimated (Figure 12, Table 29) and used as inputs for the catch survey analysis, modeling the Delaware Bay population. These mortality estimates include apportioning of Virginia and Maryland crabs, with 35% and 51% of crabs from each state, respectively, being of Delaware Bay origin.

4.3 Commercial Discards

4.3.1 Northeast Fisheries Observer Program

4.3.1.1 Program Description

Discard information from observed commercial fishing trips was obtained from NMFS' Northeast Fisheries Science Center's (NEFSC) Northeast Fisheries Observer Program (NEFOP). The NEFOP program collects data on harvested and discarded catch, gear, effort, and species' lengths and weights using trained fishery observers from Maine to North Carolina. The total catch and a subsample of the total catch from each observation (e.g., towed trawl net) are weighed. The observer program is mandatory for federally-permitted vessels which are selected at random for observation during fishing trips. The program began in 1989 but data on horseshoe crab was available beginning in 2004. Horseshoe crab landings and observed discards were used to develop discard estimates from gillnets, trawls, and dredges in the Delaware Bay states for use in the catch survey analysis (CSA). Estimates for the other regions were attempted but lacked sufficient sampling to produce reliable estimates. See the NEFOP website for additional details about the program (http://nefsc.noaa.gov/fsb/program.html).

4.3.1.2 Methods

The NEFOP data set included all landings from observed trips, including those where no horseshoe crab were encountered, as well as horseshoe crabs discarded and horseshoe crabs kept, all in pounds (Figure 13 and Figure 14). NEFOP observer data were used to develop annual ratios of observed discarded horseshoe crab to observed landings of all species by gill nets, bottom trawls, and dredges from the Delaware Bay states (Delaware, New Jersey, Maryland, and Virginia) for 2004-2017. Ratios were then applied to reported gill net, bottom trawl, and dredge landings of all species from those states for 2004-2017 as queried from the Atlantic Coastal Cooperative Statistics Program (ACCSP; Figure 15) warehouse to estimate total discards of horseshoe crab. Some landings were not available at the gear level ("NOT CODED"). These landings were partitioned into trawl, gillnet, and dredge landings by calculating the annual proportion of landings by these gear categories and then these proportions were applied to the "NOT CODED" landings. Gears that were categorized as "trawl" or "gill net" but are unlikely to capture horseshoe crabs, such as midwater trawls or anchored and drift floating gill nets, were removed from the analysis.

The annual ratios by major gear type were calculated as the ratio of the mean discards of horseshoe crab per observation (i.e., tow or net set), in pounds, to the mean landings of aggregated species per observation, also in pounds (Equation 1).

$$Equation\ 1: R = \frac{\overline{D}}{\overline{L}} = \frac{\sum_1^n D_i}{\sum_1^n L_i}$$

This ratio estimator includes all observations with observed landings of any species, including those where no horseshoe crab were discarded. The variance of the ratio estimator was calculated with Equation 2 (Pollock et al. 1994).

$$Equation\ 2: Var(R) = \frac{1}{n(n-1)\overline{L}^2}\left(\sum_1^n D_i^2 + R^2\sum_1^n L_i^2 - 2R\sum_1^n D_i L_i\right)$$

It was assumed that discarding rates during observed trips were representative of overall discarding rates in these fisheries. Small sample sizes of positive observations precluded developing ratios at finer resolution (e.g., by state or season).

For trawls, annual mean weights were calculated as the total number counted from subsamples divided by the total subsample weight and were applied to the discard estimates in weight to derive discard estimates in numbers. In years with no observer data, averages of all the years combined were used. For gill nets and dredges, there was not sufficient biological sampling to calculate the mean weight of horseshoe crabs caught as bycatch in the gear. The SAS used the state-generated conversion factors of 1 pound for male horseshoe crabs and 2.67 pounds for female horseshoe crabs. Based on commercial biological sampling sex ratio of 48% female horseshoe crabs, the conversion factor of 1.8 pounds per horseshoe crab caught as bycatch in the dredge and gill net gears were used to convert from pounds to numbers.

Ratios estimates, variances, and discard estimates by gear are in Table 30-Table 32. A discard mortality rate of 50% was assumed for both gillnet and trawl discards of horseshoe crab due to the effects of being stuck in a gill or trawl net for extended periods of time or tows. The TC discussed that the trawl discard mortality is likely lower than 50% based on field observations, maybe even as low as 5% (S. Doctor, personal communication). The TC chose to maintain the rate at 50% to be precautionary since the discard estimates are likely biased low since they do not account for biomedical trips that are known to sort and discard catch at sea and observed trips target some species other than horseshoe crabs and may handle crabs differently. A discard mortality rate of 5% was assumed for dredge discards of horseshoe crab (D. Smith, unpublished data). These mortality rates were developed from SAS and TC discussions and members’ field experience due to a lack of information about discard mortality rates from various gears for horseshoe crabs. For use in the female-only catch survey analysis, the 48% female sex ratio was applied to the dead discard numbers.

4.3.1.3 Results

Based on the data from NEFOP for the Delaware Bay region, observed landings of all species were variable (Figure 14) and most observed trips were in New Jersey and Virginia and few trips were observed in Maryland and Delaware. Of all the observed trips in the Delaware Bay region, 45% landed scallops, 16% landed short-fin squid, 7% landed Atlantic mackerel, 6% landed summer flounder, 6% landed Atlantic long-fin squid, and the remaining species comprised <5% the observed landings by weight. Horseshoe crab landings comprised <1% of the total observed landings in the data set. From 2004-2017, 51% of observed fishing trips used dredges, 46% used trawls, and 3% used gill nets.

Pounds of kept and discarded horseshoe crabs from observed fishing trips in the NEFOP data set was variable but generally increased in the Delaware Bay region from 2004-2017 (Figure 13). The increase in discards could in part be due to the male-only harvest which began in the 2014 fishing season through the present and the closure of New Jersey's horseshoe crab fishery in 2007 or be an artifact of sampling, particularly since Maryland and Delaware have fewer trips observed that encounter horseshoe crabs compared to New Jersey and Virginia. From 2004-2017, 96% of horseshoe crabs encountered on observed trips in New Jersey were discarded, 81% in Virginia, and 24% in Maryland. Delaware did not have enough encounters with horseshoe crabs to make any generalizations, but of the 136 pounds caught in observed trips in the state, 100% were discarded.

Total landings from gill nets, trawls, dredges, and not coded gears of all species by state in the Delaware Bay region from ACCSP (Figure 15) indicated stability throughout the time series with a slight decrease over time. Average landings from the Delaware Bay region for all fisheries was 558 million pounds from 2004-2017. The majority of all-species landings in the region were from New Jersey (which has had a moratorium on horseshoe crab bait harvest since 2006) followed by Virginia, Maryland, and then Delaware.

The ratio estimators varied by gear and year (Table 30-Table 32). Estimated discards of horseshoe crab also varied by gear and year (Figure 16-Figure 18) where dredges discarded the most horseshoe crabs and trawls discarded the least. Conversely, trawls were the most subsampled trips for weights used to convert discards in pounds to discards in numbers. Discards from dredges increased remarkably in 2014-2017 due to several observed trips with high discarded horseshoe crabs in those years. Estimated discards from gill nets and trawls followed similar patterns with peaks in 2011 and 2013 and decreased discards from 2014-2017. Estimated discards for all three gears combined showed an increase of discards throughout the time series (Figure 19), although those estimates were highly influenced by the dredge discard estimates.

Mortality rates of 50% for trawls and gill nets and 5% for dredges were applied to the estimated numbers of horseshoe crabs discarded to get estimated number of dead horseshoe crabs attributed to discards in the Delaware Bay region. The number of dead horseshoe crabs from discards was 101,100 on average and ranged from a low of 21,937 in 2005 to a high of 216,518 in 2013 (Figure 20). In order to be used in the CSA model, discard estimates need to be proportioned by sex. Few horseshoe crabs were sexed throughout the time series (n=209) and those that were sexed were collected primarily from the trawl fisheries. The SAS instead referred to sex data from commercial sampling programs in the Delaware Bay states to derive a sex ratio of 48% female. Applying that percentage to all years of discards data resulted in an average of 48,527 female horseshoe crabs dead from discards in all gears, ranging from 10,530 in 2005 to 103,928 in 2013 (Figure 21).

4.4 Recreational

There is no recreational fishery for horseshoe crabs. Some states allow a minimal number of crabs to be retained for personal use. Landings of this type are not quantified.

5 INDEPENDENT DATA SOURCES

5.1 Stock Assessment Subcommittee Criteria

The SAS established the following set of criteria for evaluating data sets and developing indices of relative abundance for horseshoe crab:

1. Time series: Ideally, the time series should be 20 years long to account for the lifespan of horseshoe crab. Recognizing that would eliminate many surveys, the SAS recommended at least 10 years of data be available in a survey.
2. Survey design: Surveys with statistical designs are preferred, such as surveys with random stratified sampling.
3. Gear: Surveys should operate with gear that is capable of catching horseshoe crabs and to which horseshoe crabs are available.
4. Temporal and spatial coverage: Only surveys that operate during a time and place where horseshoe crab are available for capture should be considered. Examining the precision or proportion of zero catches of horseshoe crabs in a survey can be tools for evaluating this.
5. Methodology: Survey methodology should be consistent throughout the time series or changes should be able to be accounted for in the standardization process.

The SAS evaluated several data sets for developing indices of abundance for horseshoe crab. After some preliminary analysis, nine were rejected for various reasons as indicated in Table 33 and abundance indices were developed from the remaining surveys. When possible, indices of abundance were developed by season and sex. There were also efforts to develop surveys by stage to support modelling approaches; however, stage-based indices were not able to be developed due to insufficient data. The SAS explored using nominal and GLM standardized indices, but encountered issues with these methods due to the high proportion of zero catches in many of the tows in the surveys. Therefore, all indices were developed using the delta distribution for the mean and variance for each year of a survey to specifically take into account the number of zero catches (Pennington 1983). Maps of the surveys were included when they were supplied from the data provider. A summary of the gear used and size range of horseshoe crabs caught for the surveys included in this assessment can be found in Table 34 and Figure 22, as requested by the Peer Review Panel.

5.2 Surveys

5.2.1 New Hampshire Spawning Beach Survey

5.2.1.1 Survey Design and Methods

The New Hampshire spawning survey operated for 11 years from 2002 to 2012. During the months of May through September five beach locations were surveyed in 150, 300, or 450 meter transects.

5.2.1.2 Biological and Environmental Sampling

All horseshoe crabs visible in the transects were counted and sexed. Prosomal widths were taken when possible. Eggs were recorded using a presence/absence description. Temperature, weather, cloud cover, wave action, moon stage, and salinity were recorded for environmental factors.

5.2.1.3 Evaluation of Survey Data

A spring (May and June) index was developed from this survey. Male and female indices were calculated separately for this survey because 100% of the individuals recorded were sexed. July, August, and September were dropped due to high occurrences of zero sightings. The subset data resulted in 57% zero sightings over the entire time series.

5.2.1.4 Abundance Index Trends

Abundance peaked for both male and female horseshoe crabs in 2004. Between 2005 and 2012 abundance remained relatively low (Figure 23 and Figure 24).

5.2.2 Massachusetts Resource Assessment Trawl

5.2.2.1 Survey Design and Methods

The Massachusetts Resource Assessment Trawl is an otter trawl survey which began operating annually during the months of May and September in 1978. The study area is stratified based on five bio-geographic regions and six depth zones (Figure 25). Sampling intensity is approximately 1 station per 19 square nautical miles. A minimum of two stations are assigned to each stratum. A standard tow of 20-minute duration at 2.5 knots is attempted at each station during daylight hours.

5.2.2.2 Biological and Environmental Sampling

The total weight and length-frequency of each species are recorded directly into Fisheries Scientific Computer System (FSCS) data tables. Horseshoe crab sex identification and prosomal width measurements began in 1982. Temperature and depth are recorded for each tow.

5.2.2.3 Evaluation of Survey Data

Two fall (September-October) indices were developed from this survey to reflect the differences in the horseshoe crab populations north and south of Cape Cod. The data was split into north and south based on strata so that the north was zones 4-5 and the south was zones 1-3 (Figure 25) and subset to include only tows occurring at depths between 6-14 meters where horseshoe crabs were predominantly encountered. Tows that occurred outside of these parameters had very low frequencies of horseshoe crab catch. Throughout the time series and strata, fall tows were 10% positive for horseshoe crab presence. Nearly all crabs were sexed after 1982, however the sample sizes were still small and the SAS could not justify using such small numbers to calculate a sex based index from this survey.

5.2.2.4 Abundance Index Trends

Horseshoe crab abundance varied by region. In the North Cape index (Figure 26), abundance peaked in 1980 and declined since then although the last four years exhibited mid-range abundance. There were multiple years in the survey that did not encounter any horseshoe crabs. The South Cape index shows a different pattern from the North Cape index where it begins relatively low and then experiences high abundance in 2016-2017 (Figure 27).

5.2.3 Rhode Island Costal Trawl Survey (monthly segment)

5.2.3.1 Survey Design and Methods

The Rhode Island Coastal Trawl Survey began operating in 1990. The monthly segment of the survey samples 13 fixed stations, 12 inside Narragansett Bay and 1 in Rhode Island Sound (Figure 28). At each station, an otter trawl is towed for twenty minutes.

5.2.3.2 Biological and Environmental Sampling

All catch is identified by species then measured and weighed. Horseshoe crab sex and prosomal width recordings began in 1998. Temperature, depth, salinity, and weather conditions are all recorded for environmental factors.

5.2.3.3 Evaluation of Survey Data

A spring (April - July) and fall (August – October) index was developed from this survey. The data was subset to include only tows with recorded bottom temperatures greater than 10.1°C thus eliminating a large proportion of zero catch tows. Ultimately, the SAS decided to use only the fall index due to a higher rate of percent positive tows. Throughout the time series, fall tows were 22% positive while spring tows were 13% positive. Sexes were kept combined as there are not enough crabs caught in this survey to support sex specific indices.

5.2.3.4 Abundance Index Trends

Horseshoe crab abundance has remained relatively steady according to this survey. Throughout the time series, abundance remains relatively low between 0.5 and 1.5 crabs per tow (Figure 29).

5.2.4 Connecticut DEEP Long Island Sound Trawl Survey

5.2.4.1 Survey Design and Methods

This survey began operation in 1984 and continues to sample Connecticut and New York waters during the spring (April – June) and fall (September – October) seasons. The sampling area is divided into 1x2 nautical mile sites with each site assigned to one of 12 strata defined by depth interval (0-9.0 m, 9.1-18.2 m, 18.3- 27.3 m, or 27.4+ m) and bottom type (mud, sand, or transitional) (Figure 30). Forty samples are collected each month resulting in 200 sites annually. It should be noted that this survey did not operate in the fall of 2010.

5.2.4.2 Biological and Environmental Sampling

All catch is identified by species and weighed in aggregate by species. Horseshoe crab counts began in fall 1997 while lengths and sex records began in fall 1998. Depth, salinity, temperature, and sediment type are recorded for environmental factors.

5.2.4.3 Evaluation of Survey Data

A spring (April – June) and fall (September – October) index were developed from this survey. The data was subset to include only tows with depths less than 43.5m and bottom temperatures greater than 4.3°C thus eliminating a large proportion of zero catch tows. Ultimately, the SAS decided to use only the fall index due to a higher rate of percent positive tows. Throughout the time series, fall tows were 39% positive while spring tows were 29% positive. Sexes were kept combined as there were not enough sexed crabs to support separate indices.

5.2.4.4 Abundance Index Trends

Abundance of horseshoe crabs in this survey is relatively high compared to surveys operating with similar gears. Horseshoe crabs caught per tow remained fairly steady between two and four individuals until 2010 when numbers dropped to consistently catching between one and two horseshoe crabs per tow (Figure 31).

5.2.5 New York DEC Peconic Small Mesh Trawl Survey

5.2.5.1 Survey Design and Methods

This survey began operating in 1987 and continues to sample 16 randomly selected stations in the Peconic Bay on a weekly basis from May through October. The survey area was divided into 77 sampling blocks with each block measuring 1' latitude and 1' longitude (Figure 32). The 4.8 meter semi-balloon shrimp trawl net is towed for 10 minutes at approximately 2.5 knots using a 10.7 meter lobster style workboat.

5.2.5.2 Biological and Environmental Sampling

All catch is identified by species and counted. Horseshoe crab sex and prosomal width have been recorded since 1997. Temperature, salinity, depth, dissolved oxygen, and secchi disc readings are recorded for environmental factors.

5.2.5.3 Evaluation of Survey Data

Spring (May-July) and fall (August-October) indices were developed from this survey. Tows with missing salinity, salinity greater than 32.12 (unit), missing temperature, and temperatures less than 11°C were eliminated in attempts to use only data points with complete environmental information and a higher likelihood of catching horseshoe crabs. Both seasons of the survey were fairly similar in regard to total horseshoe crabs caught and percent zeros. Throughout the entire time series, the spring survey caught 7,270 crabs with 57% of tows catching zero horseshoe crabs. The fall survey caught 7,200 crabs with a 60% zero catch rate. The SAS decided to use the fall portion of the survey to remain consistent with regional time series usage of fall inclusion only. Sexes were kept combined as there were not enough sexed crabs to support separate indices. Throughout the entire time series only 34% of crabs were sexed.

5.2.5.4 Abundance Index Trends

Horseshoe crab abundance peaked in 1991 after which numbers have been steadily decreasing. Since 2004, horseshoe crab catch per tow has been consistently below one (Figure 33).

5.2.6 New York DEC Western Long Island Beach Seine Survey

5.2.6.1 Survey Design and Methods

The New York Seine Survey began operation in 1984 in Jamaica Bay (Figure 34), Manhasset Bay (Figure 35), and Little Neck Bay (Figure 36). Pre-2000 sampling was conducted 2 times per month during May and June, once a month July through October and then 2 times per month from May through October for 2000 – 2002. Currently, 5-10 seine sites are sampled in each bay on each sampling trip. From 1984 – 1998 a 500 ft x 12 ft seine with stretch mesh in the wings and stretch mesh in the bag was used for one sampling round generally in the spring. Currently a 200 ft x 10 ft beach seine with ¼ inch square mesh in the wings, and 3/16 inch square mesh in the bunt is being used. The seine is set by boat in a "U" shape along the beach and pulled in by hand.

5.2.6.2 Biological and Environmental Sampling

All finfish species are identified and counted. Starting in 1987, invertebrates were consistently counted. Since 1998, horseshoe crabs have been counted, measured, and sex has been identified. Environmental information (air and water temperature, salinity, dissolved oxygen, tide stage, wind speed and direction, and wave height) has been recorded at each station. Bottom type, vegetation type, and percent cover have been recorded qualitatively since 1988.

5.2.6.3 Evaluation of Survey Data

Two indices of abundance were developed from this survey based on geographic location: a Jamaica Bay index and a Manhasset and Little Bays index. The latter two Bays were combined due to proximity to each other. Horseshoe crabs were most reliably caught in all three regions in May and June, although the survey runs from April through November. Without subsetting, the survey had on average 30% positive tows but when restricted to the spring months the proportion positive tows increased to 45%.

5.2.6.4 Abundance Index Trends

The Jamaica Bay index of horseshoe crab abundance shows variable abundance through the 1990s with a lot of fluctuation between high peaks and low values in the 2000s (Figure 37). From 2006 through the terminal year, the index exhibits lower abundances of horseshoe crabs in this region. For the Manhasset and Little Neck Bays index, abundance was variable with some high values from 1987-2003 (Figure 38). After 2003, the index decreased dramatically and has remained low through 2017.

5.2.7 Northeast Area Monitoring and Assessment Program Trawl Survey

5.2.7.1 Survey Design and Methods

The Northeast Area Monitoring and Assessment Program (NEAMAP) Trawl Survey began sampling the coastal ocean from Martha's Vineyard, MA to Cape Hatteras, NC since the fall of 2007 (Figure 39). The survey area is stratified by both latitudinal/longitudinal region and depth. A four-seam, three-bridle, 400x12 cm bottom trawl is towed for 20 minutes at each sampling site with a target speed-over-ground of 3.0 kts. The net is outfitted with a 2.54cm knotless nylon liner to retain the early life stages of the various fishes and invertebrates sampled by the trawl. The survey conducts two cruises a year, one in the spring (April-May) and one in the fall (September-November). A total of 150 sites are sampled per cruise, except 160 sites were sampled in the spring and fall of 2009 as part of an investigation into the adequacy of the program's stratification approach.

5.2.7.2 Biological and Environmental Sampling

For each tow, the catch is sorted by species. Horseshoe crab are measured for prosomal width and sex when possible. A number of variables (profiles of water temperature, salinity, dissolved oxygen, and photosynthetically active radiation), atmospheric data, and station identification information are recorded at each sampling site.

5.2.7.3 Evaluation of Survey Data

A spring (April- May) and a fall (October) index were developed from this survey. Horseshoe crabs were caught in the fall with 56% positive tows and in the spring when there were 72% positive tows. The SAS decided to use the fall portion of the survey to be consistent with other surveys in the region. The fall portion of the NEAMAP survey was further split to develop two indices from this data set: a New York index (strata 3-5) and a Delaware Bay index (strata 8-11). Nearly half of horseshoe crabs caught in the survey were sexed, but due to the subset data there were not enough to justify developing sex-specific indices. Based on the prosomal widths provided, this survey catches primarily adults in the fall.

5.2.7.4 Abundance Index Trends

The survey of relative abundance of horseshoe crab in the New York portion of the NEAMAP survey began with high values in 2007-2008 and the lowest value in 2010 (Figure 40). The index was variable throughout the 2010s. For the Delaware Bay index developed from the fall portion of the NEAMAP survey, horseshoe crab abundance was variable with the highest abundance in 2009 and 2015 and the lowest abundance in 2013 (Figure 41).

5.2.8 New Jersey Ocean Trawl Survey

5.2.8.1 Survey Design and Methods

New Jersey's Ocean Trawl Survey has been operating since August of 1988 and collects samples during five survey cruises per year (30 samples in January, 39 samples each in April, June, August and October) in the nearshore ocean waters of New Jersey. It uses a three-in-one design, two-seam trawl net with forward netting of 12 cm stretch mesh, rear netting of 8 cm, and a 6.4 mm bar mesh liner in the cod end. The survey incorporates a random stratified design with sampling sites selected within 15 strata (Figure 42) with longitudinal boundaries consisting of 5, 10 and 15 fathom isobaths. The latitudinal boundaries are identical with the NMFS groundfish survey except the extreme southern and northern ends of the sampling area. These strata are further divided into blocks which are 2.0 minutes longitude by 2.5 minutes latitude for the midshore and offshore strata, and 1.0 minutes longitude by 1.0 minutes latitude for the inshore strata. The standard duration of each sample is a 20-minute tow.

5.2.8.2 Biological and Environmental Sampling

Catches are sorted to species level whenever possible, enumerated, weighed (gross weight per species) and measured for length/width (cm) data. Certain species are sexed and horseshoe crabs have consistently been sexed since 1999. Environmental data include depth (m), surface and bottom water temperature (degrees Celsius), salinity (0/00) and dissolved oxygen (mg/L) along with air temperature, wind direction and speed, weather conditions, wave height, and swell direction and height.

5.2.8.3 Evaluation of Survey Data

This survey catches mainly adult horseshoe crabs, and the SAS concluded that the paucity of juvenile crabs negated development of juvenile indices from this program. A spring/summer (April and August) and a fall (October) index were developed from this survey for female adult (>= 19 cm pw), male adult (possessing male pedipalps), and all horseshoe crabs combined. The indices for all horseshoe crabs combined used the years 1989-August 2018, while the sexed indices only used the years in which the crabs were consistently sexed (1999-August 2018). Overall, horseshoe crabs were caught slightly more often in the fall (58.5% positive tows) than in the spring (51.4% positive tows). This pattern continued for female adults (46.6% positive tows in the fall, 43.7% positive tows in spring) and male adults (40.0% fall positive tows, 38.1% spring positive tows).

5.2.8.4 Abundance Index Trends

For all horseshoe crabs combined in the spring, abundance was higher in the years 1990 through 2005 peaking at 1997 and 1999, before falling between 2006 through 2010. After 2011, the abundance has been on an upward trend with a survey-high peak in 2013 (Figure 43). However, the fall index shows high abundance from 1989-1992, then fluctuations at lower levels thereafter (Figure 44). The spring index for adult female horseshoe crabs shows a trend similar to the spring index for all crabs: higher abundance in the early years followed by declines through 2010 before trending higher through 2017 with a peak during 2013 (Figure 45). This pattern is also seen in the spring indices for adult males (Figure 46). The fall indices for the sexed crabs generally followed the same patterns as for all horseshoe crabs combined but with subtle differences. While the fall indices for adult females (Figure 47) showed a peak in 2004 and adult males (Figure 48) showed peaks a year later in 2005. All of the fall indices showed fluctuating abundances with steep decreases for 2017 after a rise of varying scales in 2016. All the indices for spring and fall showed noticeable declines in 2010.

All the indices showed generally increasing trends after 2012, though the fall indices all showed steep declines for 2017. This result may have been an artifact of the timing of this survey cruise missing the fall migrations of this species.

5.2.9 New Jersey Surf Clam Dredge Survey

5.2.9.1 Survey Design and Methods

New Jersey's surf clam dredge survey has been operated by New Jersey's Bureau of Shellfisheries since 1988, with horseshoe crab catches recorded since 1998. The sample area includes the state waters component of New Jersey's ocean waters from Cape May north to the Shrewsbury Rocks off Monmouth County, NJ. The standard sample duration is a 5-minute tow. The gear type is a commercial hydraulic dredge equipped with a 72" knife and 2" X 2" steel mesh liner on the dredge floor. Through 2012, this survey collected on average 328 samples per year with the sampling conducted between June and August. In 2013, due to funding and staff shortages, the number of samples fell by more than half to 122 samples, with the subsequent years' averaging about 165 samples each. Due to this change in methodology, only the data from 1998 through 2012 were used for this assessment.

5.2.9.2 Biological and Environmental Sampling

This survey is focused on surf clam abundance and size data collection, but also records catch, sex and prosomal width (mm) information on all horseshoe crabs caught. A Peterson grab sample is taken at the end of each sample tow for bottom sediment analysis.

5.2.9.3 Evaluation of Survey Data

As this survey catches mainly adult horseshoe crabs, no juvenile indices were developed from this program. With the timing of the survey occurring mainly in the summer months of June, July and August, only one index (considered to be spring in this assessment) was developed for each of the following categories: all combined, female adult (> 180 mm pw), and male adult (possessing male pedipalps) horseshoe crabs. Positive tows for all horseshoe crabs combined made up 31.5% of all samples. The sexed indices all followed a pattern of higher positive tows for females than males: adults (21.7% female, 11.1% males).

5.2.9.4 Abundance Index Trends

For all horseshoe crabs combined, the abundance index trended upward from 2002 through 2012 after generally decreasing from 1998 to 2001 (Figure 49). The index rose above all the previous years' values in 2006 and remained above that level through 2012. The index for the adult females (Figure 50) shows fluctuations trending lower from 1998 through 2003 then rising from 2004 through 2007. There was a drop to an intermediate level of abundance in 2008 followed by another fluctuating but general trend upward through 2012. The abundance index for the adult male (Figure 51) showed generally declining fluctuations from 1998 through 2005. The index then increased through 2007, decreased to an intermediate level through 2009 before entering a general increase from 2010 through 2012.

5.2.10 Delaware Fish and Wildlife Adult Trawl Survey

5.2.10.1 Survey Design and Methods

Delaware has conducted the Adult Trawl Survey in three discrete time spans: 1966 – 1971, 1979 – 1984, and continuously since 1990. This assessment used the data from the latest time period (1990 – 2017) and was updated through 2018 for the spring portion of the survey. The survey samples 9 fixed stations monthly from March through December for an annual total of 72 samples. This survey uses a 30 foot, 2-seam otter trawl with a 3 inch stretch mesh in the wings and body and a 2 inch stretch mesh in the cod end. The sampling area includes the Delaware waters of the Delaware Bay at depths ranging from 7 – 35 m (Figure 52). The standard duration for each sample is 20 minutes at a speed of 3 knots.

5.2.10.2 Biological and Environmental Sampling

Catch is sorted to species level, enumerated, and weighed (aggregate per species) and measured for length/width to the nearest 0.5 cm. Horseshoe crabs are sexed, enumerated and measured (prosomal width). Environmental data include tide stage, water temperature (degrees Celsius), salinity (ppt), cloud cover and depth (m).

5.2.10.3 Evaluation of Survey Data

As this survey catches mainly adult horseshoe crabs. Spring (March through August) and fall (September through December) indices were developed from this survey for the following categories of horseshoe crabs: all adults combined, adult female, and adult male. Overall, the proportion positive tows varied little between the seasons with the spring showing slightly higher values than the fall (43.6% spring, 39.5% fall). A similar pattern was seen for males (36.8% spring, 36.6% fall). The pattern was reversed for females (32.6% spring, 33.0% fall). Another pattern emerged of higher respective proportion positive tows values for the males than for the females.

5.2.10.4 Abundance Index Trends

For all adult horseshoe crabs combined in the spring (Figure 53), abundance was highest in 1990 and 1991, and then a downward trend began from 1992 through 1995. It rebounded with an increase in 1996 before continuing the general trend downward through 2005. There was a moderate increase in 2006 and 2007 before dropping to low abundance levels from 2008 through 2013. Since 2014 there has been a generally upward trend with a steep increase in 2018. A similar pattern was seen for the spring indices of adult females (Figure 54) and males (Figure 55).

The fall index for all adult horseshoe crabs combined (Figure 56) showed a higher level abundance in 1990 and 1991, then dropped in 1992 and began fluctuating between low and intermediate levels through 2005. Abundance climbed steeply to a high level in 2006 before dropping again to previous low levels from 2007 through 2012. The index began a general increase from 2013 through 2015 before jumping to higher levels culminating in the time series high in 2017. A similar pattern was seen for the fall index for adult females (Figure 57) and males (Figure 58).

5.2.11 Delaware Bay Horseshoe Crab Spawning Survey

5.2.11.1 Survey Design and Methods

The ASMFC's FMP for Horseshoe crab (ASMFC 1998) required that the states of Delaware, Maryland, and New Jersey implement pilot horseshoe crab spawning surveys based on "standardized and statistically robust methodologies." In January 1999, the ASMFC convened a workshop that established a framework for such surveys in the Mid-Atlantic region. The framework built upon existing horseshoe crab spawning survey efforts by Finn et al. (1991) and Maio (1998). The survey began in 1999 and has continued through the present. Approximately 25 beaches are sampled in the Delaware Estuary during nighttime high tides in May-June. The goals are to provide an index of spawning activity and distribution in the region, increase the understanding of environmental factors on spawning activity and distribution, and promote public awareness of the role crabs play in shorebird dynamics. The survey has been shown to provide levels of spatial and temporal coverage essential for understanding trends in spawning activity (Smith and Michels 2006).

5.2.11.2 Biological and Environmental Sampling

The survey collects environmental data including water temperature, tidal height, wave height and biological data such as sex and spawning activity.

5.2.11.3 Evaluation of Survey Data

The SAS was primarily interested in this survey for the sex ratio data it provides in order to inform control rules in the Delaware Bay region. The SAS determined that this survey provides the most reliable data available for spawning beach sex ratios. For other data provided by this survey, the full annual reports are available at https://www.delawarebayhscsurvey.org/surveyreports/.

5.2.11.4 Sex Ratio Trends

Annual sex ratios from the spawning beach survey are available in Table 35. Current horseshoe crab harvest management strategies in the Delaware Bay area limit the harvest to predominantly male crabs. Concern was expressed that these strategies may cause spawning sex ratios (M:F) to drop and yet the sex ratio has increased in recent years. Annual sex ratios have ranged from 3.1:1 in 2001-2002 to 5.2:1 in 2017 over the course of the survey. M:F ratio in 2017 (5.2:1) was above the time series average (4:1).

5.2.12 Virginia Tech Horseshoe Crab Trawl Survey

5.2.12.1 Survey Design and Methods

The trawl survey conducted by Virginia Polytechnic Institute and State University (Virginia Tech) is the only survey available that is designed specifically to characterize the horseshoe crab population in coastal and lower Delaware Bay (Figure 59). The survey has operated from 2002-2011 and then again from 2016-2017 due to a lack of funding during the missing years. The survey area is stratified by distance from the shore and bottom topography. Tows are 15-minutes long and the survey only operates in the fall (mid-September-late October).

5.2.12.2 Biological and Environmental Sampling
All horseshoe crabs are counted and a subset are measured for prosomal width and identified by sex and maturity. Immature, newly mature, and mature crabs are differentiated in the data set.

5.2.12.3 Evaluation of Survey Data
This is the only survey specifically designed to catch and characterize the horseshoe crab population in its sampling region. The SAS decided to accept the indices as provided by Virginia Tech since they also used the delta distribution to model the mean and error of the annual catch.

5.2.12.4 Abundance Index Trends
The indices of abundance developed by sex and stage for horseshoe crabs in the Virginia Tech trawl survey can be found in Figure 60. Abundance varied by stage and sex, although there is a slight increase in abundance across the stages throughout the time series.

5.2.13 Maryland Coastal Bays

5.2.13.1 Survey Design and Methods
The 16’ otter trawl survey has been operating since 1989 and collects samples monthly in April through October in the coastal bays from the Delaware to the Virginia line at 20 fixed sites (Figure 61).

5.2.13.2 Biological and Environmental Sampling
All catch is identified by species and counted. Horseshoe crabs are sexed when possible and a prosomal width is measured. Tide stage, weather conditions, wind speed, depth, temperature, dissolved oxygen, and salinity are recorded for each sampling event.

5.2.13.3 Evaluation of Survey Data
A spring (April- May) and a fall (August-October) index were developed from this survey. Horseshoe crabs were more reliably caught in the spring with 14% positive tows than in the fall when there were 6% positive tows so the SAS decided to use only the spring portion of this survey in the assessment. Nearly all horseshoe crabs caught in the survey were sexed after the fall of 1993, but the SAS concluded that too few horseshoe crabs were collected in total to justify using the sex ratio from the catch as representative of the population in the region. Based on the prosomal widths provided, this survey catches primarily adults in the spring. The SAS abbreviated the survey to 1990-2017 due to high catches of horseshoe crabs that were not consistent with the following years and biased trend analyses. Maryland Department of Natural Resources supported the exclusion of the 1989 data point as well (S. Doctor, MD DNR, personal communication).

5.2.13.4 Abundance Index Trends
Abundance was high for 1994-1995, 2003, and 2010 and otherwise was relatively low (Figure 62).

5.2.14 North Carolina Estuarine Gill Net Survey

5.2.14.1 Survey Design and Methods

This floating gill net survey has been in operation since 2000 and samples in the Pamlico Sound and several river sites. Each region is overlaid with a one-minute by one-minute grid system (equivalent to one square nautical mile) and delineated into shallow (<6 feet) and deep (>6 feet) strata using bathymetric data from NOAA navigational charts and field observations (Figure 63). Gear is typically deployed within one hour of sunset and fished the next morning to keep soak times within 12 hours. Sampling initially occurred during all 12 months but was abbreviated in 2002 to no longer sample between December 15-February 14 due to low catches and unsafe working conditions.

5.2.14.2 Biological and Environmental Sampling

All horseshoe crabs caught in this survey are counted, measured for prosomal width, weighed, and sexed. Latitude, longitude, water temperature and salinity, and depth are recorded.

5.2.14.3 Evaluation of Survey Data

A spring (April- June) and a fall (August-October) index were developed from this survey. Horseshoe crabs were more reliably caught in the spring with 14% positive tows than in the fall when there were 5% positive tows, so the SAS decided to use only the spring portion of this survey in the assessment. Due to low catches of horseshoe crabs, depths over 3 m were excluded and only the Pamlico Sound region was used in this assessment. Nearly all horseshoe crabs caught in the survey were sexed, but the SAS concluded that too few horseshoe crabs were collected in total to justify using the sex ratio from the catch as representative of the population in the region. Based on the prosomal widths provided, this survey catches primarily adults in the spring. The survey encountered no horseshoe crab in the spring of 2000, the first year of the survey, so it was dropped from the analysis.

5.2.14.4 Abundance Index Trends

Horseshoe crab abundance was low from 2001-2007 and began to increase to the highest abundance in the time series in 2014 (Figure 64). The index began to decrease again after 2014 but still remains higher than the early part of the survey.

5.2.15 South Carolina Crustacean Research and Monitoring Survey

5.2.15.1 Survey Design and Methods

The Crustacean Research and Monitoring Survey (CRMS) has been operating in the Charleston Harbor and St. Helena, Port Royal, and Calibogue Sounds and since 1995. It samples monthly in the Harbor and in April, May, August, and December in the Sounds. The survey consists of 15 minutes trawls at each station. There was a vessel change in 2002 but the data was calibrated to accommodate that change.

5.2.15.2 Biological and Environmental Sampling

All catch for this survey is sorted and horseshoe crabs are counted, weighed, sexed, and measured for prosomal widths. The survey collects and reports latitude, longitude, water temperature, salinity, depth, and air temperature although not all variables are recorded consistently throughout the time series.

5.2.15.3 Evaluation of Survey Data
A spring (March-April) and a fall (August-December) index were developed from this survey. Horseshoe crabs were more reliably caught in the spring with 34% positive tows than in the fall when there were 22% positive tows, so the SAS decided to use the spring portion of this survey in the assessment. Data was subset to regions that encountered horseshoe crab. Nearly all horseshoe crabs caught in the survey were sexed, but the SAS concluded that too few horseshoe crabs were collected in total to justify using the sex ratio from the catch as representative of the population in the region. Based on the prosomal widths provided, this survey catches primarily adults in the spring.

5.2.15.4 Abundance Index Trends
The index of relative abundance of horseshoe crab developed from the CRMS indicated high abundance throughout the 2000s with lower abundance from 2010-2017 (Figure 65).

5.2.16 South Carolina Trammel Net Survey

5.2.16.1 Survey Design and Methods
The Trammel Net Survey has been operating monthly since 1995 and covers nine lower-estuarine strata along the coast of South Carolina (Figure 66). Each month, 10- 12 stations per stratum are chosen for sampling, although this number was not always achieved due to weather, tide, or time restrictions. Monthly sites were selected at random (without replacement) from a pool of 22-30 possible sites per stratum. Occasionally it was necessary to add new sites to the pool as others were lost due to changing coastal features (e.g., erosion, new docks).

5.2.16.2 Biological and Environmental Sampling
All catch for this survey is sorted and horseshoe crabs are counted, weighed, sexed, and measured for prosomal widths. The survey collects and reports depth, air temperature, water temperature, salinity, DO (1998 onwards), set duration, and tide.

5.2.16.3 Evaluation of Survey Data
A spring (March-May) and a fall (July-September) index were developed from this survey. Horseshoe crabs were more reliably caught in the spring with 13% positive tows than in the fall when there were 6% positive tows, so the SAS decided to use the spring portion of this survey in the assessment. Due to low catches of horseshoe crabs, depths over 2.2 m were excluded and data was subset to waterbodies that encountered horseshoe crab. Nearly all horseshoe crabs caught in the survey were sexed, but the SAS concluded that too few horseshoe crabs were collected in total to justify using the sex ratio from the catch as representative of the population in the region. Based on the prosomal widths provided, this survey catches primarily adults in the spring.

5.2.16.4 Abundance Index Trends

The index of abundance began relatively low in 1995 and began to increase in the late-2000s (Figure 67). The index reached its highest value in 2012 and decreased to another low in the terminal year of 2017.

5.2.17 Southeast Area Monitoring and Assessment Program

5.2.17.1 Survey Design and Methods

The Southeast Area Monitoring and Assessment Program (SEAMAP) South Atlantic Coastal Trawl Survey has been sampling from Cape Hatteras, North Carolina, to Cape Canaveral, Florida since 2001 (Figure 68). Trawls operate in the spring (early April-mid-May), summer (mid-July-early August), fall (October-mid-November). Stations are randomly selected from a pool of stations within each of 24 strata. The number of stations sampled in each stratum is determined by optimal allocation. A total of 102-112 stations are sampled each season (306-336 stations/year).

5.2.17.2 Biological and Environmental Sampling

Contents of each net are sorted separately to species and counted. Only total biomass is recorded for all other miscellaneous invertebrates (excluding cannonball jellies) and algae, which are treated as two separate taxonomic groups. Measurements of finfish are recorded as total length or fork length, measured to the nearest centimeter. Additional data are collected on individual specimens of priority species including horseshoe crabs (prosomal width in mm, individual weight, and sex). Latitude, longitude, water and air temperature, salinity, tow duration, and depth are recorded on each tow.

5.2.17.3 Evaluation of Survey Data

A spring (April-July) and a fall (October-November) index were developed from this survey. Horseshoe crabs were caught in the spring with 19% positive tows and in the fall when there were 25% positive tows. The SAS decided to use the fall-portion of the SEAMAP data. Depth was subset to 5-11 m due to low catches of horseshoe crab outside of those depths. The SAS split the data set further to develop two indices from SEAMAP: a South Carolina index and a Georgia-Florida index. A high proportion of horseshoe crabs caught in the survey were sexed, especially in the later years, but the SAS concluded that too few horseshoe crabs were collected in total to justify using the sex ratio from the catch as representative of the population when the survey was split by state. Based on the prosomal widths provided, this survey catches primarily adults in the fall.

5.2.17.4 Abundance Index Trends

The index of horseshoe crab abundance for South Carolina developed from the SEAMAP survey indicated low abundance at the beginning of the time series, an increase from 2009-2012, and a decreased abundance from 2013 through the terminal year (Figure 69). The index developed from the fall portion of the Georgia-Florida data indicates a low abundance of horseshoe crab with increased abundance in 2011, 2012, and 2016 with otherwise low abundance including in the terminal year (Figure 70).

5.2.18 Georgia Ecological Monitoring Trawl Survey

5.2.18.1 Survey Design and Methods

The Ecological Monitoring Trawl Survey (Georgia Trawl) conducted by GA DNR has operated along the Georgia coastline since 1999 (Figure 71). The survey operates monthly in creek, sound, and beach stations. There are 36 fixed stations that are sampled monthly.

5.2.18.2 Biological and Environmental Sampling

Catch is sorted by species and total number and weight are recorded. Selected finfish, shrimp and crabs are measured. Horseshoe crab counts, weights, sex are recorded. Tow duration, latitude, longitude, tide stage, water and air temperature, and salinity are recorded.

5.2.18.3 Evaluation of Survey Data

A spring (March-May) and a fall (September-November) index were developed from this survey. Horseshoe crabs were caught in the spring with 42% positive tows and in the fall with 38% positive tows. The SAS decided to use the spring-portion of the Georgia Trawl data. Depth was subset to 5-14 m due to low catches of horseshoe crab outside of those depths. All of horseshoe crabs caught in the survey were sexed, but the SAS concluded that too few horseshoe crabs were collected in total to justify using the sex ratio from the catch as representative of the population. Based on the prosomal widths provided, this survey catches primarily adults in the fall.

5.2.18.4 Abundance Index Trends

For the spring index developed from the Georgia Trawl data, abundance of horseshoe crabs varied but appeared to be increasing in recent years (Figure 72).

5.3 Index Correlations

Association of abundance indices for horseshoe crab was evaluated with Spearman's rank correlation coefficient, or Spearman's rho (ρ). This is a nonparametric test to evaluate association of two ranked variables over time (i.e., indices of abundance). Associations were evaluated between indices by region.

5.3.1 Northeast Region

There were three indices developed for the Northeast region: Massachusetts's Trawl North Cape, Massachusetts's Trawl South Cape, and the Rhode Island Monthly Trawl. The North and South Cape indices were positively correlated with each other but negatively correlated with the Rhode Island Trawl (Figure 73) although all of the correlations were insignificant ($P>0.05$).

5.3.2 New York Region

Five indices of horseshoe crab abundance were developed for the New York Region for this assessment: Connecticut Long Island Sound Trawl Survey, New York's Peconic Bays, Seine Jamaica Bay, and Little Neck and Manhasset Bays, and NEAMAP New York portion. All surveys were positively correlated with each other (Figure 74) although all were insignificant ($P>0.05$) except for the positive correlation between the Connecticut Long Island Sound Trawl Survey and New York's Peconic Bays (ρ=0.59, P=0.020) and New York's NEAMAP portion and the New York Seine Jamaica Bay (ρ=0.52, P=0.026).

5.3.3 Delaware Bay Region

Eight indices of horseshoe crab abundance were developed for the Delaware Bay region. For the correlation analysis, only the following combined sexes and adult surveys were tested: Delaware's Adult Trawl spring and fall indices, New Jersey's Ocean Trawl spring and fall indices, New Jersey Surf Clam, Maryland Coastal Bays, NEAMAP portion that operates in the Delaware Bay, and the Virginia Tech Trawl Survey. All correlations are insignificant (P>0.05) except for the correlations between the Delaware Adult Trawl spring and fall indices (ρ=0.69, p<0.001), Delaware Adult Trawl spring and New Jersey Ocean Trawl fall (ρ=0.28, P<0.001), New Jersey Ocean Trawl spring and Surf Clam surveys (ρ=-0.77, P=0.011), and NEAMAP and the Virginia Tech Trawl (ρ=0.36, P=0.020) (Figure 75).

5.3.4 Southeast Region

Six surveys were developed into abundance indices for horseshoe crab for the Southeast region: South Carolina's Trammel, CRMS, and SEAMAP (South Carolina portion), North Carolina's Gill Net Survey, Georgia Trawl Survey, and SEAMAP (Georgia-Florida portion). There were both positive and negative correlations among the surveys in this region (Figure 76) but all were insignificant (P>0.05) except for the correlations between the North Carolina Gill Net and South Carolina Trammel indices (ρ=0.53, P=0.036), the North Carolina Gill Net and South Carolina CRMS indices (ρ=-0.62, P=0.010), and SEAMAP's South Carolina and Georgia-Florida indices (ρ=0.81, P<0.001).

6 METHODS

6.1 Power Analysis

6.1.1 Background of Analysis and Model Description

Power analysis was used to calculate the probability of detecting trends in the abundance indices developed from fishery-independent data using the methods of Gerrodette (1987). Using this approach, changes in abundance can take place due to constant increments (linear model) or at a constant rate (exponential model). Linear trends were modeled as $A_i=A_1[1+r(i-1)]$ where A_i represents the abundance as a function of an index of time (i) and r is a constant increment of changes as a fraction of the starting abundance index (A_1). Exponential trends were modeled as $A_i=A_1(1+r)^{i-1}$. For a linear change, $r=R/(n-1)$ where R is the overall fraction change in abundance. For an exponential change, $r=(R+1)^{1/(n-1)} - 1$. For each survey, the median CV can be calculated as the median proportional standard error or ($SE(A_i)/A_i$). The SAS established a reference point of a power of 0.80 for surveys to detect an increasing trend.

6.1.2 Model Configuration

All fishery-independent surveys that were developed into abundance indices were tested in the power analysis including any season or sex specific variants. Variability in abundance as a function of both linear and exponential change was tested using a one-tailed test. Power was calculated for a change (R) of ±50% over a 20-year time period for both a linear and exponential trend.

6.1.3 Model Results

Median CVs, or proportional standard error, ranged from 0.132-0.817 for the surveys analyzed and power values ranged from 0.18 to 1.0 (Table 36). Surveys with low CVs had higher power and those with high CVs had lower power as was expected. Exponential trends indicated slightly higher power than linear trends. For both linear and exponential trends, the ability to detect decreasing trends was higher than that of increasing trends. The surveys with greater than a 0.80 power of being able to detect a 50% increase in abundance were Connecticut LISTS, New York Peconic Bay and Seine Survey for Little Neck and Manhasset Bays, Delaware Adult Trawl (spring portions), NEAMAP, portions of the New Jersey Ocean Trawl, New Jersey Surf Clam, Virginia Tech Trawl, North Carolina Gill Net, South Carolina CRMS, and Georgia Trawl. The remaining surveys all fell below the desired power of 0.80 and therefore the ability to detect trends in the past 20 years is limited for many of the surveys used in this assessment.

6.2 Conn Method

6.2.1 Background of Analysis and Model Description

When several population abundance indices provide conflicting signals, hierarchical analysis can be used to estimate a single population trend. The abundance indices for horseshoe crab were combined into regional composite indices using hierarchical modeling as described in Conn (2009). This method assumes each index samples a relative abundance but that the abundance is subject to sampling and process errors. It can be used on surveys with different time series, but it does assume that indices are measuring the same relative abundance.

6.2.2 Model Configuration

Abundance indices for horseshoe crabs from each region were standardized to their means. Indices were combined using the methods of Conn in R and WinBUGS. The Massachusetts Trawl North Cape, Massachusetts's Trawl South Cape, and Rhode Island Monthly Trawl were combined to form a northeast region composite index for 1978-2017. For the New York Region, the Connecticut LISTS, New York Peconic, NEAMAP (New York strata only), New York Seine Jamaica Bay, and New York Seine Little Neck and Manhasset Bay indices were combined for a New York region composite index for 1987-2016. For the Delaware Bay Region, several Conn indices were developed in order to support the models for that area. An adult composite was developed from the spring and fall components of the New Jersey OT and Delaware Adult Trawl, the NJ Surf Clam, NEAMAP (Delaware Bay strata only), VT Tech Trawl, and Maryland Coastal Bays surveys. Additionally, female-only and male-only indices were developed using the sex-specific indices developed from the New Jersey OT and Surf Clam, VT Tech Trawl, and Delaware Adult Trawl surveys. A southeast region Conn for 1995-2017 was developed from the North Carolina Gill Net, South Carolina Trammel, CRMS, and SEAMAP (South Carolina strata only), Georgia Trawl, and SEAMAP (Georgia-Florida strata only).

The estimates of process error variance for each of the indices were also examined. High sigma (σp) values, or the standard deviation of the process errors, suggest that the index may be a poor index for tracking abundance or may be measuring a different subpopulation whereas lower values indicate indices that may be better tracking the population or are consistent with the other indices included.

6.2.3 Model Results

The hierarchical index developed for the Northeast region predicted variable but stable abundance from 1978-2017, with moderate peaks in the terminal year estimates (Figure 77). The standard deviation of the process errors for the surveys used in the Northeast region Conn were higher for the Massachusetts Trawl, both the North and South Cape indices, than those of the Rhode Island Monthly Trawl (Table 37), indicating that the surveys may be tracking different populations or it may be reflecting differences in sampling programs (see Conn 2009 for a more thorough discussion).

The hierarchical index developed for the New York region predicted stable abundance throughout the time series with a slight increase in recent years (Figure 78). The standard deviation of the process errors for the surveys used in the New York region Conn had similar sigma values with the New York portion of NEAMAP being slightly higher (Table 37). This may indicate that the offshore NEAMAP trawl may be slightly out of line with the other more inshore surveys, but the sigma is still within an acceptable range.

The hierarchical indices developed for the Delaware Bay region for males and females combined, males-only, and females-only followed similar trends (Figure 79 - Figure 81). The indices predicted high abundance in the 1990s decreasing to a stable but low abundance in the early 2000s. The index is variable from 2005 through the terminal year but appears to have a slight increase from 2014-2016. The standard deviation of the process errors for the surveys used in the Delaware Bay region Conn ranged from 0.171 to 0.948 with the Virginia Tech Trawl survey having the lowest sigma values and the Delaware Adult Trawl having the highest (Table 37). The Virginia Tech Trawl survey is the only non-spawning beach survey that is specifically designed to monitor horseshoe crab and its low sigma value indicates that it is the most informative survey available.

The hierarchical index developed for the Southeast region predicted low abundance from the mid-1990s through the late 2000s when abundance starts increasing until a slight downtick in the terminal years (Figure 82). The standard deviation of the process errors for the surveys used in the Southeast region Conn had similar sigma values except for both SEAMAP indices, which had very high sigma values (Table 37). These indices may not be a good measure of horseshoe crab abundance in the region, or they may be measuring something else such as an offshore population (see Conn 2009 for a more thorough discussion).

6.3 Autoregressive Integrative Moving Average (ARIMA)

6.3.1 Background of Analysis and Model Description

Fishery independent surveys for horseshoe crabs can be quite variable, making inferences about population trends uncertain. Observed time series of abundance indices represent true changes in abundance, within survey sampling error, and varying catchability over time. One approach to minimize measurement error in the survey estimates is by using autoregressive integrated moving average models (ARIMA, Box and Jenkins 1976). The ARIMA approach derives fitted estimates of abundance over the entire time series whose variance is less than the variance of the observed series (Pennington 1986). This approach is commonly used to gain insight in stock assessments where enough data for size or age-structured assessments (e.g. yield per recruit, catch at age) are not yet available.

Helser and Hayes (1995) extended Pennington's (1986) application of ARIMA models to fisheries survey data to infer population status relative to an index-based reference point. This methodology yields a probability of the fitted index value of a particular year being less than the reference point [P(indext<reference)]. Helser et al. (2002) suggested using a two-tiered approach when evaluating reference points whereby not only is the probability of being below (or above) the reference point is estimated, the statistical level of confidence is also specified. The confidence level can be thought of as a one-tailed a-probability from typical statistical hypothesis testing. For example, if the P(indext<reference) = 0.90 at an 80% confidence level, there is strong evidence that the index of the year in question is less than the reference point. This methodology characterizes both the uncertainty in the index of abundance and in the chosen reference point. Helser and Hayes (1995) suggested the lower quartile (25th percentile) of the fitted abundance index as the reference point in an analysis of Atlantic wolfish (Anarhichas lupus) data. The use of the lower quartile as a reference point is arbitrary but does provide a reasonable reference point for comparison for data with relatively high and low abundance over a range of years.

The purpose of this analysis was to fit ARIMA models to time series of horseshoe crab abundance indices to infer the status of the population(s).

6.3.2 Model Configuration

Relative abundance indices included in this analysis are shown in Table 38. The ARIMA model fitting procedure of Pennington (1986) and bootstrapped estimates of the probability of being less than an index-based reference point (Helser and Hayes 1995) and corresponding levels of confidence (Helser et al. 2002) were coded in R (R code developed by Gary Nelson, Massachusetts Division of Marine Fisheries). ARIMA models were fit to ln transformed index values in the majority of surveys but were fit to ln+0.01 transformed index values for surveys that had an index value of 0 in one or more years. An 80% confidence level was chosen for evaluating P(indext<reference). Two index-based reference points were considered: 1) the lower quartile of the fitted abundance index (Q25) as proposed by Helser and Hayes (1995); and 2) the fitted abundance index from 1998 – the time of development of the ASMFC Interstate Management Plan for horseshoe crabs. The use of two reference points allowed

evaluation of the status of the horseshoe crabs with respect to historic levels, and just prior to the implementation of harvest restrictions to determine if such restrictions have resulted in an increase in abundance.

6.3.3 Model Results

The ARIMA models provided adequate fits to nearly all of the horseshoe crab indices. In two cases (Table 38), residuals from the ARIMA model fits were not normally distributed and subsequent bootstrapped probabilities of being below reference point values should be considered with caution. The survey whose residuals were not normally distributed were MA DMF Trawl survey north of Cape Cod and the GA Spring Trawl survey.

Trends in fitted abundance indices from ARIMA models showed much variation among surveys (Figure 83-Figure 89) both between and within regions. In the Northeast Region (Figure 83), indices generally displayed a decreasing trend with the exception of the MA DMF Trawl which showed an increasing trend after 2013 south of Cape Cod. All indices in the New York Region showed a decreasing trend (Figure 84) with the Peconic Trawl survey showing the greatest relative decrease. Trends in the Mid-Atlantic region (Figure 85–Figure 88) were either increasing in recent years (e.g. DE 30 ft. Trawl survey, NJ Surf Clam Dredge, NJ Spring Ocean Trawl) or stable (e.g. MD Coastal Bays Trawl). The Virginia Tech Trawl Survey (Figure 88) showed relatively large fluctuations prior to its interruption after 2011. Once it resumed in 2016, index values increased over those observed in 2011 and 2016 and 2017 values were similar. Indices in the Southeast Region were generally increasing prior to 2010 across all surveys (Figure 89), but since then have fluctuated or showed a slight decreasing trend in recent years.

Bootstrapped probabilities that the terminal year of indices were below reference points also varied greatly among surveys (Table 39). To generalize the probabilities of terminal year being below reference points, the SAS considered a probability of ≥0.50 as being "likely" to be below reference points (Table 40). Only those surveys whose residuals from fitted ARIMA indices were normally distributed, were overall combined-sex surveys (i.e. not double counting surveys who separated sexes), and whose terminal year was either 2016 or 2017 were considered. In the Northeast Region, 1 out of 2 surveys were likely less than the 1998 reference point and 1 out of 2 surveys were likely less than the Q25 reference point. In the New York Region, 4 out of 4 surveys were likely less than the 1998 reference point and 4 out of 5 surveys were likely less than the Q25 reference point. In the Mid-Atlantic Region, 2 out of 5 surveys were likely less than the 1998 reference point and no survey was likely less than the Q25 reference point. Finally, in the Southeast Region, no survey was below either the 1998 or the Q25 reference point. Coastwide, 7 out of 13 surveys were likely less than the 1998 reference point and 5 out of 19 surveys were likely less than the Q25 reference point.

6.4 Horseshoe Crab Operating Model

6.4.1 Background of Analysis and Model Description

The horseshoe crab is a long-lived species with females reaching sexual maturity at approximately ten years of age (Sweka et al. 2007). A major difficulty in stock assessments of horseshoe crabs is that individuals in the catch and in fishery-independent surveys cannot be aged, thus negating the application of age-structured assessment models. Application of surplus production models to horseshoe crabs has been questioned due to their long age to maturity. Following the 2009 ASMFC horseshoe crab benchmark stock assessment, the peer-review panel recommended the development of an operating model of horseshoe crab population dynamics to generate known data sets of catch and fishery-independent surveys which could then be used as input data to a surplus production model to test if such a simple model could accurately estimate fishing mortality, biological reference points, and be used to determine stock status (i.e., overfishing, overfished). Also, attempts were made in this assessment to apply an index method (Rago and Legault *unpublished manuscript,* https://www.nefsc.noaa.gov/nft/AIM.html) and a catch survey model (Collie and Sissenwine 1983) in some areas and an operating model would also be useful in evaluating the merits of these models as well.

6.4.2 Model Configuration

An operating model for horseshoe crab population dynamics was developed largely from the model described by Sweka et al. (2007). This was an age-structured model and only modeled female crabs. Life history parameters are provided in Table 41. The maximum age of crabs in the model was set to 20 years. Natural mortality (*M*) varied with age and crabs began maturing at age 10 and were fully mature by age 12. For individuals in maturing age classes (ages 10 and 11), natural mortality was lower for immature individuals compared to mature individuals. Partial recruitment to the fishery followed the same schedule as maturity. Fecundity of mature crabs was 80,300 eggs.

The number (*N*) of age class *i* at time *t* was:

$$N_{i,t} = N_{i-1,t-1}e^{(M_i + R_i \cdot F)}$$

where *R* is the age-specific partial recruitment to the fishery and *F* is the fishing mortality. Because natural mortality differed between mature and immature individuals within an age class, the model separated age 10, 11, and 12 into immature, primiparous (first time spawners), and multiparous (spawing at least once before) individuals.

$$N_{10imm,t} = N_{9,t-1}e^{(M_9 + R_9 \cdot F)}(1 - m_{10})$$

$$N_{10primi,t} = N_{9,t-1}e^{(M_9 + R_9 \cdot F)}(m_{10})$$

$$N_{11imm,t} = N_{10,t-1}e^{(M_{10imm} + R_{10imm} \cdot F)}(1 - m_{11})$$

$$N_{11primi,t} = N_{10imm,t-1}e^{(M_{10imm}+R_{10imm} \cdot F)}(m_{11})$$

$$N_{11multi,t} = N_{10primi,t-1}e^{(M_{10primi}+R_{10primi} \cdot F)}$$

$$N_{12primi,t} = N_{11imm,t-1}e^{(M_{11imm}+R_{11imm} \cdot F)}(m_{12})$$

$$N_{12multi,t} = N_{11primi,t-1}e^{(M_{11primi}+R_{11primi} \cdot F)} + N_{11multi,t-1}e^{(M_{11multi}+R_{11multi} \cdot F)}$$

Age-specific catch was calculated using Baranov's catch equation:

$$C_{i,t} = \left(\frac{R_i \cdot F}{M_i + R_i \cdot F}\right) \cdot (1 - e^{M_i+R_i \cdot F}) \cdot N_{i,t}$$

The number of female eggs produced in a year was equal to the number of sexually mature individuals multiplied by fecundity and divided by 2.

$$E_t = \left(\sum N_{i,mature,t} \cdot f\right)/2$$

Density-dependence was incorporated into the model through density-dependent egg mortality as described in Sweka et al. (2007) and Smith (2007) and depended on the number of mature crabs. As the number of spawning crabs increases, nest disturbance increases, thus bringing more eggs to the surface which do not survive and more female crabs spawn in less optimal habitat with lower egg survival. Survival of eggs to hatching as age 0 crabs was described by the function:

$$S_{egg,t} = 1 - \left(0.0957 \cdot \ln\left(\sum N_{i,mature,t} \cdot m_i\right) - 0.995\right)$$

The number of age 0 female crabs at the beginning of the year was:

$$N_{0,t} = E_t \cdot S_{egg,t}$$

The model was coded in a MS Excel spreadsheet and the carrying capacity (K) of the simulated population was determined by allowing the population to grow under no fishing mortality until the number of mature females reached an asymptote. To determine the maximum sustainable yield of this simulated population, the population started at K and was projected 400 years into the future. The fishing mortality associated with maximum sustainable yield (Fmsy) was solved for by maximizing the total catch in year 400 and the associated biomass at maximum sustainable yield (Bmsy) was equal to the total number of mature female crabs in year 400 when catch was maximized.

Given the life history parameters of this simulated population, the carrying capacity was determined to be 14,569,967 mature female crabs. Maximum sustainable yield was determined to be 647,609 female crabs which corresponded to an Fmsy of 0.1613 and a Bmsy of 5,433,439 crabs (Figure 90).

6.4.3 Simulated Data

Following development of the operating model, four data sets were simulated to examine how accurately a surplus production model (ASPIC; Prager 1994) and a catch survey model could estimate population parameters. In each of these scenarios, the model started with the population at equilibrium at the carrying capacity. Fishing mortality, F, was then allowed to vary annually according to a uniform distribution with bounds described in Table 42. The data time series used in the surplus production and catch survey models started 10 years after harvesting of the population began and ran for a total of 50 years. The harvest scenarios simulated were:

1) Constant F and a "one-way trip" of a declining population

2) Decreasing F through time

3) Very low F after initial harvest followed by a period of increased F

4) Decreasing F followed by very low F. Age-specific natural mortality was allowed to slightly vary according to a normal distribution with a CV = 0.01.

Fishery-independent surveys were generated for the surplus production and catch survey models by assuming values of the catchability coefficient (q) equaled 0.00012. Simulations for testing the surplus production applied q to total number of mature females while simulations for the catch survey model applied q separately for primiparous and multiparous individuals in order to generate an index for newly recruited individuals and previously recruited individuals, respectively. A fifty-year time series of each scenario's catch and fishery-independent indices were then used as input data to an index method, surplus production model, and catch survey model to evaluate model performance.

6.5 Application of an Index Method for Horseshoe Crab

The SAS attempted to apply An Index Method (AIM) model to horseshoe crabs in each region along the coast. This method was developed by Rago and Legault (unpublished manuscript) and is available in the NOAA Fisheries Toolbox (https://www.nefsc.noaa.gov/nft/AIM.html). This is a data poor stock assessment model that only requires a time series of catch data and a corresponding index of abundance and is typical of the situation in all regions of the coast other than the Delaware Bay for horseshoe crabs. AIM fits a linear relationship between the replacement ratio derived from a smoothed index of abundance and relative F (catch/abundance index) and characterizes the population response to varying levels of fishing mortality. If the relationship between the replacement ratio and relative F is valid, AIM can be used to estimate the level of relative F at which point the population is likely to be stable and catch recommendations can be made.

Although the minimal data requirements of AIM were attractive to use in the assessment of horseshoe crabs, the SAS abandoned its application for multiple reasons. In the New York region, AIM was not a suitable stock assessment model because of the general continuous decline in abundance indices despite changes in catch (i.e., a "one-way trip" situation). There are no general guidelines on the number of years to smooth the abundance index when calculating the replacement ratio, and the SAS attempted different numbers of years in smoothing. The significance of the linear relationship between the replacement ratio and relative F varied greatly depending on both the number of years used in smoothing and the fishery-independent surveys used in the model even when those surveys all assessed the same population of horseshoe crabs. It made intuitive sense that the number of smoothing years should reflect the life history of the horseshoe crabs with a long time to maturity and a 10-year smoothing was tested with simulated data from the operating model. Results of this testing were very inconsistent between simulated data series and the SAS determined that AIM did not adequately capture the dynamics of a long-lived species such as horseshoe crab and further application of this model was dropped from this assessment.

6.6 Testing of Surplus Production Model with the Operating Model

6.6.1 Background of Analysis and Model Description

The surplus production model was developed for horseshoe crabs in the Delaware Bay region because of its relatively simple modeling approach. Surplus production models combine the effects of recruitment, growth, and mortality into a single function and assume no size or age structure in the population. It requires a time-series of fishery removals and one or more time-series of catch-per-unit effort from a survey. The model assumes that the population is closed, the environment is constant, abundance indices are proportional to the true population abundance, total catch is known without error, the stock responds instantaneously to changes, and that the intrinsic rate of increase (r) and carrying capacity (K) remain constant.

The 2009 benchmark stock assessment included the application of a surplus production model for the Delaware Bay region (ASMFC 2009a). The model was not included in the 2013 stock assessment update because the benchmark did not include mortality due to the biomedical industry which was considered an oversight. Additionally, in 2009, the Peer Review Panel expressed concern about the long time period (~9 years) horseshoe crabs spend before they recruit to the fishery and questioned if this is a suitable model for the species. They suggested that the SAS further evaluate the violation of the assumption that "the stock reacts instantaneously to changes in conditions" given only mature crabs are included in the model and it takes the species 9-11 years to mature. Additionally, the Panel stated that the potential for this model to provide good estimates of stock status relative to reference points (e.g., FMSY) in regions outside the Delaware Bay would be challenging due to lack of contrast in the time series that were available for those regions.

The Panel made several suggestions for testing the surplus production model for horseshoe crab before using it to assess the stock. They recommended that an operating model for evaluating the performance of the surplus production model should be explored such as the simple age-structured operating model similar to Sweka et al. (2007). They suggested the development of an operating model of horseshoe crab population dynamics to generate known data sets of catch and fishery-independent surveys which could then be used as input data to a surplus production model to test if such a simple model could accurately estimate fishing mortality, biological reference points, and be used to determine stock status (i.e., overfishing, overfished).

6.6.2 Model Configuration

The SAS tested the application of the surplus production model with an age-structured operating model adapted from Sweka et al. (2007), described in Section 6.3, before developing it for horseshoe crab by region for this assessment.

All four simulated data sets were analyzed with the surplus production model in ASPIC (Prager 1994). The non-equilibrium Graham-Schaefer, or logistic, form was used to test this model for horseshoe crab. For inputs into the model, the simulated catch and abundance index were used. The starting values for the model were calculated as follows:

1) B_1/K =0.05

2) MSY=1/2*Maximum Catch

3) K=10*Maximum Catch

4) q=Average Index Value/(2*Maximum Catch)

Both MSY and K had minimum and maximum constraints of 1/8 and 8 times their values. The surplus production model estimates MSY and the associated MSY-based references points of B_{MSY}, the stock biomass associated with MSY, and F_{MSY}, the fishing mortality that maximizes the yield from the population. These absolute values are usually imprecise (Prager 1994) since they require good estimates of catchability (q). Relative biomass (B/B_{MSY}) and relative fishing mortality (F/F_{MSY}) can be used to determine overfishing and overfished status. All of the calculations for horseshoe crab were done in numbers, not weight, although “biomass” will still be referenced in the model outputs.

6.6.3 Model Results

6.6.3.1 Simulation 1

The first simulation represented a constant F and a “one-way trip” of a declining population. The pattern of the true F and the ASPIC-estimated F followed similar patterns but were on different scales with the true F being higher than the surplus production estimated F (Figure 91). True population numbers and ASPIC-estimated numbers had a similar result where the patterns were alike, but the scales were different with the estimated population numbers being higher than the true numbers. The application of a surplus production model often results in imprecise absolute values of fishing mortality and biomass, but relative fishing mortality and biomass usually can be used to determine overfishing and overfished status. Both the relative fishing mortality and biomass followed similar patterns throughout the time series when comparing the true values to the ASPIC-estimated values. Both relative F’s indicated overfishing (F/F_{MSY} >1) but the true values indicated that the stock was not overfished (B/B_{MSY}>1) whereas

ASPIC determined the stock was overfished for most years (B/B_{MSY}<1). The difference in overfished status between ASPIC and true values from the operating model is a concern for the application of the surplus production model for horseshoe crab.

6.6.3.2 Simulation 2

The second simulation represented a decreasing *F* through time. The pattern of the true *F* and the ASPIC-estimated F followed similar patterns but were on different scales with the true *F* being higher than the surplus production estimated *F* (Figure 92). True population numbers and ASPIC-estimated numbers had a similar result where the patterns were alike, but the scales were different with the ASPIC-estimated population numbers being higher. The application of a surplus production model often results in imprecise absolute values of fishing mortality and biomass, but relative fishing mortality and biomass usually can be used to determine overfishing and overfished status. Both the relative fishing mortality and biomass followed similar patterns throughout the time series when comparing the true values to the ASPIC-estimated values, but true relative *F* indicated some overfishing in the early years (F/F_{MSY} >1) whereas ASPIC indicated no overfishing. True and ASPIC-estimated relative biomass were similar in pattern and values with both indicating that the stock was not overfished (B/B_{MSY} >1).The difference in overfishing status is a concern for the application of the surplus production model for horseshoe crab.

6.6.3.3 Simulation 3

The third simulation represented an institution of a moratorium followed by a low *F*. The pattern of the true *F* and the ASPIC-estimated *F* followed similar patterns but were on different scales with the true *F* being higher than the surplus production estimated *F* (Figure 93). True population numbers and ASPIC-estimated numbers had a similar result where the patterns were alike, but the scales were different with the ASPIC-estimated population numbers being higher. The application of a surplus production model often results in imprecise absolute values of fishing mortality and biomass, but relative fishing mortality and biomass usually can be used to determine overfishing and overfished status. Both the relative fishing mortality and biomass followed similar patterns throughout the time series when comparing the true values to the ASPIC-estimated values, but true relative *F* indicated some overfishing in the early years (F/F_{MSY} >1) whereas ASPIC indicated no overfishing. True and ASPIC-estimated relative biomass were similar in pattern and values with both indicating that the stock was not overfished (B/B_{MSY}>1).The difference in overfishing status is a concern for the application of the surplus production model for horseshoe crab.

6.6.3.4 Simulation 4

The fourth simulation represented a high *F* flowed by a moratorium. The pattern of the true *F* and the ASPIC-estimated *F* followed similar patterns but were on different scales with the true *F* being higher than the surplus production estimated *F* (Figure 94). True population numbers and ASPIC-estimated numbers had a similar result where the patterns were alike, but the scales were different with the ASPIC-estimated population numbers being higher. The application of a surplus production model often results in imprecise absolute values of fishing mortality and biomass, but relative fishing mortality and biomass usually can be used to determine overfishing and overfished status. Both the relative fishing mortality and biomass followed similar patterns throughout the time series when comparing the true values to the ASPIC-estimated values, but true relative *F* indicated some overfishing in the early years (F/F_{MSY} >1) whereas ASPIC indicated no overfishing. True and ASPIC-estimated relative biomass were similar in pattern and values with both indicating that the stock was not overfished (B/B_{MSY}>1). The difference in overfishing status is a concern for the application of the surplus production model for horseshoe crab.

6.6.3.5 Summary of Model Results

The application of the surplus production model for assessing the status of horseshoe crabs was tested using simulated data from an operating model as suggested by the 2009 Peer Review Panel. The simulated data results indicated that the surplus production model is poor at estimating absolute values of horseshoe crab population numbers and fishing mortality. In all four scenarios, ASPIC overestimated population numbers and underestimated *F*. For relative fishing mortality and biomass, ASPIC suggested a different overfishing or overfished status from the true simulated values for all four scenarios. For simulation 1 where *F* was variable but stable and population numbers were decreasing, ASPIC results suggested the stock was overfished when the true values from the operating model did not. Conversely, for simulations 2-4 where *F* decreased throughout the time series in different ways, ASPIC underestimated relative fishing mortality and failed to show overfishing in the first decade of the simulation. Ultimately, when comparing the true values and the estimated values, the surplus production model did not successfully estimate relative quantities compared to the true quantities. The simulation work confirms the suspicions of the 2009 Peer Review Panel and indicates that the application of the surplus production model for horseshoe crab is not appropriate. The results are likely due to the violation of the assumption that “the stock reacts instantaneously to changes in conditions” given only mature crabs are included in the model and it takes the species 9-11 years to mature. Therefore, the surplus production model was not further developed for horseshoe crab in this assessment.

6.7 Catch Survey Analysis

6.7.1 Background of Analysis

Initial attempts at modeling Delaware Bay horseshoe crab stock dynamics using a catch-survey analysis (CSA) began in 2008 (ASMFC 2009a) adhering largely to the methods described in Collie and Sissenwine (1983). The horseshoe crab’s unique life history was well-suited to the two-stage modeling approach, as newly mature horseshoe crabs (termed ‘primiparous’) exhibit readily-identifiable secondary sexual characteristics, cease molting, and recruit into the spawning population in the ensuing year (Schuster and Sekiguchi 2003). Horseshoe crabs that have spawned at least once (termed ‘multiparous’) bear identifiable, permanent, mating abrasions (Hata and Hallerman 2009b, 2009c). Relative abundances of primiparous and multiparous crabs are measured in the Virginia Tech horseshoe crab trawl survey (VT survey) in the fall directly outside of the population's major spawning grounds (Hata and Hallerman 2018). Primiparous and multiparous females were used as indices of pre-recruits and full-recruits in the CSA model. The original model contained a limited survey time series (8 years) and lacked some sources of harvest information (most notably biomedical mortalities). Realistic outputs were producible, although model instability was an issue (due to the shortened time series and survey variability) that could be overcome by allowing a freely-estimable primiparous catchability parameter (R. Wong, unpublished). Given the favorable horseshoe crab life history and early modeling work, the 2009 Stock Assessment Peer Review Panel encouraged the continued development of the CSA in future assessments (ASMFC 2009a).

6.7.2 Model Description

A catch multiple survey analysis (CMSA) was developed for this stock assessment tailored to available horseshoe crab survey and harvest information in order to produce estimates of Delaware Bay adult female abundance and fishing mortality rates (poor fit to survey indices prevented the development of male-only and combined split-sex models.). The CMSA contains a similar, simplified model structure to the Chesapeake Bay Blue Crab sex-specific catch multiple survey analysis by Miller et al. (2011). The model tracks the dynamics between two horseshoe crab stages: a) primiparous (newly mature yet spawning-naive) females; and b) multiparous (spawning-experienced) females. The broad assertion is that all primiparous females will participate in the proceeding spring spawning event, thus fully entering the multiparous stage within a single year (12-month period). It is also widely accepted that horseshoe crabs undergo a terminal molt at maturity (Shuster and Sekiguchi 2003). Therefore, multiparous abundance in a given year is a direct function of the primiparous and multiparous abundance in the previous year minus harvest and natural mortality. These adjacent reproductive stages are readily-identifiable in the field (Hata and Hallerman 2009b, 2009c), making horseshoe crabs well-suited to the catch-survey model dynamics.

The catch multiple survey model is based on the first order difference equation:

$$N_{y+1} = \left(\left(N_y + R_y\right)e^{-Mt} - C_y\right)e^{-M(1-t)} \quad (1)$$

which relates the fully-recruited abundance at the beginning of the year (N_{y+1}), to the fully-recruited abundance at the beginning of the previous year (N_y), plus pre-recruit abundance in the previous year(R_y), minus catch (C_y), all decremented by natural mortality, M, with t representing the fraction of the year corresponding to the harvest midpoint.

Minimum data requirements for the model include: i) annual indices of relative abundance for each size stage; ii) relative selectivities of size stages to the survey gear; iii) annual harvest; and iv) an estimate of instantaneous natural mortality rate.

Survey indices of abundance are assumed proportional to absolute stock sizes and are described by

$$r_{i,y} = s_i q_i R_y e_i^{\delta y} \qquad (2)$$

and

$$n_{i,y} = q_i N_y e_i^{\eta y} \qquad (3)$$

where $r_{i,}$ and $n_{i,}$ are the observed indices of pre-recruit and fully-recruited horseshoe crabs from survey *i*, q_i is the survey catchability coefficient, and $e^{\eta y}$ and $e^{\delta y}$ are lognormally distributed random variables, which represent survey measurement errors. The term *s* relates the pre-recruit catchability to the full-recruit catchability expressed as the ratio of q_r/q_n (Conser 1994).

$$s = q_r/q_n \qquad (4)$$

Annual exploitation rates μ were calculated as

$$\mu_y = {C_y}\Big/{(R+N)_y} \qquad (5)$$

Instantaneous fishing mortality rates F were calculated from relationships between μ, instantaneous total mortality rate Z, and annual mortality rate A.

$$Z_{y+1} = \ln\left(\frac{(R_y + N_y)}{N_{y+1}}\right) \qquad (6)$$

$$A_y = 1 - e^{-Z_y} \qquad (7)$$

$$F_y = \mu_y \frac{Z_y}{A_y} \qquad (8)$$

Parameters are estimated by minimizing the objective function, which is the sum of the likelihood components for each data source. Each likelihood component consists of

$$L_i = k_i + \frac{1}{2} \sum_{y \in i} \left(\left(\ln O_{i,y} - \ln P_{i,y} \right)^2 / cv_{i,y} \right) \qquad (9)$$

where *O* and *P* are observed and predicted values of the indices of abundance for each survey *i*. Constants *k* were ignored to simplify the equations. Empirical survey *cv* (coefficient of variations) were used for each year of the index *i,y*. Likelihood weightings λ were employed to best use available horseshoe crab data sources.

6.7.3 Model Configuration

The unit stock being modeled in the CMSA was the Delaware Bay horseshoe crab population. The region, for purposes of defining the boundaries of this unit stock, included states from New Jersey to Virginia. All horseshoe crabs found in Delaware Bay and ocean waters of New Jersey and Delaware are considered part of the Delaware Bay stock. A significant proportion of horseshoe crabs found in ocean areas of Maryland and Virginia also belong to this unit stock.

After a review of genetics and tagging work, the Delaware Bay Ecosystem Technical Committee of the ASMFC concluded that 51% and 35% of horseshoe crabs found in the ocean areas of Maryland and Virginia are likely of Delaware Bay origin, as necessary to determine quota allocations across the region (ASMFC 2012). This assessment operated under this allocation arrangement for purposes of defining the unit stock and its harvest removals from across States within this region.

A one-year model time step based on the January to December calendar year was used. All model parameters were estimated in the log scale.

The CMSA model was implemented in ADMB version 12.0. Log-scale standard deviations of parameters and derived values were generated in ADMB as described in Fournier et al. (2012).

Three fishery-independent surveys provided information about Delaware Bay adult female abundance: the VT survey (see 5.2.12), Delaware Fish and Wildlife Adult Trawl Survey (see 5.2.10), and New Jersey Ocean Trawl Survey (see 5.2.8) (Figure 95 and Figure 96). Stage-specific, swept-area abundance estimates of primiparous and multiparous females from the VT survey (Hata and Hallerman 2018) were used as pre-recruit (r) and full-recruit (n) indices (Table 43). VT swept-area estimates were based on mean crab densities (assuming a lognormal delta-distribution) expanded to the Delaware Bay survey area, 5,127 km^2. The ratio s was set to unity, given no evidence to support differences in catchability between stages of similar size and, ostensibly, distribution. Since VT collections occur in October, these indices were lagged forward to represent n and r at the start of the ensuing calendar year (January). The VT survey did not operate from 2012 to 2015 due to funding limitations. Aggregate stage (r+n) indices were constructed from the DE and NJ trawl surveys, since mature animals were not specifically categorized as primiparous or multiparous in the field. Aggregate stage indices were based on spring trawl collections and were assumed to reflect abundance at the start of the model time-step. Empirical annual survey CVs were incorporated into the modeling framework.

Three sources of harvest were included in the CMSA model: i) commercial bait landings (see 4.1.2); ii) commercial discard mortalities (see 4.3.1.3); and iii) biomedical mortalities (see 4.2.6). All harvest data were partitioned to only adult female horseshoe crabs of Delaware Bay origin (Figure 97). Data collection and harvest quantification methods are described in detail in section 4. Discard data were unavailable for 2003, so it was assumed that discard mortalities equaled the 3-year average value estimated in 2004-2006.

Instantaneous natural mortality rate (M) on adult females was assumed to be M=0.274 based from empirical estimates of survival rates (mean =0.76) of tagged adult Delaware Bay horseshoe crabs from 2009-2017 (D.R. Smith, unpublished; see 2.1.3 and 2.6) and also on aligning mortality rate with long-held assumptions about maturity and longevity (see 2.6). M was assumed constant across years and equal for primiparous and multiparous females since both stages will experience spawning-related mortality, the primary source of adult natural mortality. A comprehensive review of natural mortality is provided in 2.6.

6.7.4 Testing of CMSA with the Operating Model

The SAS tested the application of the CMSA with an age-structured operating model adapted from Sweka et al. (2007), described in Section 6.3, before developing it for horseshoe crab for this assessment. Four simulated data sets were analyzed using CMSA in ADMB version 12.0 and the results are described below. To match the development of the operating model, the CSA used M=0.47 for simulation testing. Simulated primiparous and multiparous indices were provided along with catch values as inputs to the model. Comparisons were made between true population size and F and the estimated values calculated by the CMSA.

After reviewing the testing of the CMSA with the operating model, the SAS was satisfied with its performance and found it to be appropriate for further development and use in this assessment.

6.7.4.1 Simulation 1

The first simulation represented a constant F that ranged from 0.18-0.22 and a "one-way trip" of a declining population. The pattern of true and CMSA-estimated F, population estimates, and index estimates were nearly identical throughout the time series (Figure 98). To get total horseshoe crab numbers, the estimated primiparous and multiparous numbers were added together for the CMSA-estimated values and compared to the true values from the operating model.

6.7.4.2 Simulation 2

The second simulation represented a decreasing F through time. The pattern of true and CMSA-estimated F was nearly identical, with the CMSA slightly overestimating F in the beginning of the time series but otherwise predicting F to be similar to the true values (Figure 99). To get total horseshoe crab numbers, the estimated primiparous and multiparous numbers were added together for the CMSA-estimated values and compared to the true values from the operating model. The CMSA slightly underestimated the population but was very close to the true numbers. The index fits were very close to the true values.

6.7.4.3 Simulation 3

The third simulation represented an institution of a moratorium followed by a low F. The pattern of true and CMSA-estimated F was nearly identical, with the CMSA slightly overestimating F in the beginning of the time series but otherwise predicting F to be similar to the true values (Figure 100). To get total horseshoe crab numbers, the estimated primiparous and multiparous numbers were added together for the CMSA-estimated values and compared to the true values from the operating model. The CMSA slightly underestimated the population but was very close to the true numbers. The model fits to the indices were very close to the true values as well.

6.7.4.4 Simulation 4

The fourth simulation represented a high *F* followed by a moratorium. The pattern of true and CMSA-estimated *F* was nearly identical, with the CMSA slightly overestimating *F* in the beginning of the time series but otherwise predicting *F* to be similar to the true values (Figure 101). To get total horseshoe crab numbers, the estimated primiparous and multiparous numbers were added together for the CMSA-estimated values and compared to the true values from the operating model. The CMSA slightly underestimated the population but was very close to the true numbers. The model fits to the indices were very close to the true values as well.

6.7.5 Base Model Run

A base model was selected from extensive model building and testing of inputs, starting values, bounds, and choice of CVs and likelihood weights λ (Table 43).

The use of swept-area abundance estimates as inputs for r and n in lieu of mean catch-per-tow or densities was highly influential in the evolution of the base model. Given the artifact of unusually low magnitudes of annual landings, the use of swept area, scaled-up primiparous and multiparous estimates was needed in order to properly scale model-estimated population size. Catch is the critical input in model equation eq. (1) for scaling the population size. The CMSA time series occurs during a period of severe landings restrictions relative to historic levels and commercial moratoria (2007-present) on female harvest, which has resulted in marginal commercial landings (and elevated commercial discard rates). Given the use of swept-area estimates, a catchability coefficient was not estimated for the VT survey.

Survey indices and annual CVs from 2003--2018 were used in the base model (except 2013-2016 for the VT survey) (Table 43, Figure 95, Figure 96). The VT survey was not conducted in 2013-2016.

Model catch consisted of all commercial bait landings, commercial discard mortalities, and biomedical mortalities of Delaware Bay adult female horseshoe crabs from the unit region from 2003-2017 (Table 43, Figure 97). A 15% mortality rate was used for bled females reported by the biomedical industry based on a comprehensive literature review and analysis (Section 4.2.1).

Likelihood weights λ_i were based on results of a hierarchical analysis of adult female indices from the VT, DE, and NJ trawl surveys (Conn 2009). The Conn (2009) hierarchical analysis produces a composite index from multiple indices, whereby process error variances (σ^p) generated for each index can be used as an inverse measure of how well the index contributes to the composite (Conn 2009). The inverse Conn variances $(\sigma^p)^{-1}$ for VT, DE, and NJ survey indices (viz. 4.3, 1.12, and 1.8) were proportioned to sum to 1 (viz. 0.59, 0.16, 0.25) and used as λ_i for each likelihood component in the base model (Table 43). Twenty parameters were estimated: median primiparous abundance (1); primiparous abundance for each year (16); catchability coefficients (2) for the Delaware and New Jersey surveys; and multiparous abundance for the start of time series (1), summarized in Table 44.

6.7.6 Model Results

The base model produced excellent convergence criteria and was highly stable and robust to a wide range of starting parameter input values and bounds. Model predictions fit indices well, with excellent agreement with the primiparous index and well-behaved fits through observed multiparous indices (Figure 102-Figure 105).

Estimated primiparous abundance is fairly stable through the time series (Table 45, Figure 106). Rising multiparous abundance is evident and reflects some of the large increases seen in the multiparous trawl indices in later years (Table 45, Figure 107, Figure 108). Fishing mortality rates are very low (average *F*=**CONFIDENTIAL**[1]), seemingly properly reflecting the current period of highly protective fishery restrictions and moratoria (Figure 109).

6.7.7 Retrospective Analysis

Minor retrospective error or bias was detected from a data peel to 2009 (Figure 110-Figure 112). Mohn's (1999) ρ statistic for total, multiparous, and primiparous abundance was **CONFIDENTIAL** (Table 46). This is consistent with very little retrospective error seen in CSA estimates using simulated population data (Mesnil 2003).

6.7.8 Sensitivity Runs

Several sensitivity runs of the CMSA were conducted to evaluate effects of assumptions on natural mortality, harvest, λ, CVs, q, and starting values (Table 47, Figure 113).

A likelihood profile of *M* sensitivity runs showed best fit to data between $0.15 \leq M \leq 0.25$, much lower than the previously assumed M=0.47 for adults and supporting the base model M=0.274 (Figure 114). This lower level of *M* is in better agreement with the understanding of the horseshoe crab's extended longevity (>20y) and late maturity.

Varying catch inputs had little effect on model outputs given the low overall magnitude of removals. Model outputs of terminal *F* ranged from 0.007 when excluding biomedical data to **CONFIDENTIAL** when testing different assumed mortality rates of bled biomedical harvest ranging from 4%, 15%, and 30% (Table 47).

Commercial discard mortalities were a newly added source of harvest in this assessment. Beginning in 2007, discard mortalities have consistently been the biggest source of removals on the stock following the implementation of a commercial moratorium on female harvest in Delaware Bay. When discard mortalities were removed from the base model, terminal year

[1] Benchmark base run values are CONFIDENTIAL because they are based on harvest that includes numbers of horseshoe crabs attributed the biomedical industry. Values without biomedical data are F_{2017}=0.007 and B_{2018}=8,718,040. The benchmark values of F_{2017} and B_{2018} with the biomedical data, although minimally different, represent the best data but are CONFIDENTIAL.

fishing mortality was *F*= **CONFIDENTIAL**, a **CONFIDENTIAL** % reduction from the base model *F* (Table 47).

An equal weight λ_i =1 model produced considerably higher terminal stock size estimates since greater emphasis on the VT survey was no longer specified, allowing the model to more closely fit the sharply rising DE and NJ trawl indices. A base model using the unproportionalized Conn weights (4.3, 1.16, 1.8; VT, DE, NJ) predictably had little impact on outputs (Table 47).

Using fixed survey-wide CVs rather than annual CVs for each year of the index was tested. Survey-wide CVs [0.35, 0.258, 0.353, 0.258; VT_r, VT_n, DE, NJ] based on empirical average annual CVs produced slightly higher terminal N estimates (Table 47). Implementing survey-wide CVs reflecting the group's subjective confidence in each survey [0.25, 0.5, 0.5; VT, DE, NJ] resulted in similar outputs to the base model run (Table 47).

Allowing the base model to freely estimate the VT survey catchability coefficient resulted in inflated (roughly 3X) stock size estimates (Table 47). This is an interesting result as the model is seeking a larger stock size in relation to catch, beyond the credible range of expected values. Excessive observation error in surveys, over-specified harvest, or over-specified *M* in the base model could contribute to this situation.

Model runs that excluded parameter estimations in 2013-2016 due to the missing VT survey years were explored. Terminal year outputs were nearly identical to base model outputs.

The base model was highly robust to large variations in starting values of R, N, and q. Model convergence and parameter estimations were unchanged from changes in starting values ranging by more than an order of magnitude (Table 47).

6.7.9 Discussion

Rising adult abundance is evident in model outputs. Stock rebuilding is not surprising given an extended period of significantly reduced commercial landings and tight management controls on the fishery beginning in the early 2000s. Delaware Bay female commercial bait landings in the late 1990s easily exceeded 500,000 per year (see 4.1.2), while bait landings during the model period have averaged 78,000 crabs. Estimated multiparous abundance is stable from 2003 to 2012 and then rises considerably by 2017 (Figure 103). A delayed rebuilding response in multiparous abundance is consistent with slow maturity, long life span, and density-dependent recruitment.

Estimated primiparous abundance occurs in a fairly narrow range around **CONFIDENTIAL** crabs in years with available primiparous and multiparous indices (2003-2012; Figure 106). Although aggregate survey indices are available in 2013-2016, estimates of primiparous and multiparous abundance during this time block (2013-2016) are highly uncertain given the lack of survey indices to allocate abundance between stages. This generally stable recruitment is consistent with a life history dependent on relatively finite amounts of beach habitat for yearly egg burial and incubation. As Sweka et al. (2007) demonstrate, there is an upper cap on the amount of egg production in the population due in part to the maximum capacity of spawning habitat and density-dependent egg mortality. Fairly stable primiparous recruitment with incrementally expanding multiparous abundance would be expected from a species in the mid to later-stages of rebuilding, due to capped recruitment potential, slow growth, low mortality, and long lifespan.

6.7.10 Caveats

The CMSA model is understandably highly levered on the VT survey, as this survey is the only source of information about primiparous and multiparous stages. The magnitude of the VT swept area estimates is assumed to be representative of the Delaware Bay population size, R, N. This assumption was critical in informing the model about population scale. Although q_vt is input to 1, the model can freely estimate R, N above or below r_vt and n_vt in order to best fit all available data. As seen in sensitivity runs, R and N become more inflated as less weight is given to the VT survey (i.e. equal λs) or when the model is allowed to freely estimate q_vt. In reality, the VT swept area estimates are likely minimum estimates of abundance given: 1) the VT trawl gear efficiency is less than 100%; and 2) the VT survey spatial area may be a low estimate of Delaware Bay unit stock spatial area (excludes inside waters of Delaware Bay).

Natural mortality *M* is a critical input in the CMSA model. Although *M* is generally specified well according to sensitivity runs, and is supported by empirical survival estimates, there is some evidence *M* could still be over-specified given the mean ratio of 3.48 multiparous to primiparous females observed in the VT survey along with long-held assumptions about maturity and longevity. For example, assuming maturity starts at 10 years and lifespan ends at 20 years, the *M* needed to achieve this ratio is *M*=0.23 (closer to the preferred *M* in the likelihood profile). Another possible caveat is the assumption of a constant *M* for both stages, since *M* may increase with age to some extent given higher spawning mortality associated with declining condition as horseshoe crabs age (Penn and Brockmann 1995).

Model catch is assumed known with no error. The biggest source of uncertainty in harvest inputs was associated with discard mortalities. Annual discard mortalities were the products of observer discard rates and reported fishery trips, further proportioned by sex using fishery-independent sex-ratios. It was assumed that 100% of discards were adult stage horseshoe crabs, although this almost certainly is an overestimation. It was also required to make broad assumptions about discard mortality rates, basing mortality rates (i.e. 50% trawl, 5% dredge) on the SAS's collective experience in managing Mid-Atlantic fisheries combined with an understanding of horseshoe crab biology. Since data were unavailable, it was assumed 2003 discard mortalities were equal to the average of the next three years of estimates (2004-2006). High variability in discard rates, use of external sex ratios, and judgment-based mortality rates are clear caveats to consider and warrant study to refine future estimates. Whereas estimates of discard mortalities may be biased high from assuming 100% adult status, commercial bait harvest may be underestimated from undocumented illegal horseshoe crab harvest caused by the short commercial quota seasons and the high value of adult females as bait in eel and whelk fisheries.

The missing time block (2013-2016) of VT survey information in the model is not ideal, but it isn't as problematic as it could be since the model only tracks two stages rather than multiple cohorts through a time-age matrix. The most obvious problem it presents is that the 2017 estimate of multiparous abundance is based only on the three observed survey indices without the aid of information about R and N from the previous year, 2016. Ultimately, these missing years deprive a fuller understanding of the observed rising population trajectory, since a large increase occurs between 2012 and 2017. This multiparous increase is observed in both aggregate survey indices and male horseshoe crab indices in Delaware Bay, and is further supported by excellent spawning beach numbers in the 2018 Delaware Spawning Beach Survey based on anecdotal observation (J. Zimmerman, personal communication).

7 STOCK STATUS

7.1 Current Overfishing, Overfished/Depleted Definitions

To date, no overfishing or overfished definitions have been adopted by the Management Board.

7.2 Development of Reference Points for Horseshoe Crab

For this assessment, biological reference points were developed for the Delaware Bay horseshoe crab population. Reference points for other populations were not developed because of insufficient information on life history and a lack of suitable stock assessment models to gauge status relative to reference points. Two general methods to develop reference points for female horseshoe crabs were used: 1) reference points derived from a population projection model for Delaware Bay female horseshoe crabs and 2) egg-per-recruit (EPR) and yield-per-recruit (YPR) models. Male horseshoe crab reference points were based on the sex ratio of male:female horseshoe crabs.

7.2.1 Methods

The projection model was based on the age-structured horseshoe crab model of Sweka et al. (2007) and used as an operating model to determine the efficacy of the stock assessment models used in this assessment. Age-0 natural mortality was equal to 10.4143 which came from an estimate of age 0 survival in Delaware Bay from Botton et al. (2003). Estimates of natural mortality at the juvenile (M_{juv}) and mature (M_{mat}) ages in the Sweka et al. (2007) model were based on a study by Carmichael et al. (2003) from Pleasant Bay, MA and may not accurately reflect those in Delaware Bay. In the present projection model, to develop reference points, M_{mat} was reduced from 0.470 in Sweka et al. (2007) to 0.274 to match the value used in the CMSA in this assessment. Justification for the use of this value comes from analysis of tagging data (Section 2.1.3).

There is no empirical estimate of the carrying capacity (K) for female horseshoe crabs in Delaware Bay and previous estimates of the carrying capacity (~14 million) were based on projecting the Sweka et al. (2007) model forward until an equilibrium was reached under no fishing mortality. This level was a function of both the age-specific natural mortality schedule and an assumed density-dependent egg mortality function (Smith 2007). Because M_{mat} was reduced in this current model and there are no estimates of M_{juv} specific to the Delaware Bay, the SAS was very uncertain as to what the actual female carrying capacity of the Delaware Bay is, which makes development of biological reference points difficult.

In order to derive biological reference points from the current projection model, three different levels of female horseshoe crab K were considered and values of M_{juv} required to stabilize the population at those levels under a situation of no fishing mortality were solved for. The lowest level of K was 10 million horseshoe crabs, which is a level slightly greater than the current estimate of female abundance from the CMSA model results. An intermediate level of 14 million was chosen to represent the current management of Delaware Bay horseshoe crabs under the Adaptive Resource Management (ARM) framework whereby 80% of K gives value to the harvest of female horseshoe crabs in the optimization routine. Finally, an upper level of 18 million was chosen to acknowledge that current management's estimate of K may be an underestimate. For each level of K, M_{juv} was determined by setting the population level at the K and solving for a value of M_{juv} that resulted in a finite population growth rate (λ) of 1.0 from a population projection matrix (leslie matrix).

The population projection model was coded in a MS Excel spreadsheet and began with a stable age distribution at a given level of K. To determine the maximum sustainable yield of this simulated population, the population was projected 400 years into the future. The fishing mortality associated with maximum sustainable yield (F_{msy}) was solved for by maximizing the total catch in year 400, and the associated number at maximum sustainable yield (N_{msy}) was equal to the total number of mature female crabs in year 400 when catch was maximized. F_{20} and F_{40} reference points were estimated by solving for the F that resulted in 20% or 40% of K in year 400, and the number associated with F_{20} and F_{40} was also estimated. This process was completed for each of three possible levels of K explored and resulted in three suites of biological reference points.

Life history parameters used in the projection model (Table 48) were used to generate parameters in per-recruit models (Table 49). The difference between these two tables of life history parameters was that those of the projection model separated ages 10 and 11 into immature and mature individuals while those of the per-recruit model combined them into a single age 10- and 11-year classes. Maturity in the projection model represented the probability of an individual becoming mature at age i if it was immature at age i-1 whereas maturity in the per-recruit models represented the proportion of the age class that was mature at age i.

Per-recruit modeling was performed according to the methods of Gabriel et al. (1989) in the R package fishmethods. It was assumed that 30% of natural mortality occurred before spawning and 0% of fishing mortality occurred before spawning. The EPR model estimated the F rate that preserved 20% (F_{20}) and 40% (F_{40}) of the maximum EPR of an unfished population. In the YPR model, it was assumed that individuals did not recruit to the fishery until they were sexually mature and once sexually mature, a terminal molt occurred after which the weight of individuals remained the same throughout the remainder of their life. Thus, age-specific weights were simply set to 1.0 for all ages and the YPR values could be interpreted as the number of individuals per recruit.

7.2.2 Results and Discussion

The reference points from the projection model varied with the assumed level of K (Table 50). F_{MSY} ranged from 0.0695 to 0.0796 and values of F_{40}, which is often used as a proxy for F_{MSY} were of similar magnitude (range = 0.0632 to 0.0724).[2]

As an additional check on the coding of the projection model, life history parameters were input into the population projection matrix (leslie matrix). The effects of the various F reference points on population growth rates (λ or the dominant eigenvalue from the projection matrix) were tested using the R package demogR. The population number was set at the estimated K, N_{msy}, N_{40}, and N_{20} to appropriately include density dependent egg mortality in the projection matrix and corresponding F values of 0, F_{msy}, F_{40}, and F_{20} were used. In all cases $\lambda = 1.0$ indicating a stable population at those levels of F and confirming the coding of the operating model was capturing the population dynamics as expected.

The EPR and YPR models were determined unsuitable in determining reference points for a species such as horseshoe crab. The EPR model estimated F_{20} ranging from 2.2508 to 2.2676 and F_{40} ranging from 0.6444 to 0.6465, depending on the juvenile natural mortality used. All of these values appeared to be excessively high given the natural mortality of the species (Table 51). When these values of F were input into the projection model, the population crashed to less than 1% of the carrying capacity. Also, the plot of YPR vs. F showed no declining trend in YPR as F increased (Figure 115). The life history of horseshoe crabs, with greater mortality on mature individuals compared to immature individuals, density dependent egg mortality not accounted for in a traditional EPR model, and a terminal molt and lack of increasing weight with age are responsible for these questionable per-recruit results and reference points based on traditional per-recruit models should be avoided.

Management of horseshoe crabs can call for sex specific harvest rates because sexes are easily distinguishable, and ideally, separate sex-specific reference points would be developed and used. Unfortunately, the catch survey model could not estimate the abundance and fishing mortality for male horseshoe crabs. In lieu of having male reference points which could be compared to the CMSA results, the SAS recommends using the sex ratio of male:female crabs from the Delaware Bay spawning survey as a reference point for male horseshoe crabs. This sex ratio reference point would be 2:1. If the sex ratio is >2:1 on the spawning beaches, it can safely be assumed that adequate egg fertilization is occurring, and the abundance of male horseshoe crabs is not limiting the growth of the horseshoe crab population. This assumption is consistent with current management of horseshoe crabs in the Delaware Bay area under the ARM model.

[2] The Peer Review Panel did not endorse the use of the reference points developed for this stock assessment.

7.3 Stock Status Determination

Although reference points were developed for the Delaware Bay population as described above, the Peer Review Panel recommended that these not be used for comparison to CMSA model output and recommended status determinations be based on ARIMA analyses within each region and coastwide. The reference point from the ARIMA fits was the 1998 index-based reference point because this reference point represents the point in time when horseshoe crabs became actively managed by the ASMFC and status relative to this reference point gives an indication of the effects of management on populations. ARIMA results from surveys used to determine stock status included those surveys with combined-sex indices, residuals of ARIMA model fits were normally distributed, time series extending back to at least 1998, and terminal years were 2016 or 2017.

Stock status was based on the percentage of surveys within a region (or coastwide) having a >50% probability of their terminal year fitted value being less the 1998 index-based reference point. “Poor” status was >66% of surveys meeting this criterion, “Good” status was <33% of surveys, and “Neutral” status was 34 – 65% of surveys (Table 53). The stock status of the Northeast region was neutral; New York region was poor; Delaware Bay region was neutral; and Southeast region was good. The overall coastwide status was neutral.

Applying these stock status criteria to summary ARIMA results from the 2009 benchmark assessment and 2013 update assessment gives a general idea of how status has changed through time. The status of the Delaware Bay region and Southeast region has remained consistently neutral and good, respectively, through time. The status of the Northeast region has changed from neutral, to poor, and back to neutral. The status of the New York region has trended downward from good, to neutral, and now poor. These trends in time should be viewed with caution because the number of surveys in each region has changed in the current assessment and the index values have changed due to our use of the delta distribution for estimates of the mean and variance of each survey index. Previous assessments used index values as given to the SAS by state TC members with no standardization. Previous assessments also included all subsets of a survey (e.g., male and female indices from the same survey) which resulted in “double counting” of individual surveys.

A more detailed description of the surveys used to determine stock status is provided in Table 54. Recent trends (5 year and 10 year) were characterized for each survey by linear regression fitted ARIMA values. An alpha level of 0.10 used to determine if a significant trend occurred over these recent time periods. The Northeast region contained only two surveys meeting the criteria for use in stock determination (MA DMF trawl south of Cape Cod and the RI monthly trawl survey from the fall) and these surveys had conflicting trends. The MA DMF trawl survey south of Cape Cod showed an increasing trend in recent years while the Rhode Island monthly trawl survey continued to show a declining trend. There was consistency among New York region surveys with three out of four showing declining trends in the past five years and all showing declining trends in the past 10 years. Surveys from the Delaware Bay and Southeast regions showed either no trend or increasing trends.

Despite the aforementioned caveats when interpreting changes in regional status through time in Table 53, it is clear that the status of the New York region has declined through time. The surveys in the New York region are largely the same since the 2009 benchmark assessment and have consistently been combined-sex surveys. The difference in this assessment was that the Little Neck and Manhasset Bay surveys were combined into a single survey whereas they were considered separate surveys in previous assessments. The status of the New York survey has gone from good, to neutral, to poor. There is no mortality associated with biomedical collections in the New York region and bait harvest has been reduced from historic levels with a current NY state mandated quota of 150,000 per year. Two hypotheses for the continued decline in abundance are: 1) bait harvest remains at a level that is not sustainable in the New York region; or 2) the habitat has changed and cannot support the number of horseshoe crabs it once did.

7.3.1 Uncertainty

ARIMA results give some indication of stock status (whether the populations are increasing or decreasing) and the probability of the current state of the populations being less than an index-based reference point. However, specific reasons for continued decline, as seen in the New York region, remain elusive and it cannot be determined if these declines are a result of excessive exploitation or changes in habitat suitability.

There also remains much uncertainty about embayment and region-specific populations that could not be modelled as part of this assessment because of a lack of data. Maine, New Hampshire, and Florida were grouped into regions that may not reflect the abundance of horseshoe crabs in those areas. Additionally, the regional groupings used in this assessment reflect the SAS and TC's best efforts to reflect biology and management units but the states are encouraged to consider the embayment-specific populations of horseshoe crabs that are in their state's waters. There is evidence that there are embayment-specific populations in Maine, New Hampshire, and Florida, as well as in other states (see section 2.1), and yet there are no sufficient surveys to track abundance for these populations. These issues can persist even when there is sufficient data available for tracking abundance. For example, populations of horseshoe crab north and south of Cape Cod in Massachusetts exhibit different patterns, as does the abundance index in Rhode Island, and yet these indices were combined in this stock assessment to represent the Northeast region. The Gulf of Maine could be considered its own region in future assessments if there are any additional suitable indices from that area and the Massachusetts North Cape index may be better categorized to that region. Similar considerations could be made for Florida if there was data to support it. All of the Atlantic states are encouraged to monitor and manage the horseshoe crab populations at appropriate levels and collect additional data as needed.

7.4 Comparison of Assessment Management Advice to ARM Model

Management advice that may stem from this stock assessment versus the Adaptive Resource Management (ARM) model represents two different, and somewhat competing, management objectives (Table 55). This stock assessment can form the basis for single species management in the Delaware Bay, while the ARM model represents multi-species management with the harvest of horseshoe crabs constrained by the needs of shorebirds such as the red knot. Currently, management of horseshoe crabs in the Delaware Bay falls under Addendum VII of the fisheries management plan, which calls for the use of the ARM model when making annual harvest recommendations.

Underlying the ARM model are population models for both red knots and horseshoe crabs. The optimization routine in the ARM model determines the best choice among five potential harvest packages (numbers of male and females that can be harvested) given the current abundance of each species in order to maximize the long-term value of horseshoe crab harvest. The ARM model values female harvest only when the abundance of Red Knots reaches 81,900 birds (a value related to the historic abundance of red knots in the Delaware Bay) or when the abundance of female horseshoe crabs reaches 80% of their carrying capacity (11.2 million assuming a carrying capacity of 14 million). On an annual basis, the ARM model is used to select the optimum harvest package to implement for the next year given the current year's estimate of horseshoe crab abundance from the swept area estimate from the VA Tech trawl survey and a mark-resight estimate of red knot abundance.

At the present time, neither the 81,900 red knot threshold nor the 11.2 million female horseshoe crab thresholds are met. This assessment estimates there are **CONFIDENTIAL** female horseshoe crabs and the ARM workgroup estimated there were 45,221 red knots in Delaware Bay in 2018. While the Peer Review Panel did not endorse the use of the reference points developed for this stock assessment, they did suggest that the ARM Workgroup consider using the population estimates from the CMSA as the best available population estimates of horseshoe crabs in the Delaware Bay region.

8 RESEARCH RECOMMENDATIONS

The SAS identified several research recommendations that would benefit horseshoe crab and future stock assessments. Research recommendations have been categorized as future research, data collection, and assessment methodology and listed in order of priority. The SAS recommends that an update be considered in five years and a benchmark stock assessment considered in ten years given the life history of horseshoe crab and the need for more data. The SAS and TC recommend that during the years between this assessment and the next, members remain proactive about maintaining surveys and research programs and continuing to initiate or participate in activities that accomplish some of the research recommendations listed below.

Future Research

- Determine relationship between age, stage, and size for horseshoe crabs.
- Compare densities of horseshoe crabs nearshore, offshore, and in bays, compare different stages (i.e., primiparous and multiparous), and look at movements among embayments within regions (i.e., around Cape Cod, Long Island).

- Characterize the proportion of states' landings that comprise crabs of Delaware Bay origin. This can be done through a directed tag/release study, genetics/microchemistry study, or both.
- Collect more life history information, particularly for juveniles, on growth, molt timing, and distribution.
- Evaluate the effect of warming temperatures on distribution and timing of spawning for horseshoe crabs.
- Address the issue of gear saturation for spawning beach surveys and/or explore analyses that would be less sensitive to gear saturation. Explore the methodology and data collection of spawning beach surveys and the ability of these surveys to track spawning abundance.
- Determine if there is illegal take-and-use at sea, transfer at sea, and poaching from spawning areas for horseshoe crabs and estimate the amount if possible.

Data Collection

- Continue to fund and operate the full Virginia Tech Trawl Survey annually.
- Conduct a gear efficiency study of the Virginia Tech Trawl Survey given the importance of using swept-area estimates of abundance in modeling the Delaware population.
- Better characterize the discards, landings, and discard mortality by gear.
- Increase the priority of maintaining and managing horseshoe crab data in and among states, both fishery-dependent and –independent, and improve communication between data providers.
- Continue current biosampling for sex and weight and expand where possible.
- Develop a standardized biosampling protocol to cover different seasons and obtain weights, ages, stages, and widths of horseshoe crabs using a random sampling design.
- Expand or implement fishery-independent surveys (e.g., spawning, benthic trawl, tagging) to target horseshoe crabs throughout their full range including estuaries. Highest priority should be given to implementing directed surveys in the Northeast and New York regions.
- Collect sex and stage data in fishery-independent surveys. Surveys should consider using similar methods as the Virginia Tech Trawl Survey and collect biological data by sex and stage, particularly by primiparous and multiparous.
- Continue to evaluate biomedically bled crabs' mortality rates. Consider a tagging study of biomedically bled horseshoe crabs to obtain relative survival and collaborations between researchers and biomedical facilities that would result in peer-reviewed mortality estimates.
- Maintain consistent data collection and survey designs for spawning beach surveys each year and encourage spawning beach surveys to conduct the data collection for the survey and tagging resights separately.

Assessment Methodology

- The ARM working group should consider using the population estimates from the CMSA model as an input to the ARM model as well as estimated mortality from discards and the biomedical industry.
- Further develop the catch-survey analysis and apply assessment modeling beyond the Delaware Bay region, which would require more stage-based data collection.
- Develop a stage-based or length-based model specific for horseshoe crabs that addresses their life history characteristics.
- Estimate the survival of early life stages (e.g., age-zero, juveniles) and growth rates.
- Explore the possibility of using a delay-difference model for future assessments. Because of the life history of horseshoe crab, this would require 20-30 years of data before it could be developed.
- Continue to evaluate tagging data by fitting capture-recapture models that include a short-term (1 year) bleeding effect, account for spatial distribution of harvest pressure, account for capture methodology, and account for disposition of recaptured tagged individuals. Potential methodological approaches include use of time-varying individual covariates to indicate which crabs are 1 year from bleeding and use of hierarchical models to estimate interannual variation in survival within time periods defined by major regulatory changes.

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10 TABLES

Table 1. Coastwide horseshoe crab (HSC) commercial bait landings in numbers, 1998-2016, as validated by ACCSP. The 2017 landings are from state compliance reports.

Year	Female HSC (#s)	Male HSC (#s)	Unclassified Sex (#s)	Total HSC (#s)
1998	382,199	413,698	1,120,553	1,916,450
1999	388,280	466,540	1,750,460	2,605,280
2000	189,653	392,123	1,095,137	1,676,913
2001	155,561	280,626	349,220	785,407
2002	299,296	558,704	408,794	1,266,795
2003	233,583	415,456	399,061	1,048,100
2004	146,399	201,252	308,790	656,441
2005	142,303	258,774	309,457	710,534
2006	201,063	212,478	383,870	797,411
2007	141,705	191,574	452,325	785,604
2008	89,817	229,265	333,781	652,863
2009	115,590	355,323	293,741	764,654
2010	97,546	269,886	245,067	612,499
2011	79,827	315,679	297,364	692,870
2012	135,266	287,991	373,610	796,867
2013	83,161	477,844	390,357	951,362
2014	38,314	423,265	325,819	787,397
2015	33,398	247,593	315,655	596,646
2016	42,636	353,061	345,065	740,762
2017	160,726	675,241	158,524	994,491

Table 2. State bait harvest quotas for 2019 as determined by the interstate FMP (ASMFC) and state-specific regulations (state).

Jurisdiction	ASMFC Quota 2019	State Quota 2019
MA	330,377	165,000
RI	26,053	8,398
CT	48,689	48,689
NY	366,272	150,000
NJ*	162,136	0
DE*	162,136	162,136
MD*	255,980	255,980
VA**	172,828	172,828
NC	24,036	24,036
SC	0	0
GA	29,312	29,312
FL	9,455	9,455
TOTAL	1,587,274	1,025,834

***Male-only harvest**

****Virginia harvest east of the COLREGS line is limited to 81,331 male-only crabs under the ARM harvest package #3. Value shown is the total state quota.**

Table 3. Numbers of tags released and recaptured by region.

		Recaptured by region								
Release region	# Released	Ches Bay	Coast DE-VA	Coast NY-NJ	Del Bay	Gulf	NC	North east	South east	Unk
Ches Bay	840	105	6	1	0	0	0	0	0	0
Coast DE-VA	96,095	18	5,983	123	2856	0	9	85	5	5
Coast NY-NJ	27,765	0	18	2872	44	1	1	142	1	0
Del Bay	78,841	5	506	291	14,006	1	4	27	3	17
Gulf	1,853	0	2	0	0	142	0	0	2	0
NC	280	1	1	0	1	0	4	1	0	0
Northeast	98,274	2	17	965	31	0	0	19,158	3	7
Southeast	13,305	0	5	6	9	3	0	6	1,713	0
Unknown	17	0	0	8	0	0	0	8	0	1

Table 4. Recapture (%) relative to total recaptures for each region of release.

		Recapture Region								
Release region	**Released**	**Ches Bay**	**Coast DE-VA**	**Coast NY-NJ**	**Del Bay**	**Gulf**	**NC**	**Northeast**	**Southeast**	**Unk**
Ches Bay	840	93.75	5.36	0.89	0.00	0.00	0.00	0.00	0.00	0.00
Coast DE-VA	96,095	0.20	65.86	1.35	31.44	0.00	0.10	0.94	0.06	0.06
Coast NY-NJ	27,765	0.00	0.58	93.28	1.43	0.03	0.03	4.61	0.03	0.00
Del Bay	78,841	0.03	3.41	1.96	94.25	0.01	0.03	0.18	0.02	0.11
Gulf	1,853	0.00	1.37	0.00	0.00	97.26	0.00	0.00	1.37	0.00
NC	280	12.50	12.50	0.00	12.50	0.00	50.00	12.50	0.00	0.00
Northeast	98,274	0.01	0.08	4.78	0.15	0.00	0.00	94.92	0.01	0.03
Southeast	13,305	0.00	0.29	0.34	0.52	0.17	0.00	0.34	98.34	0.00
Unknown	17	0.00	0.00	47.06	0.00	0.00	0.00	47.06	0.00	5.88

Table 5. Regional apparent annual survival rates, averaged among years 2009-2017.

Region	Phi-hat	SE	LCL	UCL
Coastal DE-VA	0.71	0.0118	0.6874	0.7335
Coastal NY-NJ	0.62	0.0162	0.5884	0.6516
Delaware Bay	0.76	0.0137	0.7275	0.7813
Northeast	0.67	0.0058	0.6587	0.6813
Southeast	0.63	0.0350	0.5545	0.6907

Table 6. Annual survival and movement rates for Delaware Bay and coastal embayments in Delaware and Virginia for the years 2003 to 2017 estimated from multi-state model using program MARK.

Parameter	Location	Estimate	Standard error	Lower confidence limit	Upper confidence limit
Annual survival rate	Coastal DE-VA	0.61	0.0148	0.5820	0.6400
	Delaware Bay	0.79	0.0103	0.7677	0.8080
	Other areas	0.59	0.0349	0.5182	0.6541
Annual movement rate	Coastal embayments to Delaware Bay	0.28	0.0478	0.1944	0.3804
	Coastal embayments to other areas	0.03	0.0014	0.0286	0.0339
	Delaware Bay to coastal embayments	0.23	0.0344	0.1741	0.3085
	Delaware Bay to other areas	0.02	0.0008	0.0233	0.0263
	Other areas to coastal embayments	0.70	0.1048	0.4643	0.8581
	Other areas to Delaware Bay	0.27	0.1038	0.1169	0.5097

Table 7. Instantaneous natural mortality rate (M) schedule.

Age	*S*	*M*	Reference
Age 0 to Age 1	0.00003	10.4143	Botton et al. 2003
Ages 1 to 8	0.9738	0.0265	Carmichael et al. 2003 (Table 13)
Age 9 to Age 10	0.7994	0.2239	Mean of 1-8 and 11-17 - assumption
Age 10 to Age 11	0.7994	0.2239	Mean of 1-8 and 11-17 - assumption
Ages 11 to 17	0.6250	0.4700	Carmichael et al. 2003 (Table 10 -mean of instars 20-23)
Ages 18 to 19	0.08	2.5257	Carmichael et al. 2003 (Table 10 –Instar 24)
Age 20	0		All dead - assumption

Table 8. Inputs for estimating natural morality for horseshoe crabs. NOAA average water temperatures for Lewes DE (https://www.nodc.noaa.gov/dsdt/cwtg/all_meanT.html).

Inputs	Combined-sex	Females	Males
Maximum Observed Age	27	27	27
Average Water Temp C*	12.99	12.99	12.99
K	0.15	0.14	0.17
L_inf cm	23.08	26.39	21.12
T0	0.10	0.12	0.09

Table 9. Models and estimates of age-invariant instantaneous natural mortality rates for horseshoe crabs.

Model	Formula	M (combined-sex)	M (females)	M (males)
Hoenig (1983)	Z = exp(1.44-0.982*ln(tmax)), 134 stocks	0.166	0.166	0.166
	Z = exp(1.46-1.01*ln(tmax)), 84 fish stocks	0.154	0.154	0.154
Longevity-Based ROTs	Z = ln(1.5%)/tmax or 4.22/tmax	0.156	0.156	0.156
	Z = ln(5%)/tmax or 3/tmax	0.111	0.111	0.111
Pauly (1980)	ln(M) = -0.0066-0.279*ln(Linf)+0.6543*ln(K)+0.4634*ln(T)	0.399	0.359	0.440
	ln(M) = -0.0152-0.279*ln(Linf)+0.6543*ln(K)+0.4634*ln(T)	0.396	0.356	0.436
Jensen (1996)	M = gK; g = 1.598	0.246	0.221	0.275

Table 10. Hypothetical instantaneous natural mortality rate schedules for horseshoe crab based on von Bertalanffy growth.

	Gislason, et al. 2010	Gislason, et al. 2010	Lorenzen 1996	Lorenzen 1996
Age	**Male M**	**Female M**	**Male M**	**Female M**
0	8.95	11.13	3.73	4.05
1	1.42	1.55	1.44	1.42
2	0.68	0.72	0.98	0.94
3	0.44	0.45	0.79	0.74
4	0.33	0.33	0.68	0.62
5	0.27	0.26	0.61	0.55
6	0.23	0.22	0.56	0.50
7	0.20	0.19	0.53	0.46
8	0.18	0.17	0.50	0.44
9	0.17	0.16	0.48	0.42
10	0.16	0.14	0.47	0.40
11	0.15	0.14	0.45	0.39
12	0.15	0.13	0.45	0.37
13	0.14	0.12	0.44	0.37
14	0.14	0.12	0.43	0.36
15	0.14	0.11	0.43	0.35
16	0.13	0.11	0.42	0.35
17	0.13	0.11	0.42	0.34
18	0.13	0.11	0.42	0.34
19	0.13	0.10	0.41	0.34
20	0.13	0.10	0.41	0.33
21	0.13	0.10	0.41	0.33
22	0.12	0.10	0.41	0.33
23	0.12	0.10	0.41	0.33
24	0.12	0.10	0.41	0.33
25	0.12	0.10	0.41	0.32
26	0.12	0.10	0.40	0.32
27	0.12	0.10	0.40	0.32

Table 11. Data and results for the Mann-Kendall test of temporal trends in sex ratios, defined as the ratio of males to females. Significant p-values are presented in bold. Trends test not applicable for biomedical data due to the low number of years with sex-specific harvest data. Survey type refers to fisheries independent (FI) and dependent (FD) data. Confidential biomedical data have been removed from this public document.

Source	Type	State	Location	Sex Ratio	tau	p value	Years included in analysis
Trawl	FI	NJ	DE_Bay Fall	2.16	0.18	0.19	1990-2017
Trawl	FI	NJ	**DE_Bay Spr**	**1.27**	**0.38**	**0.00**	1990-2017
Trawl	FI	NJ	NJ_Ocean_Fall	1.13	0.18	0.28	1999-2017
Trawl	FI	NJ	NJ_Ocean_Spr	1.03	0.13	0.46	1999-2017
Trawl	FI	NJ	NJ_SurfClam	0.51	-0.05	0.84	1998-2012
Spawning	FI	NH	Beaches	1.55	0.31	0.21	2002-2012
Landings	FD	MD	MD	1.49	-	-	1998-2016
Landings	FD	VA	**VA**	**1.30**	**0.45**	**0.02**	2001-2016
Landings	FD	NJ	NJ	2.52	-0.17	0.60	1998-2006
Landings	FD	DE	DE	1.87	-	-	1998-2016
Commercial	FD	VA	VA_SIW	0.64	0.28	0.14	2000:2003, 2006:2017
Commercial	FD	VA	**VA_SOW**	**1.28**	**0.69**	**0.00**	2000, 2002, 2005, 2006, 2008, 2010:2017
Biomed	FD	**CONFIDENTIAL**					
Biomed	FD						
Biomed	FD						
Biomed	FD						
Biomed	FD						
Biomed	FD						

Table 12. Sex ratio and proportion female information, along with associated confidence limits, for each survey of available fisheries-independent and –dependent data sources.

Type	Source	Year	Proportion Female	LCL	UCL	Sex Ratio	LCL	UCL
Trawl	NJ_SurfClam	1998	57.9%	45.7%	70.1%	0.73	0.36	1.09
Trawl	NJ_SurfClam	1999	63.4%	51.7%	75.1%	0.58	0.29	0.87
Trawl	NJ_SurfClam	2000	60.0%	52.6%	67.4%	0.67	0.46	0.87
Trawl	NJ_SurfClam	2001	65.0%	54.5%	75.5%	0.54	0.29	0.79
Trawl	NJ_SurfClam	2002	68.3%	58.4%	78.3%	0.46	0.25	0.68
Trawl	NJ_SurfClam	2003	73.2%	64.7%	81.6%	0.37	0.21	0.52
Trawl	NJ_SurfClam	2004	80.1%	74.7%	85.4%	0.25	0.17	0.33
Trawl	NJ_SurfClam	2005	86.5%	80.6%	92.5%	0.16	0.08	0.24
Trawl	NJ_SurfClam	2006	74.2%	68.5%	80.0%	0.35	0.24	0.45
Trawl	NJ_SurfClam	2007	64.2%	53.7%	74.6%	0.56	0.30	0.81
Trawl	NJ_SurfClam	2008	62.4%	55.0%	69.8%	0.60	0.41	0.79
Trawl	NJ_SurfClam	2009	72.2%	61.3%	83.1%	0.39	0.18	0.59
Trawl	NJ_SurfClam	2010	60.8%	54.4%	67.2%	0.64	0.47	0.82
Trawl	NJ_SurfClam	2011	69.8%	61.2%	78.4%	0.43	0.26	0.61
Trawl	NJ_SurfClam	2012	53.6%	36.9%	70.3%	0.87	0.28	1.45
Trawl	NJ_Ocean_Spr	1996	59.9%	51.6%	68.2%	0.67	0.44	0.90
Trawl	NJ_Ocean_Spr	1999	44.2%	36.3%	52.1%	1.26	0.86	1.67
Trawl	NJ_Ocean_Spr	2000	48.8%	43.4%	54.3%	1.05	0.82	1.28
Trawl	NJ_Ocean_Spr	2001	45.5%	38.2%	52.7%	1.20	0.85	1.55
Trawl	NJ_Ocean_Spr	2002	62.4%	50.5%	74.2%	0.60	0.30	0.91
Trawl	NJ_Ocean_Spr	2003	48.0%	40.8%	55.1%	1.08	0.77	1.40
Trawl	NJ_Ocean_Spr	2004	50.8%	45.2%	56.5%	0.97	0.75	1.19
Trawl	NJ_Ocean_Spr	2005	47.5%	41.1%	54.0%	1.10	0.82	1.39
Trawl	NJ_Ocean_Spr	2006	54.0%	38.0%	70.0%	0.85	0.30	1.40
Trawl	NJ_Ocean_Spr	2007	52.9%	40.5%	65.4%	0.89	0.45	1.33
Trawl	NJ_Ocean_Spr	2008	50.1%	45.4%	54.9%	1.00	0.81	1.18
Trawl	NJ_Ocean_Spr	2009	44.4%	37.4%	51.4%	1.25	0.90	1.61
Trawl	NJ_Ocean_Spr	2010	41.5%	37.7%	45.2%	1.41	1.19	1.63
Trawl	NJ_Ocean_Spr	2011	55.9%	46.7%	65.1%	0.79	0.49	1.08
Trawl	NJ_Ocean_Spr	2012	46.4%	40.5%	52.2%	1.16	0.89	1.43
Trawl	NJ_Ocean_Spr	2013	53.7%	44.0%	63.4%	0.86	0.53	1.20
Trawl	NJ_Ocean_Spr	2014	51.6%	40.4%	62.8%	0.94	0.52	1.36
Trawl	NJ_Ocean_Spr	2015	46.2%	32.4%	60.0%	1.16	0.52	1.81
Trawl	NJ_Ocean_Spr	2016	48.6%	42.8%	54.3%	1.06	0.82	1.30
Trawl	NJ_Ocean_Spr	2017	45.0%	29.1%	60.9%	1.22	0.44	2.00

Type	Source	Year	Proportion Female	LCL	UCL	Sex Ratio	LCL	UCL
Trawl	NJ_Ocean_Fall	1999	51.9%	46.1%	57.7%	0.93	0.71	1.14
Trawl	NJ_Ocean_Fall	2000	50.6%	41.2%	60.0%	0.98	0.61	1.34
Trawl	NJ_Ocean_Fall	2001	51.6%	43.4%	59.9%	0.94	0.63	1.25
Trawl	NJ_Ocean_Fall	2002	49.9%	42.1%	57.7%	1.00	0.69	1.32
Trawl	NJ_Ocean_Fall	2003	45.6%	37.6%	53.6%	1.19	0.81	1.58
Trawl	NJ_Ocean_Fall	2004	51.1%	46.5%	55.8%	0.96	0.78	1.13
Trawl	NJ_Ocean_Fall	2005	38.0%	31.8%	44.2%	1.63	1.20	2.06
Trawl	NJ_Ocean_Fall	2006	43.9%	36.6%	51.1%	1.28	0.90	1.66
Trawl	NJ_Ocean_Fall	2007	43.9%	38.8%	49.1%	1.28	1.01	1.54
Trawl	NJ_Ocean_Fall	2008	58.8%	49.2%	68.4%	0.70	0.42	0.98
Trawl	NJ_Ocean_Fall	2009	49.7%	35.6%	63.8%	1.01	0.44	1.58
Trawl	NJ_Ocean_Fall	2010	46.2%	31.1%	61.3%	1.16	0.46	1.87
Trawl	NJ_Ocean_Fall	2011	42.8%	30.7%	54.9%	1.34	0.68	2.00
Trawl	NJ_Ocean_Fall	2012	45.1%	30.6%	59.7%	1.22	0.50	1.93
Trawl	NJ_Ocean_Fall	2013	65.0%	42.2%	87.9%	0.54	0.00	1.08
Trawl	NJ_Ocean_Fall	2014	43.3%	34.2%	52.4%	1.31	0.83	1.80
Trawl	NJ_Ocean_Fall	2015	47.2%	36.5%	57.9%	1.12	0.64	1.60
Trawl	NJ_Ocean_Fall	2016	39.7%	27.6%	51.8%	1.52	0.75	2.29
Trawl	NJ_Ocean_Fall	2017	47.1%	32.6%	61.7%	1.12	0.47	1.77
Trawl	DE_Spr	1990	56.7%	41.7%	71.7%	0.76	0.30	1.23
Trawl	DE_Spr	1991	48.8%	41.3%	56.3%	1.05	0.74	1.36
Trawl	DE_Spr	1992	55.2%	46.8%	63.6%	0.81	0.54	1.09
Trawl	DE_Spr	1993	44.0%	33.9%	54.1%	1.27	0.75	1.79
Trawl	DE_Spr	1994	38.4%	27.4%	49.4%	1.60	0.86	2.35
Trawl	DE_Spr	1995	49.6%	41.5%	57.8%	1.01	0.68	1.34
Trawl	DE_Spr	1996	65.2%	55.4%	74.9%	0.53	0.30	0.77
Trawl	DE_Spr	1997	44.4%	34.4%	54.4%	1.25	0.75	1.76
Trawl	DE_Spr	1998	52.5%	41.7%	63.4%	0.90	0.51	1.30
Trawl	DE_Spr	1999	42.9%	34.5%	51.4%	1.33	0.87	1.79
Trawl	DE_Spr	2000	46.7%	39.3%	54.1%	1.14	0.80	1.48
Trawl	DE_Spr	2001	48.6%	39.6%	57.6%	1.06	0.68	1.44
Trawl	DE_Spr	2002	65.0%	29.5%	100.5%	0.54	0.00	1.38
Trawl	DE_Spr	2003	52.5%	36.6%	68.5%	0.90	0.32	1.48
Trawl	DE_Spr	2004	75.0%	0.0%	100.0%	0.33	0.00	1.77
Trawl	DE_Spr	2005	71.4%	26.3%	100.0%	0.40	0.00	1.28
Trawl	DE_Spr	2006	48.8%	38.4%	59.2%	1.05	0.61	1.49
Trawl	DE_Spr	2007	37.0%	26.8%	47.1%	1.70	0.96	2.45
Trawl	DE_Spr	2008	41.7%	20.4%	62.9%	1.40	0.18	2.62
Trawl	DE_Spr	2009	38.8%	26.4%	51.2%	1.58	0.75	2.40

Type	Source	Year	Proportion Female	LCL	UCL	Sex Ratio	LCL	UCL
Trawl	DE_Spr	2011	25.5%	13.6%	37.4%	2.93	1.09	4.76
Trawl	DE_Spr	2012	45.5%	31.0%	60.0%	1.20	0.50	1.90
Trawl	DE_Spr	2013	37.5%	7.7%	67.3%	1.67	0.00	3.78
Trawl	DE_Spr	2014	39.2%	30.2%	48.2%	1.55	0.97	2.14
Trawl	DE_Spr	2015	36.1%	26.0%	46.3%	1.77	0.99	2.55
Trawl	DE_Spr	2016	42.7%	34.4%	50.9%	1.34	0.89	1.80
Trawl	DE_Spr	2017	33.4%	25.8%	41.0%	2.00	1.31	2.68
Trawl	DE_Fall	1990	39.5%	30.9%	48.0%	1.53	0.99	2.08
Trawl	DE_Fall	1991	41.5%	31.2%	51.8%	1.41	0.81	2.01
Trawl	DE_Fall	1992	26.1%	16.6%	35.5%	2.83	1.45	4.22
Trawl	DE_Fall	1993	30.5%	24.3%	36.8%	2.28	1.61	2.95
Trawl	DE_Fall	1994	26.5%	4.6%	48.3%	2.78	0.00	5.90
Trawl	DE_Fall	1995	46.1%	36.2%	56.0%	1.17	0.71	1.64
Trawl	DE_Fall	1996	29.1%	23.2%	35.0%	2.43	1.74	3.13
Trawl	DE_Fall	1997	46.3%	37.4%	55.2%	1.16	0.75	1.57
Trawl	DE_Fall	1998	33.3%	20.3%	46.4%	2.00	0.83	3.17
Trawl	DE_Fall	1999	35.1%	23.1%	47.2%	1.85	0.87	2.82
Trawl	DE_Fall	2000	50.9%	40.3%	61.6%	0.96	0.55	1.37
Trawl	DE_Fall	2001	44.4%	0.0%	96.1%	1.25	0.00	3.87
Trawl	DE_Fall	2002	35.3%	0.0%	72.7%	1.83	0.00	4.83
Trawl	DE_Fall	2003	23.3%	9.9%	36.6%	3.30	0.82	5.78
Trawl	DE_Fall	2004	33.3%	0.0%	100.0%	2.00	0.00	27.41
Trawl	DE_Fall	2005	42.9%	0.0%	100.0%	1.33	0.00	4.50
Trawl	DE_Fall	2006	27.0%	18.7%	35.2%	2.71	1.57	3.85
Trawl	DE_Fall	2007	27.3%	11.9%	42.6%	2.67	0.60	4.73
Trawl	DE_Fall	2008	37.5%	0.0%	76.4%	1.67	0.00	4.43
Trawl	DE_Fall	2009	26.5%	7.5%	45.4%	2.78	0.07	5.48
Trawl	DE_Fall	2010	31.8%	0.4%	63.2%	2.14	0.00	5.25
Trawl	DE_Fall	2011	18.8%	0.0%	41.2%	4.33	0.00	10.71
Trawl	DE_Fall	2012	22.7%	0.0%	47.5%	3.40	0.00	8.20
Trawl	DE_Fall	2013	41.6%	27.6%	55.6%	1.41	0.60	2.22
Trawl	DE_Fall	2014	31.1%	18.7%	43.5%	2.21	0.93	3.50
Trawl	DE_Fall	2015	43.4%	33.1%	53.7%	1.31	0.76	1.85
Trawl	DE_Fall	2016	27.0%	22.2%	31.8%	2.71	2.04	3.37
Trawl	DE_Fall	2017	25.1%	17.7%	32.5%	2.99	1.81	4.16

Type	Source	Year	Proportion Female	LCL	UCL	Sex Ratio	LCL	UCL
Survey	NH_Spawn	2002	40.4%	32.4%	48.4%	1.47	0.98	1.96
Survey	NH_Spawn	2003	48.8%	46.4%	51.2%	1.05	0.95	1.15
Survey	NH_Spawn	2004	48.8%	47.1%	50.4%	1.05	0.98	1.12
Survey	NH_Spawn	2005	46.5%	43.1%	49.9%	1.15	0.99	1.31
Survey	NH_Spawn	2006	46.2%	42.8%	49.5%	1.17	1.01	1.32
Survey	NH_Spawn	2007	49.7%	39.1%	60.3%	1.01	0.58	1.44
Survey	NH_Spawn	2008	32.1%	27.4%	36.8%	2.11	1.66	2.57
Survey	NH_Spawn	2009	28.0%	19.9%	36.0%	2.58	1.55	3.61
Survey	NH_Spawn	2010	23.7%	13.5%	33.9%	3.21	1.40	5.03
Survey	NH_Spawn	2011	47.8%	45.5%	50.2%	1.09	0.99	1.19
Survey	NH_Spawn	2012	45.7%	42.7%	48.7%	1.19	1.04	1.33
Landings	MD	1998	69.2%	-	-	0.45	-	-
Landings	MD	1999	82.6%	-	-	0.21	-	-
Landings	MD	2000	53.2%	-	-	0.88	-	-
Landings	MD	2001	50.3%	-	-	0.99	-	-
Landings	MD	2002	36.5%	-	-	1.74	-	-
Landings	MD	2003	43.3%	-	-	1.31	-	-
Landings	MD	2004	40.1%	-	-	1.49	-	-
Landings	MD	2005	36.0%	-	-	1.78	-	-
Landings	MD	2006	65.7%	-	-	0.52	-	-
Landings	MD	2007	59.0%	-	-	0.69	-	-
Landings	MD	2008	40.5%	-	-	1.47	-	-
Landings	MD	2009	30.8%	-	-	2.25	-	-
Landings	MD	2010	26.2%	-	-	2.82	-	-
Landings	MD	2011	21.3%	-	-	3.69	-	-
Landings	MD	2012	32.4%	-	-	2.09	-	-
Landings	MD	2013	0.0%	-	-	Inf	-	-
Landings	MD	2014	0.0%	-	-	Inf	-	-
Landings	MD	2015	0.0%	-	-	Inf	-	-
Landings	MD	2016	0.0%	-	-	Inf	-	-
Landings	VA	2001	30.2%	-	-	2.31	-	-
Landings	VA	2002	58.0%	-	-	0.72	-	-
Landings	VA	2003	87.1%	-	-	0.15	-	-
Landings	VA	2004	84.8%	-	-	0.18	-	-
Landings	VA	2005	67.7%	-	-	0.48	-	-

Type	Source	Year	Proportion Female	LCL	UCL	Sex Ratio	LCL	UCL
Landings	VA	2007	50.5%	-	-	0.98	-	-
Landings	VA	2008	44.1%	-	-	1.27	-	-
Landings	VA	2009	34.6%	-	-	1.89	-	-
Landings	VA	2010	38.5%	-	-	1.60	-	-
Landings	VA	2011	36.6%	-	-	1.73	-	-
Landings	VA	2012	53.0%	-	-	0.89	-	-
Landings	VA	2013	53.1%	-	-	0.88	-	-
Landings	VA	2014	26.4%	-	-	2.79	-	-
Landings	VA	2015	32.7%	-	-	2.06	-	-
Landings	VA	2016	33.1%	-	-	2.02	-	-
Landings	NJ	1998	28.1%	-	-	2.56	-	-
Landings	NJ	1999	33.1%	-	-	2.02	-	-
Landings	NJ	2000	23.9%	-	-	3.19	-	-
Landings	NJ	2001	26.1%	-	-	2.83	-	-
Landings	NJ	2002	28.2%	-	-	2.54	-	-
Landings	NJ	2003	25.8%	-	-	2.87	-	-
Landings	NJ	2004	27.6%	-	-	2.63	-	-
Landings	NJ	2005	27.9%	-	-	2.59	-	-
Landings	NJ	2006	41.1%	-	-	1.43	-	-
Landings	DE	1998	53.9%	-	-	0.85	-	-
Landings	DE	1999	44.4%	-	-	1.25	-	-
Landings	DE	2000	45.6%	-	-	1.19	-	-
Landings	DE	2001	41.4%	-	-	1.41	-	-
Landings	DE	2002	39.4%	-	-	1.54	-	-
Landings	DE	2003	34.4%	-	-	1.91	-	-
Landings	DE	2004	35.0%	-	-	1.86	-	-
Landings	DE	2005	30.7%	-	-	2.25	-	-
Landings	DE	2006	17.9%	-	-	4.58	-	-
Landings	DE	2007	0.0%	-	-	Inf	-	-
Landings	DE	2008	0.0%	-	-	Inf	-	-
Landings	DE	2009	0.0%	-	-	Inf	-	-
Landings	DE	2010	0.0%	-	-	Inf	-	-
Landings	DE	2011	0.0%	-	-	Inf	-	-
Landings	DE	2012	0.0%	-	-	Inf	-	-
Landings	DE	2013	0.0%	-	-	Inf	-	-
Landings	DE	2014	0.0%	-	-	Inf	-	-
Landings	DE	2015	0.0%	-	-	Inf	-	-
Landings	DE	2016	0.0%	-	-	Inf	-	-
Commercial	SIW	2000	50.6%	-	-	0.98	-	-

Type	Source	Year	Proportion Female	LCL	UCL	Sex Ratio	LCL	UCL
Commercial	SIW	2002	58.2%	-	-	0.72	-	-
Commercial	SIW	2003	63.3%	-	-	0.58	-	-
Commercial	SIW	2004	-	-	-	-	-	-
Commercial	SIW	2005	-	-	-	-	-	-
Commercial	SIW	2006	83.2%	-	-	0.20	-	-
Commercial	SIW	2007	74.2%	-	-	0.35	-	-
Commercial	SIW	2008	75.4%	-	-	0.33	-	-
Commercial	SIW	2009	65.6%	-	-	0.53	-	-
Commercial	SIW	2010	67.1%	-	-	0.49	-	-
Commercial	SIW	2011	61.8%	-	-	0.62	-	-
Commercial	SIW	2012	66.1%	-	-	0.51	-	-
Commercial	SIW	2013	51.6%	-	-	0.94	-	-
Commercial	SIW	2014	48.8%	-	-	1.05	-	-
Commercial	SIW	2015	48.6%	-	-	1.06	-	-
Commercial	SIW	2016	61.8%	-	-	0.62	-	-
Commercial	SIW	2017	55.6%	-	-	0.80	-	-
Commercial	SOW	2000	79.5%	-	-	0.26	-	-
Commercial	SOW	2002	89.3%	-	-	0.12	-	-
Commercial	SOW	2005	56.5%	-	-	0.77	-	-
Commercial	SOW	2006	76.7%	-	-	0.30	-	-
Commercial	SOW	2007	-	-	-	-	-	-
Commercial	SOW	2008	59.3%	-	-	0.69	-	-
Commercial	SOW	2010	66.7%	-	-	0.50	-	-
Commercial	SOW	2011	44.9%	-	-	1.23	-	-
Commercial	SOW	2012	25.4%	-	-	2.93	-	-
Commercial	SOW	2013	52.0%	-	-	0.92	-	-
Commercial	SOW	2014	41.6%	-	-	1.41	-	-
Commercial	SOW	2015	46.5%	-	-	1.15	-	-
Commercial	SOW	2016	23.4%	-	-	3.27	-	-
Commercial	SOW	2017	24.6%	-	-	3.07	-	-

Biomedical **CONFIDENTIAL** Data Removed

Table 13. Commercial bait landings in numbers of horseshoe crabs by region, 1998-2016. The four regions are the Northeast (Maine, Massachusetts, Rhode Island), New York (Connecticut, New York), Delaware Bay (New Jersey, Delaware, Maryland, Virginia), and Southeast (North Carolina, South Carolina, Georgia, Florida).

Year	Region				Coastwide
	Northeast	New York	Delaware Bay	Southeast	
1998	413,700	387,045	1,088,393	27,312	1,916,450
1999	573,618	439,076	1,530,614	61,972	2,605,280
2000	288,310	644,363	718,805	25,435	1,676,913
2001	137,733	140,582	497,962	9,130	785,407
2002	142,770	209,351	900,241	14,432	1,266,795
2003	131,286	149,450	741,369	25,995	1,048,100
2004	75,466	166,002	402,696	12,277	656,441
2005	55,843	170,855	476,123	7,713	710,534
2006	149,851	199,270	437,490	10,800	797,411
2007	109,166	323,320	343,632	9,486	785,604
2008	111,392	181,284	333,946	26,241	652,863
2009	109,996	150,118	471,515	33,025	764,654
2010	75,243	155,404	370,921	10,931	612,499
2011	101,884	167,573	396,286	27,127	692,870
2012	145,218	203,679	423,296	24,674	796,867
2013	166,775	191,242	561,031	32,314	951,362
2014	144,212	155,004	461,579	26,603	787,397
2015	125,596	164,956	280,991	25,103	596,646
2016	131,101	188,767	395,697	25,197	740,762

Table 14. Horseshoe crab commercial bait harvest in numbers for the Delaware Bay states by sex, 1998-2017, validated by ACCSP. The number of female horseshoe crabs of Delaware Bay origin was developed to support the catch survey analysis for that region. See section 4.1.3 for how these numbers were developed.

Year	Female HSC (#s)	Male HSC (#s)	Unclassified Sex (#s)	Total HSC (#s)	DB Origin HSC (#s)	Female DB Origin HSC (#s)
1998	382,199	413,698	292,496	1,088,393	867,959	435,810
1999	388,280	466,540	675,794	1,530,614	1,041,126	530,743
2000	189,653	392,123	137,029	718,805	560,745	189,434
2001	155,561	280,626	61,775	497,962	375,546	120,932
2002	299,296	558,704	42,241	900,241	736,242	257,378
2003	233,583	415,456	92,330	741,369	592,206	220,354
2004	146,399	201,252	55,045	402,696	261,560	108,843
2005	142,303	258,774	75,046	476,123	335,971	116,577
2006	201,063	212,478	23,949	437,490	253,187	104,048
2007	141,705	191,574	10,353	343,632	200,858	67,674
2008	89,817	229,265	14,864	333,946	209,414	44,329
2009	115,590	355,323	602	471,515	268,547	48,663
2010	97,546	269,886	3,489	370,921	196,307	41,385
2011	79,827	315,679	780	396,286	235,358	33,728
2012	135,266	287,991	39	423,296	241,717	56,112
2013	83,161	477,844	26	561,031	341,199	29,111
2014	38,314	423,265		461,579	294,504	13,410
2015	33,398	247,593		280,991	201,066	11,689
2016	42,636	353,061		395,697	235,009	14,923
2017	48,447	524,359		572,806	369,161	16,956

Table 15. Numbers of horseshoe crabs collected, bled, and estimated mortality for the biomedical industry as reported in annual FMP Reviews.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*	2017
A. Number of crabs brought to biomedical facilities (bait and biomedical crabs)	335,501	282,723	282,787	478,911	491,543	521,330	551,052	600,772	622,098	525,667	534,702	563,631	426,286	575,760
B. Number of bait crabs bled	40,572	36,103	46,600	63,424	69,062	106,365	71,989	78,005	81,433	61,297	67,143	69,731	77,946	95,231
C. Number of biomedical-only crabs collected (not counted against state bait quotas)	284,215	248,475	237,822	416,824	422,958	414,959	480,914	545,164	541,956	464,657	467,897	494,123	344,495	483,245
D. Reported observed mortality of biomedical-only crabs from collection to release	10,145	3,030	2,450	4,663	6,476	6,318	6,829	24,139	7,370	5,447	5,658	5,362	1,004	6,057
E. Number of biomedical-only crabs bled	101,020	190,362	177,599	352,645	397,809	386,118	412,781	486,850	497,956	440,402	432,340	464,506	318,523	444,115
F. Estimated post-bleeding mortality of bled biomedical-only crabs (15% est. mortality)	15,153	28,554	26,640	52,897	59,671	57,918	61,917	73,028	74,693	66,060	64,851	69,676	47,778	66,617
G. Total estimated mortality on biomedical crabs not counted against state bait quotas (15% est. mortality)	25,298	31,584	29,090	57,560	66,147	64,236	68,746	97,166	82,063	71,507	70,509	75,038	48,782	72,674

***Some biomedical collections were reduced in 2016 due to temporary changes in production.**

Table 16. Summary of studies that estimate a mortality rate of crabs bled for biomedical purposes and the same size of crabs bled to obtain the rate. See Appendix A for complete citations for each published paper.

Author(s)	Year	Mortality Rate	Sample Size
Rudloe	1983	0.10	4822
		0.03	40
Thompson	1998	0.15	20
		0.00	594
SCDNR	1999	0.07	132
Wenner and Thompson	2000	0.08	75
Kurz and James-Pirrri	2002	0.20	10
Walls and Berkson	2003	0.00	10
		0.30	10
		0.00	30
		0.00	30
		0.20	30
		0.00	30
		0.07	30
		0.17	30
Hurton and Berkson	2005	0.00	40
		0.00	40
		0.00	40
		0.00	40
		0.03	39
		0.05	39
		0.10	39
		0.15	39
Leschen and Correia	2010	0.15	15
		0.23	19
		0.40	13
		0.07	14
		0.31	14
		0.20	14
		0.20	17
		0.29	21
		0.49	14
		0.10	9
		0.40	15
		0.27	18
DeLancey and Floyd	2012	0.20	50
Anderson et al.	2013	0.00	7
		0.14	7
		0.14	7
		0.43	7
Linesh	2017	0.11	48
Owings	2017	0.00	8
		0.06	17
		0.14	8
		0.13	8
		0.44	9
		0.75	8

Table 17. All trawl captured horseshoe crabs that have been tagged and released since 1999. Shaded gray columns indicate biomedical companies that tag bled crabs (Lonza and Wako).

Release Year	Lonza	MDDNR	NCCRUISE	NYDEC	SHU	VATECH	Wako
1999	2,500	975	0	0	0	0	0
2000	2,500	0	0	0	0	0	0
2001	2,500	0	0	0	0	0	0
2002	2,499	0	0	0	0	0	0
2003	0	0	6	0	0	450	0
2004	2,500	0	3	0	0	330	0
2005	5,496	0	0	0	0	219	0
2006	5,000	0	9	0	0	196	0
2007	5,596	0	16	961	0	202	0
2008	5,496	0	8	257	0	233	75
2009	4,076	0	0	14	2	1,169	102
2010	4,950	0	0	26	3	0	68
2011	5,000	0	0	303	0	408	34
2012	4,150	0	0	65	11	0	153
2013	4,350	0	3	0	125	0	332
2014	2,400	0	0	0	123	0	437
2015	1,275	0	1	43	89	0	636
2016	2,449	0	0	0	51	0	275
2017	2,814	0	0	32	41	37	219
Totals	**65,551**	**975**	**46**	**1,701**	**445**	**3,244**	**2,331**

Table 18. List of recaptured trawl-tagged crabs since 1999. Shaded gray columns indicate biomedical companies that tag bled crabs (Lonza and Wako).

Recover Year	Lonza	MDDNR	NCCRUISE	NYDEC	SHU	VATECH	Wako
1999	16	1	0	0	0	0	0
2000	59	24	0	0	0	0	0
2001	65	18	0	0	0	0	0
2002	124	11	0	0	0	0	0
2003	117	5	0	0	0	2	0
2004	114	3	0	0	0	8	0
2005	140	3	0	0	0	9	0
2006	392	1	0	0	0	13	0
2007	261	0	0	20	0	22	0
2008	371	1	1	11	0	14	0
2009	505	3	0	18	0	11	5
2010	432	1	0	9	1	50	0
2011	470	0	1	9	0	40	4
2012	283	0	1	4	5	24	9
2013	371	1	0	3	0	46	10
2014	282	0	0	2	2	20	15
2015	237	0	0	2	4	13	22
2016	212	0	0	2	1	6	31
2017	250	0	0	0	3	13	18
Totals	**4,701**	**72**	**3**	**80**	**16**	**291**	**114**

Table 19. Total recaptures by years at large (YAL) for all trawl captured, bled male and female horseshoe crabs since 1999.

	Females			Males		
YAL	Alive	Dead	Unknown	Alive	Dead	Unknown
0	348	377	263	657	298	211
1	176	48	131	391	59	122
2	52	31	71	243	58	91
3	51	24	50	150	41	62
4	38	18	39	107	39	43
5	18	12	27	83	23	29
6	8	8	18	76	21	32
7	1	5	19	50	15	10
8	3	3	11	32	15	11
9	1	0	9	13	7	9
10	1	1	8	7	5	6
11	3	3	7	7	6	5

Table 20. Total recaptures by years at large (YAL) for trawl captured, unbled male and female horseshoe crabs since 1999.

	Females			Males		
YAL	Alive	Dead	Unknown	Alive	Dead	Unknown
0	37	23	6	67	20	6
1	14	8	4	52	7	4
2	10	7	4	25	6	2
3	10	4	1	31	15	2
4	8	9	0	17	4	3
5	4	1	1	10	4	2

Table 21. Model statistics for the top 6 out of 70 models fit to the capture recapture data for horseshoe crabs tagged in the coastal Delaware and Virginia geographic area between 1999 and 2017. Model names include group and time effects for apparent survival (Phi) and capture probability (p); npar=number of parameters; AICc=corrected Akaike Information Criteria; Delta AICc=0 indicates the best fitting model.

Model	npar	AICc	Delta AICc
Phi(~sex * bled * timebin3) p(~sex * bled * time)	144	52255.95	0
Phi(~sex * time) p(~sex * bled * time)	162	52264.21	8.263303
Phi(~bled * timebin3) p(~sex * bled * time)	120	52286.22	30.26859
Phi(~sex * bled * timebin4) p(~sex * bled * time)	138	52288.65	32.70104
Phi(~sex * bled * timebin3) p(~bled * time)	72	52289.79	33.83709
Phi(~sex * time) p(~bled * time)	90	52310.64	54.68489

Table 22. Apparent survival (Phi_hat) estimated from the best fitting model (Table 21). Estimates are annual survival within 3-year periods with standard error (SE) and 95% confidence intervals (LCL, UCL).

		Not bled				Bled			
Sex	Years	Phi_hat	SE	LCL	UCL	Phi_hat	SE	LCL	UCL
F	1999-2001	0.5576	0.1386	0.2953	0.7914	0.7747	0.0667	0.6191	0.8791
F	2002-2004	0.6263	0.1078	0.4046	0.8051	0.8212	0.0527	0.6945	0.9027
F	2005-2007	1.000*	0.0001	0.0000	1.0000	0.5068	0.0227	0.4623	0.5512
F	2008-2010	0.6483	0.0488	0.5480	0.7371	0.7472	0.0313	0.6811	0.8036
F	2011-2013	0.7036	0.0770	0.5352	0.8303	0.8434	0.0547	0.7050	0.9238
F	2014-2017	0.7022	0.3896	0.0577	0.9891	0.8126	0.1769	0.3079	0.9769
M	1999-2001	0.7068	0.0729	0.5474	0.8276	0.9161	0.0408	0.7940	0.9687
M	2002-2004	0.7243	0.0870	0.5278	0.8606	0.7215	0.0280	0.6636	0.7729
M	2005-2007	0.9010	0.0752	0.6357	0.9793	0.7472	0.0210	0.7039	0.7860
M	2008-2010	0.6365	0.0268	0.5825	0.6873	0.6731	0.0208	0.6311	0.7125
M	2011-2013	0.6804	0.0438	0.5892	0.7596	0.8624	0.0358	0.7762	0.9189
M	2014-2017	0.7813	0.1789	0.3145	0.9653	0.6660	0.0790	0.4986	0.7999

* Survival for unbled females during 2005-2007 was not estimable.

Table 23. Annual biomedical data availability by state. State-year combinations filled green indicate that number of crabs collected, number or percent bled, number or percent observed dead, and sex ratio (for at least a subsample) were all reported. State-year combinations filled yellow indicate that number of crabs collected was reported and at least one of the following, indicated within the cell, was not reported: number or percent bled (NB), number or percent observed dead (ND), or sex ratio (NS). State-year combinations filled red indicate that number of crabs collected was not reported.

[Table Removed Due to **CONFIDENTIAL** Data]

Table 24. Proportions of horseshoe crabs collected for biomedical use that were observed dead and bled by state.

[Table Removed Due to **CONFIDENTIAL** Data]

Table 25. Reported sex ratios of horseshoe crabs used for biomedical purposes by state and year, shown as percent female. No sex ratios were reported prior to 2004.

[Table Removed Due to **CONFIDENTIAL** Data]

Table 26. Regional (NE: Northeast, DB: Delaware Bay, SE: Southeast; CONFIDENTIAL data removed) and coastwide estimates of biomedical mortality (numbers of crabs) using bleeding mortalities of 4%, 15%, and 30%. Delaware Bay estimates include all crabs caught from New Jersey through Virginia, not only those of Delaware Bay origin.

Year	Biomedical Mortality with 4% Bleeding Mortality				Biomedical Mortality with 15% Bleeding Mortality				Biomedical Mortality with 30% Bleeding Mortality			
	NE	DB	SE	Coastwide	NE	DB	SE	Coastwide	NE	DB	SE	Coastwide
1999				7,511				22,528				43,007
2000				10,236				31,563				60,644
2001				12,500				36,316				68,791
2002				20,783				46,150				80,742
2003				19,579				43,479				76,069
2004				32,431				66,450				112,838
2005				22,557				54,772				98,702
2006				23,351				56,189				100,965
2007				26,922				74,936				140,409
2008				22,388				66,148				125,818
2009				21,762				64,236				122,153
2010				23,340				68,747				130,664
2011				43,613				97,166				170,195
2012				27,288				82,064				156,757
2013				23,063				71,507				137,568
2014				24,020				71,577				136,429
2015				26,511				77,608				147,283
2016				13,745				48,782				96,561
2017				23,822				72,674				139,291

Table 27. Directed (bait and biomedical) use mortality by numbers of crabs using biomedical bleeding mortalities of 4%, 15%, and 30%. Biomedical mortalities are also shown as annual percentages of total directed use mortality.

Year	Bait Harvest	Biomedical Use					
		Total Mortality with 4% Bled Mortality	% Directed Use Mortality	Total Mortality with 15% Bled Mortality	% Directed Use Mortality	Total Mortality with 30% Bled Mortality	% Directed Use Mortality
1999	2,605,280	7,511	0.29%	22,528	0.86%	43,007	1.62%
2000	1,676,913	10,236	0.61%	31,563	1.85%	60,644	3.49%
2001	785,407	12,500	1.57%	36,316	4.42%	68,791	8.05%
2002	1,266,795	20,783	1.61%	46,150	3.51%	80,742	5.99%
2003	1,048,100	19,579	1.83%	43,479	3.98%	76,069	6.77%
2004	656,441	32,431	4.71%	66,450	9.19%	112,838	14.67%
2005	710,534	22,557	3.08%	54,772	7.16%	98,702	12.20%
2006	797,411	23,351	2.85%	56,189	6.58%	100,965	11.24%
2007	785,604	26,922	3.31%	74,936	8.71%	140,409	15.16%
2008	652,863	22,388	3.32%	66,148	9.20%	125,818	16.16%
2009	764,654	21,762	2.77%	64,236	7.75%	122,153	13.77%
2010	612,499	23,340	3.67%	68,747	10.09%	130,664	17.58%
2011	692,870	43,613	5.92%	97,166	12.30%	170,195	19.72%
2012	796,867	27,288	3.31%	82,064	9.34%	156,757	16.44%
2013	951,362	23,063	2.37%	71,507	6.99%	137,568	12.63%
2014	787,397	24,020	2.96%	71,577	8.33%	136,429	14.77%
2015	596,646	26,511	4.25%	77,608	11.51%	147,283	19.80%
2016	740,762	13,745	1.82%	48,782	6.18%	96,561	11.53%
2017	994,491	23,822	2.34%	72,674	6.81%	139,291	12.29%

Table 28. Commercial bait harvest and biomedical harvest by region in numbers of horseshoe crabs, 1999-2016. The numbers for biomedical harvest represent the total number of horseshoe crabs bled and released with the 15% mortality applied. % Biomed represents the percent amount of directed harvest (bait + biomedical) attributed to biomedical regionally and coastwide.

[Table Removed Due to **CONFIDENTIAL** Data]

Table 29. Estimated biomedical mortality (numbers of crabs) for crabs of Delaware Bay origin, with bleeding mortalities of 4%, 15%, and 30%, used as inputs in the Catch Multiple Survey Analysis model. This includes all biomedical mortality from New Jersey, 51% of biomedical mortality from Maryland, and 35% of biomedical mortality from Virginia.

[Table Removed Due to **CONFIDENTIAL** Data]

Table 30. Estimated horseshoe crab dredge discards in weight (lbs) and numbers. Data collected in 2010 was used to convert weight to discards in numbers for all years. To convert pounds (lbs) to numbers, a conversion of 1.8 pounds/crab was used.

Year	Ratio	Ratio CV	Discards (lbs)	Discards LCI	Discards UCI	n Fish Counted	Total Subsample Weight (lbs)	n Subsamples	Mean Weight (lbs)	Discards (numbers)
2004	0.00081	0.22006	583,410	326,642	840,178	NA	NA	NA	NA	317,935
2005	0.00065	0.19863	342,233	206,277	478,189	NA	NA	NA	NA	186,503
2006	0.00232	0.47539	1,223,591	60,219	2,386,964	NA	NA	NA	NA	666,807
2007	0.00031	0.34298	172,505	54,173	290,836	NA	NA	NA	NA	94,008
2008	0.00079	0.28886	432,739	182,734	682,743	NA	NA	NA	NA	235,825
2009	0.00118	0.23483	603,889	320,266	887,512	NA	NA	NA	NA	329,095
2010	0.00164	0.59808	811,481	0	1,782,147	21	75	1	3.57	442,224
2011	0.00079	0.31310	389,230	145,492	632,969	NA	NA	NA	NA	212,115
2012	0.00049	0.55345	217,559	0	458,378	NA	NA	NA	NA	118,561
2013	0.00017	0.31907	62,813	22,729	102,896	NA	NA	NA	NA	34,230
2014	0.00594	0.87940	2,237,922	0	6,173,968	NA	NA	NA	NA	1,219,576
2015	0.00380	0.34944	1,406,693	423,577	2,389,809	NA	NA	NA	NA	766,590
2016	0.01193	0.37253	4,523,910	1,153,293	7,894,527	NA	NA	NA	NA	2,465,346
2017	0.00568	0.55577	2,003,434	0	4,230,343	NA	NA	NA	NA	1,091,790

Table 31. Estimated horseshoe crab gill net discards in weight (lbs) and numbers. Data collected in 2005 was used to convert weight to discards in numbers for all years. To convert pounds (lbs) to numbers, a conversion of 1.8 pounds/crab was used.

Year	Ratio	Ratio CV	Discards (lbs)	Discards LCI	Discards UCI	n Fish Counted	Total Subsample Weight (lbs)	n Subsamples	Mean Weight (lbs)	Discards (numbers)
2004	0.01899	0.42285	239,909	37,018	442,801	NA	NA	NA	NA	130,741
2005	0.00373	0.29202	35,358	14,707	56,008	1	4	1	4.00	19,268
2006	0.00225	0.38654	13,853	3,144	24,562	NA	NA	NA	NA	7,549
2007	0.01465	0.38903	175,329	38,913	311,745	NA	NA	NA	NA	95,547
2008	0.00926	0.39576	90,751	18,920	162,581	NA	NA	NA	NA	49,455
2009	0.01389	0.49618	147,298	1,126	293,471	NA	NA	NA	NA	80,272
2010	0.03066	0.21314	246,878	141,641	352,115	NA	NA	NA	NA	134,538
2011	0.04753	0.29030	392,901	164,784	621,017	NA	NA	NA	NA	214,115
2012	0.01197	0.30259	76,634	30,257	123,010	NA	NA	NA	NA	41,762
2013	0.05793	0.38904	416,868	92,513	741,222	NA	NA	NA	NA	227,176
2014	0.00990	0.44947	128,300	12,967	243,634	NA	NA	NA	NA	69,918
2015	0.00933	0.24701	86,424	43,728	129,120	NA	NA	NA	NA	47,098
2016	0.00301	0.16393	16,613	11,167	22,060	NA	NA	NA	NA	9,054
2017	0.00324	0.23918	34,092	17,784	50,399	NA	NA	NA	NA	18,579

Table 32. Estimated horseshoe crab trawl discards in weight (lbs) and numbers. Year-specific data was used to convert weight to numbers for 2012-2016. For the remaining years, data was pooled among all years of available data for the conversions.

Year	Ratio	Ratio CV	Discards (lbs)	Discards LCI	Discards UCI	n Fish Counted	Total Subsample Weight (lbs)	n Subsamples	Mean Weight (lbs)	Discards (numbers)
2004	0.00173	0.35004	1,495	448	2,541	NA	NA	NA	NA	1,700
2005	0.00659	0.65466	5,235	0	12,089	NA	NA	NA	NA	5,954
2006	0.00214	0.48793	2,729	66	5,392	NA	NA	NA	NA	3,104
2007	0.02139	0.43254	15,591	2,104	29,079	NA	NA	NA	NA	17,734
2008	0.02147	0.36827	47,298	12,461	82,135	NA	NA	NA	NA	53,798
2009	0.02243	0.32233	62,144	22,082	102,207	735	237	4	0.32	77,605
2010	0.02183	0.46159	46,695	3,587	89,802	NA	NA	NA	NA	53,112
2011	0.03961	0.32002	170,758	61,465	280,050	NA	NA	NA	NA	194,225
2012	0.02051	0.31988	67,766	24,412	111,120	1751	1906	14	1.09	62,255
2013	0.04386	0.29299	112,787	46,695	178,879	2791	1555	13	0.56	202,436
2014	0.01057	0.31140	20,617	7,777	33,458	488	456	6	0.93	22,064
2015	0.04630	0.27952	89,541	39,484	139,598	3386	3,244	33	0.96	93,467
2016	0.03534	0.23252	51,907	27,768	76,045	1739	1,823	27	1.05	49,520
2017	0.010384	0.22696	32,090	17,524	46,656	1,711	1,192	22	0.70	30,614

Table 33. Surveys considered for developing abundance indices for horseshoe crab. Table indicates which surveys were accepted for index development and which were rejected.

Data Source	Survey	Accepted	Rejected	Reason(s) Rejected			
				Time series too short or broken	Rare occurance of HSC	Inconsistent methods, gear changes	Better survey available with similar coverage
ME DMR	ME-NH Trawl		X		X		
NH F&G	Habitat Monitoring Survey		X	X			
NH F&G	Spawning Survey	X					
MA DMF	Resource Assessment Trawl	X					
MA DMF	Spawning Beach Survey		X	X		X	
RI DEM	Coastal Trawl Survey (seasonal segment)		X				X
RI DEM	Coastal Trawl Survey (monthly segment)	X					
Sacred Heart Univ	Project limulus		X			X	
CT DEEP	Long Island Trawl Survey	X					
NYS DEC	Peconic Bay Small Mesh Trawl Survey	X					
NYS DEC	Western Long Island Beach Seine Survey	X					
NYS DEC	Horseshoe Crab Spawning and Tagging Survey		X			X	
NJ DFW	Ocean Trawl	X					
NJ DFW	Delaware Bay Trawl Survey		X				X
NJ DFW	Surf Clam Survey	X					
DE DFW	Adult Trawl Survey (30')	X					
DE DFW	Juvenile Trawl Survey (16')		X				X
MD DNR	Coastal Bays	X					
Virginia Tech	Virginia Tech Mid-Atl HSC Benthic Trawl	X					
NC DMF	North Carolina fisheries independent gillnet survey	X					
SC DNR	Crustacean Research and Monitoring large trawl survey	X					
SC DNR	SEAMAP- South Atlantic Coastal Trawl Survey	X					
SC DNR	Trammel Net Survey	X					
GA DNR	Ecological Monitoring Trawl Survey	X					
FL FWC	Fisheries- Independent Monitoring Program (FIM)		X	X	X		
NMFS	NEFSC Trawl		X		X		X
NEAMAP	NEAMAP	X					

Table 34. List of fishery-independent surveys that were developed in relative abundance indices for this stock assessment, the gear used in the survey, the minimum and maximum prosomal width, and median prosomal width of horseshoe crabs caught.

Survey	Gear	Range of widths (cm)	Median width (cm)
MA DMF	3/4 size North Atlantic type two seam otter trawl; codend has a 6.4 mm knotless liner	4-53	16
RI Trawl	Otter trawl with a ¼ mesh inch line; survey net is 210 x 4.5”, 2 seam (40’ / 55’), mesh size 4.5”	4-31	23
CT LISTS	Otter trawl with 102 mm mesh in wings and belly, 76 mm mesh in tailpiece, 51 mm mesh codend	5-34	22
NY Peconic	Trawl - 4.8 meter semi-balloon shrimp trawl net	4-53	23
NY WLIS	Seine - ¼ inch square mesh in the wings, 3/16 inch square mesh in the bunt	2-53	17
NEAMAP	Trawl - four-seam, three-bridle, 400x12 cm bottom trawl	4-53	17
NJ OT	Two-seam trawl with forward netting of 12 cm stretch mesh, rear netting of 8 cm, lined with 6.4 mm bar mesh liner	3-53	20
NJ Surfclam	Commercial hydraulic clam dredge	2-53	15
DE Adult	30 ft 2-seam otter trawl, 3" (7.6cm) stretch mesh in wings and body, 2" (5.1cm) stretch mesh in cod end	4-53	19
Virginia Tech	Two-seam trawl with net body of 15.2 cm stretched mesh, bag 14.3 cm stretched mesh	2-53	16
MD Coastal	Otter trawl, usually 5.5 or 6 inch mesh	6-38	19
NC Esturine	Floating gill nets with 30-yard segments of 3, 3 ½, 4, 4 ½, 5, 5 ½, 6, and 6 ½ inch stretched mesh	1-50	20
SC CRMS	20-foot trawl net, with 1” stretch mesh	2-53	23
SC Trammel	183 x 2.1 m trammel net	2-48	23
SEAMAP	Paired 75-ft (22.9-m) mongoose-type Falcon trawl nets with 1.875-in (47.6-mm) stretch mesh	2-53	23
GA Trawl	40' flat beam trawl	4-53	22

Table 35. Indices of bay-wide male and female horseshoe crab spawning activity (ISA), number of beaches surveyed, standard deviation (SD), coefficient of variations (CV), 90% confidence intervals (CI) and sex ratio for the Delaware Bay from 1999 to 2017 (Source: DE DFW).

Year	Beaches Surveyed	Male				Female				Annual Sex Ratio (M:F)
		ISA	90% CI	SD	CV (%)	ISA	90% CI	SD	CV (%)	
1999	17	2.5	1.86, 3.37	0.45	18	0.77	0.62, 0.97	0.1	13	3.2
2000	22	2.96	2.31, 3.80	0.45	15	0.91	0.74, 1.13	0.12	13	3.2
2001	22	2.37	1.91, 2.95	0.31	13	0.75	0.63, 0.90	0.08	10	3.1
2002	23	2.86	2.45, 3.34	0.27	9	0.91	0.79, 1.04	0.07	8	3.1
2003	23	2.89	2.50, 3.33	0.25	9	0.8	0.71, 0.91	0.06	8	3.6
2004	24	2.93	2.55, 3.36	0.24	8	0.77	0.68, 0.87	0.06	7	3.8
2005	23	3.23	2.79, 3.74	0.29	9	0.82	0.72, 0.93	0.07	9	3.9
2006	24	3.99	3.49, 4.56	0.33	8	0.99	0.89, 1.10	0.07	7	4
2007	24	4.22	3.63, 4.90	0.38	9	0.89	0.78, 1.01	0.07	8	4.7
2008	25	2.3	1.83, 2,90	0.32	14	0.68	0.59, 0.78	0.06	9	3.4
2009	26	4.67	4.11, 5.29	0.36	8	1	0.89, 1.11	0.06	6	4.7
2010	25	3.39	2.93, 3.94	0.31	9	0.8	0.70, 0.92	0.07	8	4.2
2011	25	3.31	2.83, 3.87	0.31	10	0.64	0.57, 0.72	0.05	7	5.2
2012	25	2.44	1.97, 3.01	0.31	13	0.56	0.47, 0.67	0.06	10	4.4
2013	25	3.2	2.98, 3.44	0.14	4	0.85	0.80, 0.91	0.03	4	3.8
2014	25	2.28	2.09, 2.48	0.12	5	0.54	0.50, 0.59	0.03	5	4.2
2015	23	2.75	2.59, 2.92	0.1	4	0.66	0.62, 0.70	0.02	4	4.2
2016	25	4.1	3.86, 4.36	0.2	4	0.9	0.85, 0.95	0.03	3	4.6
2017	25	3.68	3.37, 4.02	0.2	5	0.71	0.65, 0.78	0.04	6	5.2

Table 36. Results of the power analysis by survey for linear and exponential trends in horseshoe crab abundance indices over a twenty-year period. Power were calculated as the probability of detecting a 50% change following the methods of Gerrodette (1987). Sex includes all mature horseshoe crab or multiparous (M) or primiparous (P) if indicated.

State	Survey	Season	Sex	Time Period	Median CV	Linear Trend		Exponential Trend	
						+50%	-50%	+50%	-50%
NH	Beach Spawner	Spring	Female	2002-2012	0.488	0.33	0.46	0.35	0.51
NH	Beach Spawner	Spring	Male	2002-2012	0.488	0.33	0.46	0.35	0.51
MA	Trawl North Cape	Fall	All	1978-2017	0.817	0.18	0.24	0.20	0.30
MA	Trawl South Cape	Fall	All	1978-2017	0.574	0.27	0.37	0.29	0.42
RI	Monthly Trawl	Fall	All	1998-2016	0.365	0.48	0.66	0.50	0.70
CT	CT LISTS	Fall	All	1997-2016	0.254	0.74	0.91	0.75	0.92
NY	Peconic Bay	Fall	All	1987-2016	0.132	1.00	1.00	1.00	1.00
NY	Seine - Jamaica	Spring	All	1987-2017	0.418	0.40	0.56	0.42	0.60
NY	Seine - LN & Man	Spring	All	1987-2017	0.302	0.61	0.80	0.63	0.82
DE	Adult Trawl	Fall	All	1990-2017	0.341	0.53	0.71	0.54	0.74
DE	Adult Trawl	Spring	All	1990-2017	0.272	0.69	0.87	0.70	0.88
DE	Adult Trawl	Fall	Female	1990-2017	0.337	0.54	0.72	0.55	0.75
DE	Adult Trawl	Spring	Female	1990-2017	0.275	0.68	0.86	0.70	0.88
DE	Adult Trawl	Fall	Male	1990-2017	0.380	0.46	0.63	0.47	0.67
DE	Adult Trawl	Spring	Male	1990-2017	0.281	0.67	0.85	0.68	0.87
NY	NEAMAP	Fall	All	2007-2017	0.303	0.61	0.80	0.62	0.82
DB	NEAMAP	Fall	All	2008-2016	0.213	0.86	0.97	0.87	0.97
NJ	Ocean Trawl	Fall	All	1989-2017	0.329	0.55	0.74	0.57	0.77
NJ	Ocean Trawl	Spring	All	1989-2017	0.284	0.66	0.84	0.67	0.86
NJ	Ocean Trawl	Fall	Female	1999-2017	0.298	0.62	0.81	0.64	0.83
NJ	Ocean Trawl	Spring	Female	1999-2017	0.250	0.75	0.91	0.76	0.92
NJ	Ocean Trawl	Fall	Male	1999-2017	0.373	0.47	0.65	0.49	0.68
NJ	Ocean Trawl	Spring	Male	1999-2017	0.298	0.62	0.81	0.64	0.83
NJ	Surf Clam	Summer	All	1998-2012	0.135	1.00	1.00	1.00	1.00
NJ	Surf Clam	Summer	Female	1998-2012	0.141	0.99	1.00	0.99	1.00
NJ	Surf Clam	Summer	Male	1998-2012	0.199	0.90	0.98	0.90	0.99
MD	Coastal Bays	Spring	All	1990-2017	0.500	0.32	0.45	0.34	0.50
NJ-VA	Virginia Tech Trawl	Fall	Female - M	2002-2017	0.262	0.72	0.89	0.73	0.90
NJ-VA	Virginia Tech Trawl	Fall	Female - P	2002-2017	0.300	0.62	0.81	0.63	0.83
NJ-VA	Virginia Tech Trawl	Fall	Male - M	2002-2017	0.281	0.67	0.85	0.68	0.87
NJ-VA	Virginia Tech Trawl	Fall	Male - P	2002-2017	0.336	0.54	0.73	0.55	0.75
NC	Gillnet	Spring	All	2001-2016	0.152	0.99	1.00	0.99	1.00
SC	SEAMAP	Fall	All	2001-2017	0.435	0.54	0.38	0.58	0.40
GA-FL	SEAMAP	Fall	All	2001-2017	0.390	0.61	0.44	0.65	0.46
SC	CRMS	Spring	All	1995-2017	0.291	0.64	0.83	0.65	0.85
SC	Trammel	Spring	All	1995-2017	0.344	0.52	0.71	0.54	0.74
GA	Trawl	Spring	All	1999-2017	0.176	0.95	1.00	0.95	1.00

Table 37. List of surveys used in the regional Conn indices and their associated sigma values, or the standard deviation of the process error. All surveys are for combined sexes and adult horseshoe crabs unless specified in the parentheticals.

Survey	σ^p
MA Trawl North Cape (Fall)	4.097
MA Trawl South Cape (Fall)	2.651
RI Monthly (Fall)	0.308
CT LISTS (Fall)	0.224
NY Peconic (Fall)	0.641
NY Seine Jamaica Bay (Spring)	0.466
NY Seine Little N & Manh (Spring)	0.298
NY NEAMAP (Fall)	0.705
DB NEAMAP (Fall)	0.680
NJ Ocean Trawl (Spring)	0.602
NJ Ocean Trawl (Fall)	0.467
NJ Ocean Trawl (Spring, F only)	0.535
NJ Ocean Trawl (Spring, M only)	0.626
NJ Ocean Trawl (Fall, F only)	0.541
NJ Ocean Trawl (Fall, M only)	0.709
NJ Surf Clam	0.579
NJ Surf Clam (F only)	0.429
NJ Surf Clam (M only)	0.362

Survey	σ^p
DE Adult Trawl (Fall)	0.918
DE Adult Trawl (Spring, F only)	0.820
DE Adult Trawl (Spring, M only)	0.806
DE Adult Trawl (Fall, F only)	0.714
DE Adult Trawl (Fall, M only)	0.817
VT Tech Trawl	0.171
VT Tech Trawl (F only)	0.233
VT Tech Trawl (M only)	0.155
MD Coastal Bays (Spring)	0.561
NC Gillnet (Pamlico Sound, Spring)	0.423
SC Trammel (Spring)	0.280
SC CRMS (Spring)	0.819
SEAMAP (SC only, Fall)	4.281
GA Trawl (Spring)	0.651
SEAMAP (GA & FL, Fall)	3.551

Table 38. Results of autoregressive integrated moving average (ARIMA) model fits for horseshoe crab surveys. W is the Shapiro-Wilk test statistic for normality of residuals (p value in parentheses); n is the number of years in the time series; r1, r2, and r3 are the first three autocorrelations; θ is the moving average parameter; SE is the standard error of θ; and σ^2c is the variance of the index.

Survey	Years	n	W	p	r_1	r_2	r_3	θ	SE	σ^2_c
Northeast Region										
MA DMF Trawl – North of Cape Cod	1978-2017	40	0.82	0.01	-0.43	-0.11	0.06	1.00	0.13	3.82
MA DMF Trawl – South of Cape Cod	1978-2017	40	0.96	0.17	-.39	-0.01	-0.10	0.63	0.21	1.79
NH Spawner - Female	2002-2012	11	0.96	0.74	-0.31	-0.22	0.06	0.59	0.27	0.71
NH Spawner - Male	2002-2012	11	0.90	0.20	-0.36	-0.19	0.05	0.62	0.23	0.31
RI Monthly Trawl - Fall	1998-2016	19	0.96	0.58	-0.29	-0.29	0.24	0.64	0.24	0.40
New York Region										
CT Long Island Sound Trawl - Fall	1997-2016	20	0.93	0.15	-0.24	-0.20	-0.12	0.49	0.23	0.17
NEAMAP - Fall	2007-2017	11	0.92	0.34	-0.31	-0.13	-0.08	0.78	0.70	0.71
NY Jamaica Bay Seine	1988-2016	29	0.99	0.96	-0.52	-0.10	0.38	0.75	0.15	0.57
NY Little Neck and Manhasset Bay Seine	1988-2016	29	0.96	0.36	-0.40	-0.17	0.07	0.64	0.15	0.29
NY Peconic Trawl	1987-2016	30	0.97	0.53	-0.52	0.32	-0.16	0.21	0.19	0.20
Mid-Atlantic Region										
DE 30 ft Trawl - Fall	1990-2017	28	0.97	0.49	-0.24	-0.11	0.17	0.62	0.16	1.22
DE 30 ft Trawl - Fall Female	1990-2017	28	0.95	0.20	-0.32	-0.04	0.07	0.63	0.15	1.11
DE 30 ft Trawl - Fall Male	1990-2017	28	0.96	0.35	-0.28	-0.11	0.17	0.64	0.15	1.32
DE 30 ft Trawl - Spring	1990-2017	28	0.96	0.34	0.09	-0.07	0.19	0.57	0.18	1.15
DE 30 ft Trawl - Spring Female	1990-2017	28	0.96	0.40	-0.10	-0.22	0.17	0.61	0.17	1.02
DE 30 ft Trawl - Spring Male	1990-2017	28	0.94	0.09	-0.29	-0.13	0.20	0.63	0.17	1.32
MD Coastal Bays Trawl - Spring	1990-2017	28	0.96	0.31	-0.44	-0.10	0.14	1.00	0.11	0.40
NEAMAP - Fall	2007-2017	11	0.92	0.30	-0.45	-0.12	0.12	1.00	0.29	0.48
NJ Ocean Trawl - Fall	1989-2017	29	0.97	0.49	-0.55	0.28	-0.28	0.75	0.15	0.45
NJ Ocean Trawl - Fall Female	1999-2017	19	0.94	0.32	-0.19	-0.19	-0.13	1.00	0.15	0.21
NJ Ocean Trawl - Fall Male	1999-2017	19	0.97	0.87	-0.34	0.12	-0.30	1.00	0.16	0.27

Table 38 ***Continued***

Survey	Years	n	W	p	r_1	r_2	r_3	θ	SE	σ^2_c
Mid-Atlantic Region										
NJ Ocean Trawl - Spring	1989-2017	29	0.97	0.50	-0.42	-0.04	0.00	0.48	0.18	0.32
NJ Ocean Trawl - Spring Female	1999-2017	19	0.93	0.16	-0.37	0.01	-0.05	0.45	0.22	0.34
NJ Ocean Trawl - Spring Male	1999-2017	19	0.93	0.15	-0.22	-0.09	-0.10	0.27	0.30	0.29
NJ Surf Clam Dredge	1998-2012	15	0.97	0.90	-0.36	-0.09	0.17	0.41	0.19	0.15
NJ Surf Clam Dredge - Female	1998-2012	15	0.96	0.74	-0.47	0.20	-0.23	0.68	0.23	0.15
NJ Surf Clam Dredge - Male	1998-2012	15	0.97	0.92	-0.38	0.06	0.00	0.54	0.28	0.28
VA Tech Trawl	2002-2017	12	0.92	0.32	-0.49	-0.05	0.19	0.64	0.29	0.21
VA Tech Trawl - Immature Female	2002-2017	12	0.97	0.91	-0.52	-0.05	0.21	1.00	0.30	0.39
VA Tech Trawl - Immature Male	2002-2017	12	0.96	0.78	-0.51	-0.10	0.24	1.00	0.32	0.47
VA Tech Trawl - Mature Female	2002-2017	12	0.92	0.26	0.04	-0.33	-0.46	0.00	0.47	0.17
VA Tech Trawl - Mature Male	2002-2017	12	0.89	0.13	-0.14	-0.06	-0.65	0.45	0.59	0.25
VA Tech Trawl - Newly Mature Female	2002-2017	12	0.92	0.28	-0.14	0.10	-0.71	0.03	0.37	0.47
VA Tech Trawl - Newly Mature Male	2002-2017	12	0.93	0.41	-0.27	-0.19	-0.04	0.60	0.31	1.10
Southeast Region										
GA Trawl - Spring	1999-2017	19	0.87	0.02	-0.50	0.16	-0.22	0.77	0.15	0.44
NC Gillnet - Spring	2001-2016	16	0.90	0.08	0.10	-0.27	-0.30	0.10	0.30	0.12
SC CRMS	1995-2017	23	0.96	0.53	-0.25	-0.20	0.09	0.32	0.27	0.43
SC Trammel Net	1995-2017	23	0.96	0.54	-0.33	-0.33	0.18	0.73	0.14	0.31
SEAMAP - SC Fall	2001-2017	17	0.93	0.19	-0.14	-0.09	-0.32	0.52	0.17	3.48
SEAMAP GA-FL - Fall	2001-2017	17	0.97	0.75	-0.13	-0.35	-0.23	0.42	0.24	2.55

Table 39. Reference points from the ARIMA model for each survey and the probability that the terminal year's fitted index (i_f) is below the reference point. The 1998 reference is i_{1998} and the lower quartile reference is Q_{25}. Reference points are based on ln transformed index values. Surveys that began after 1998 do not have a 1998 reference value.

Survey	i_f	i_{1998}	$P(i_f<i_{1998})$	Q_{25}	$P(i_f<Q_{25})$
Northeast Region					
MA DMF Trawl – North of Cape Cod	-0.70	-0.66	0.41	-0.59	0.21
MA DMF Trawl – South of Cape Cod	-0.11	-1.13	0.08	-1.60	0.04
NH Spawner - Female	0.73			0.69	0.34
NH Spawner - Male	1.14			1.18	0.44
RI Monthly Trawl - Fall	-1.16	-0.88	0.62	-0.92	0.56
New York Region					
CT Long Island Sound Trawl - Fall	0.06	0.86	1.00	0.32	0.83
NEAMAP - Fall	1.19			0.98	0.23
NY Jamaica Bay Seine	-0.69	0.10	0.96	-0.34	0.64
NY Little Neck and Manhasset Bay Seine	0.33	1.47	1	0.48	0.60
NY Peconic Trawl	-1.65	0.38	1.00	-0.81	0.97
Mid-Atlantic Region					
DE 30 ft Trawl - Fall	1.90	0.59	0.02	0.19	0.00
DE 30 ft Trawl - Fall Female	0.70	-0.45	0.03	-0.82	0.00
DE 30 ft Trawl - Fall Male	1.40	0.02	0.02	-0.26	0.01
DE 30 ft Trawl - Spring	1.28	1.07	0.33	0.10	0.04
DE 30 ft Trawl - Spring Female	0.33	0.25	0.50	-0.66	0.06
DE 30 ft Trawl - Spring Male	0.61	0.21	0.21	-0.52	0.04
MD Coastal Bays Trawl - Spring	-1.14	-1.00	0.36	-1.30	0.01
NEAMAP - Fall	2.82			2.69	0.05
NJ Ocean Trawl - Fall	1.48	1.89	0.82	1.42	0.32
NJ Ocean Trawl - Fall Female	0.72			0.67	0.11
NJ Ocean Trawl - Fall Male	0.79			0.71	0.07
NJ Ocean Trawl - Spring	2.42	2.36	0.51	1.62	0.00
NJ Ocean Trawl - Spring Female	1.53			0.66	0.00
NJ Ocean Trawl - Spring Male	1.76			0.57	0.00
NJ Surf Clam Dredge	0.85	0.11	0.00	-0.06	0.00
NJ Surf Clam Dredge - Female	-0.52	-0.60	0.12	-0.75	0.04
NJ Surf Clam Dredge - Male	-1.13	-1.02	0.54	-1.70	0.01
VA Tech Trawl	4.65			4.46	0.04
VA Tech Trawl - Immature Female	3.02			2.87	0.02
VA Tech Trawl - Immature Male	2.66			2.44	0.01
VA Tech Trawl - Mature Female	2.83			2.08	0.00
VA Tech Trawl - Mature Male	3.80			3.16	0.00
VA Tech Trawl - Newly Mature Female	1.26			0.46	0.04

Table 39 ***Continued***

Survey	i_f	i_{1998}	$P(i_f<i_{1998})$	Q_{25}	$P(i_f<Q_{25})$
Mid-Atlantic Region					
VA Tech Trawl - Newly Mature Male	1.24			0.76	0.03
Southeast Region					
GA Trawl - Spring	0.89			0.54	0.03
NC Gillnett - Spring	-0.47			-1.30	0.00
SC CRMS	0.22	-1.00	0.00	-0.25	0.13
SC Trammel Net	-0.67	-1.39	0.00	-1.12	0.00
SEAMAP - SC Fall	0.60			-0.36	0.02
SEAMAP GA-FL - Fall	-0.11			-1.08	0.02

Table 40. Number of surveys with terminal year having a greater than 0.50 probability of being less than the reference point (i.e. likely less than the reference point). Time series were only included in this summary if the terminal year was 2016 or 2017, residuals from ARIMA model fits were normally distributed, and combined-sex surveys. Those surveys that did not begin until after 1998 were not included in the $P(if<i_{1998})>0.50$ summary.

Region	$P(i_f<i_{1998})>0.50$	$P(i_f<Q_{25})>0.50$
Northeast	1 out of 2	1 out of 2
New York	4 out of 4	4 out of 5
Mid-Atlantic	2 out of 5	0 out of 7
Southeast	0 out of 2	0 out of 5
Coastwide	7 out of 13	5 out of 19

Table 41. Horseshoe crab life history parameters used in the operating model.

Age	Natural mortality (*M*)	Probability of Maturing[3] (m)	Fishery Recruitment (*R*)	Fecundity (*f*)
0	10.4143	0.00	0.00	0
1 – 9	0.0265	0.00	0.00	0
10	0.0265[1]; 0.4700[2]	0.20	0.00[1];1.0[2]	80,300
11	0.0265[1]; 0.4700[2]	0.6577	0.00[1];1.0[2]	80,300
12	0.4627	1.00	0.99	80,300
13 – 17	0.4700	1.00	1.00	80,300
18 – 20	2.5257	1.00	1.00	80,300

[1]immature individuals; [2]mature individuals

[3]The probability of maturing represents the probability of becoming a mature individual at age *i* if that individual was immature at age *i*-1.

Table 42. Scenarios of *F* simulated by the operating model to generate data sets used in a surplus production model and a catch survey model. Fishing mortality varied annually according to a uniform distribution with bounds described below.

	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
Years	**Min *F***	**Max *F***	**Min *F***	**Max *F***	**Min *F***	**Max *F***	**Min *F***	**Max *F***
2001 - 2020	0.18	0.22	0.18	0.22	0.18	0.22	0.18	0.22
2021 - 2040	0.18	0.22	0.08	0.12	0.01	0.02	0.06	0.10
2040 - 2060	0.18	0.22	0.02	0.06	0.02	0.06	0.01	0.02

Table 43. Catch multiple survey analysis base model inputs. *Values shown in millions. CONFIDENTIAL biomedical data has been removed.

	Lambdas			Starting Values							
M	VT	DE	NJ	R	N	q_de	q_nj	s	Biomed.		
0.274	0.59	0.16	0.25	2.0E+06	3.6E+06	2.3E-07	5.0E-07	1	15%		
		Harvest			Survey Indices				Coefficient of Variation		
Year	Commercial	Discard	Biomedical	VT*, r	VT*, n	DE	NJ	VT, r	VT, n	DE	NJ
2003	220,354	35,941		1.537	4.959	1.203	2.246	0.24	0.26	0.492	0.188
2004	108,843	39,416		0.794	3.379	0.056	2.502	0.45	0.22	0.566	0.229
2005	116,577	10,530		0.358	2.735	0.093	2.77	0.32	0.2	0.43	0.241
2006	104,048	18,560		0.479	3.138	1.411	1.856	0.34	0.22	0.305	0.258
2007	67,674	29,444		2.051	6.611	1.284	1.474	0.33	0.31	0.274	0.249
2008	44,329	30,441		2.373	7.746	0.185	2.37	0.33	0.25	0.379	0.32
2009	48,663	45,789		2.571	6.311	0.34	1.368	0.36	0.4	0.356	0.289
2010	41,385	55,649		0.885	2.975	0.206	0.579	0.26	0.33	0.492	0.302
2011	33,728	103,092		1.338	5.178	0.25	2.215	0.74	0.26	0.385	0.256
2012	56,112	27,810		0.845	5.29	0.275	1.804	0.34	0.2	0.296	0.249
2013	29,111	103,928		-	-	0.111	7.996	-	-	0.448	0.347
2014	13,410	51,346		-	-	1.218	3.358	-	-	0.266	0.239
2015	11,689	52,134		-	-	0.439	3.145	-	-	0.289	0.249
2016	14,923	73,226		-	-	1.079	3.989	-	-	0.215	0.244
2017	16,956	38,009		1.608	6.024	1.6	5.613	0.22	0.17	0.216	0.25
2018	-	-	-	1.48	7.185	3.127	3.104	0.27	0.27	0.237	0.226

Table 44. The number of parameters estimated in the catch multiple survey analysis: median primiparous abundance (1); primiparous abundance for each year (16); catchability coefficients (2) for the Delaware and New Jersey surveys; and multiparous abundance for the start of the time series (1).

Parameter	No. Estimates	Description
R_{median}	1	Median primiparous abundance (log-scale)
Φ	16	Deviations from median primiparous abundance (log-scale)
N_0	1	Initial multiparous abundance (log-scale)
q_de	1	Catchability coefficient for the Delaware trawl survey (log-scale)
q_nj	1	Catchability coefficient for the New Jersey survey (log-scale)

Table 45. Selected catch multiple survey analysis based model outputs: q=catchability coefficients; R=primiparous abundance; N=multiparous abundance; u=exploitation rate; Z= instantaneous total mortality rate; A=annual mortality rate; and F=instantaneous fishing mortality rate.

[Table Removed Due to **CONFIDENTIAL** Data]

Table 46. Mohn's p statistic for total, multiparous, and primiparous abundance.

[Table Removed Due to **CONFIDENTIAL** Data]

Table 47. Sensitivity runs for the catch multiple survey analysis model. All runs that included CONFIDENTIAL biomedical data have been removed.

	Name	M	λ VT	λ DE	λ NJ	Biomed	Starting Values *R*	*N*	*q_de*	*q_nj*	Terminal Output Values *NegLL*	*R*	*N*	*F*
M [0.10-0.80]	Base													
	alt_base													
	M_0.10													
	M_0.15													
	M_0.19													
	M_0.195													
	M_0.198													
	M_0.199													
	M_0.20													
	M_0.201													
	M_0.202													
	M_0.203													
	M_0.204													
	M_0.205													
	M_0.206													
	M_0.21													
	M_0.25													
	M_0.30													

	M_0.35													
	M_0.40													
	M_0.45													
	M_0.47													
	M_0.50													
	M_0.80													
Harvest	**Biomed_0%**	0.274	0.59	0.16	0.25	0%	14.5	15.1	-15.3	-14.5	25.16	1,587,760	7,145,540	0.007
	Biomed_4%													
	Biomed_30%													
	Discard=0													
λ	**λ=Conn unadj.**													
	λ=1													
cv	**cv_average**													
	cv_fixed													
	cv_off													
q_VT	**q_vt**													
	q_vt_s													
s [0.5-1.5]	**s_0.5**													
	s_0.6													
	s_0.7													
	s_0.8													

	s_0.9					
	s_1.0					
	s_1.1					
	s_1.2					
	s_1.3					
	s_1.4					
	s_1.5					
	s_free					
Starting Values	**R_14.0**					
	R_14.3					
	R_14.7					
	N_14.4					
	N_15.8					
	N_17.0					
	q_DE_-14.6					
	q_DE_-16.0					
	q_DE_-17.5					
	q_NJ_-13.8					
	q_NJ_-15.5					
	q_NJ_-17.0					

Table 48. Horseshoe crab life history parameters used in the projection model to estimate biological reference points.

Age	Natural mortality (M)[1]	Probability of Maturing (m)[2]	Fishery Recruitment (R)	Fecundity (f)
0	10.4143	0.00	0.00	0
1 – 9	0.0817, 0.0744, 0.0685	0.00	0.00	0
$10_{immature}$	0.0817, 0.0744, 0.0685	0.00	0.00	80,300
10_{mature}	0.274	0.20	1.00	80,300
$11_{immature}$	0.0817, 0.0744, 0.0685	0.00	0.00	80,300
11_{mature}	0.274	0.66	1.00	80,300
12	0.274	1.00	1.00	80,300
13 – 20+	0.274	1.00	1.00	80,300

[1]Three levels of natural mortality corresponding to K = 10, 14, 18 million female horseshoe crabs, respectively.
[2]The probability of maturing represents the probability of becoming a mature individual at age i if that individual was immature at age i-1.

Table 49. Horseshoe crab life history parameters used in the egg- and yield-per-recruit modeling.

Age	Natural Mortality (M)[1]	Proportion Mature (m)	Fishery Recruitment (R)	Fecundity (f)	Weight
1	0.0817, 0.0744, 0.0685	0	0	0	1
2	0.0817, 0.0744, 0.0685	0	0	0	1
3	0.0817, 0.0744, 0.0685	0	0	0	1
4	0.0817, 0.0744, 0.0685	0	0	0	1
5	0.0817, 0.0744, 0.0685	0	0	0	1
6	0.0817, 0.0744, 0.0685	0	0	0	1
7	0.0817, 0.0744, 0.0685	0	0	0	1
8	0.0817, 0.0744, 0.0685	0	0	0	1
9	0.0817, 0.0744, 0.0685	0	0	0	1
10	0.1173,0.1112, 0.1064	0.2000	0.2000	80,300	1
11	0.2156, 0.2131, 0.2111	0.7163,0.7159, 0.7156	0.7050	80,300	1
12	0.274	1	1	80,300	1
13	0.274	1	1	80,300	1
14	0.274	1	1	80,300	1
15	0.274	1	1	80,300	1
16	0.274	1	1	80,300	1
17	0.274	1	1	80,300	1
18	0.274	1	1	80,300	1
19	0.274	1	1	80,300	1
20	0.274	1	1	80,300	1

[1]Three levels of natural mortality corresponding to K = 10, 14, 18 million female horseshoe crabs, respectively.

Table 50. Reference points for female horseshoe crab harvest in the Delaware Bay generated from a population projection model. Reference points were generated for a range of possible carrying capacities (*K*) and associated juvenile mortalities (M_{juv}) needed to stabilize an unfished population at those carrying capacities.

K	M_{juv}	N_{msy}	F_{msy}	MSY	u_{msy}	N_{40}	F_{40}	N_{20}	F_{20}
10,000,000	0.0817	3,664,522	0.0695	215,498	0.0588	4,000,000	0.0632	2,000,000	0.1140
14,000,000	0.0744	5,132,293	0.0749	324,508	0.0632	5,600,000	0.0682	2,800,000	0.1232
18,000,000	0.0685	6,600,291	0.0796	442,334	0.0670	7,200,000	0.0724	3,600,000	0.1310

Table 51. Reference points generated from horseshoe crab egg-per-recruit models for the Delaware Bay population under varying levels of juvenile natural mortality (M_{juv}).

M_{juv}	F_{20}	F_{40}
0.0817	2.2675	0.6465
0.0744	2.2582	0.6453
0.0685	2.2508	0.6443

Table 52. Sex specific fishing mortality (*F*) and biomass reference points for the Delaware Bay region generated from a population projection model (Table 50) along with terminal year values from the base run of the catch survey model. [3]

	Delaware Bay Horseshoe Crabs	
	Reference Point	**Benchmark Values**
Females	F_{MSY} = 0.0695 - 0.0796	F_{2017} = **CONFIDENTIAL***
	N_{MSY} = 3,664,522 - 6,600,291	N_{2018} = **CONFIDENTIAL***
Males	Sex Ratio (M:F) = 2:1	2017 Sex Ratio (M:F) = 5.2:1

***Benchmark values are CONFIDENTIAL because they are based on harvest that includes numbers of horseshoe crabs attributed the biomedical industry. Values without biomedical data are F_{2017}=0.007 and B_{2018}=8,718,040. The benchmark values of F_{2017} and B_{2018} with the biomedical data are slightly higher and lower, respectively, and although minimally different, represent the best data but are CONFIDENTIAL. The stock status of not overfished and overfishing not occurring is unchanged with or without the biomedical data.**

[3] The Peer Review Panel did not endorse the use of the reference points developed for this stock assessment.

Table 53. Stock status determination for the coastwide and regional stocks based on the 1998 index-based reference points from ARIMA models. Status was based on the percentage of surveys within a region (or coastwide) having a >50% probability of their terminal year fitted value being less than the 1998 index-based reference point. "Poor" status was >66% of surveys meeting this criterion, "Good" status was <33% of surveys, and "Neutral" status was 34 – 65% of surveys. The same criteria were applied to ARIMA results from the 2009 benchmark assessment and 2013 update assessment for comparison purposes. NOTE: The suite of surveys used in each assessment as well as the index values differed between assessments (see Section 7.3 for explanation).

Region	2009 Benchmark	2013 Update	2019 Benchmark	2019 Stock Status
Northeast	2 out of 3	5 out of 6	1 out of 2	Neutral
New York	1 out of 5	3 out of 5	4 out of 4	Poor
Delaware Bay	5 out of 11	4 out of 11	2 out of 5	Neutral
Southeast	0 out of 5	0 out of 2	0 out of 2	Good
Coastwide	7 out of 24	12 out of 24	7 out of 13	Neutral

Table 54. Details of surveys used in determining regional stock status. Arrows indicate increasing (↗), decreasing (↘), or stable (↔) trends over the most recent 5 and 10 year periods. $P(i_f<i_{1998})$ represents the probability of the terminal year's fitted index value (i_f) being less than the 1998 index-based reference point from ARIMA modeling. The average of this probabilities within a region is also given.

Region	SurveyName	5 year trend	10 year trend	$P(i_f<i_{1998})$	Avg. Prob
New England	MA DMF Trawl - South of Cape Cod	↗	↗	0.08	
	RI Monthly Trawl - Fall	↘	↘	0.62	0.35
New York	CT Long Island Sound Trawl - Fall	↘	↘	1.00	
	NY Jamaica Bay Seine	↘	↘	0.96	
	NY Little Neck and Manhasset Bay Seine	↘	↘	1.00	
	NY Peconic Trawl	↔	↘	1.00	0.99
Delaware Bay	DE 30 ft Trawl - Fall	↗	↗	0.02	
	DE 30 ft Trawl - Spring	↗	↗	0.33	
	MD Coastal Bays Trawl - Spring	↗	↔	0.36	
	NJ Ocean Trawl - Fall	↔	↔	0.82	
	NJ Ocean Trawl - Spring	↗	↗	0.51	0.41
Southeast	SC CRMS	↗	↔	0.00	
	SC Trammel Net	↔	↗	0.00	0.00

Table 55. Comparison of the current stock assessment and the adaptive resource management (ARM) model for horseshoe crabs in the Delaware Bay region.

	Coastwide Stock Assessment	**Adaptive Resource Management (ARM)**
Management objective	Maximum sustainable yield	Maximum yield while maintaining ecological function (shorebird constraints)
Model types	Single species models	Multi-species models
Management triggers	Reference points based on HSC biology and life history (F_{msy}, B_{msy}, etc.)	Threshold values based on Red Knot abundance (81,900) **OR** female HSC abundance (80% of K, 11.2 million)
Status conclusions	Not overfished; overfishing not occurring	Thresholds for each species not met – female harvest not valued
Management recommendations	Female harvest could increase	Continued male only harvest (as of 2018)

11 FIGURES

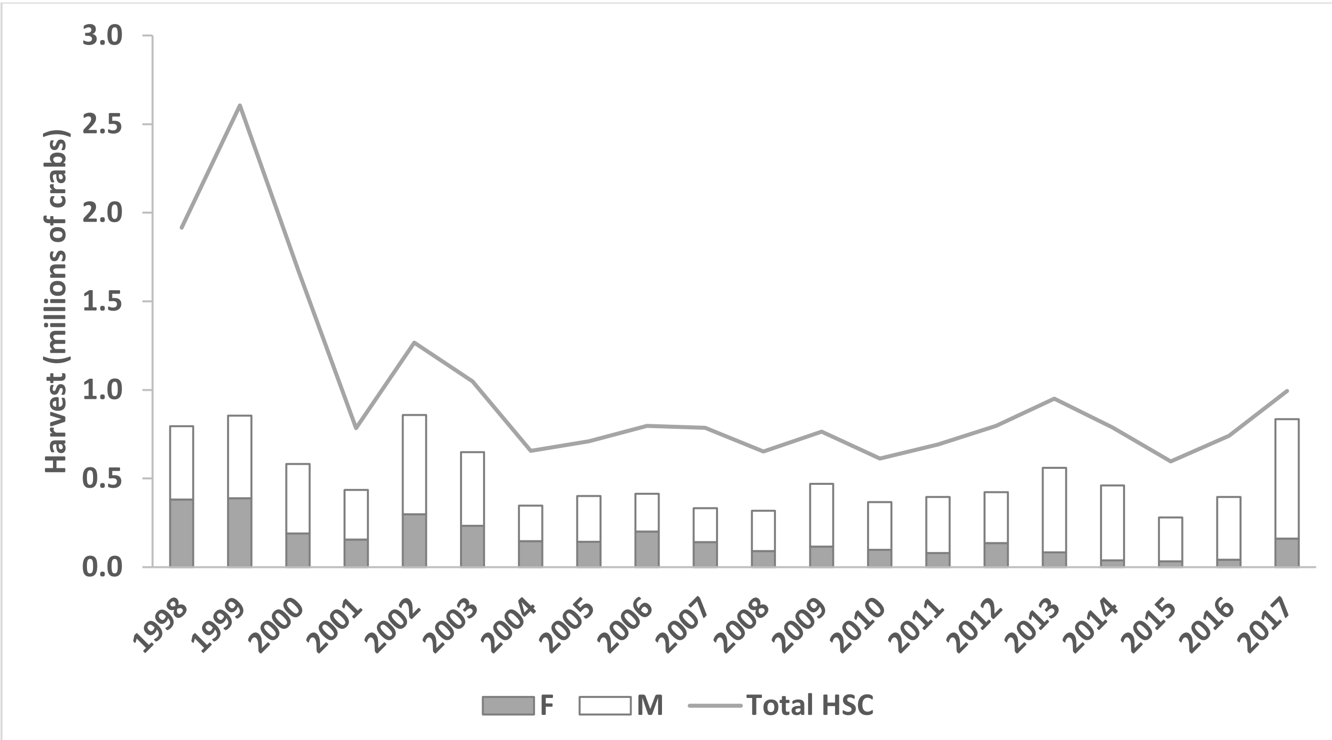

Figure 1. Coastwide horseshoe crab bait landings, 1998-2017, in numbers and by sex. Not every state along the Atlantic coast provides comprehensive sex data and therefore some are unclassified. Landings from 1998-2016 were validated by ACCSP; 2017 landings came from the 2018 FMP Review and state compliance reports.

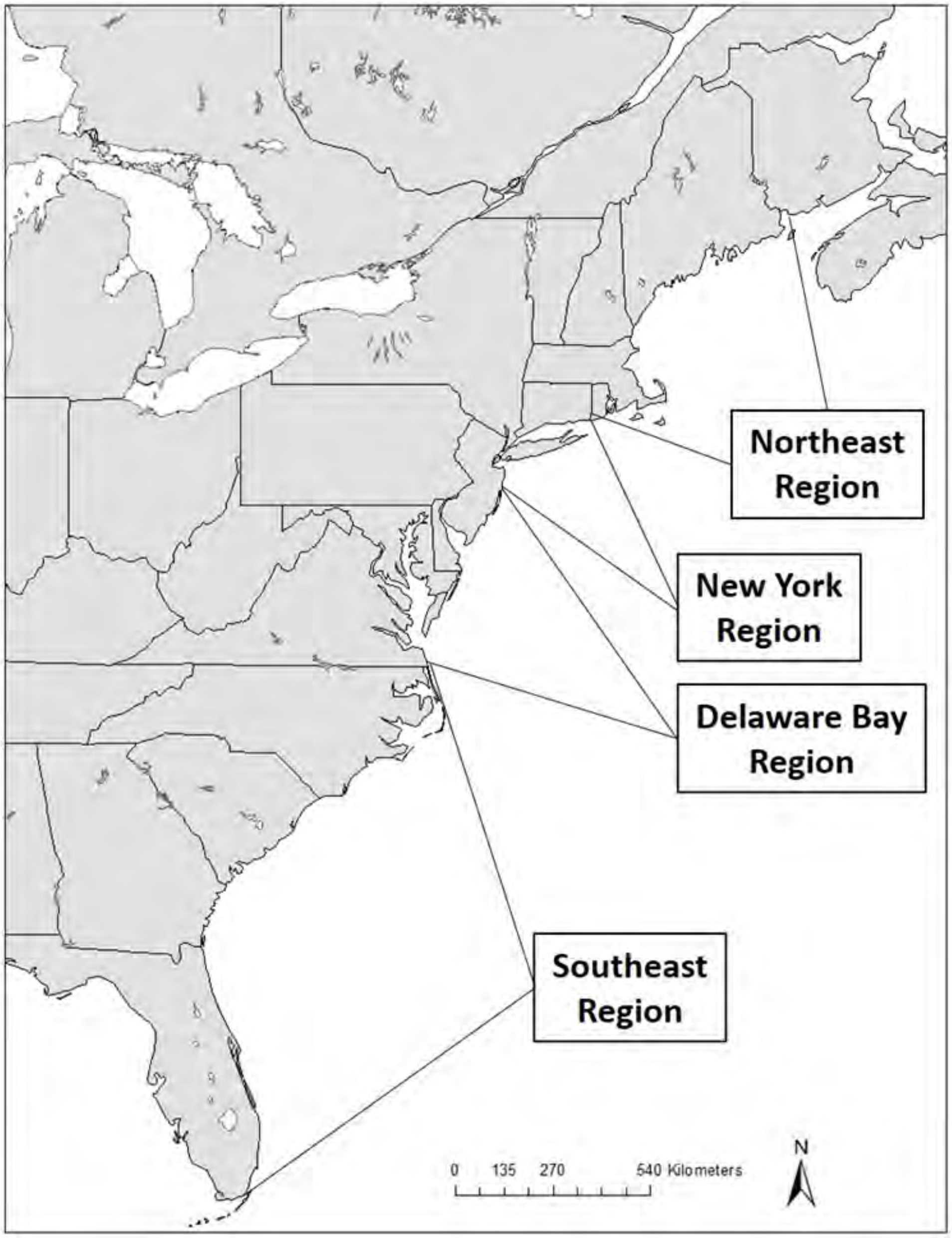

Figure 2. Map of the Atlantic coast showing the regions for horseshoe crab assessment.

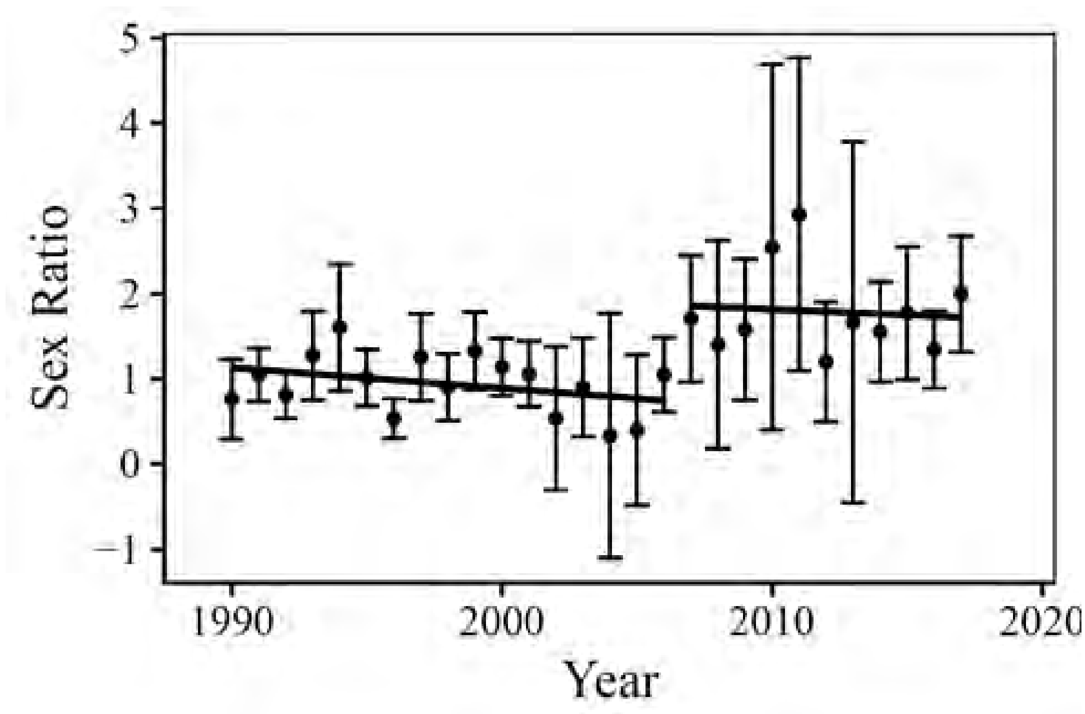

Figure 3. Annual sex ratio (M:F) and associated confidence intervals for horseshoe crabs collected in the Delaware Bay 30’ adult trawl survey from 1990 to 2017. Despite significant increases in sex ratio for these data, breakpoint analysis detected a significant shift in the relationship between these variables in 2006.

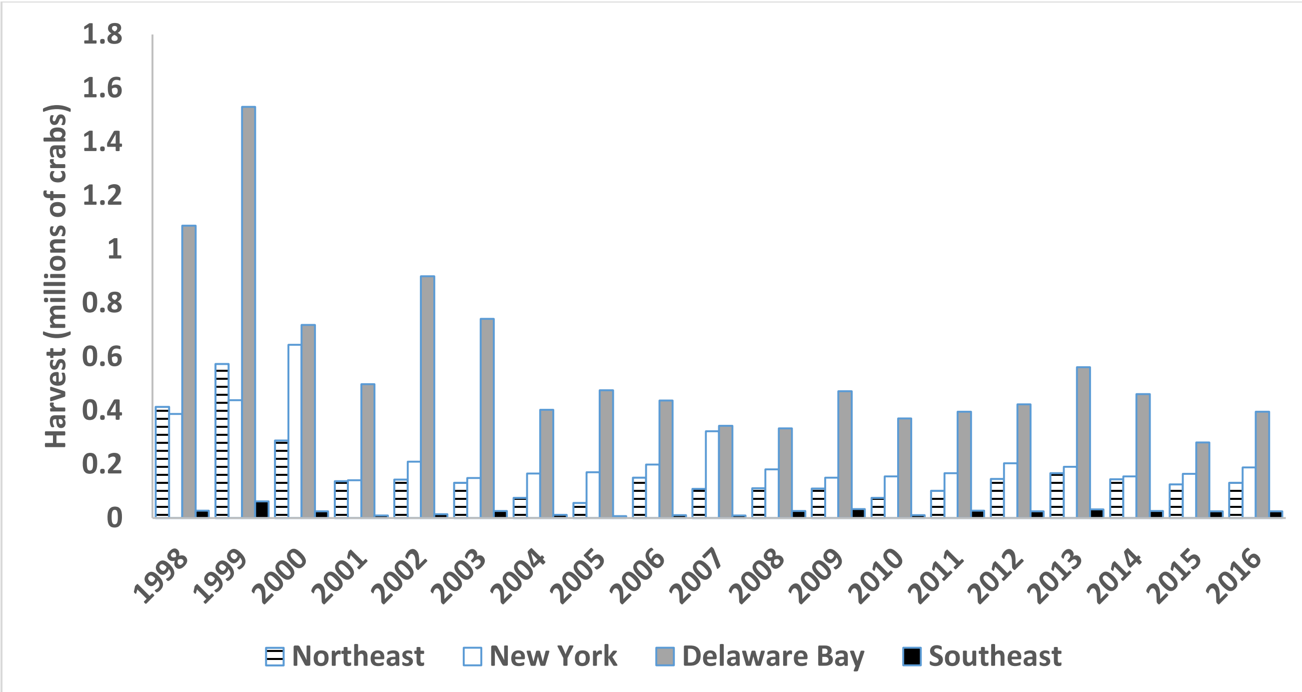

Figure 4. Horseshoe crab bait harvest by region, 1998-2016. The four regions are the Northeast (Maine, Massachusetts, Rhode Island), New York (Connecticut, New York), Delaware Bay (New Jersey, Delaware, Maryland, Virginia), and Southeast (North Carolina, South Carolina, Georgia, Florida).

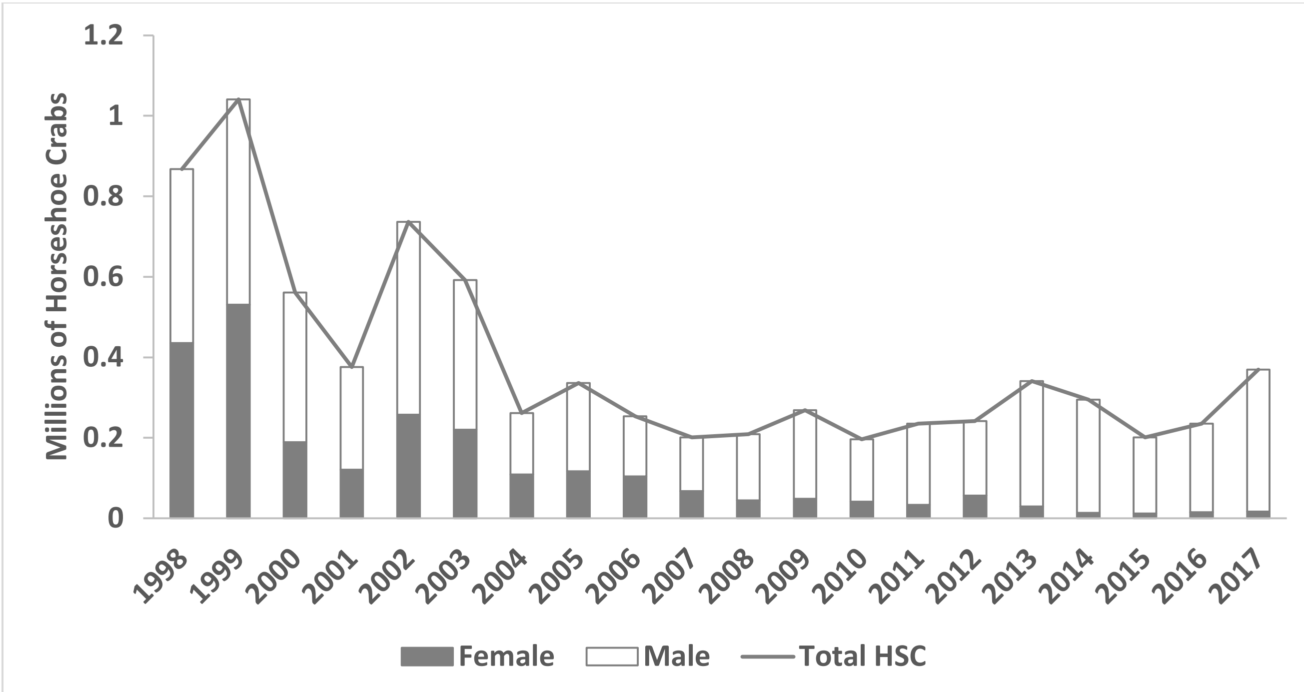

Figure 5. **Horseshoe crab bait landings of Delaware Bay origin, 1998-2017, by sex to support the catch multiple survey model. All landings were validated through ACCSP.**

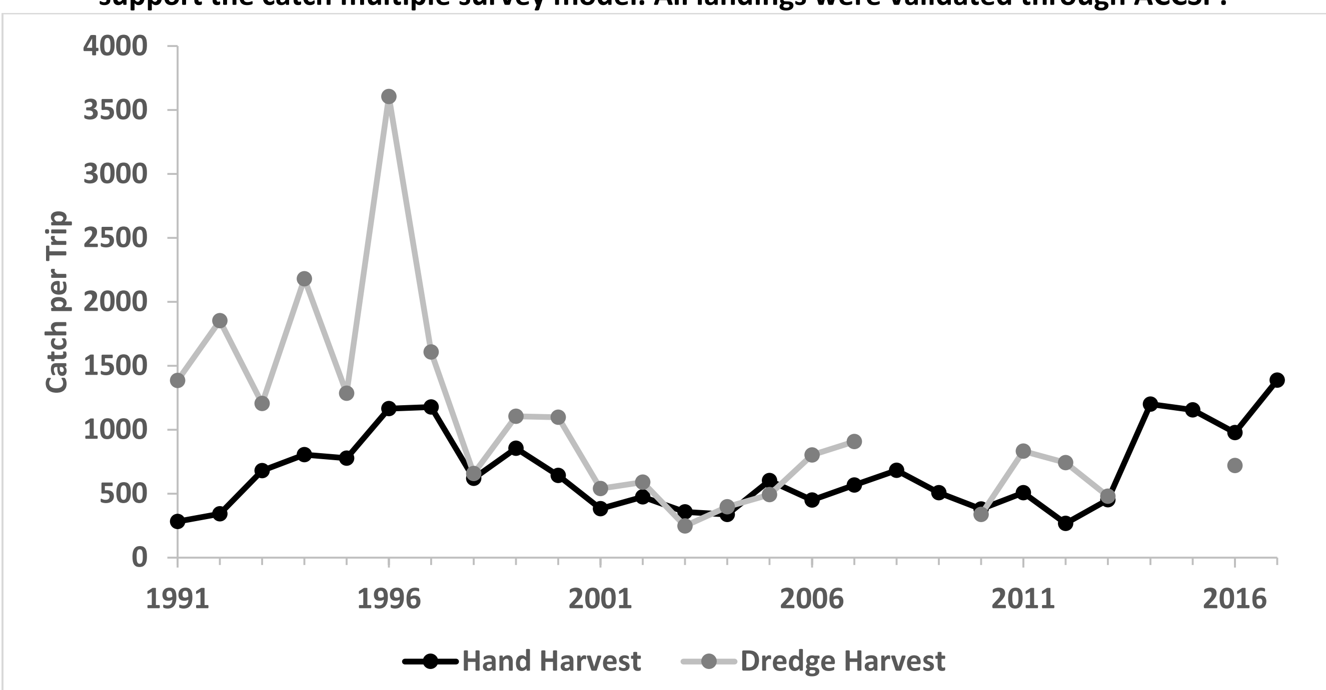

Figure 6. **Delaware's commercial horseshoe crab catch rates (mean number of crabs per trip). Missing values for dredge harvest in 2008, 2009, 2014, 2015, and 2017 are due to no dredge fishery in those years. Source: Delaware's Department of Fish and Wildlife's 2017 Compliance Report.**

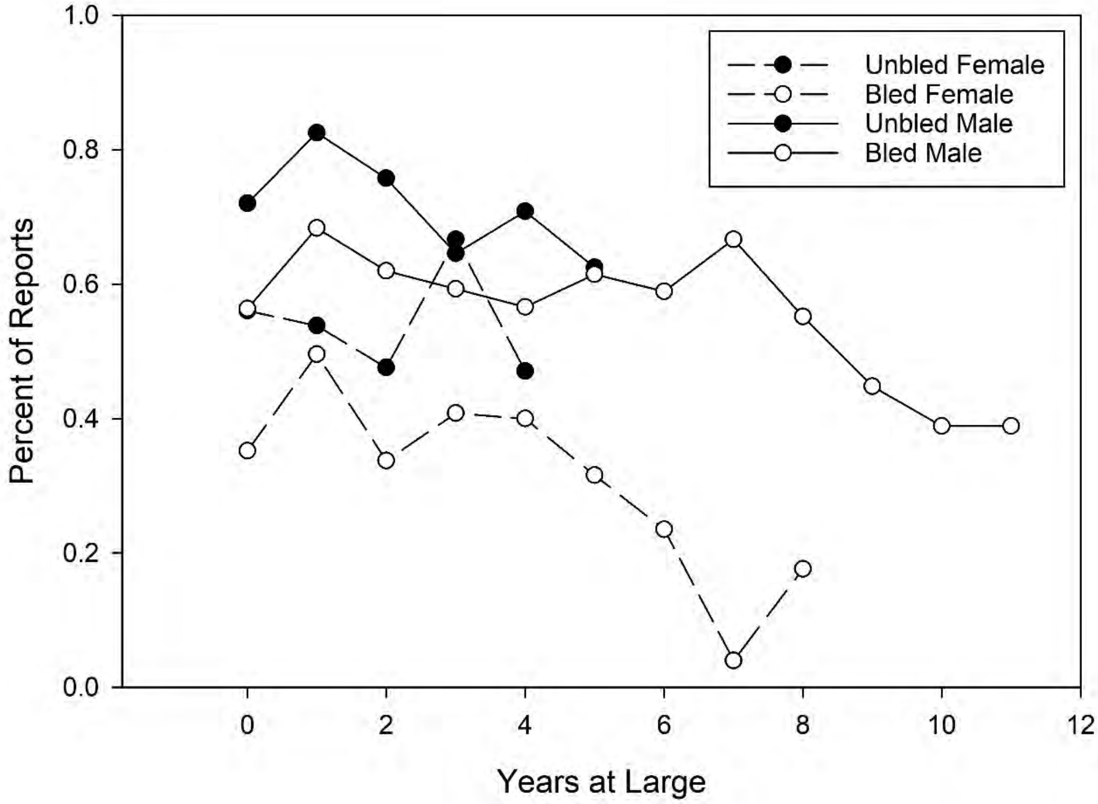

Figure 7. Comparison of bled (open circles) and unbled (filled circles) male (solid line) and female (dashed line) horseshoe crabs recaptured as alive over time.

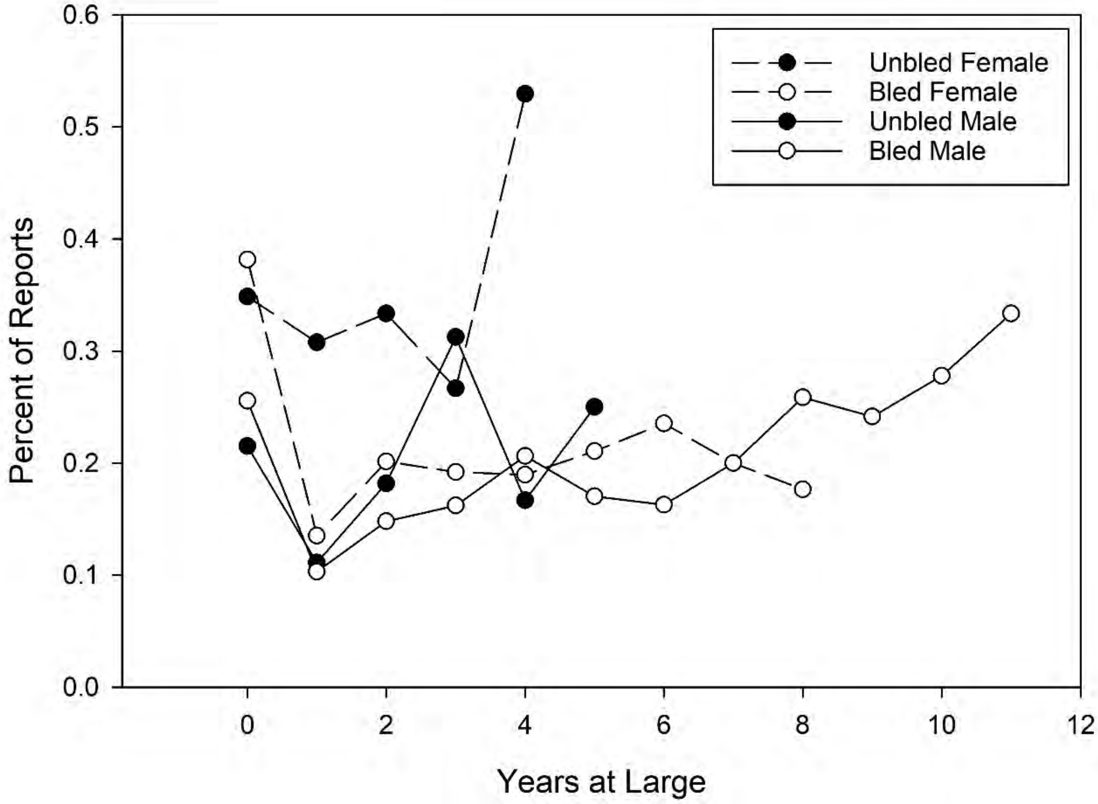

Figure 8. Comparison of bled (open circles) and unbled (filled circles) male (solid line) and female (dashed line) horseshoe crabs recaptured as dead over time.

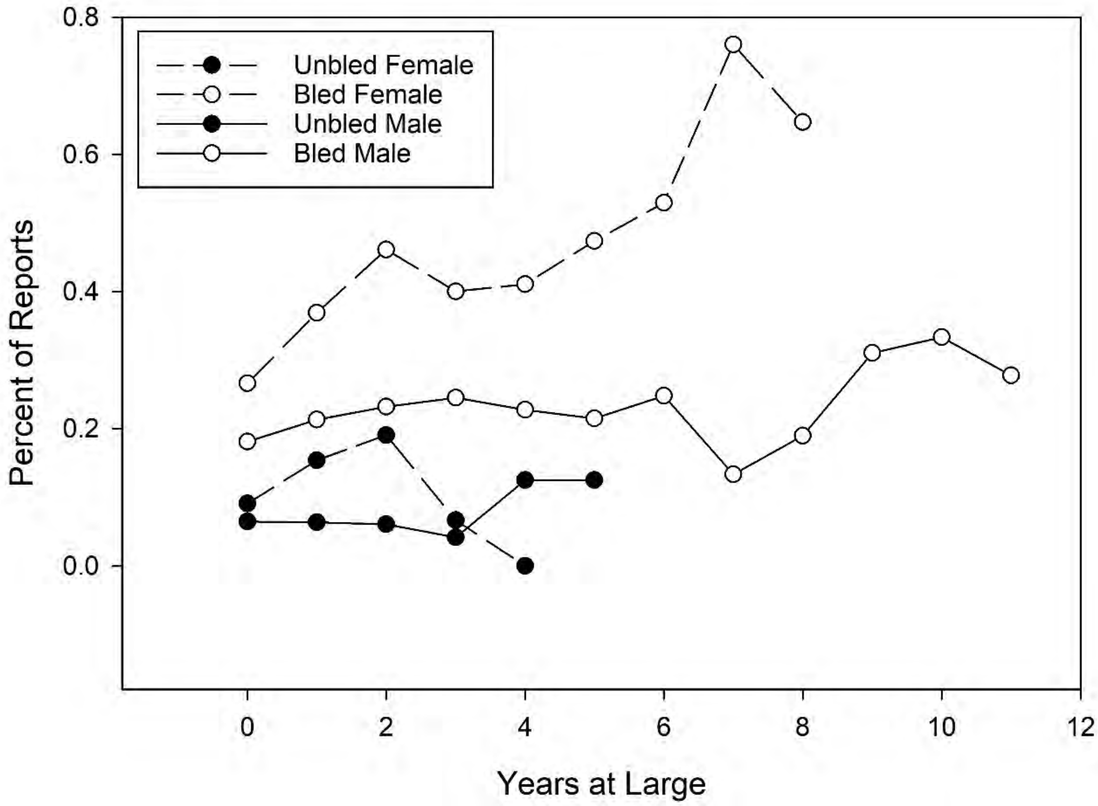

Figure 9. Comparison of bled (open circles) and unbled (filled circles) male (solid line) and female (dashed line) horseshoe crab tags reported as unknown disposition (e.g., tag was found unattached from crab).

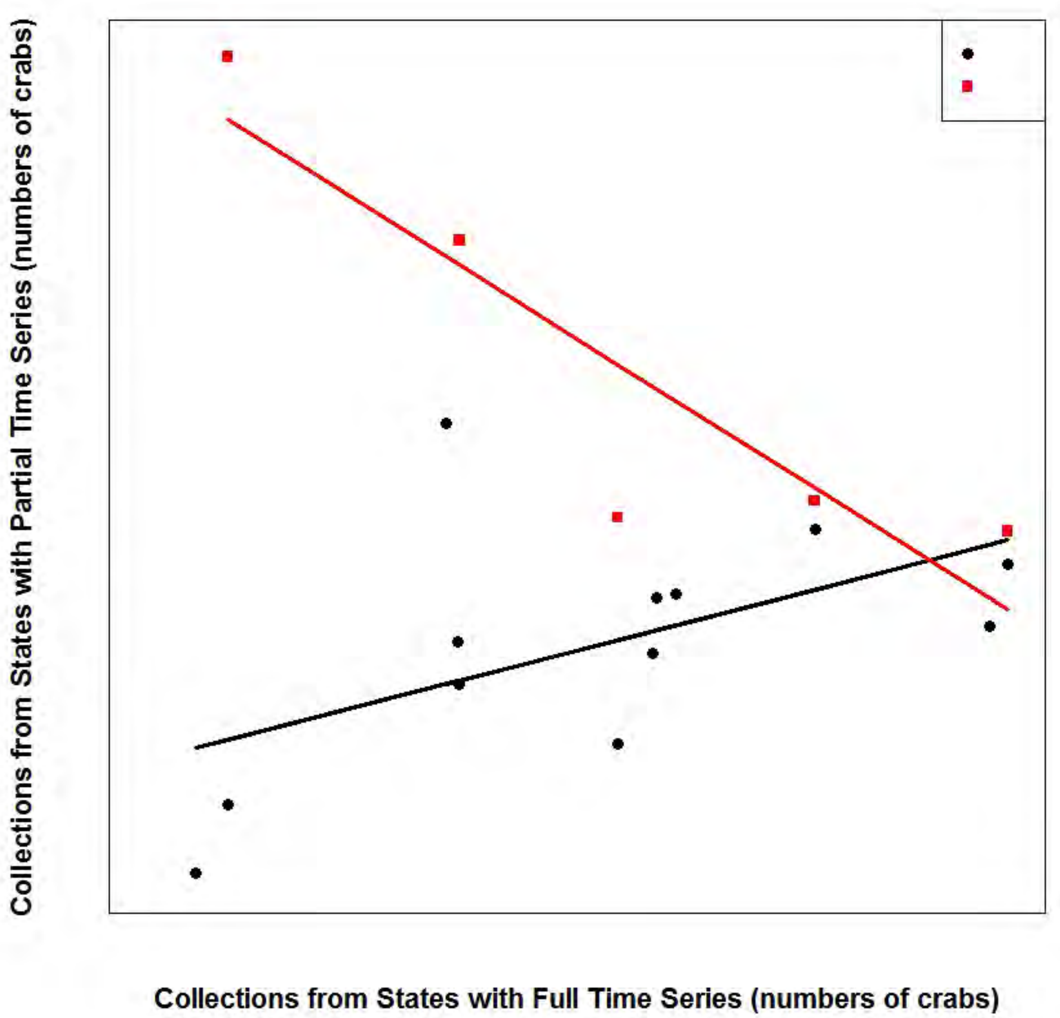

Figure 10. Linear regressions of biomedical collections of horseshoe crabs from states with partial and full time series from 1999-2017. Axis values and state names have been removed due to CONFIDENTIAL data.

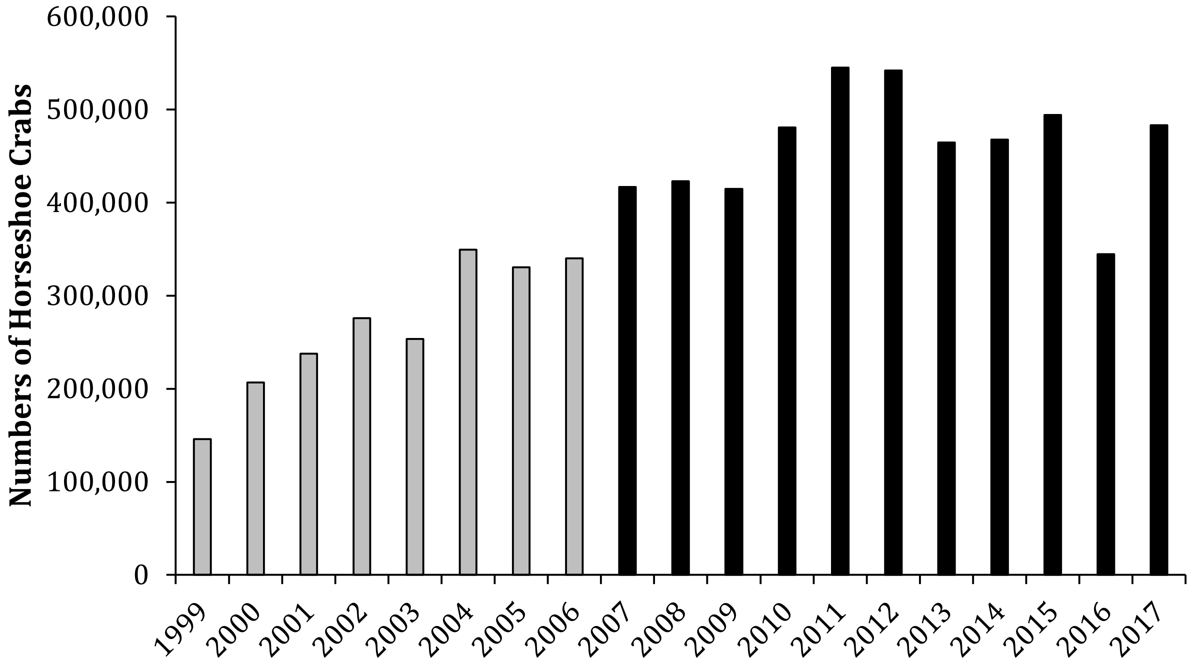

Figure 11. Annual numbers of horseshoe crabs collected solely for biomedical use coastwide. These numbers do not include crabs that entered the bait market after bleeding. Black bars indicate years in which all states reported collection numbers, and grey bars indicate years that include imputed values for at least one state due to missing data when collections were known to have occurred.

[Figure Removed Due to **CONFIDENTIAL** Data]

Figure 12. Estimated mortality attributable to biomedical use of horseshoe crabs along the US Atlantic coast. Sex-specific mortality of crabs of Delaware (DE) Bay origin is highlighted. Delaware Bay origin crabs include 100% of New Jersey, 51% of Maryland, and 35% of Virginia mortality, based on genetic information.

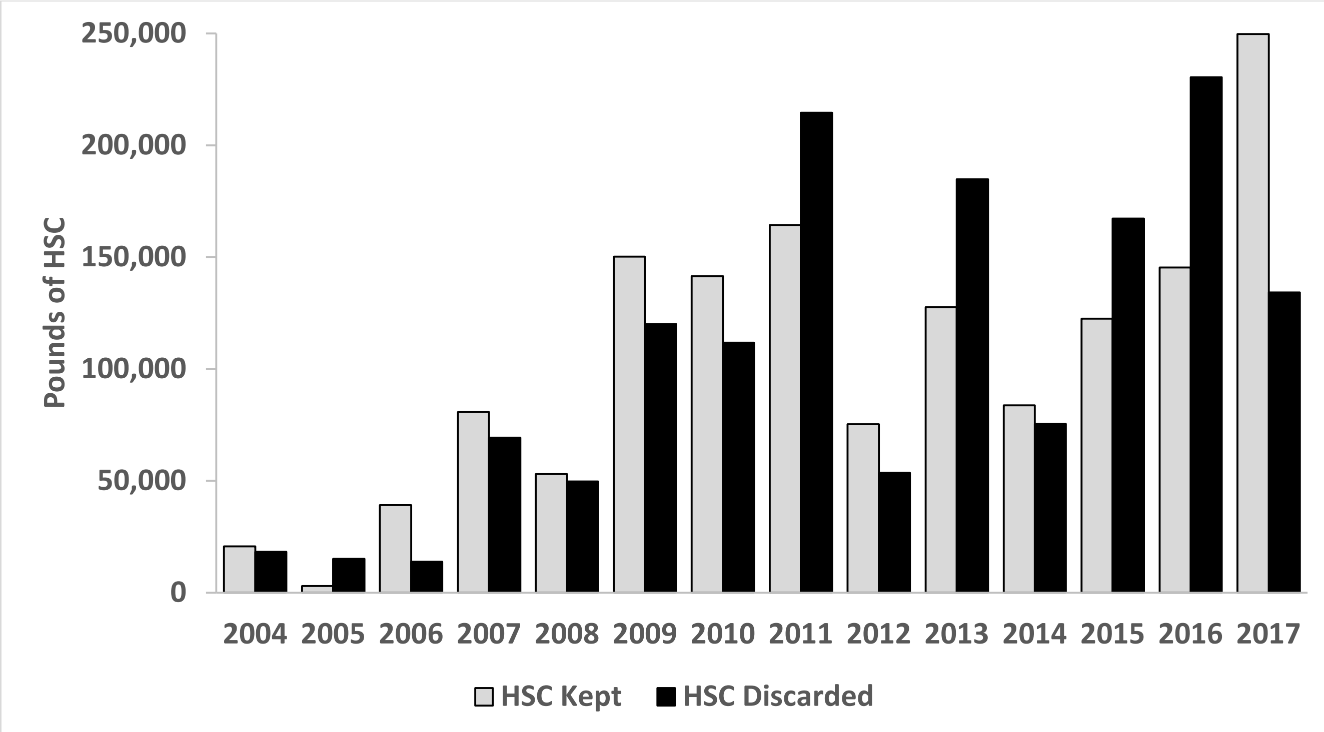

Figure 13. Total pounds of horseshoe crabs (HSC) discarded and horseshoe crabs kept in observed fishing trips in the NEFOP data set for the Delaware Bay states, 2004-2017.

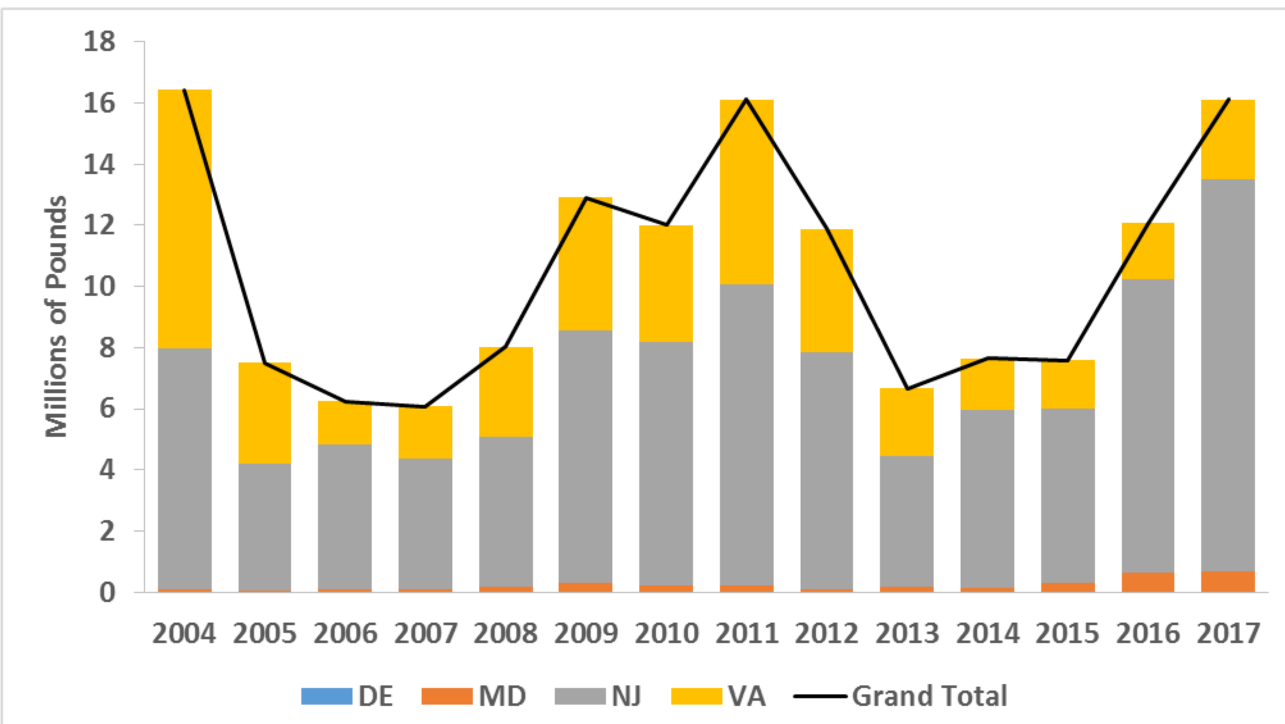

Figure 14. Total pounds of observed landings, all species, from the NEFOP data set for the Delaware Bay states, 2004-2017.

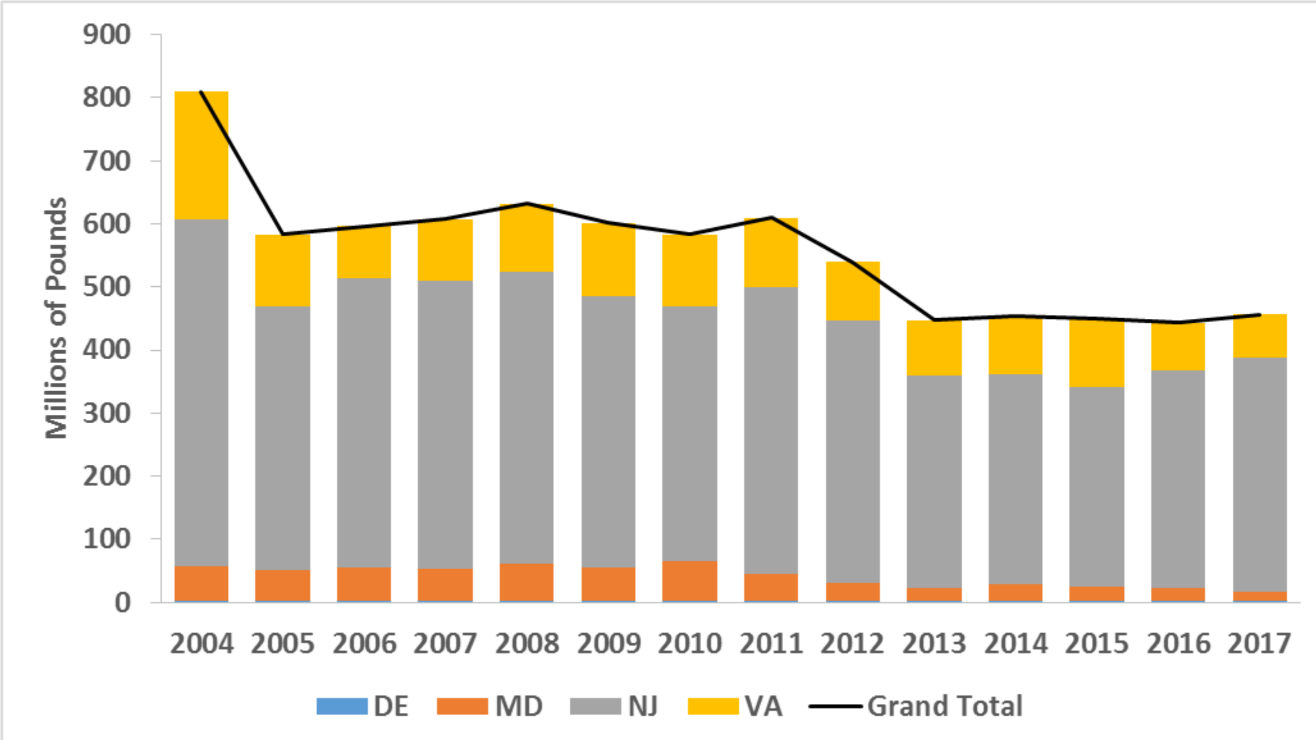

Figure 15. All species landings by state for gillnets, trawls, dredge, and "not coded" for the Delaware Bay region for 2004-2017 (source: ACCSP).

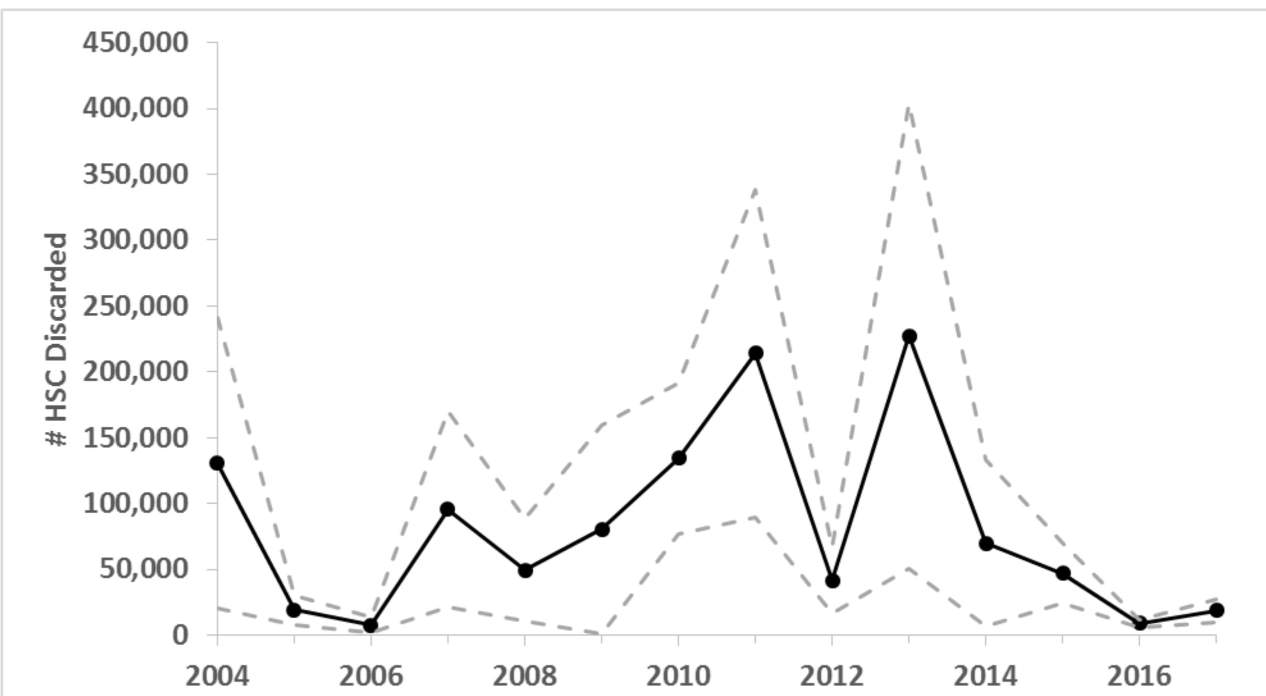

Figure 16. Estimated number of horseshoe crabs discarded from gill nets in the Delaware Bay region, 2004-2017, with 95% confidence intervals.

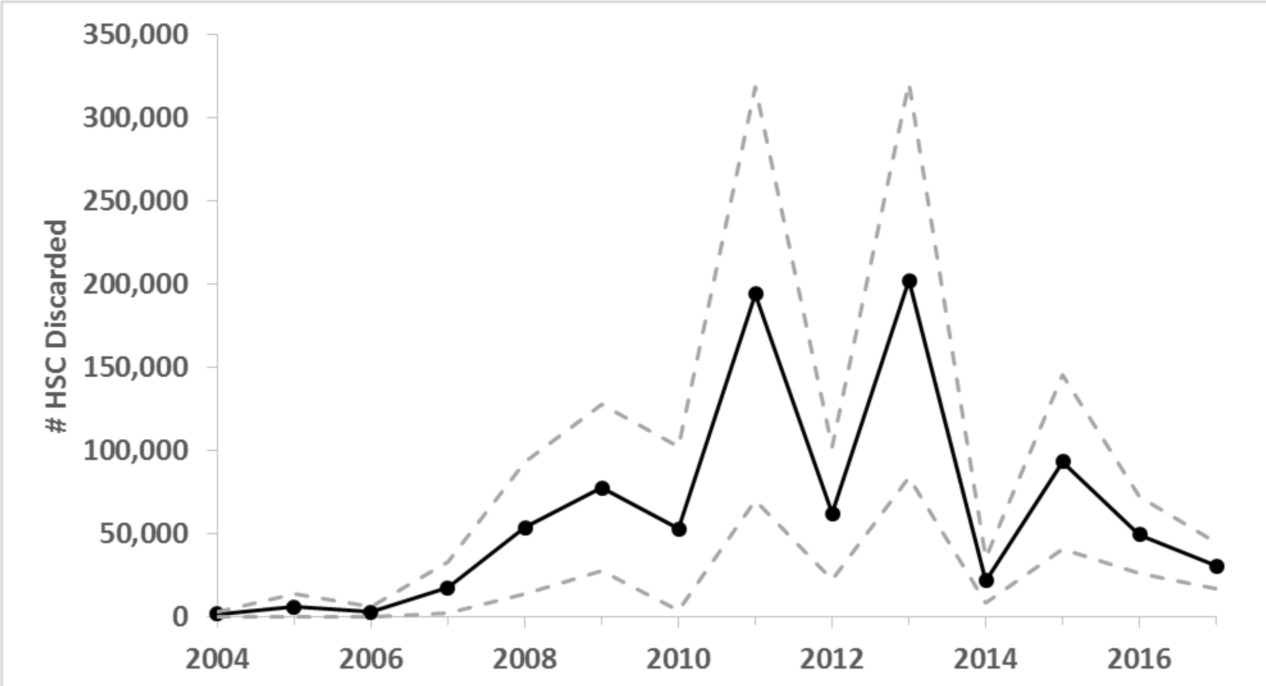

Figure 17. Estimated number of horseshoe crabs discarded from trawls in the Delaware Bay region, 2004-2017, with 95% confidence intervals.

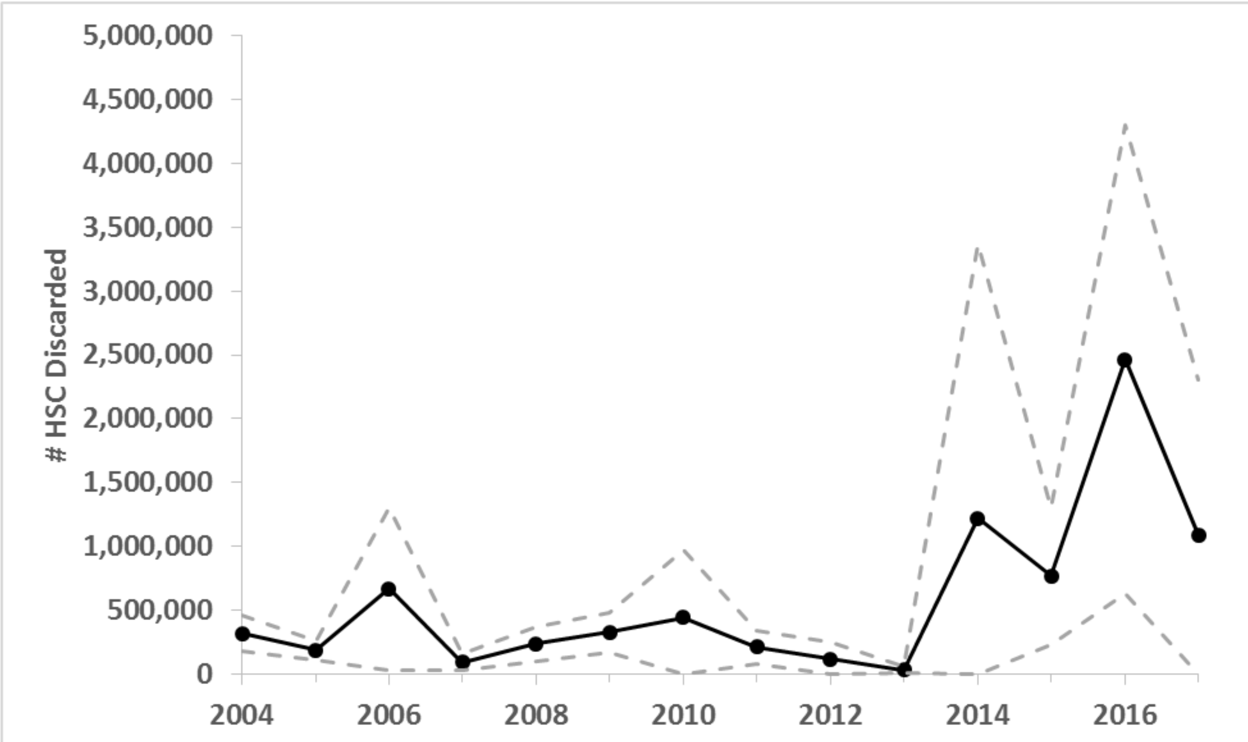

Figure 18. Estimated number of horseshoe crabs discarded from dredges in the Delaware Bay region, 2004-2017, with 95% confidence intervals.

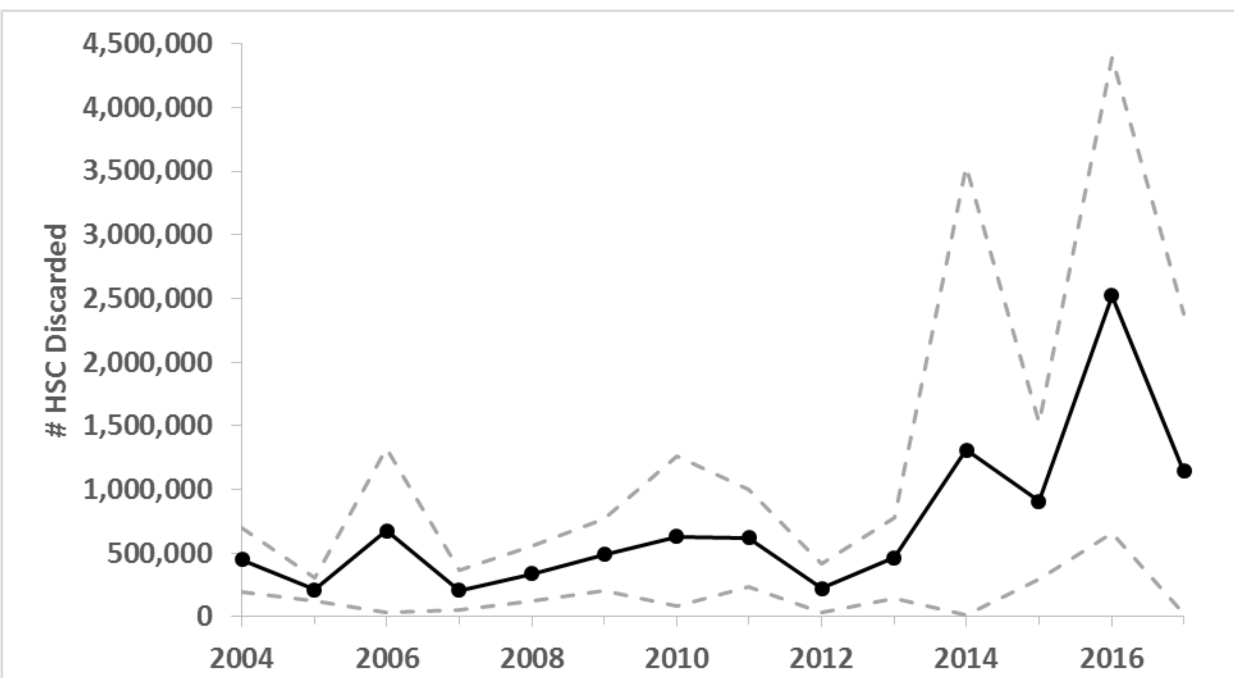

Figure 19. Estimated number of horseshoe crabs discarded from gill nets, trawls, and dredges in the Delaware Bay region, 2004-2017, with 95% confidence intervals.

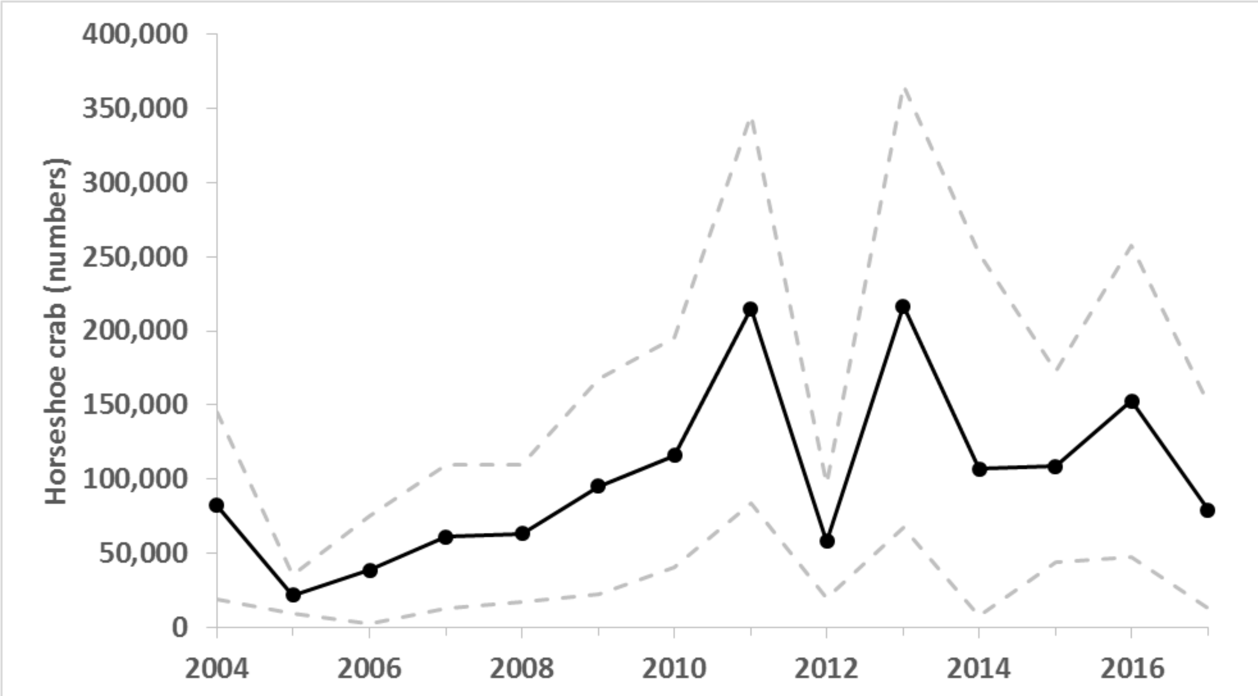

Figure 20. Number of dead discarded horseshoe crabs in the Delaware Bay region, 2004-2017, from gillnets, trawls, and dredges with 95% confidence intervals.

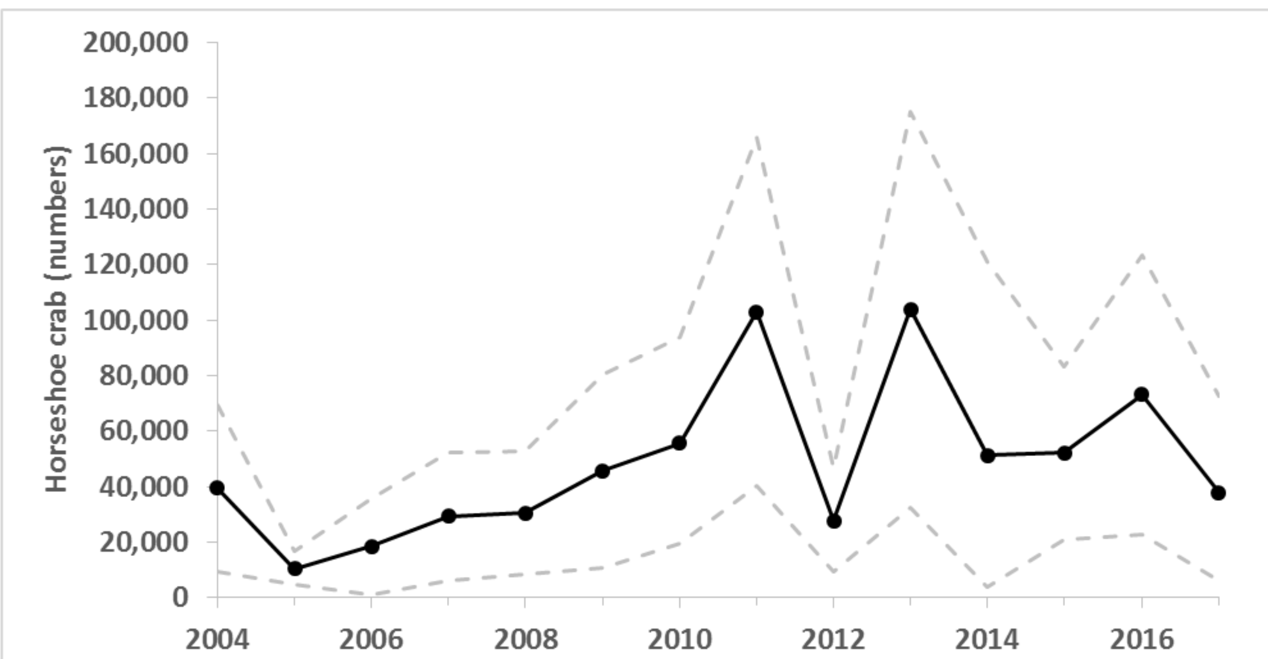

Figure 21. Number of dead discarded female horseshoe crabs in the Delaware Bay region, 2004-2017, from gillnets, trawls, and dredges with 95% confidence intervals.

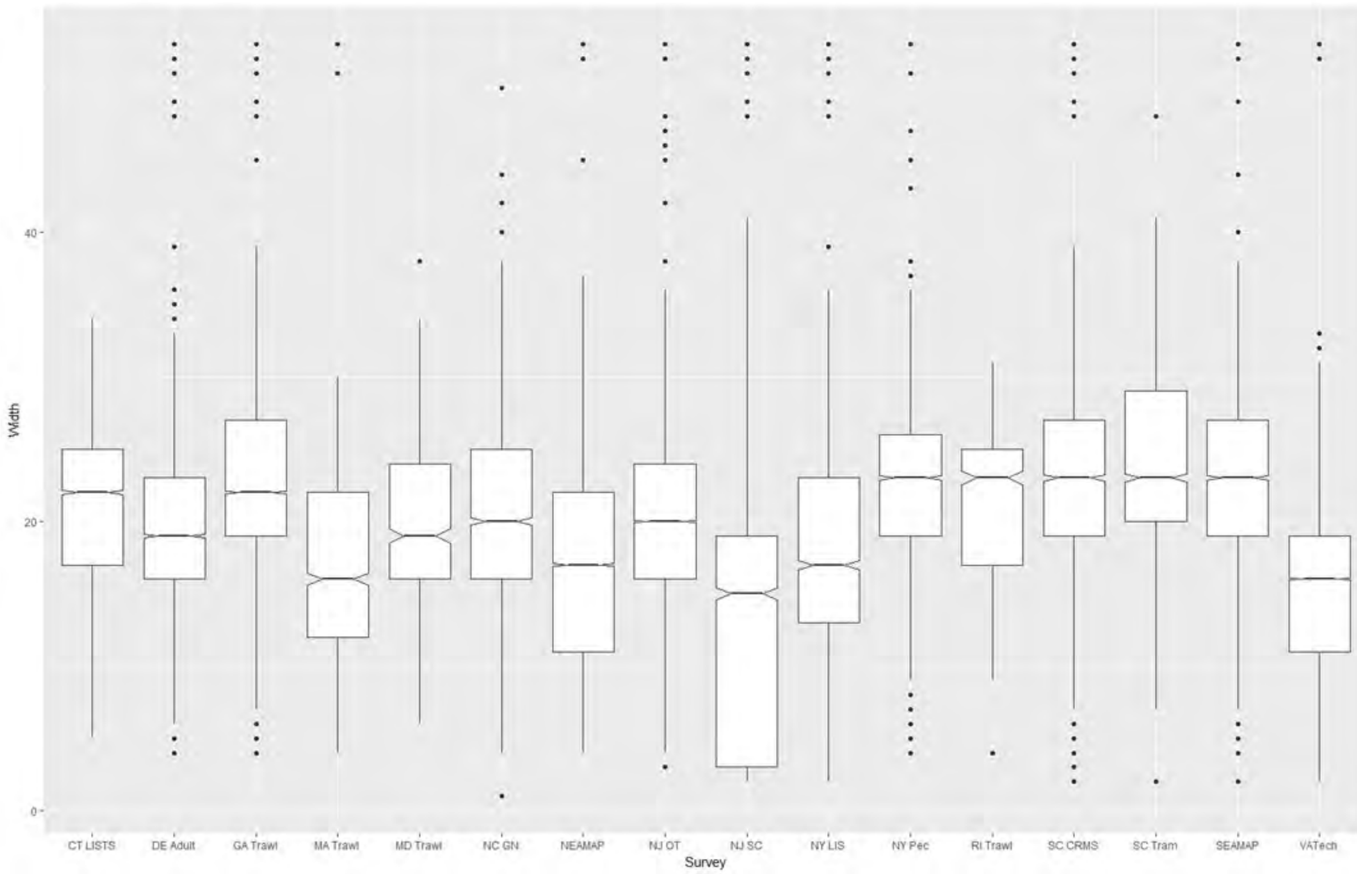

Figure 22. Boxplot of horseshoe crab prosomal widths (cm) caught in each fishery independent survey used in this assessment.

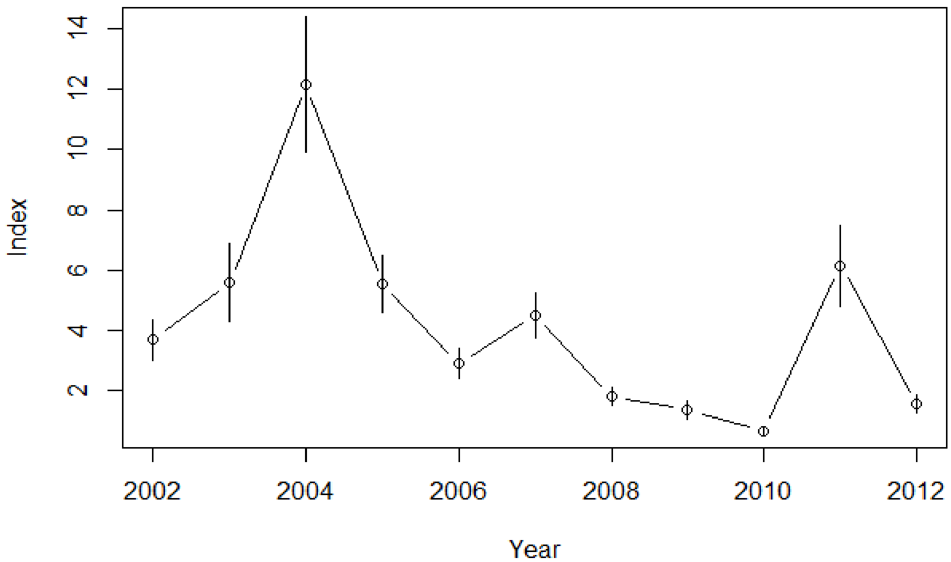

Figure 23. Index of relative abundance of female horseshoe crabs (delta mean crabs per sampling event) developed from the spring portion of New Hampshire's Spawning Beach Survey with 95% confidence intervals.

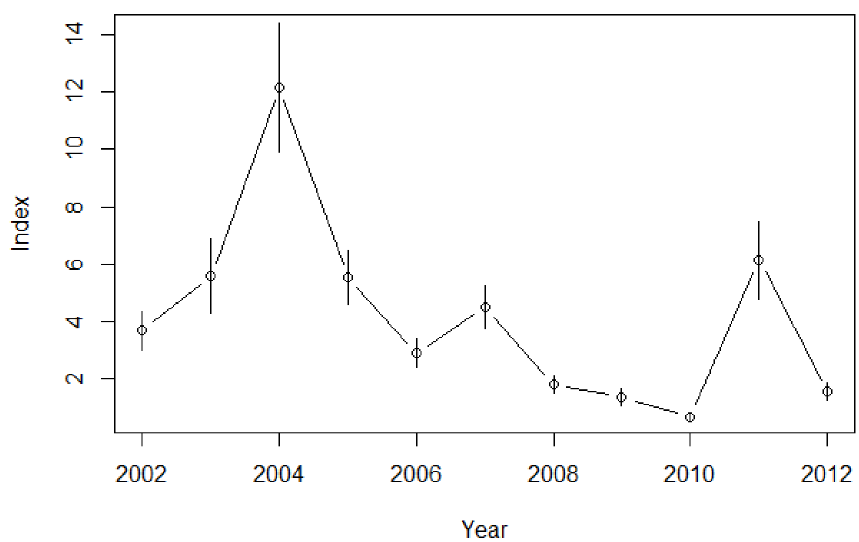

Figure 24. Index of relative abundance of male horseshoe crabs (delta mean crabs per sampling event) developed from the spring portion of New Hampshire's Spawning Beach Survey with 95% confidence intervals.

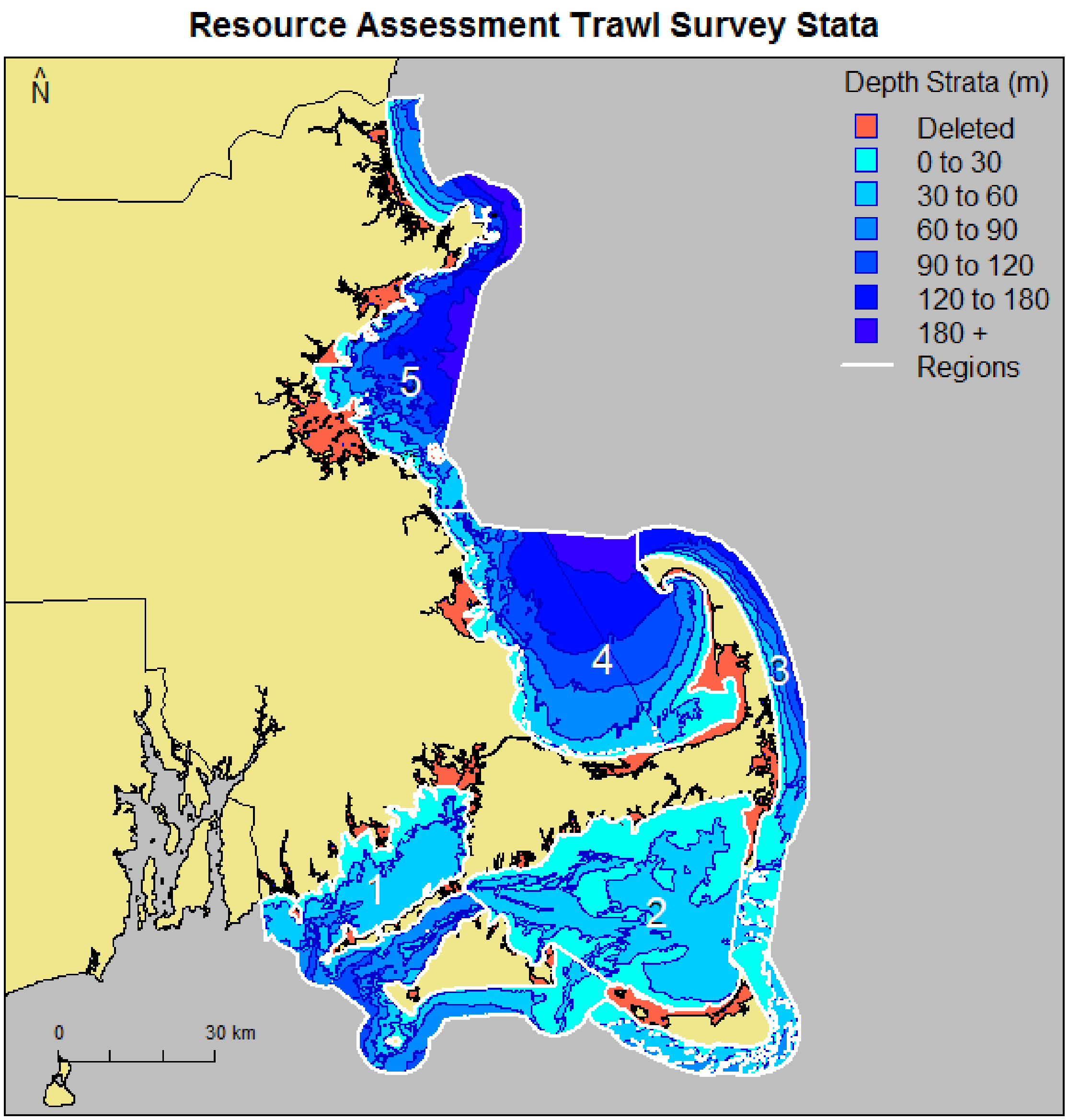

Figure 25. Map of Massachusetts Assessment Trawl Survey Strata.

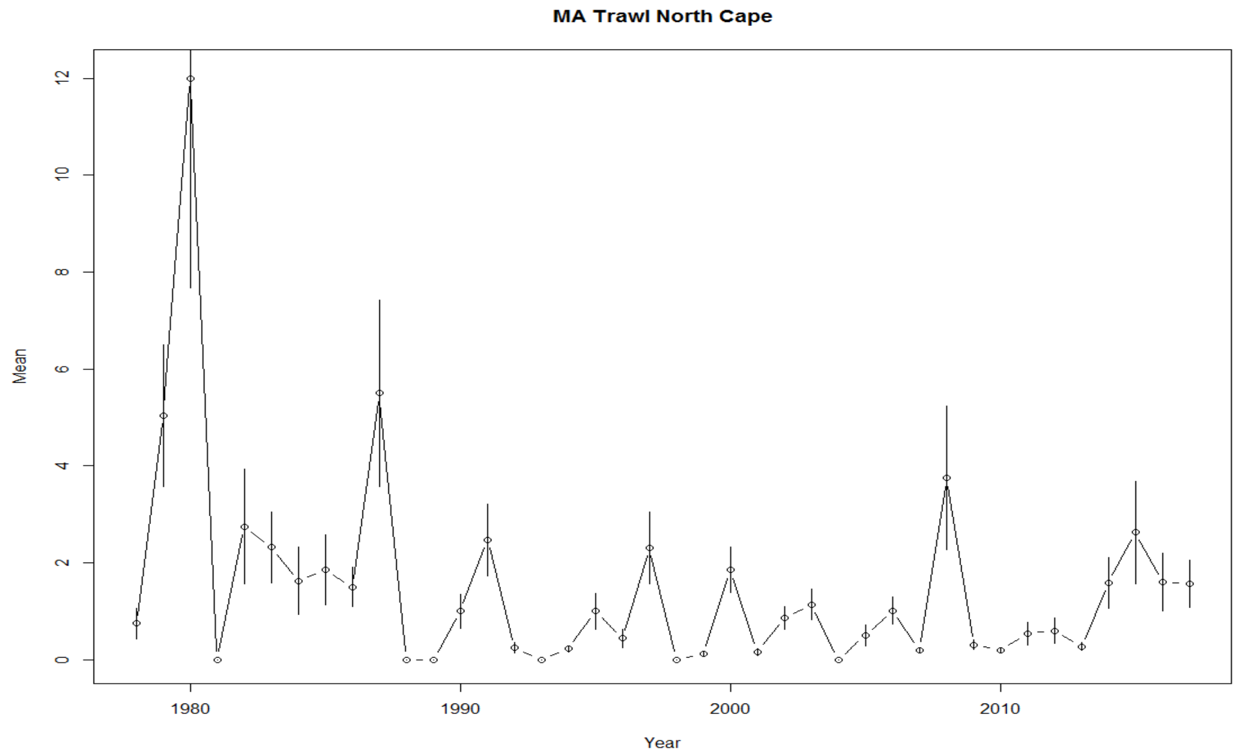

Figure 26. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the fall portion of Massachusetts' Resource Assessment Trawl Survey in strata north of Cape Cod with 95% confidence intervals.

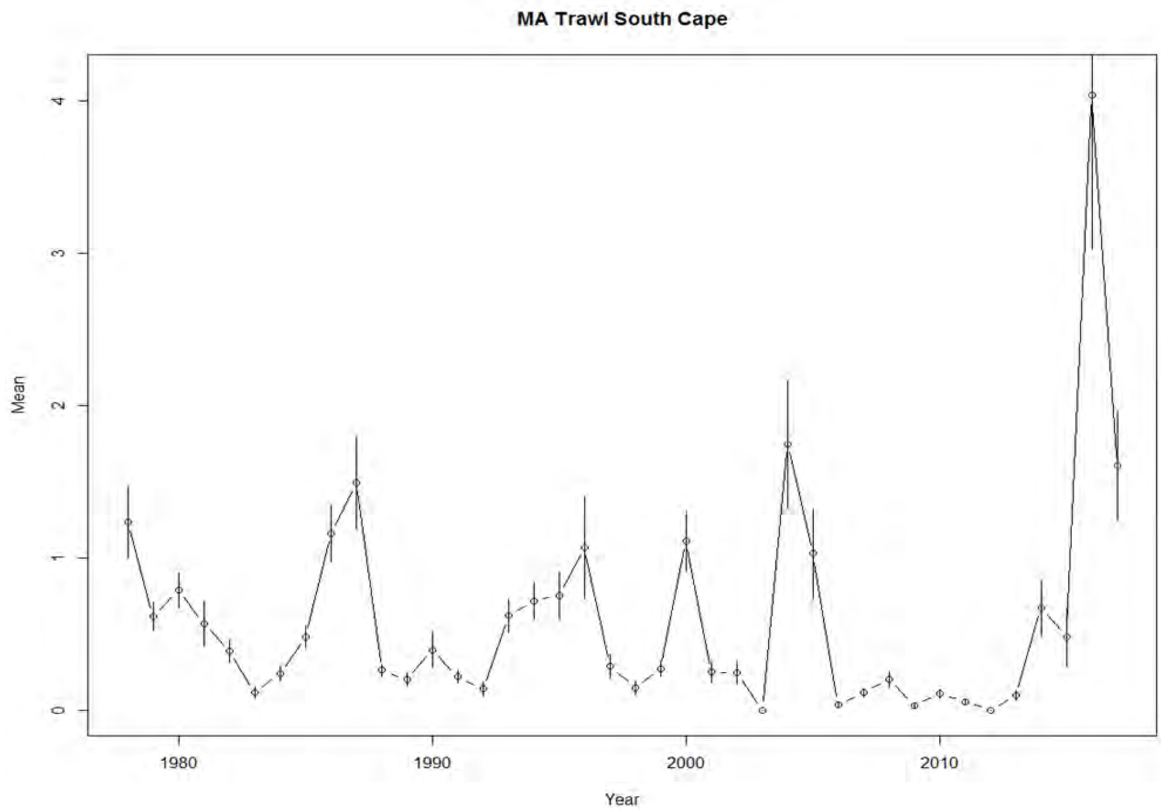

Figure 27. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the fall portion of Massachusetts' Resource Assessment Trawl Survey in strata south of Cape Cod with 95% confidence intervals.

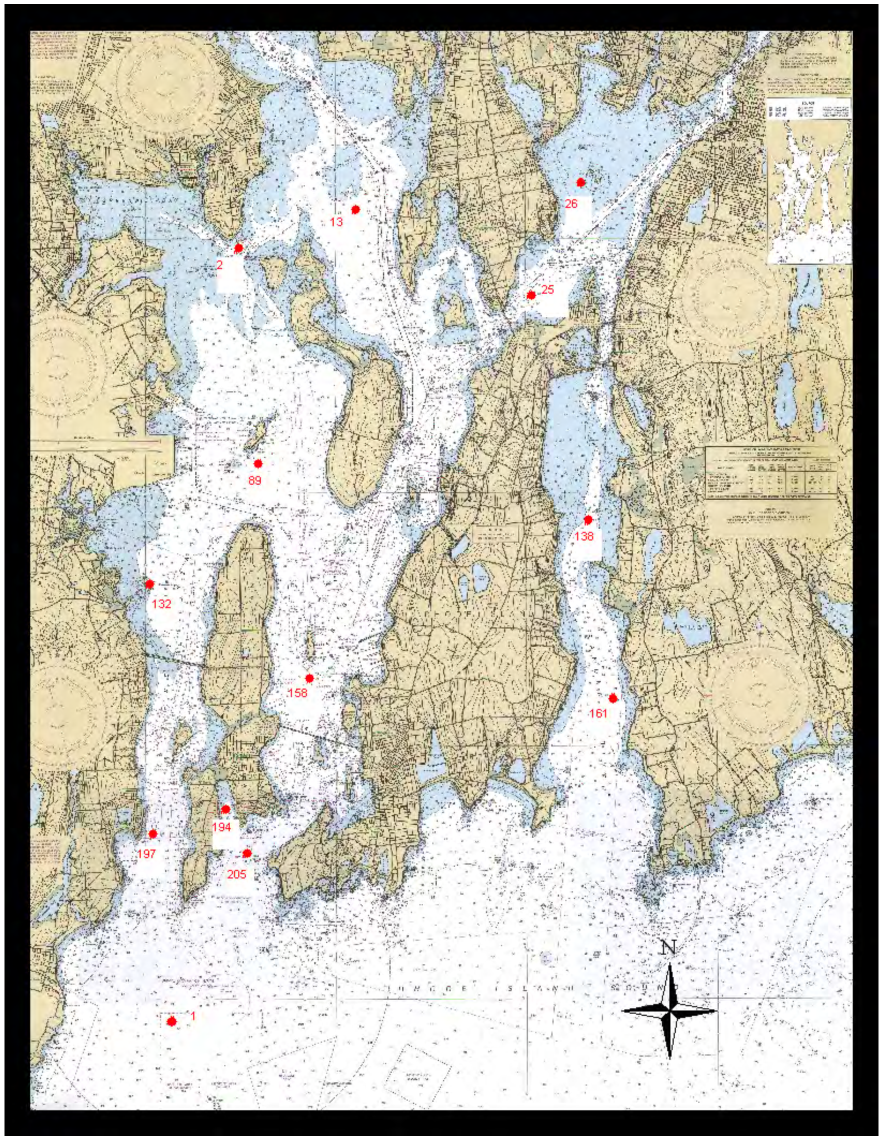

Figure 28. Map of Rhode Island Coastal Trawl Survey Monthly Segment fixed tow stations.

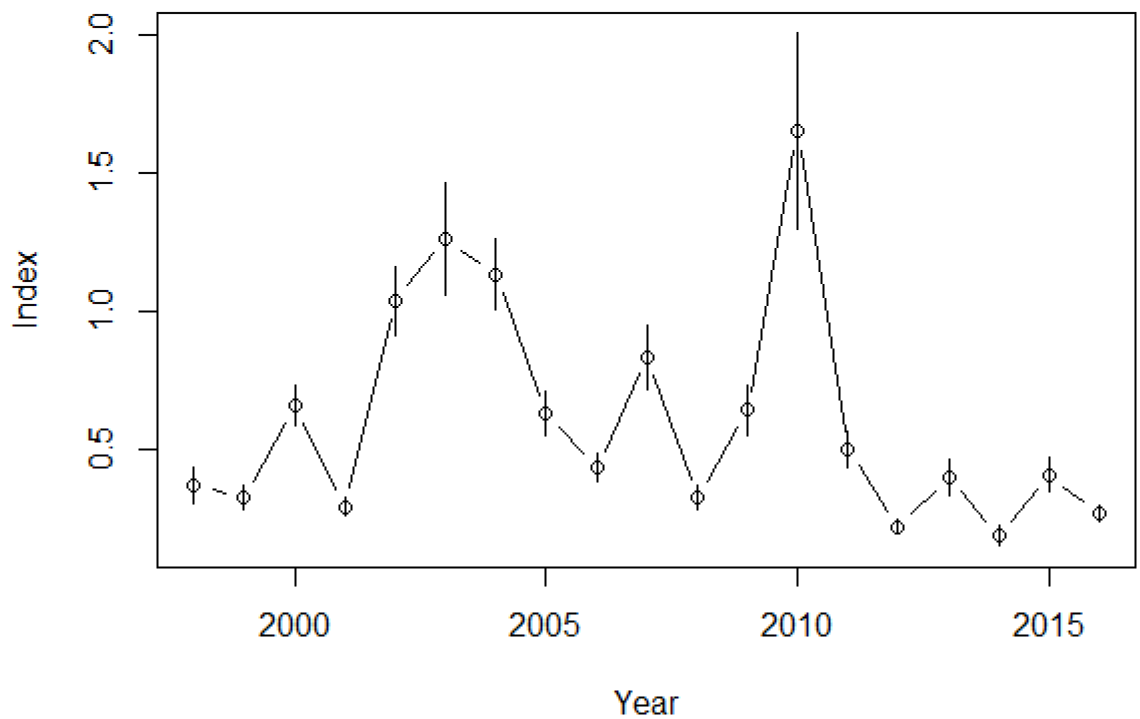

Figure 29. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the fall portion of Rhode Island's Coastal Trawl Survey Monthly Segment with 95% confidence intervals.

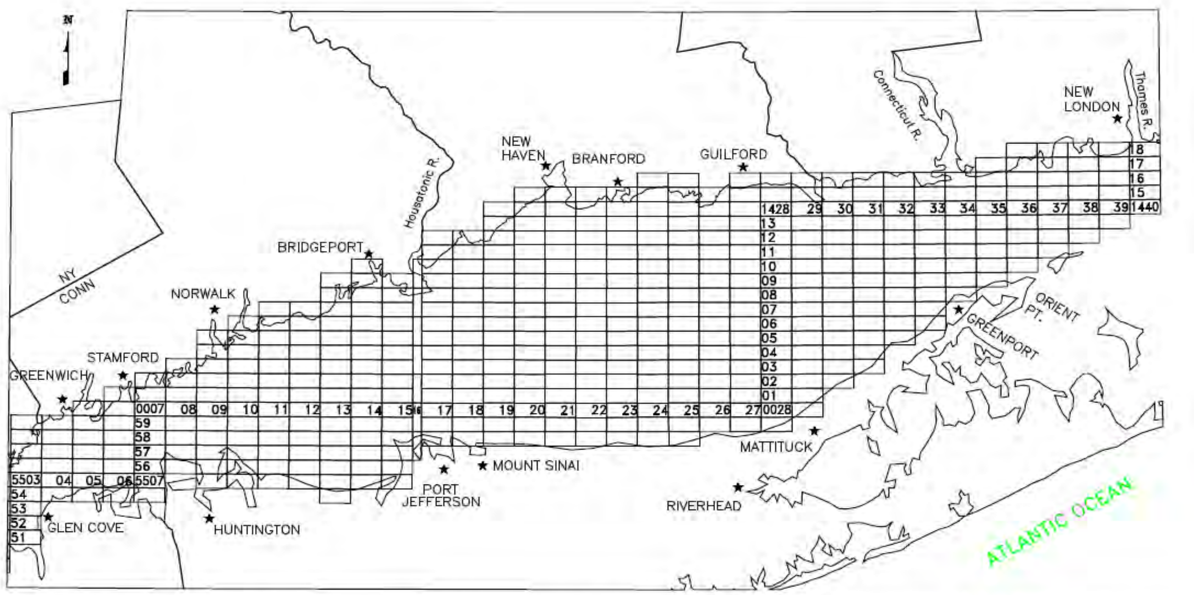

Figure 30. Map pf Connecticut DEEP Long Island Sound Trawl Survey site grid.

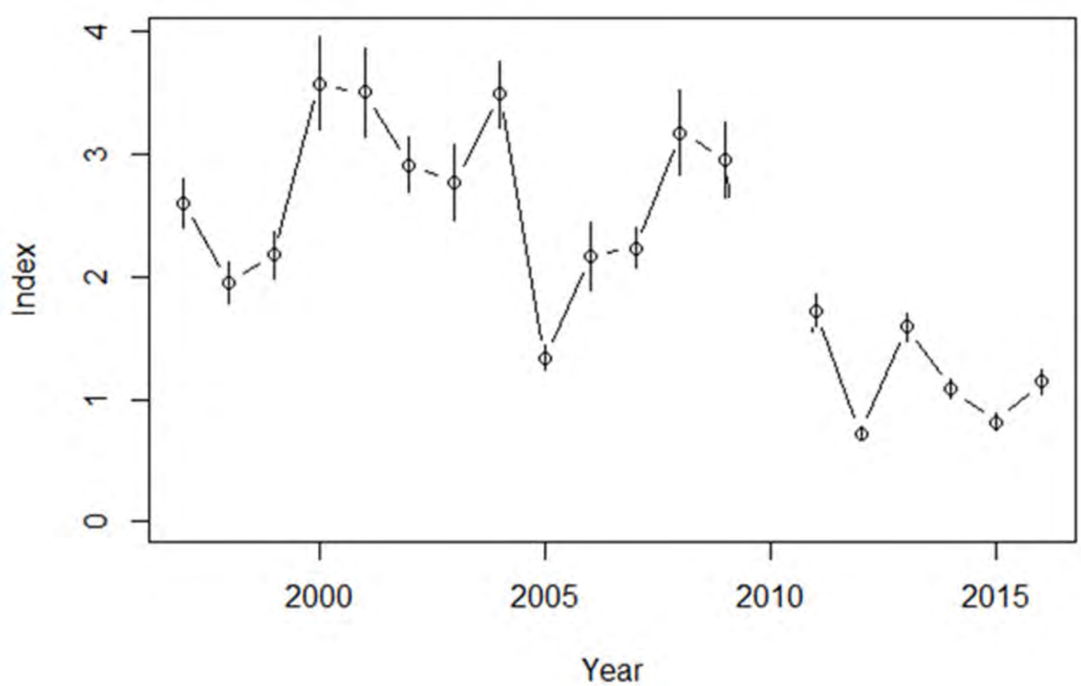

Figure 31. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the fall portion of Connecticut DEEP Long Island Sound Trawl Survey with 95% confidence intervals.

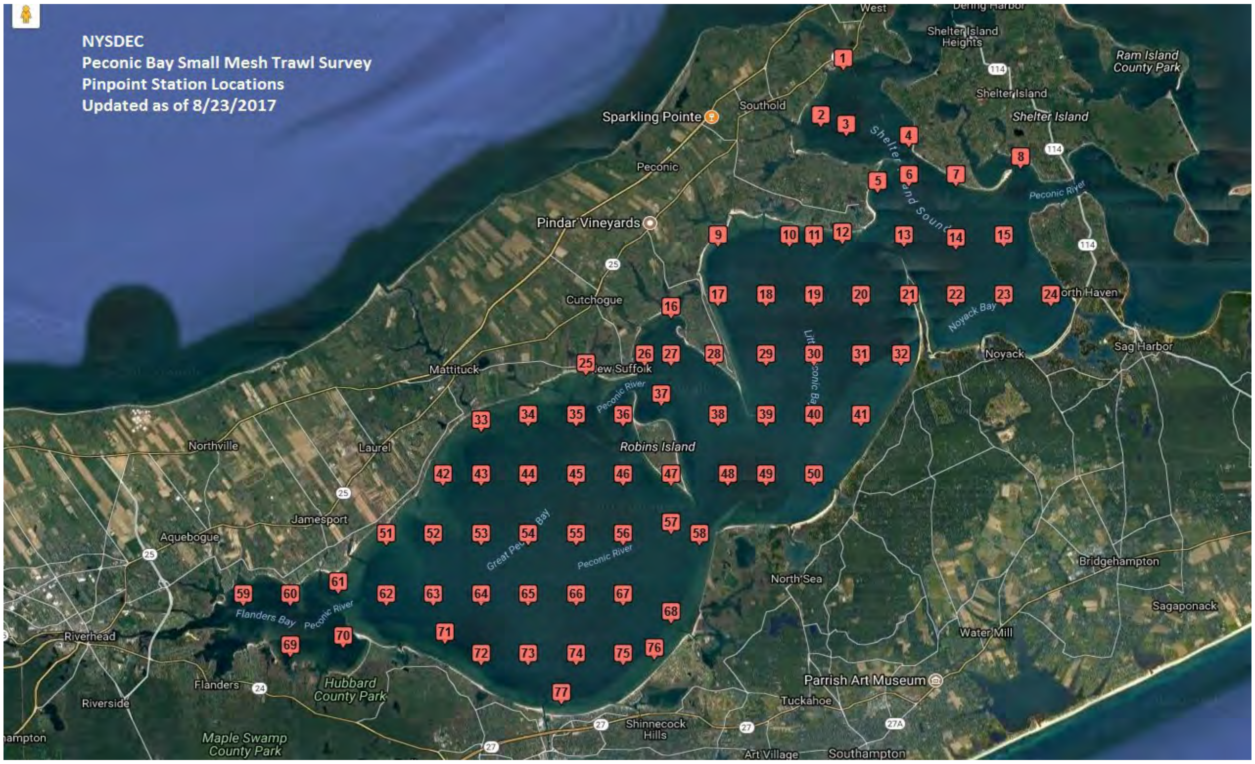

Figure 32. Map of New York Peconic Bay Small Mesh Trawl Survey Sampling Grid.

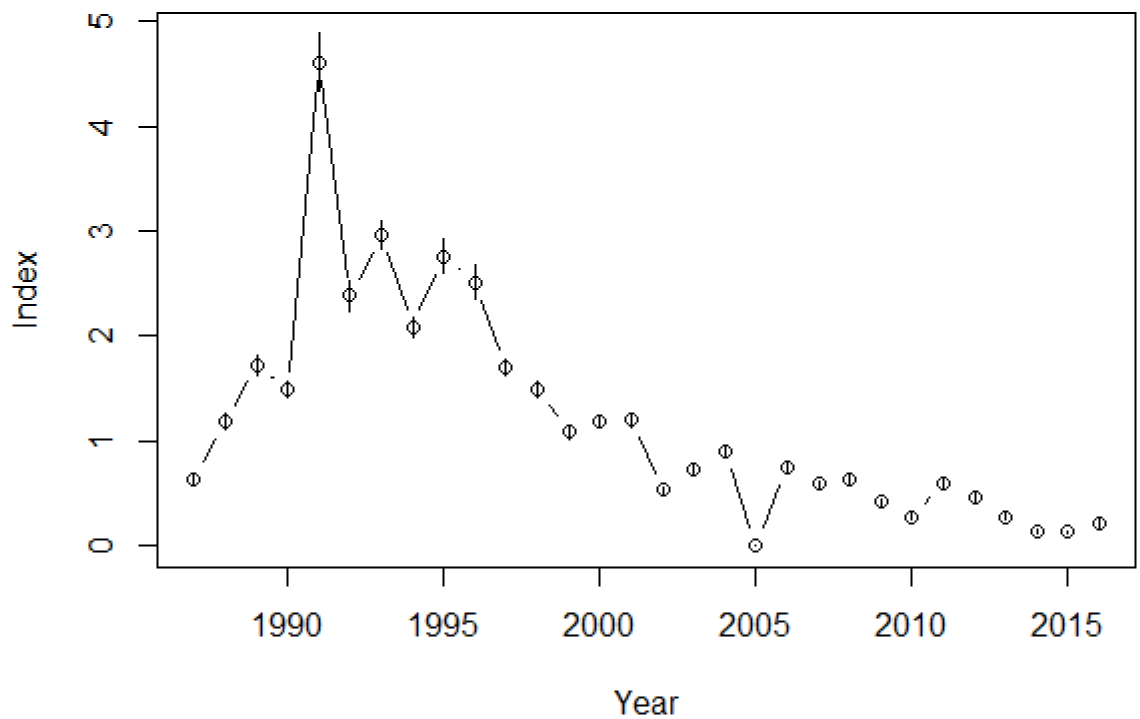

Figure 33. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the fall portion of the New York DEC Peconic Bay Small Mesh Trawl Survey with 95% confidence intervals.

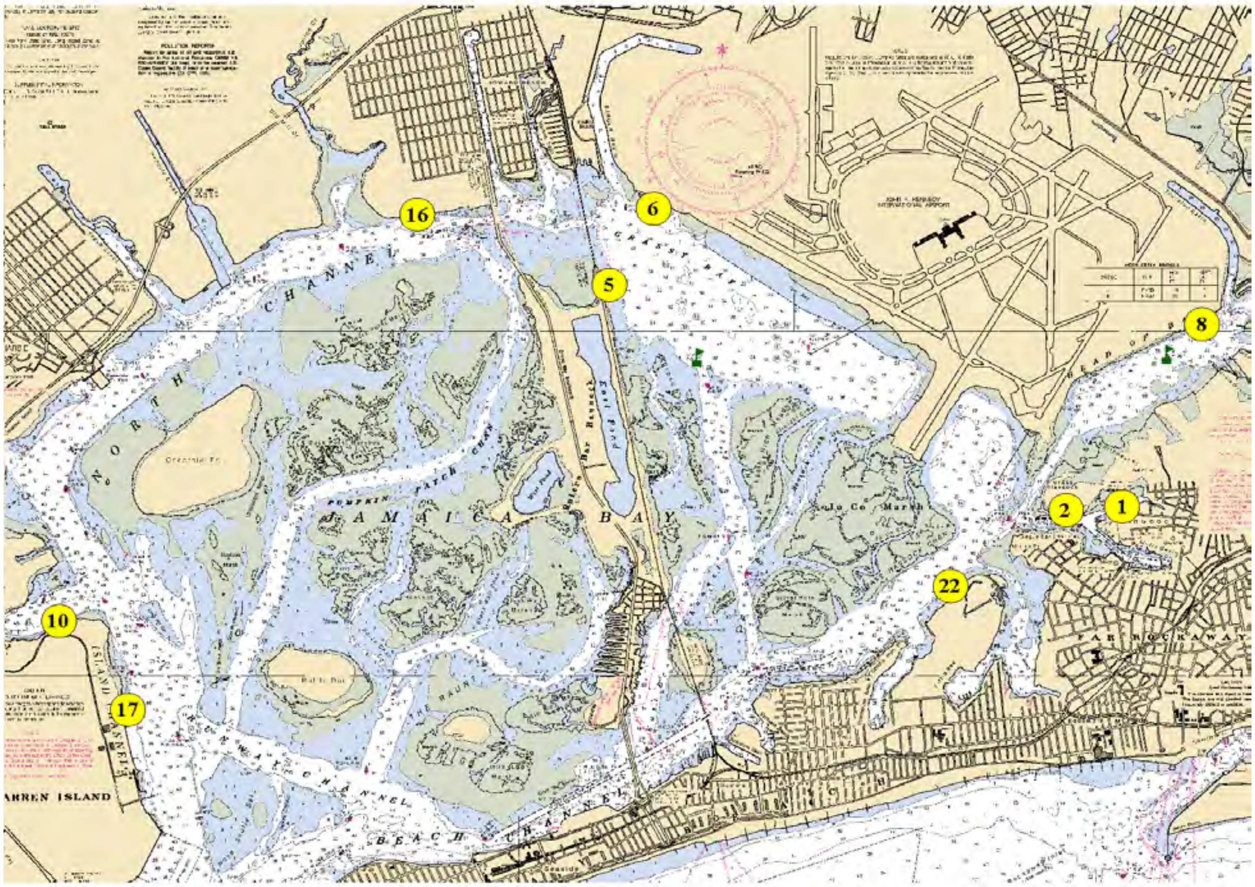

Figure 34. Map of New York DEC Western Long Island Beach Seine Survey Jamaica Bay Stations.

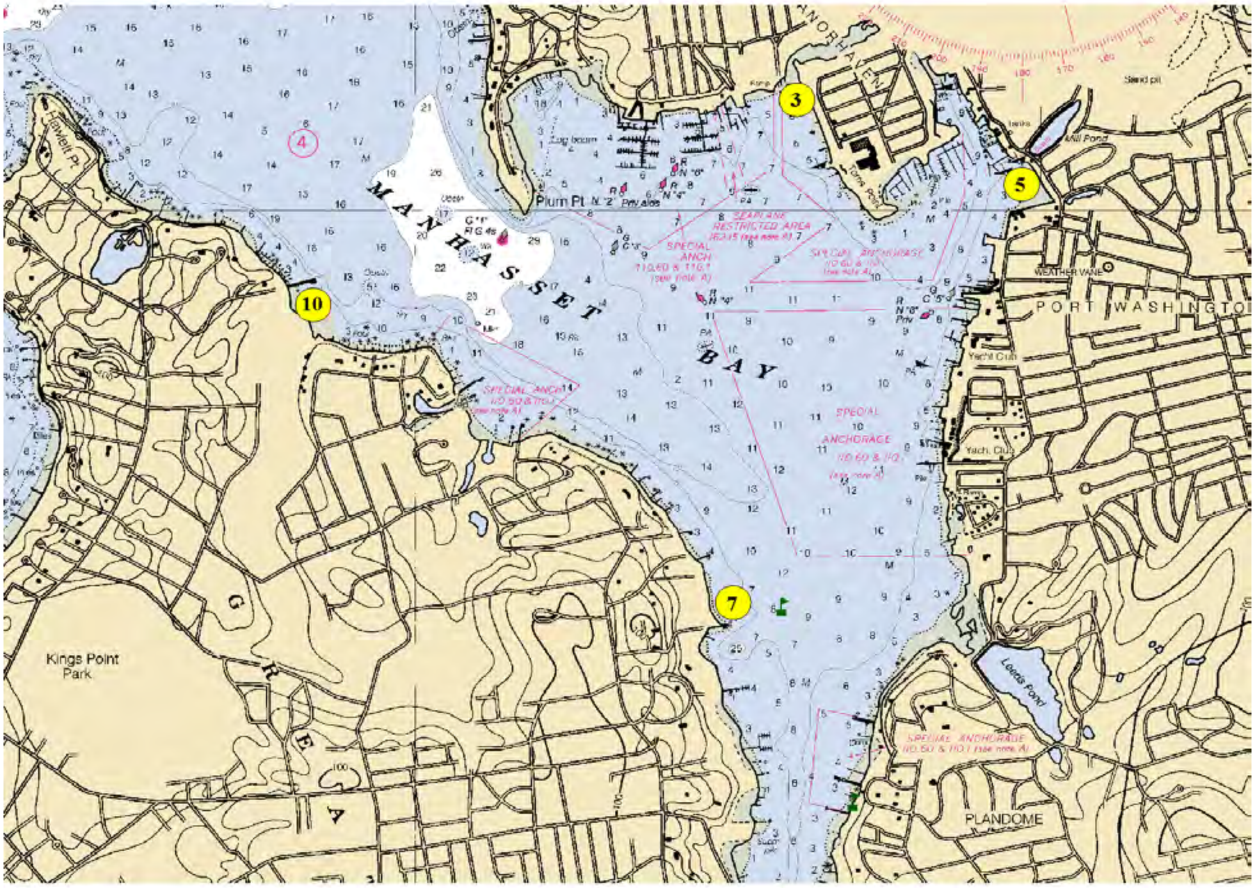

Figure 35. Map of New York DEC Western Long Island Beach Seine Survey Manhasset Bay Stations.

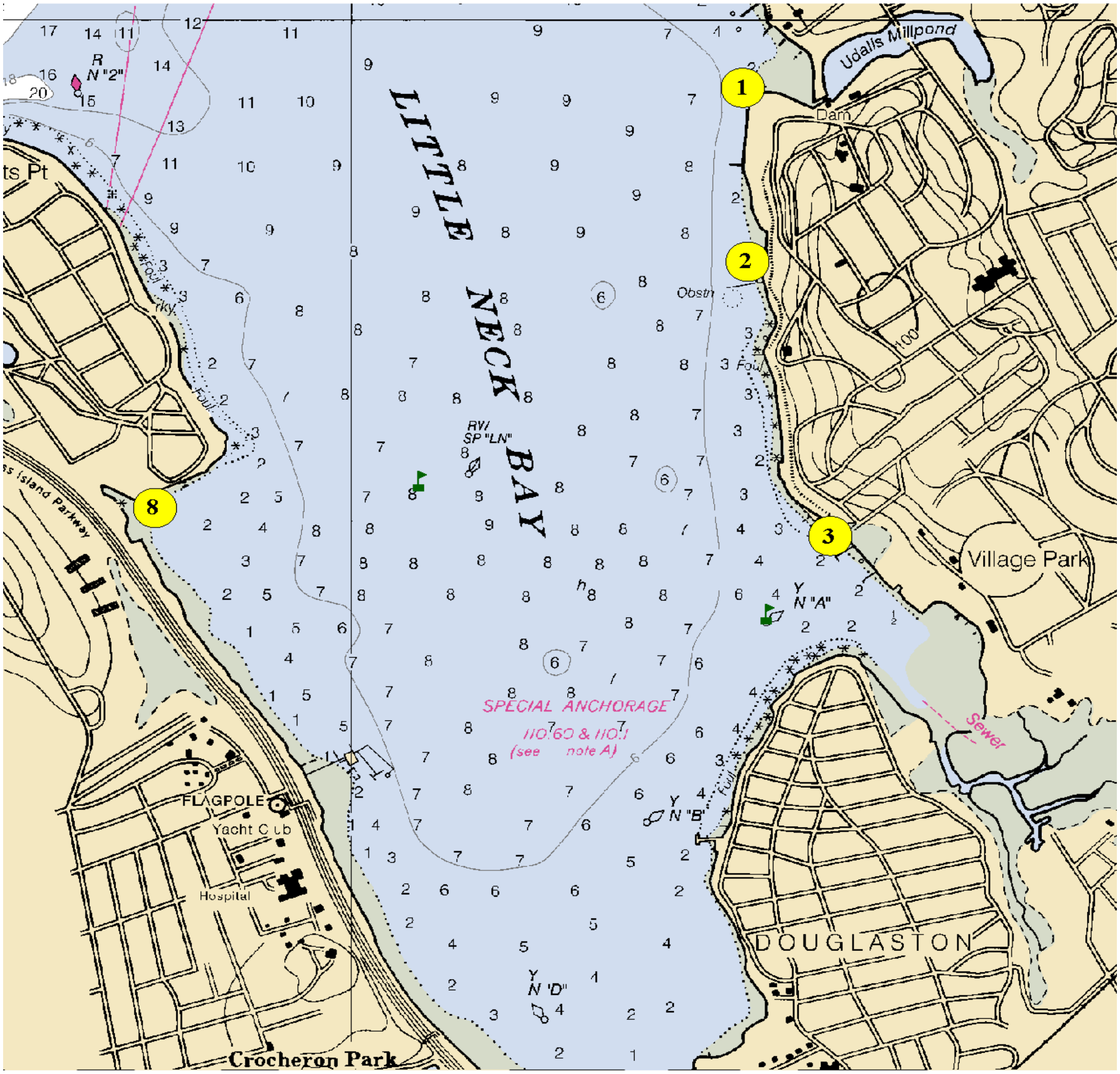

Figure 36. Map of New York DEC Western Long Island Beach Seine Survey Little Neck Bay Stations.

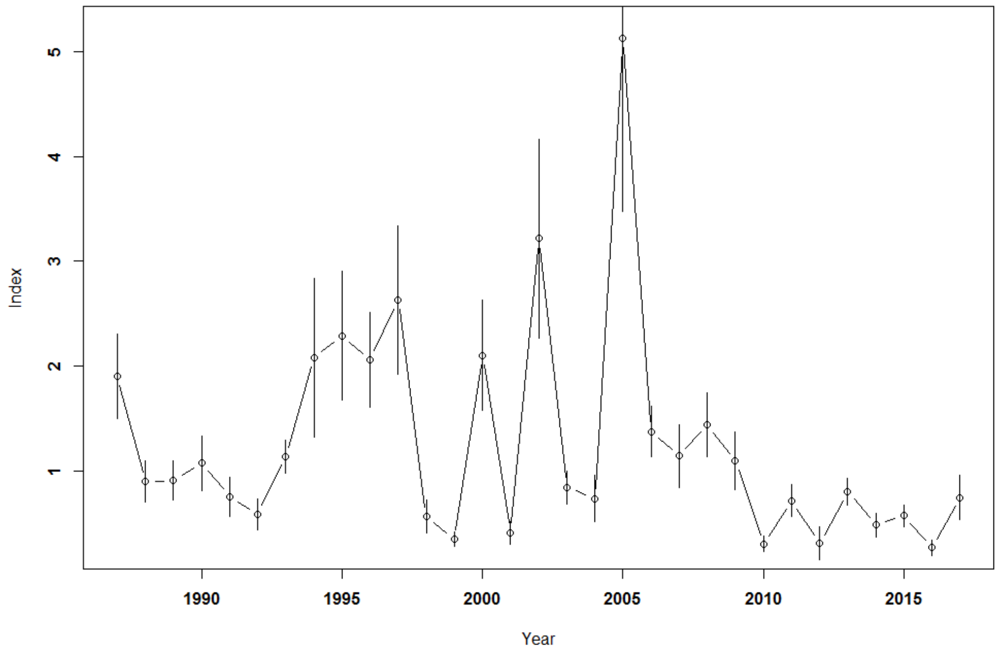

Figure 37. Index of relative abundance of horseshoe crab (delta mean catch per tow) in Jamaica Bay developed from the spring portion of the New York Seine Survey with 95% confidence intervals.

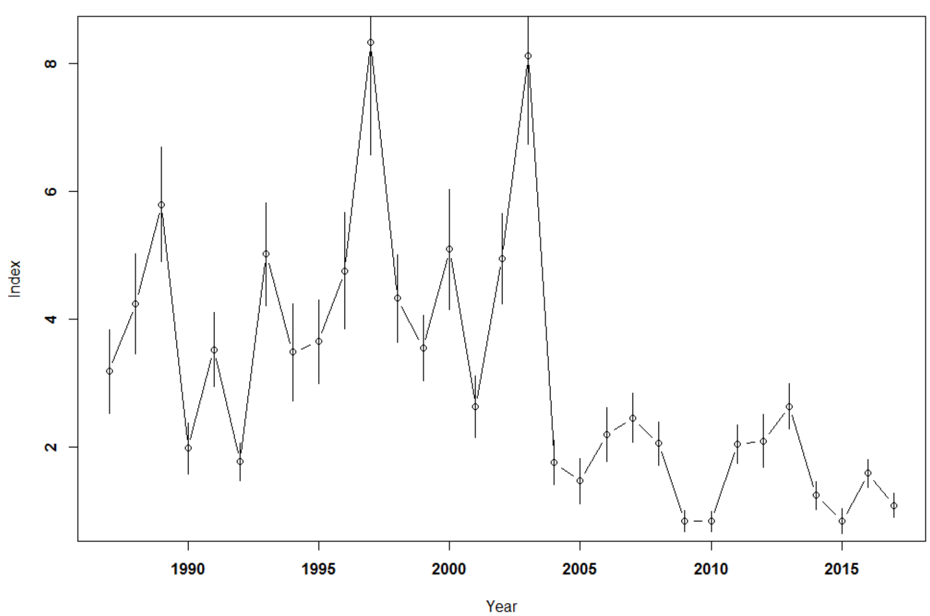

Figure 38. Index of relative abundance of horseshoe crab (delta mean catch per tow) in Manhassett and Little Neck Bays developed from the spring portion of the New York Seine Survey with 95% confidence intervals.

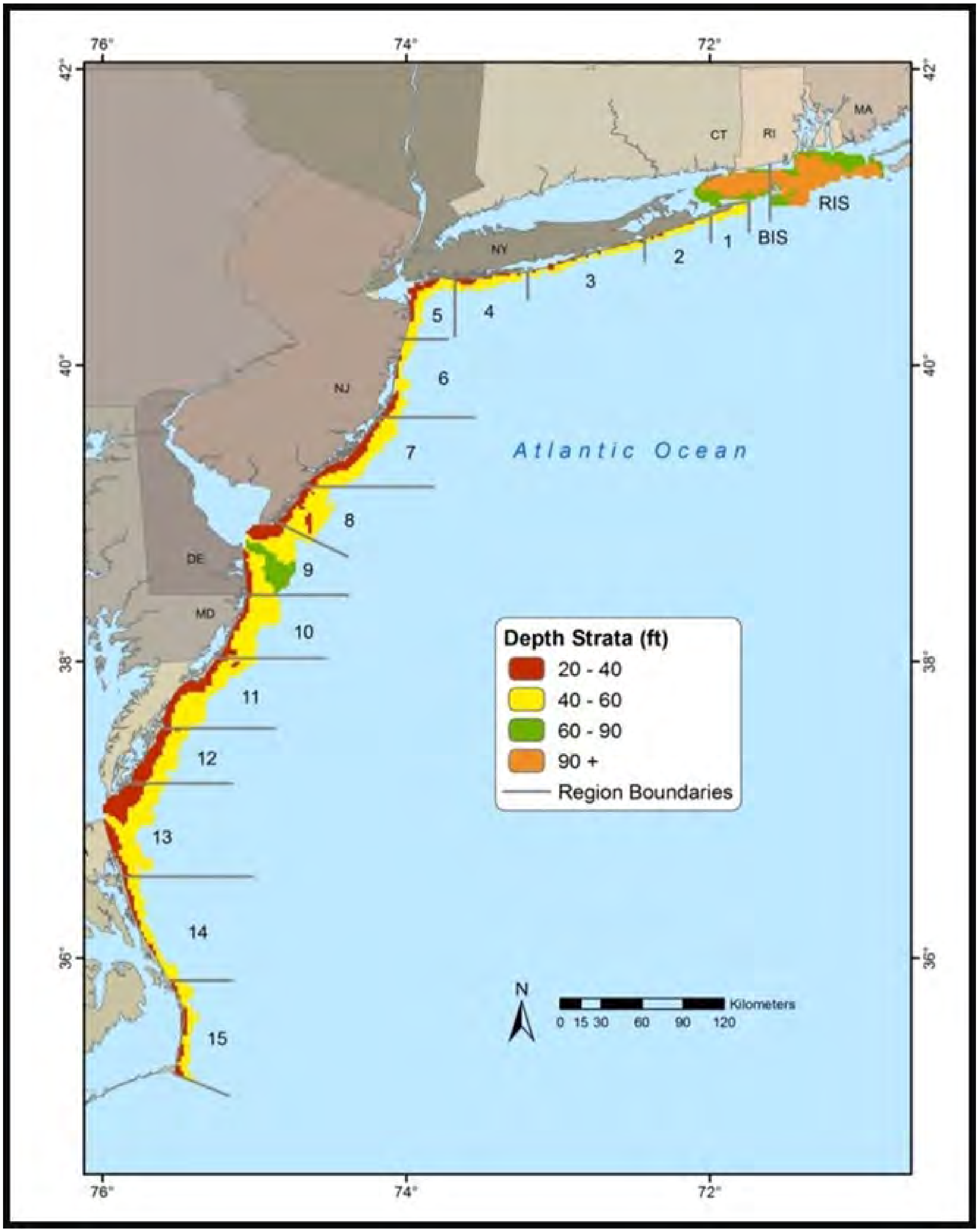

Figure 39. Map of the sampling strata used in the NEAMAP survey (map provided by NEAMAP and available on the website http://www.neamap.net/index.html.

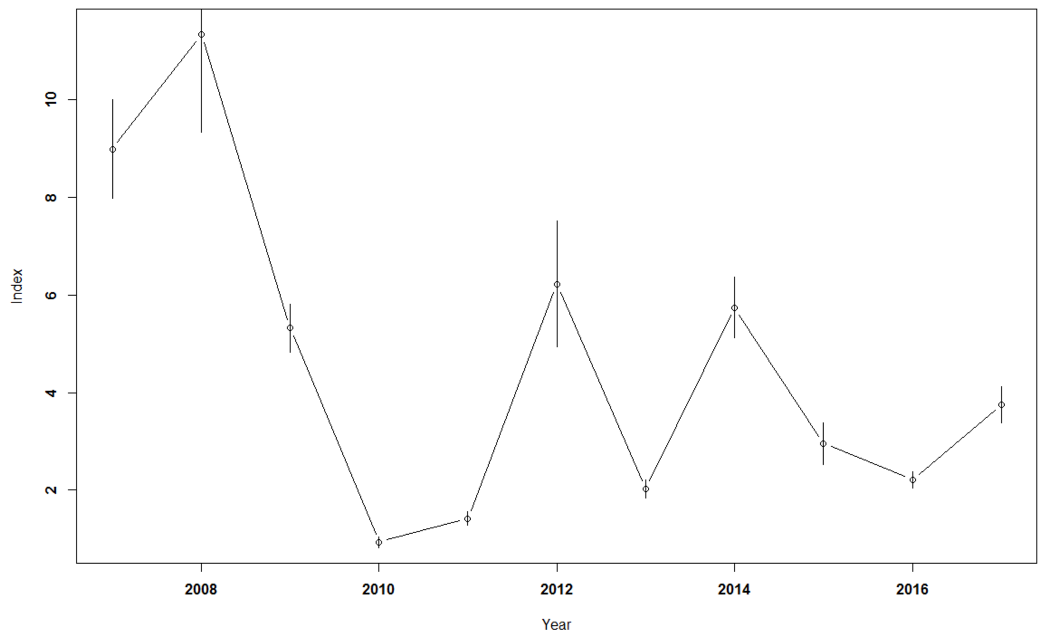

Figure 40. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the fall portion of NEAMAP for the New York region with 95% confidence intervals.

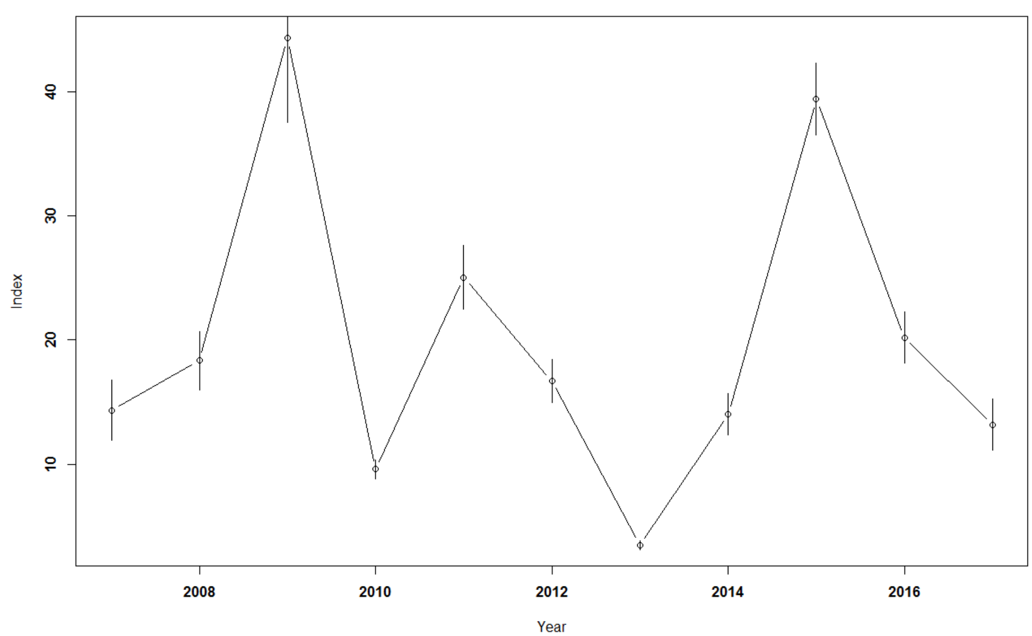

Figure 41. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the fall portion of NEAMAP for the Delaware Bay region with 95% confidence intervals.

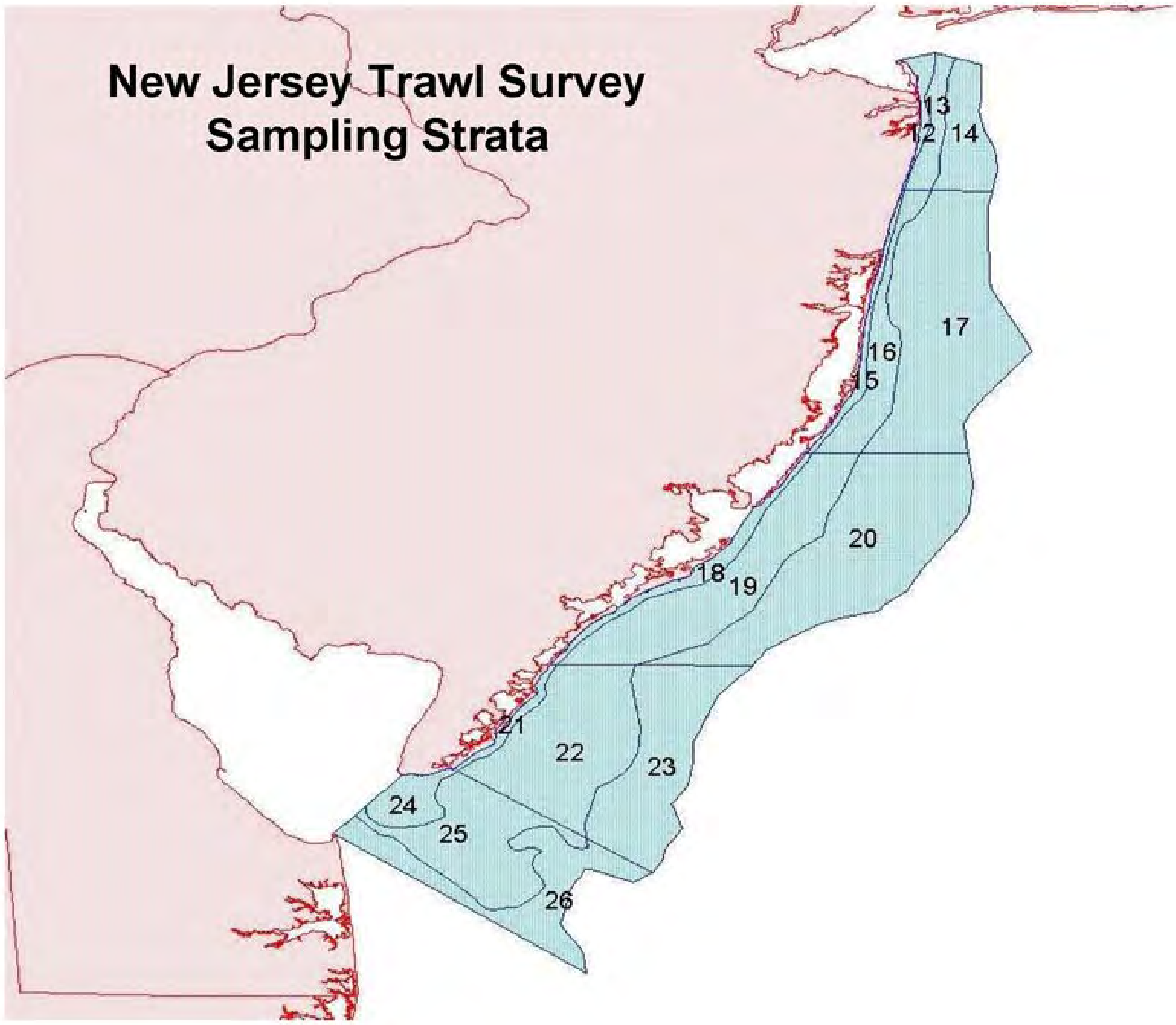

Figure 42. New Jersey Ocean Trawl Survey sampling area with survey strata defined.

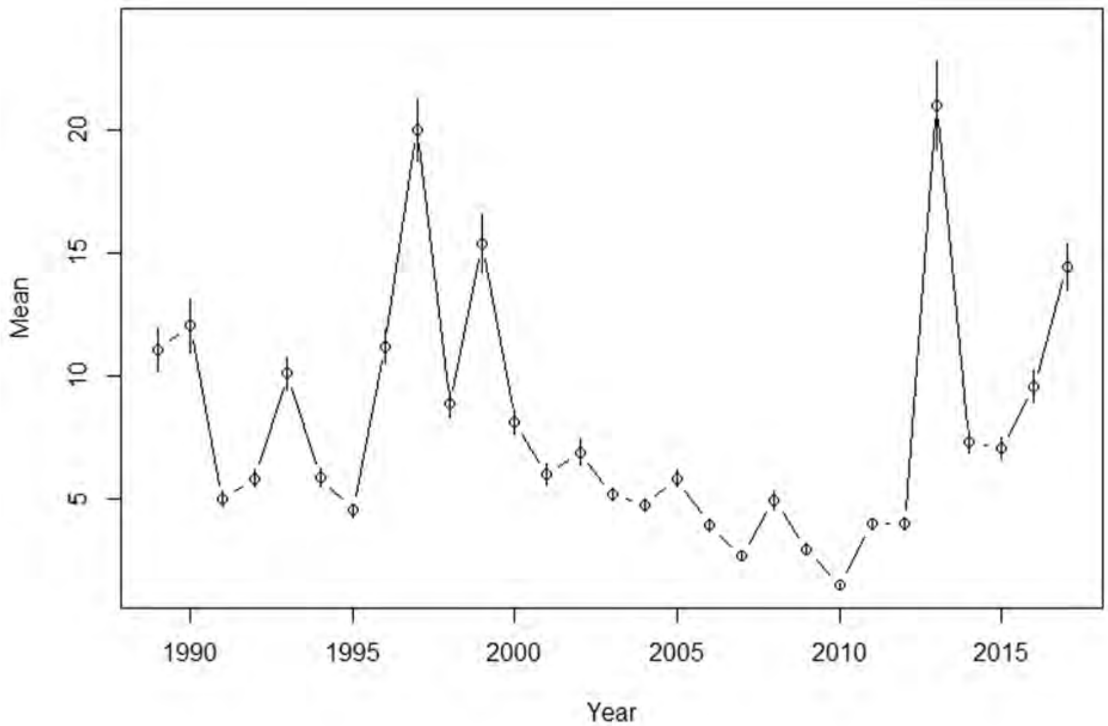

Figure 43. Abundance index for all horseshoe crabs in the spring (April and August) samples from New Jersey's Ocean Trawl Survey.

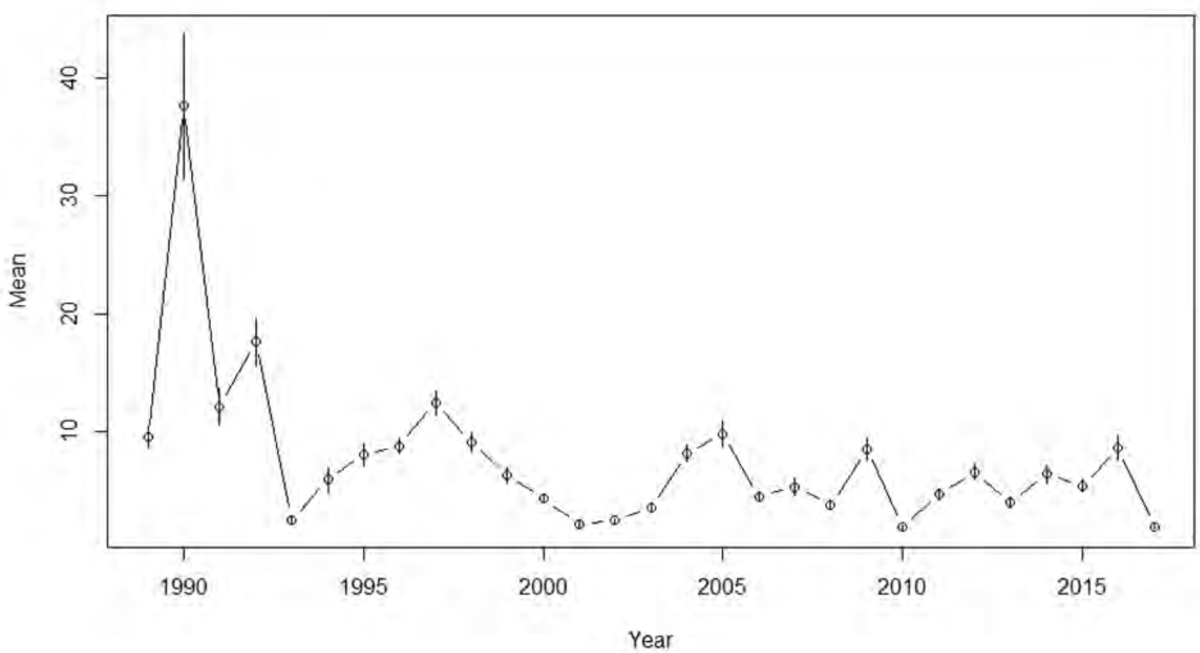

Figure 44. Abundance index for all horseshoe crabs in the fall (October) samples from New Jersey's Ocean Trawl Survey.

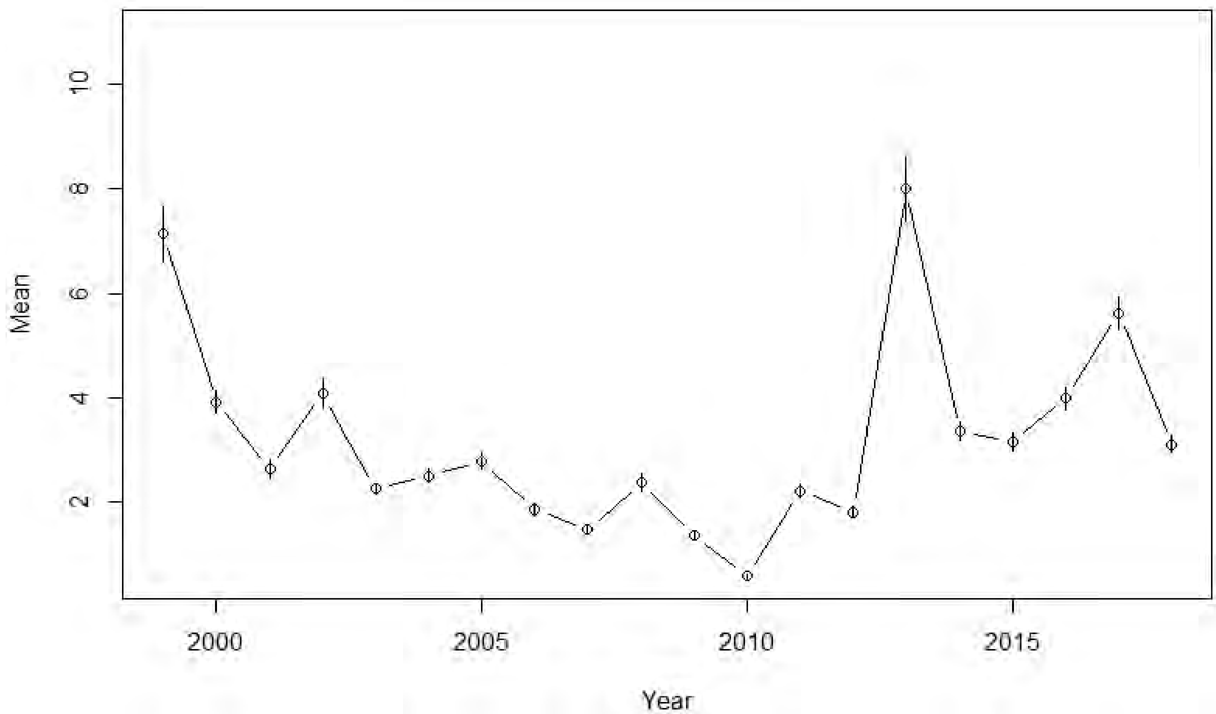

Figure 45. Abundance index for adult female horseshoe crabs (>= 19 cm pw) in the spring (April and August) from New Jersey's Ocean Trawl Survey.

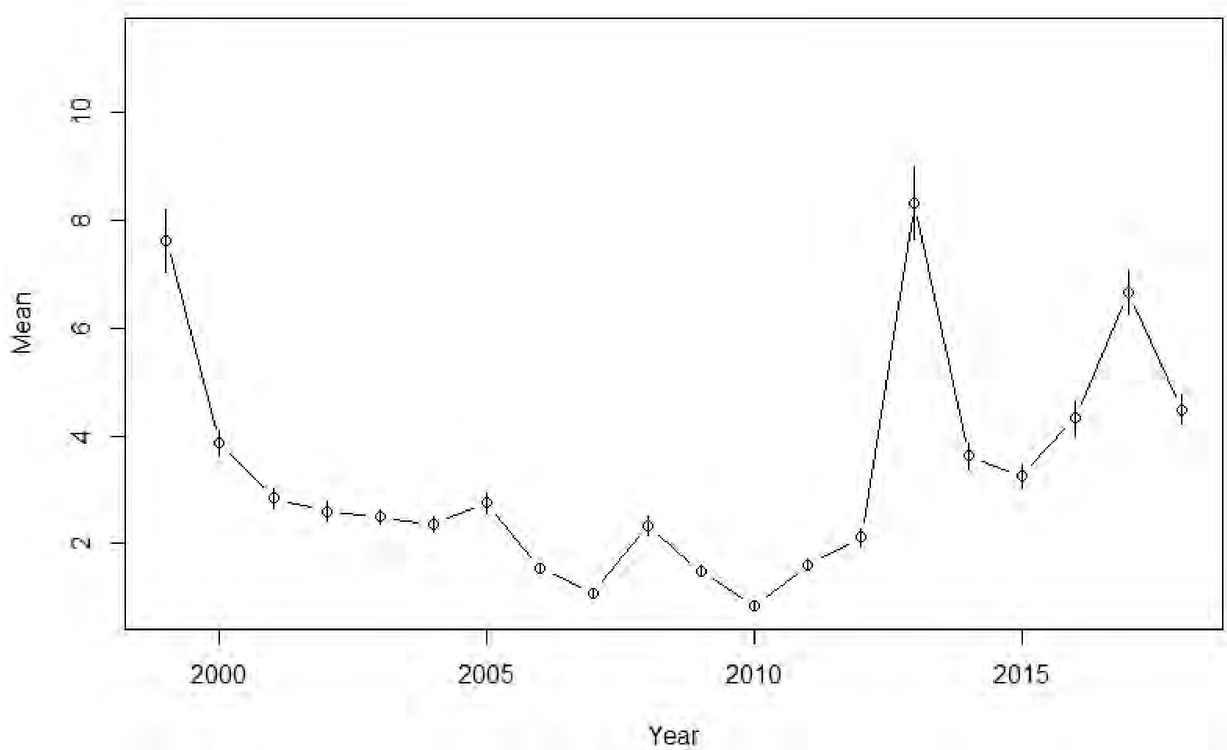

Figure 46. Abundance index for adult male horseshoe crabs in the spring (April and August) from New Jersey's Ocean Trawl Survey.

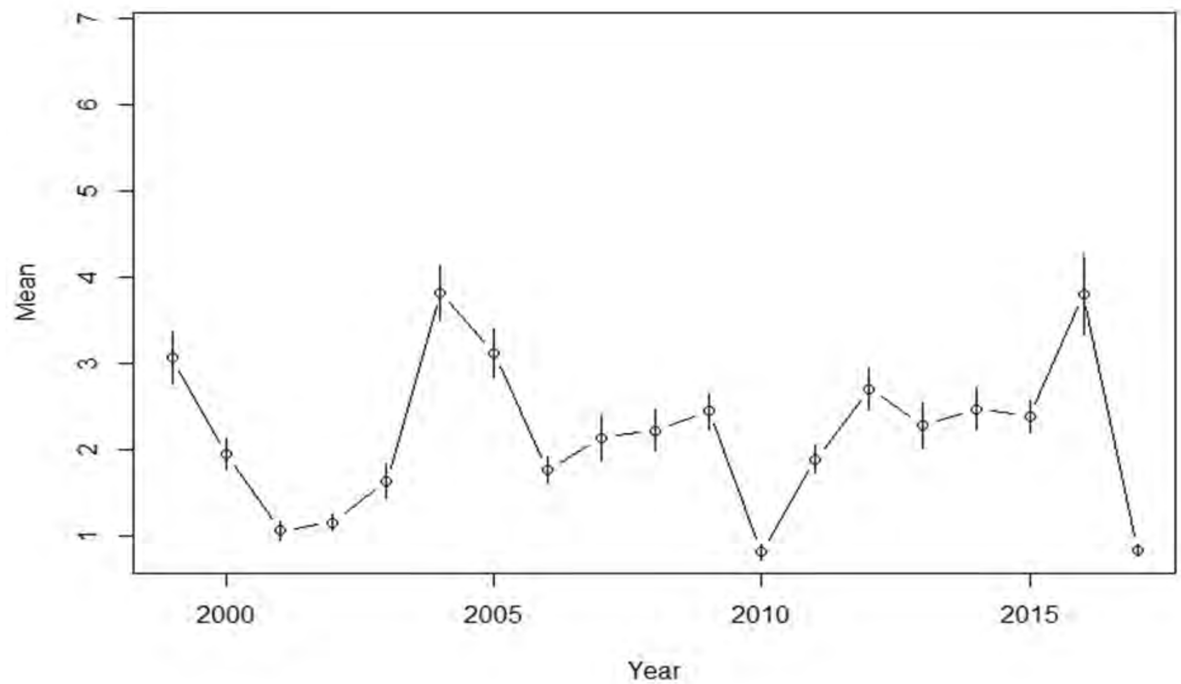

Figure 47. Abundance index for adult female horseshoe crabs (>= 19 cm pw) in the fall (October) from New Jersey's Ocean Trawl Survey.

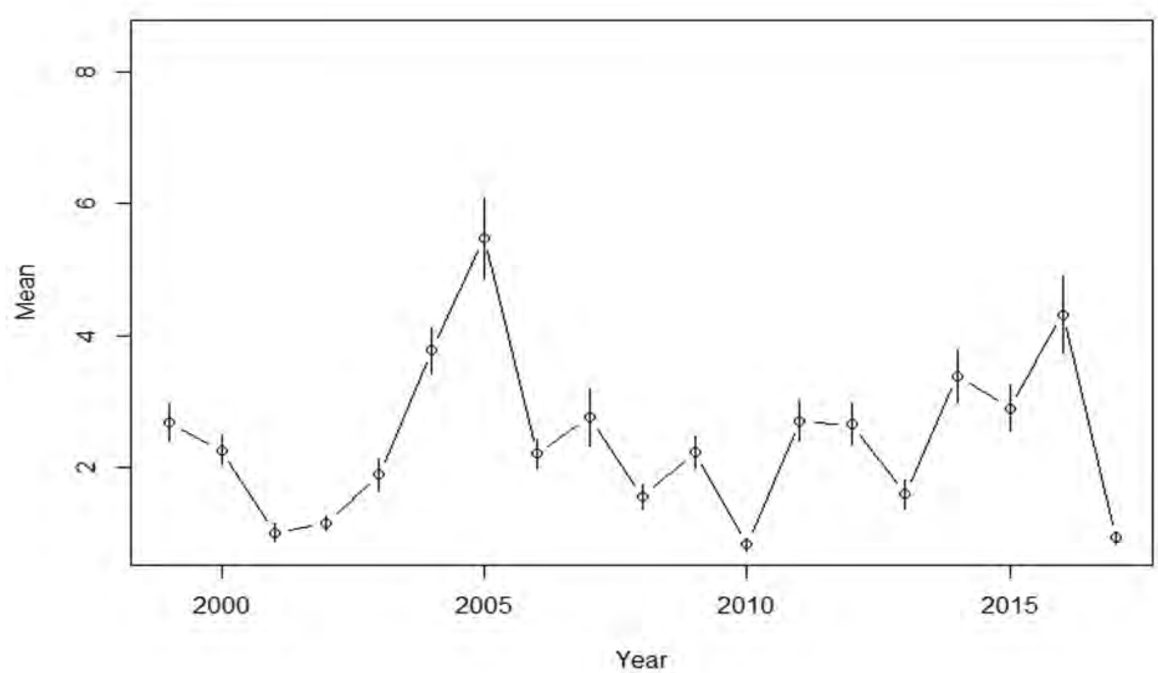

Figure 48. Abundance index for adult male horseshoe crabs in the fall (October) from New Jersey's Ocean Trawl Survey.

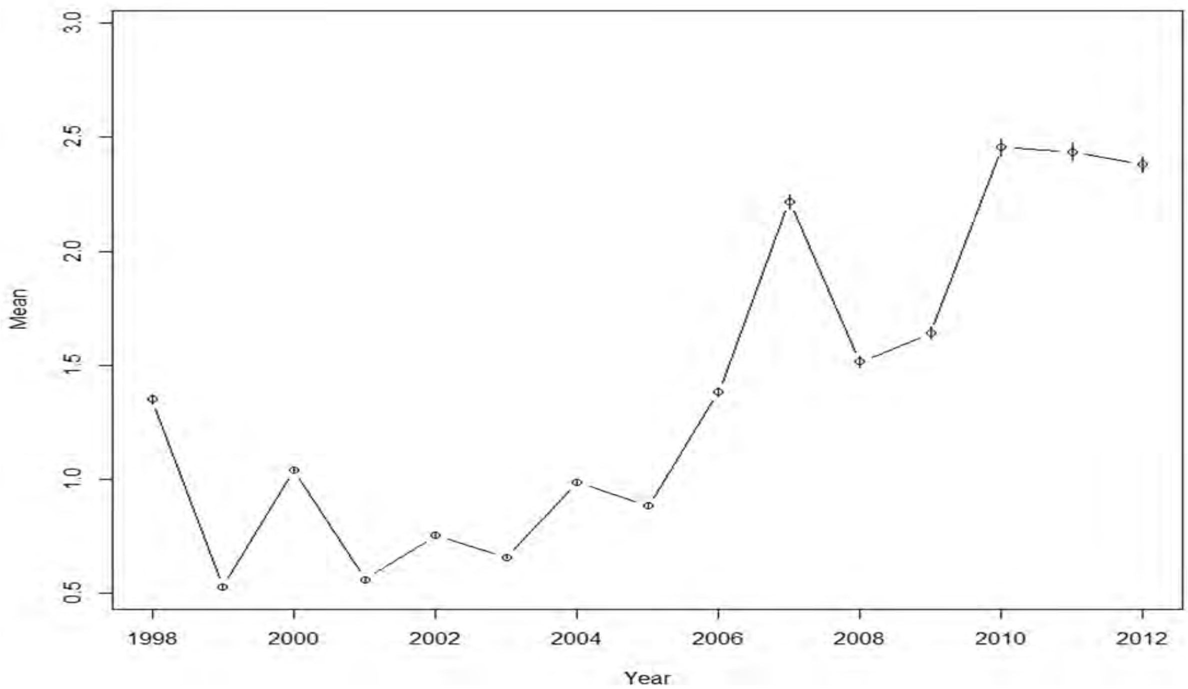

Figure 49. Abundance index for all horseshoe crabs combined in New Jersey's Surf Clam Dredge Survey (June, July, August).

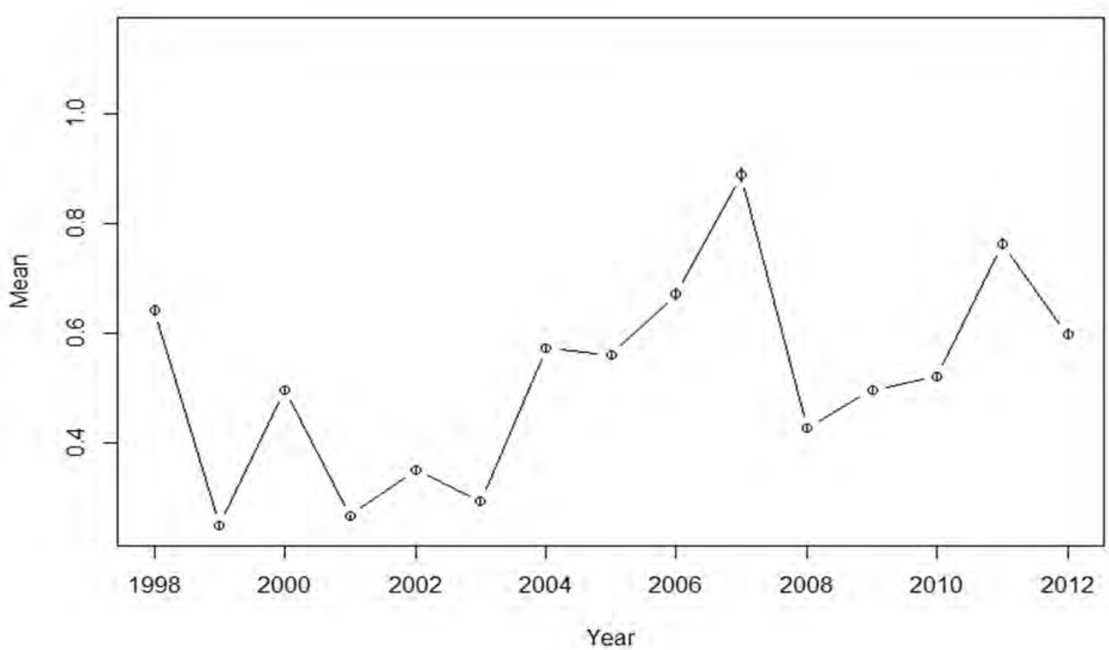

Figure 50. Abundance index for adult female horseshoe crabs (> 180 mm pw) in New Jersey's Surf Clam Dredge Survey (June, July, August).

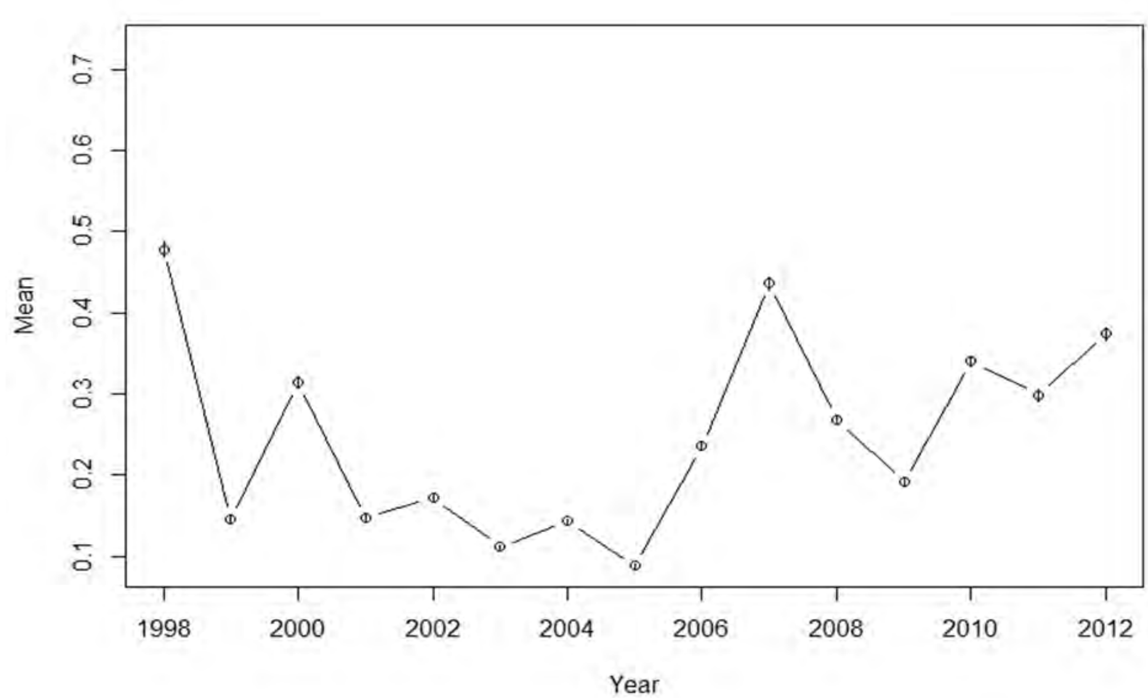

Figure 51. Abundance index for adult male horseshoe crabs (possessing male pedipalps) in New Jersey's Surf Clam Dredge Survey (June, July, August).

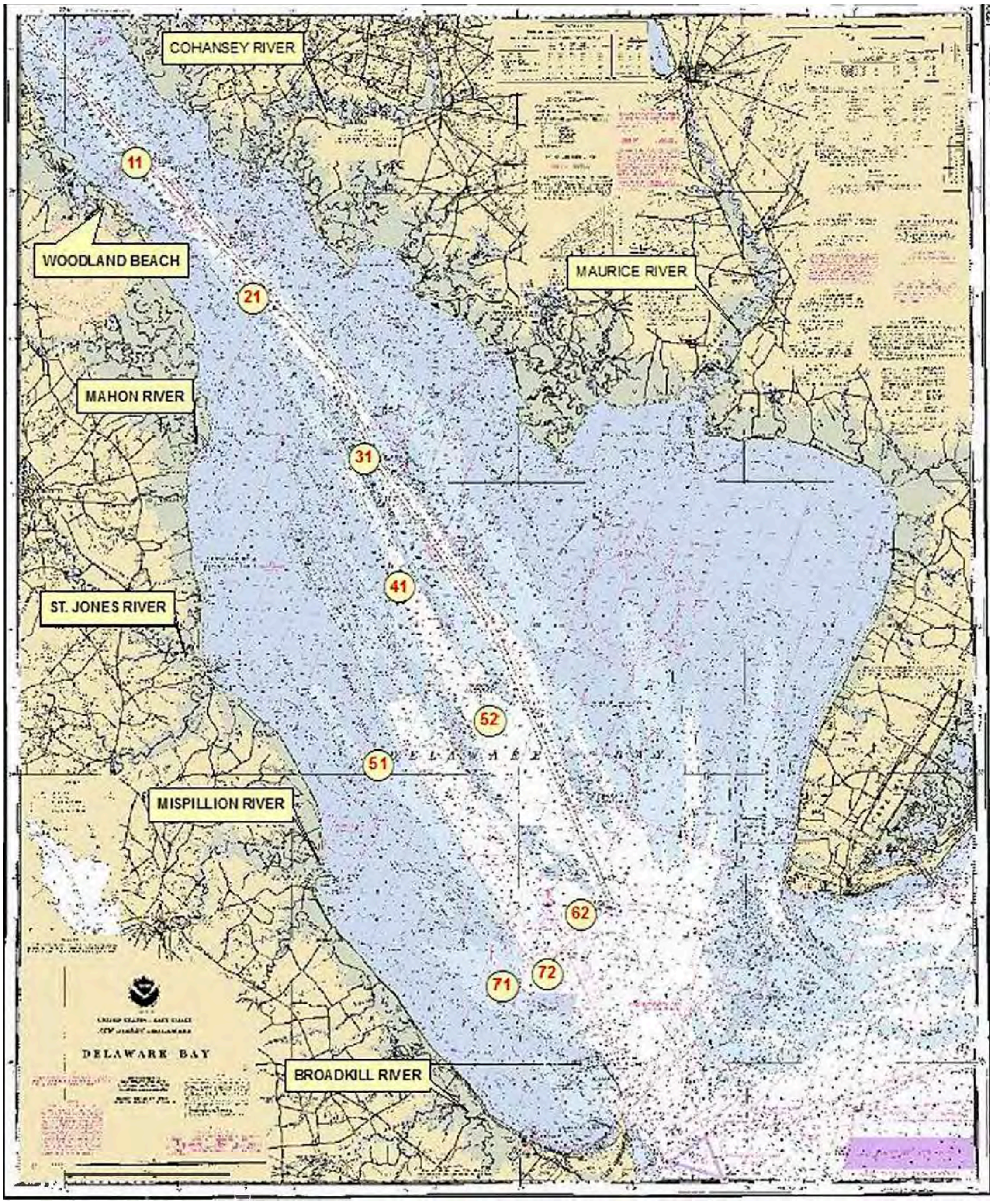

Figure 52. Delaware Fish & Wildlife Adult Trawl Survey sampling area and stations.

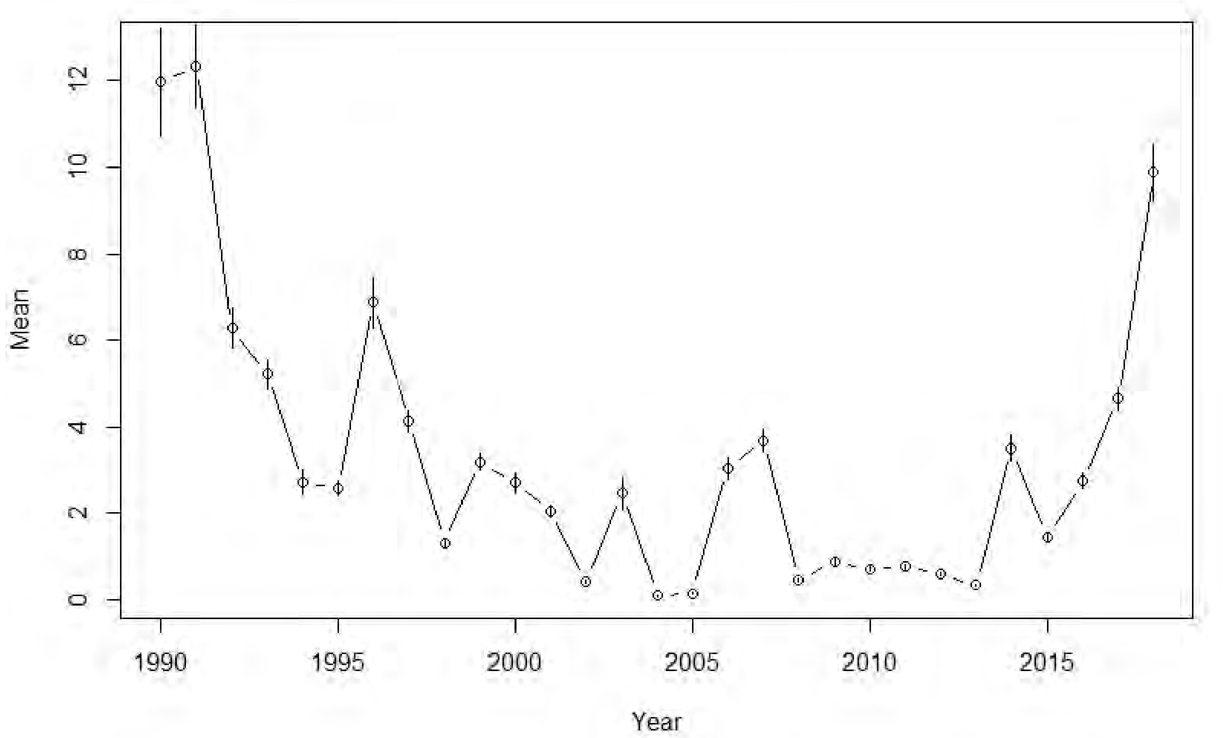

Figure 53. Delaware Fish and Wildlife Adult Trawl Survey abundance index for all adult horseshoe crabs combined in spring (March through August).

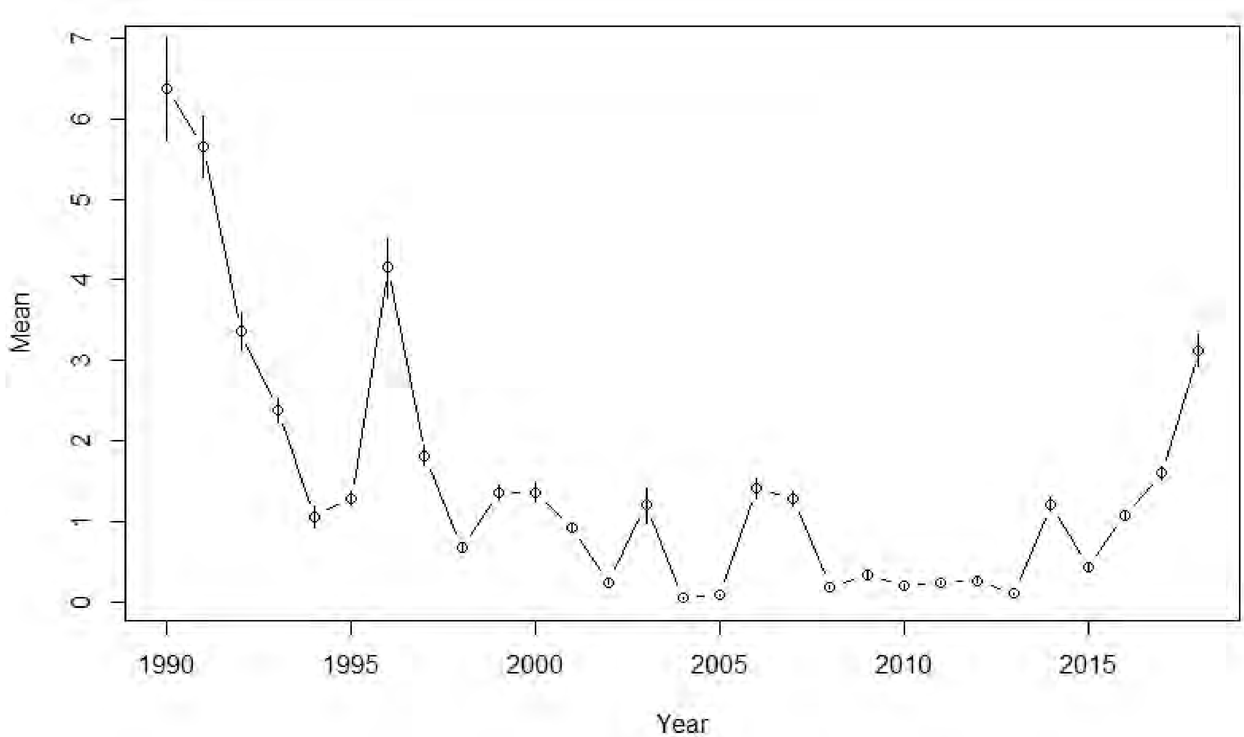

Figure 54. Delaware Fish and Wildlife Adult Trawl Survey abundance index for all adult female horseshoe crabs in spring (March through August).

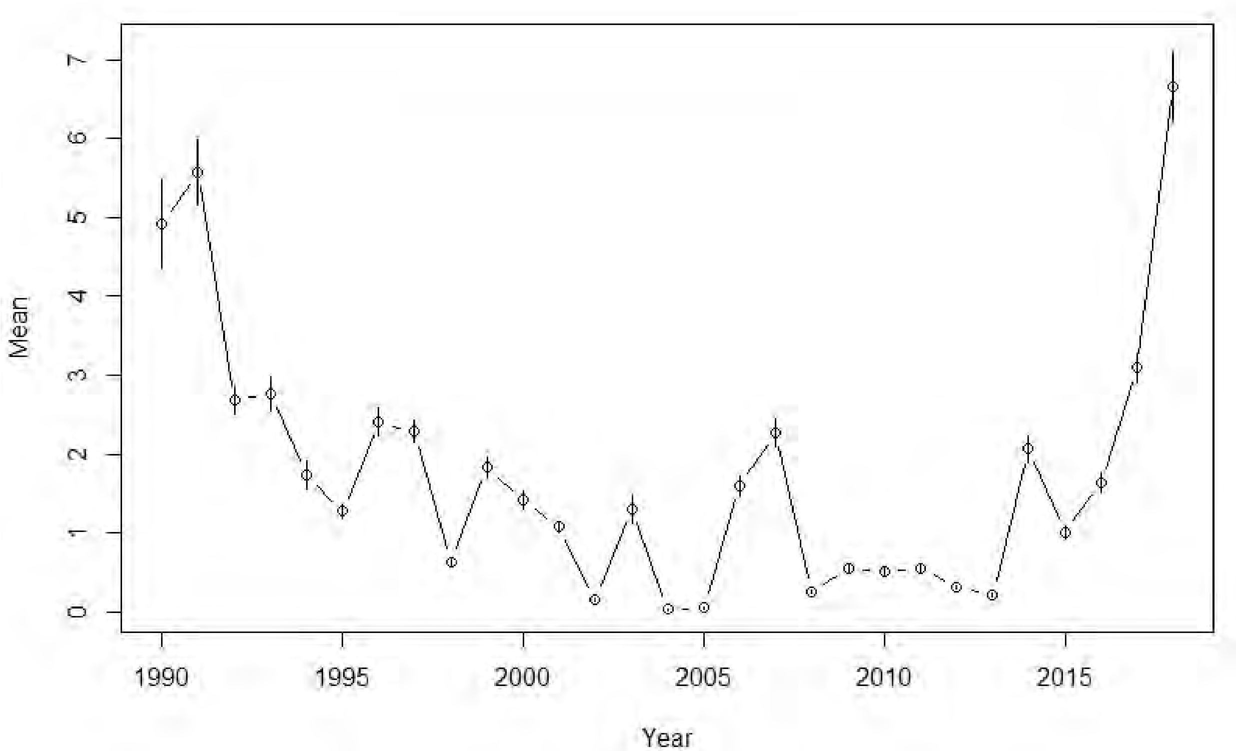

Figure 55. Delaware Fish and Wildlife Adult Trawl Survey abundance index for all adult male horseshoe crabs in spring (March through August).

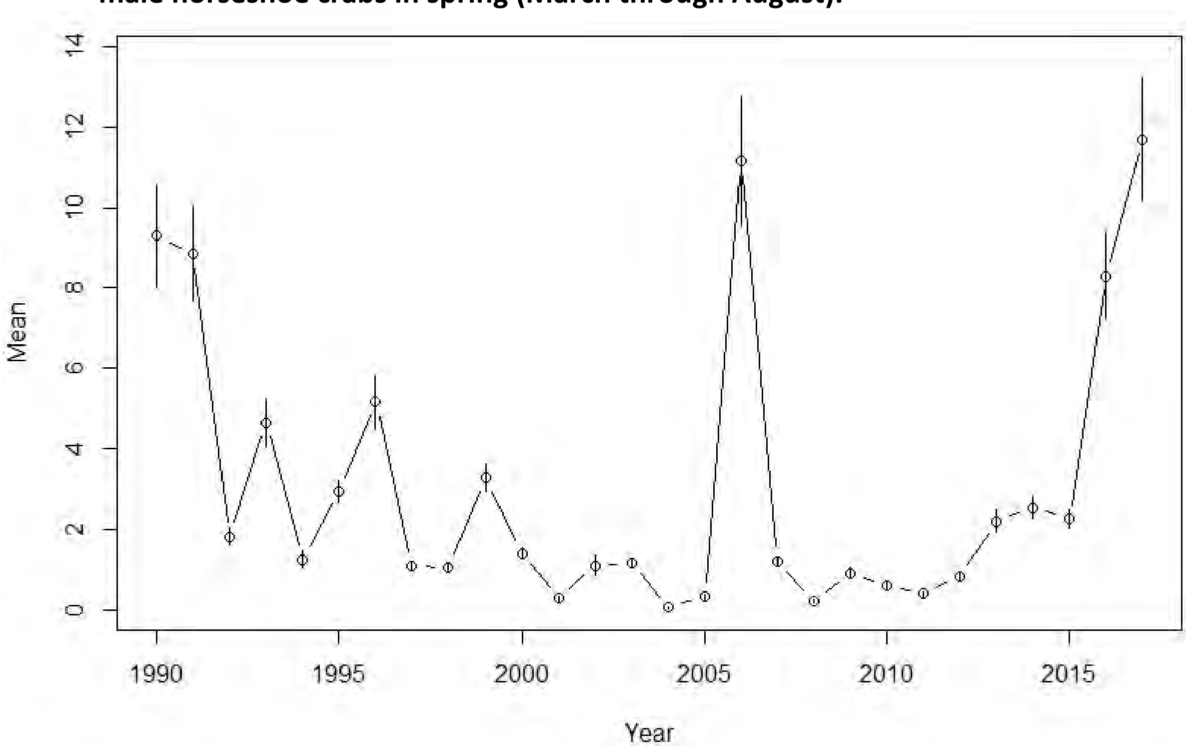

Figure 56. Delaware Fish and Wildlife Adult Trawl Survey abundance index for all adult horseshoe crabs combined in fall (September through December).

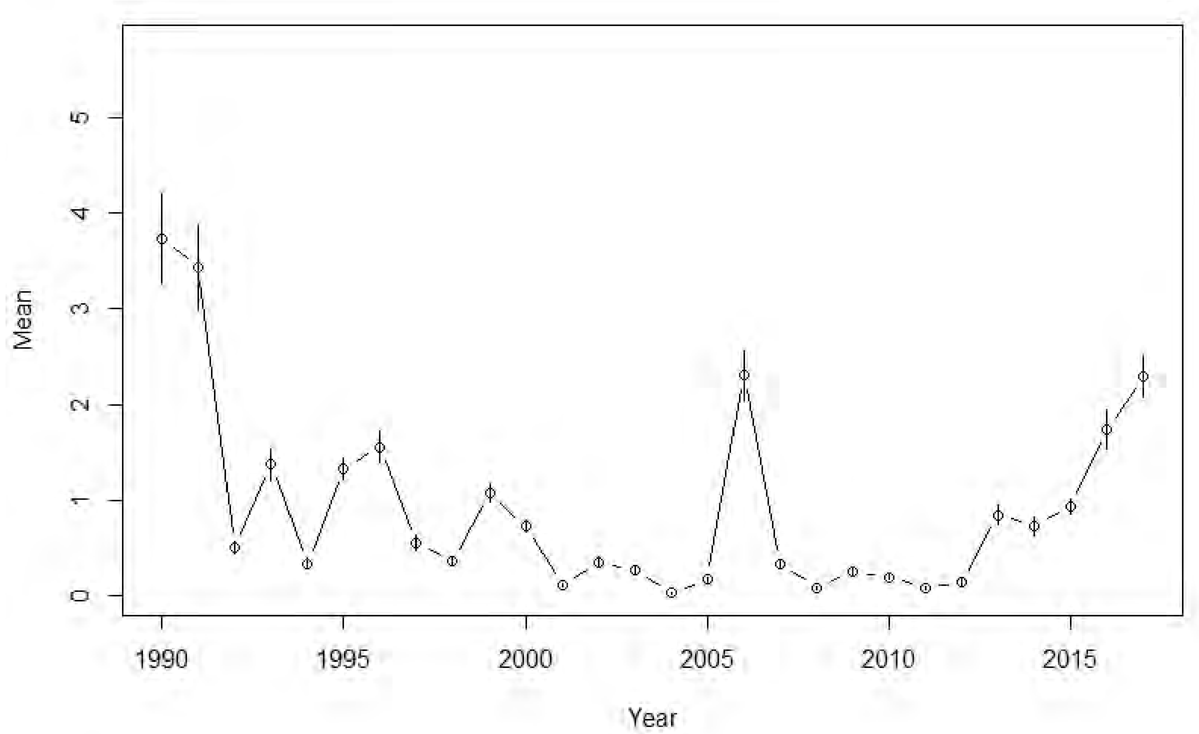

Figure 57. Delaware Fish and Wildlife Adult Trawl Survey abundance index for adult female horseshoe crabs in fall (September through December).

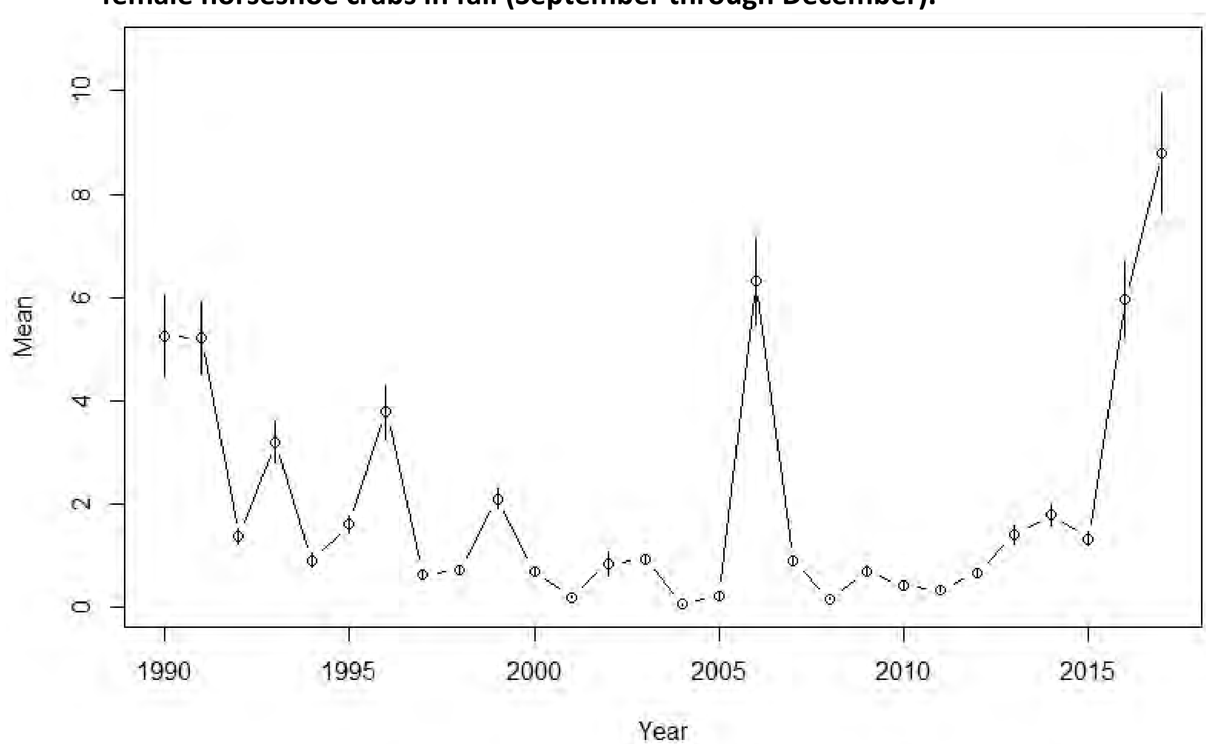

Figure 58. Delaware Fish and Wildlife Adult Trawl Survey abundance index for adult male horseshoe crabs in fall (September through December).

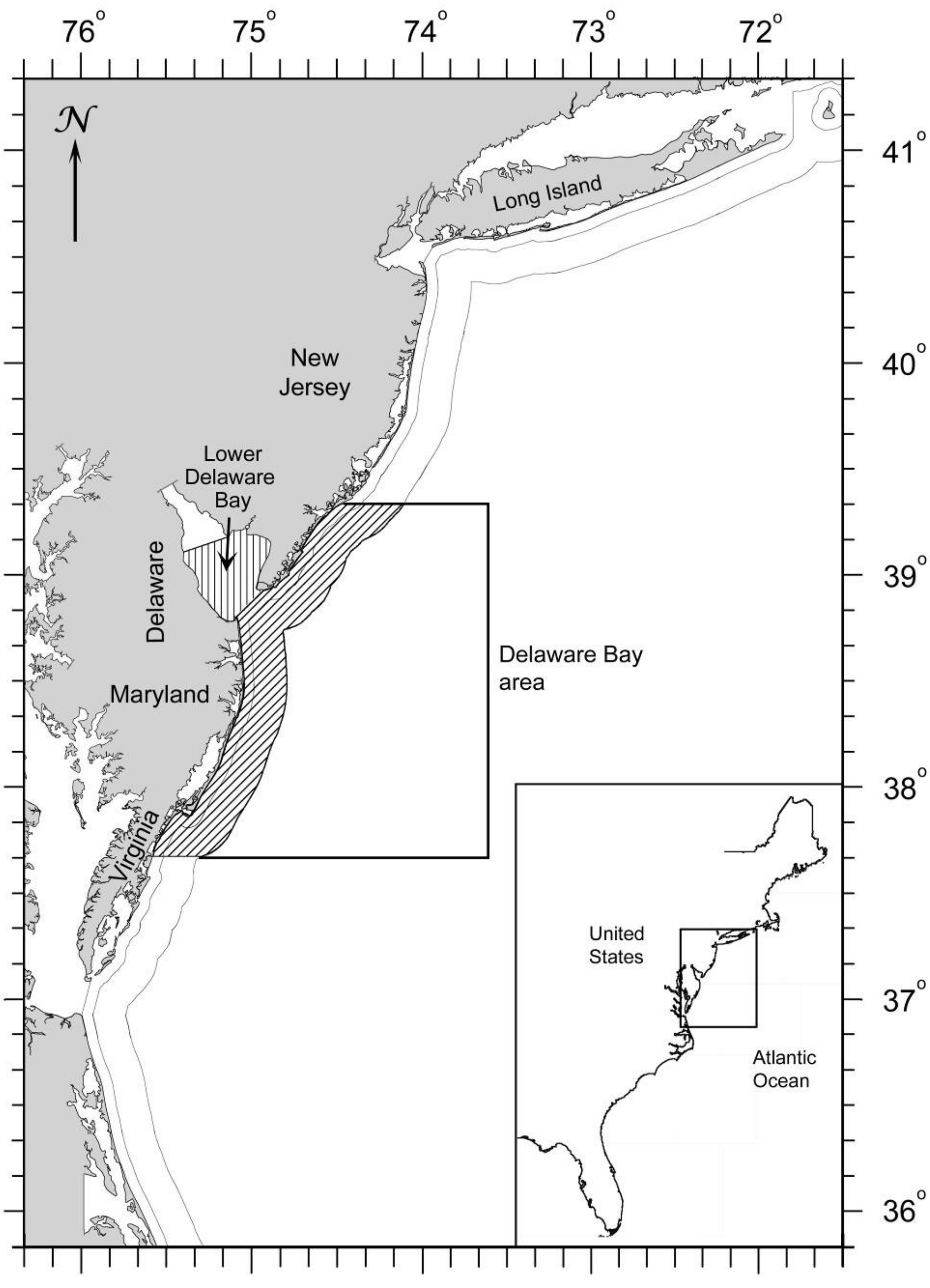

Figure 59. Virginia Tech trawl survey sampling area. The coastal Delaware Bay area (DBA) and Lower Delaware Bay (LDB) survey areas are indicated. Mean catches among years were compared using stations within the shaded portions of the survey area in the annual report (map provided by Virginia Tech).

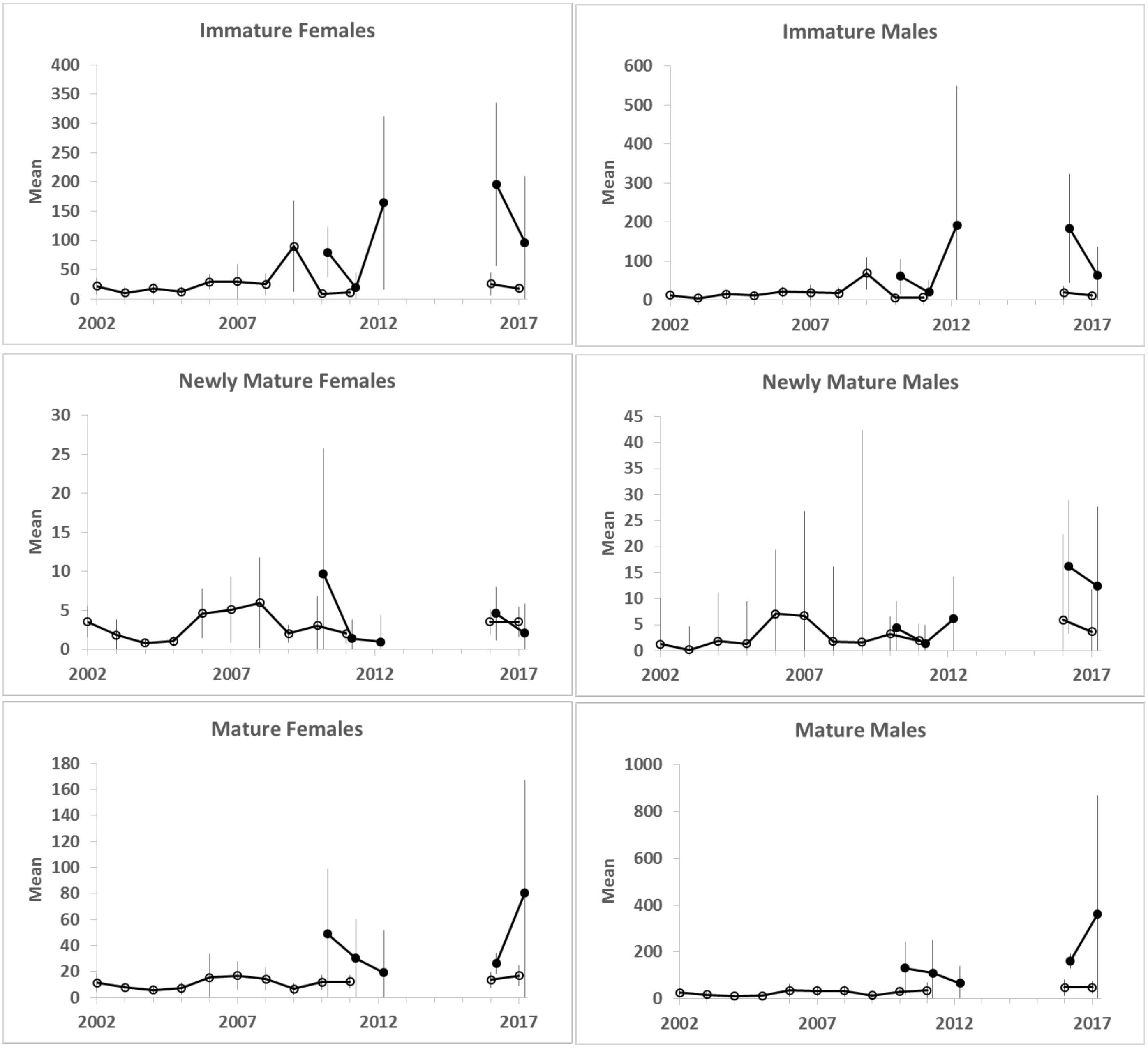

Figure 60. Delta distribution model mean catches per tow of horseshoe crabs in the lower Delaware Bay survey by demographic group with coastal Delaware Bay area survey means for comparion. Vertical lines indicate 95% confidence limits. Solid symbols indicate the lower Delaware Bay survey. Open symbols indicate the coastal Delaware Bay area survey. Note differences in y-axis scales.

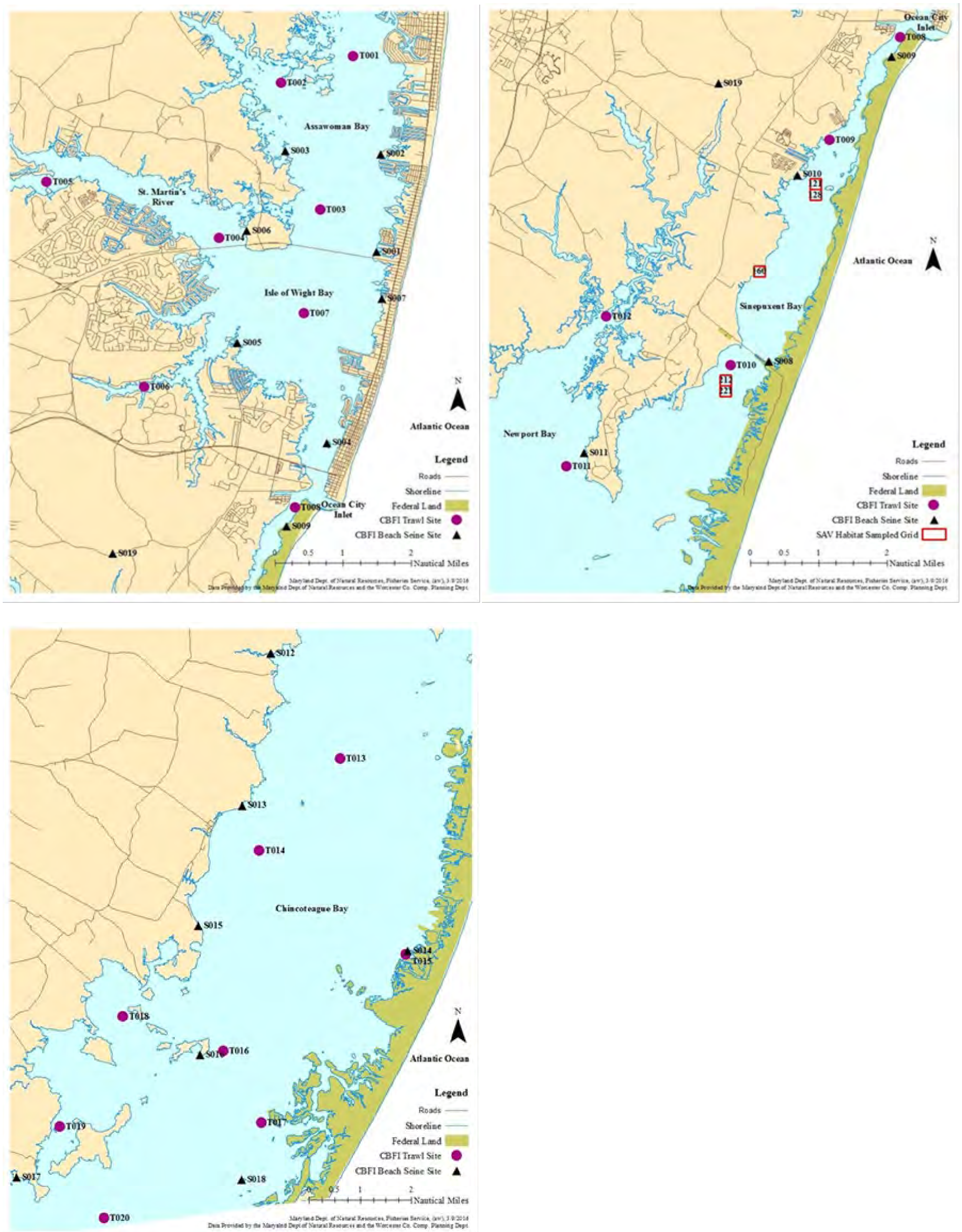

Figure 61. Map of the Maryland Coastal Bays Survey sampling sites. Trawl sites are labled with the prefix of "T" (map from MD DNR).

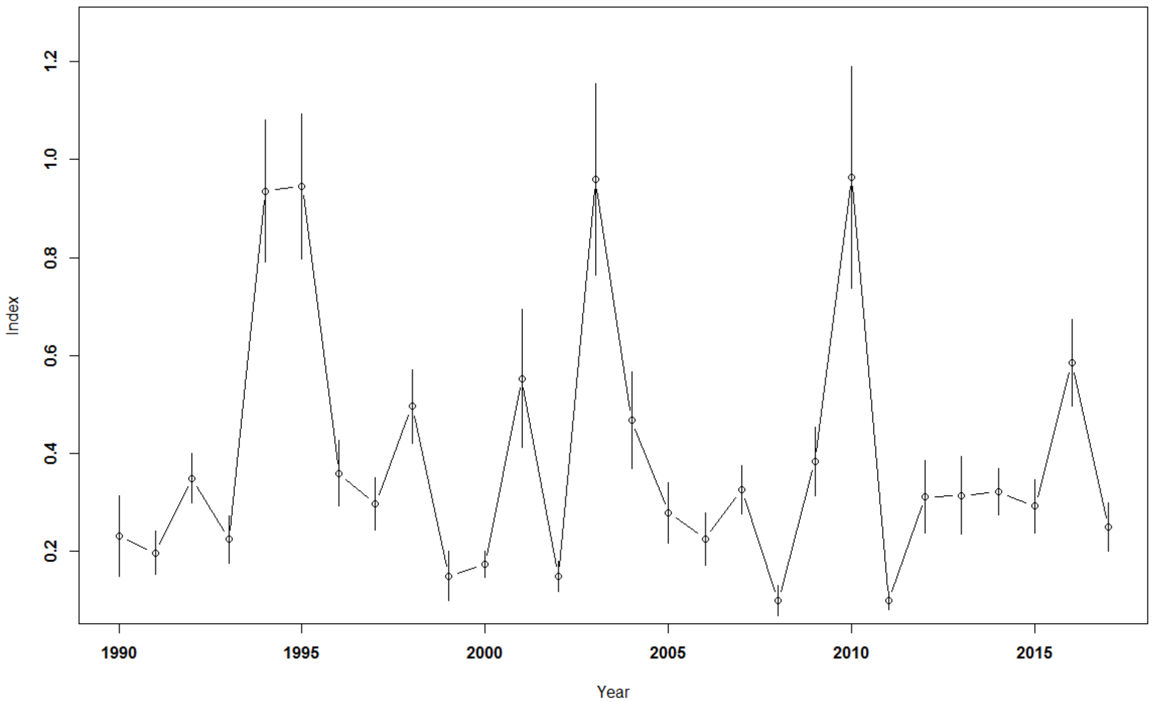

Figure 62. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the spring portion of Maryland's Coastal Bays Survey with 95% confidence intervals.

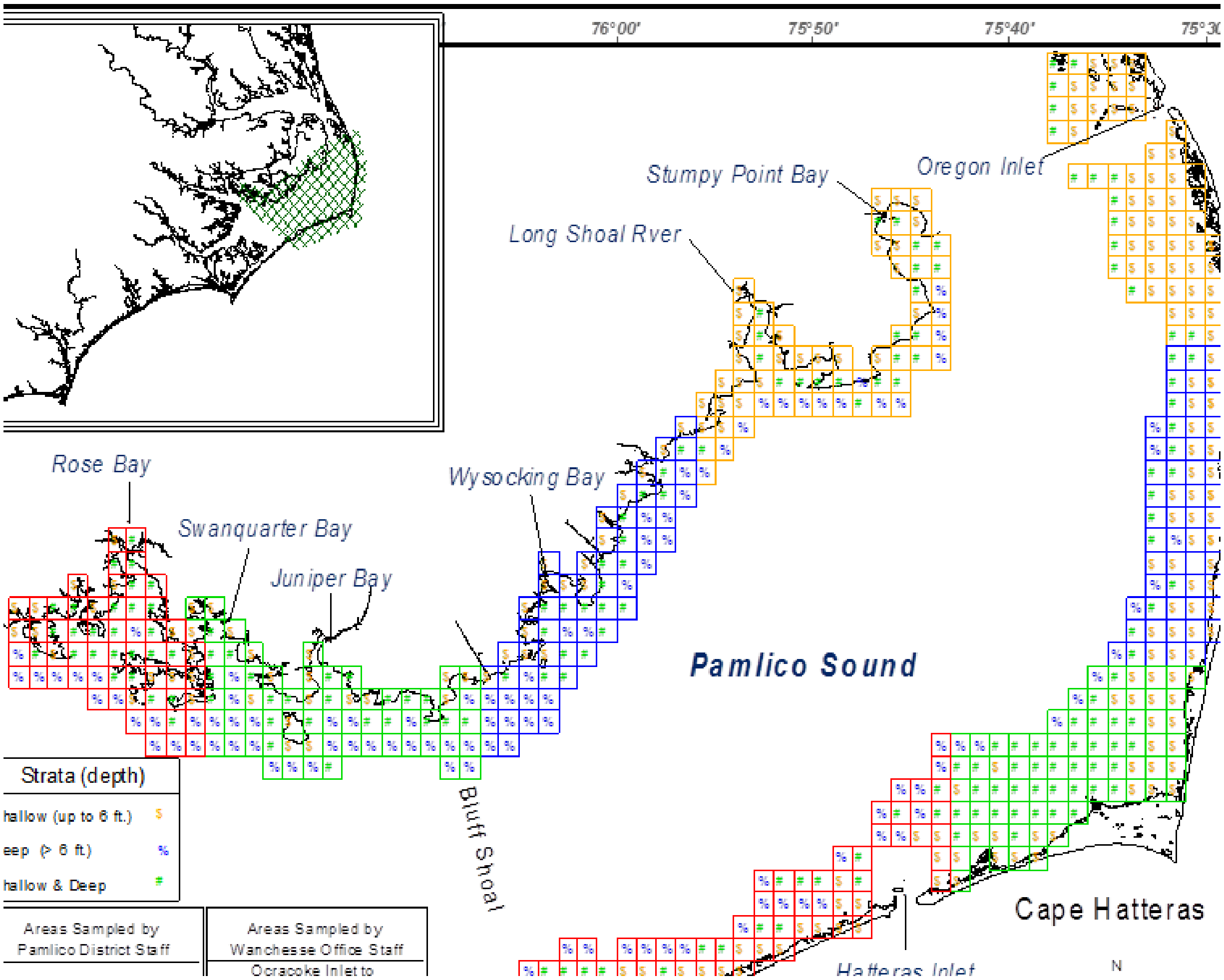

Figure 63. Map of the sampling sites for North Carolina's Estuarine Gillnet fishery independent survey. This survey also operates in several rivers, but only the Pamlico Sound sites were used for developing an index of horseshoe crab abundance for this region (map provided by NC DNR).

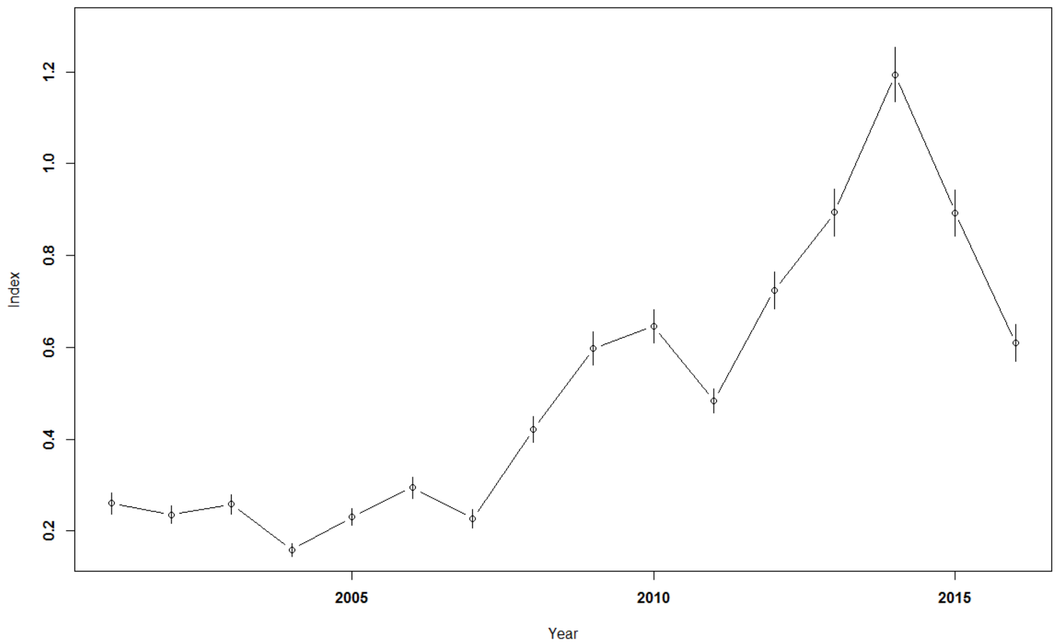

Figure 64. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the spring portion of North Carolina's Estuarine Gill Net Survey with 95% confidence intervals.

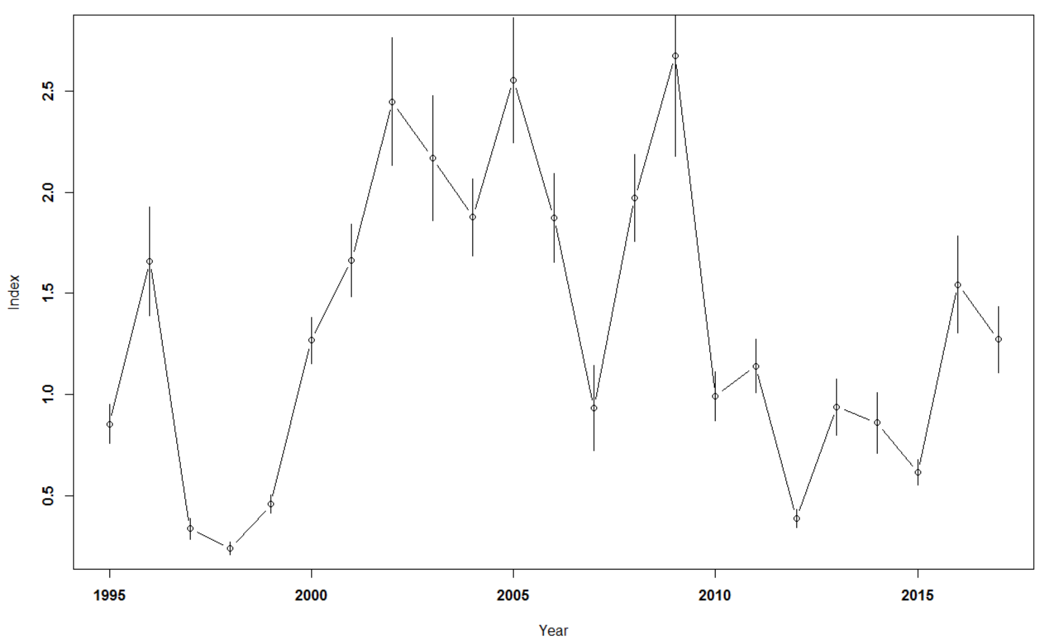

Figure 65. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the spring portion of South Carolina's CRMS with 95% confidence intervals.

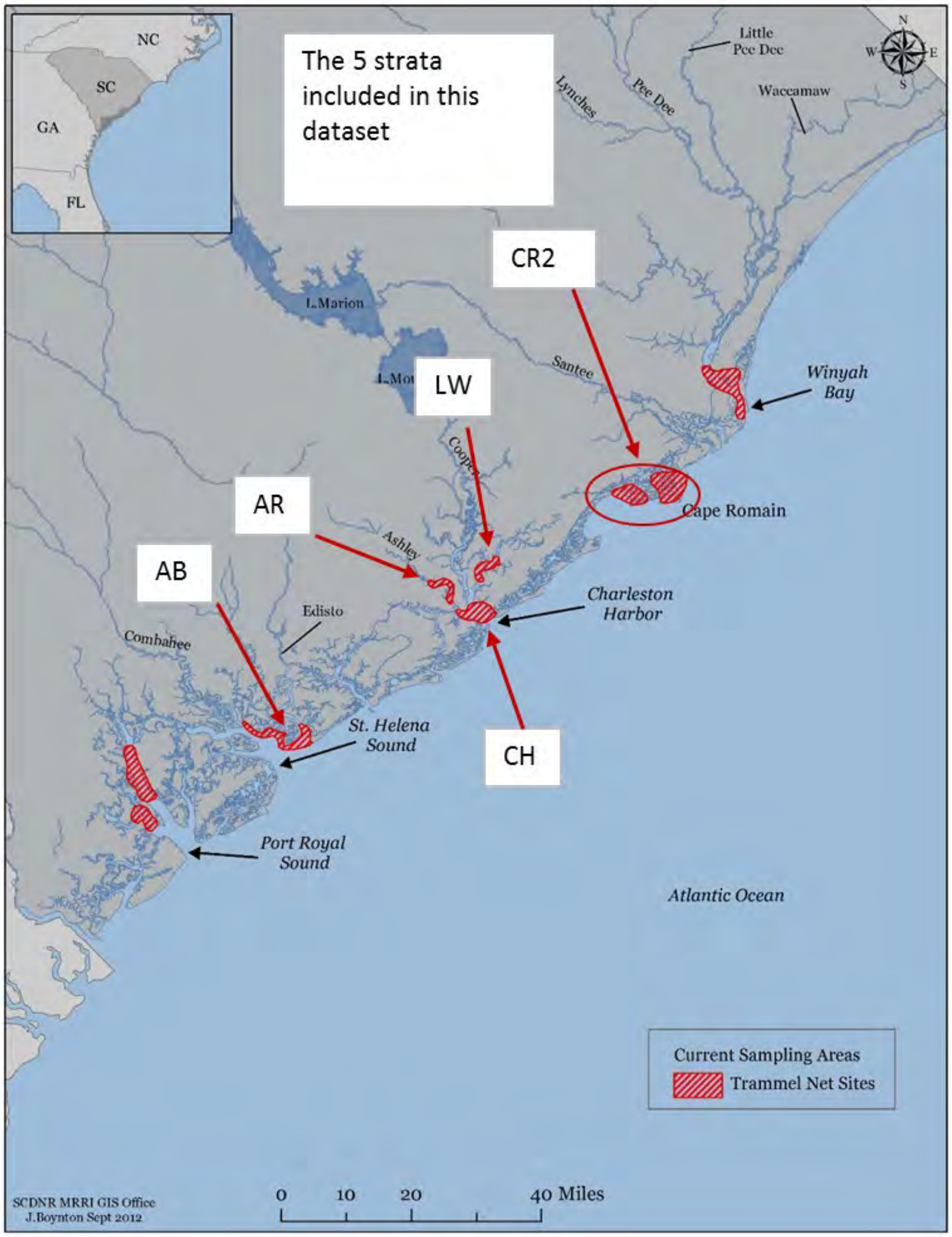

Figure 66. Areas samples by the trammel net, electrofishing, and long-line surveys of the SC DNR Inshore Fisheries Section. Trammel net strata used for analyses in this report: AB - ACE Basin; AR - Ashley River; CH - Charleston Harbor; LW - Lower Wando River; CR2 - Cape Romain (map provided by SC DNR).

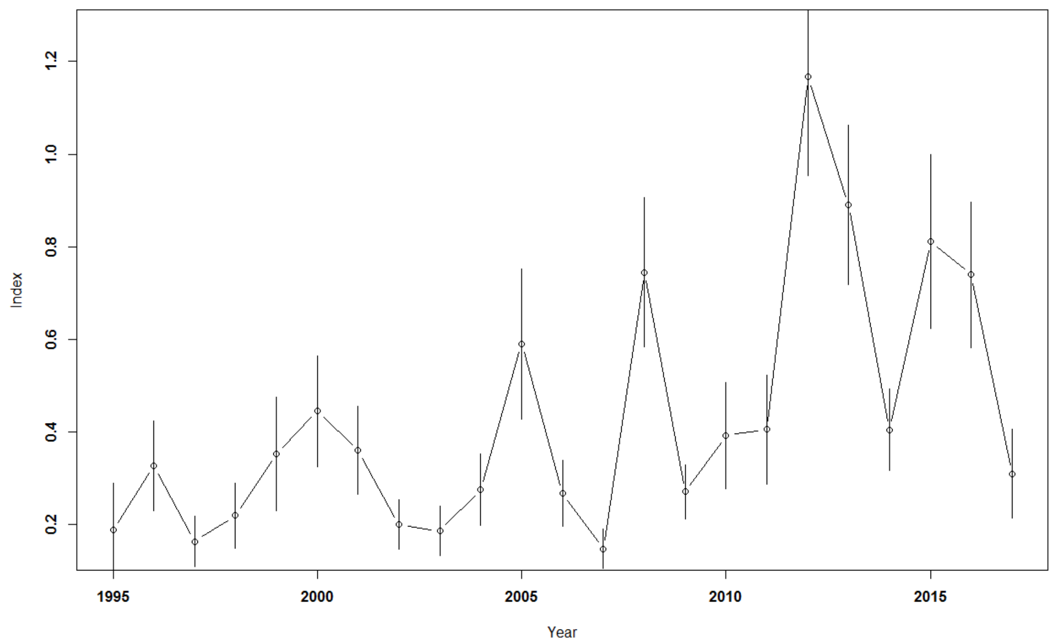

Figure 67. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the spring portion of South Carolina's Trammel Net Survey with 95% confidence intervals.

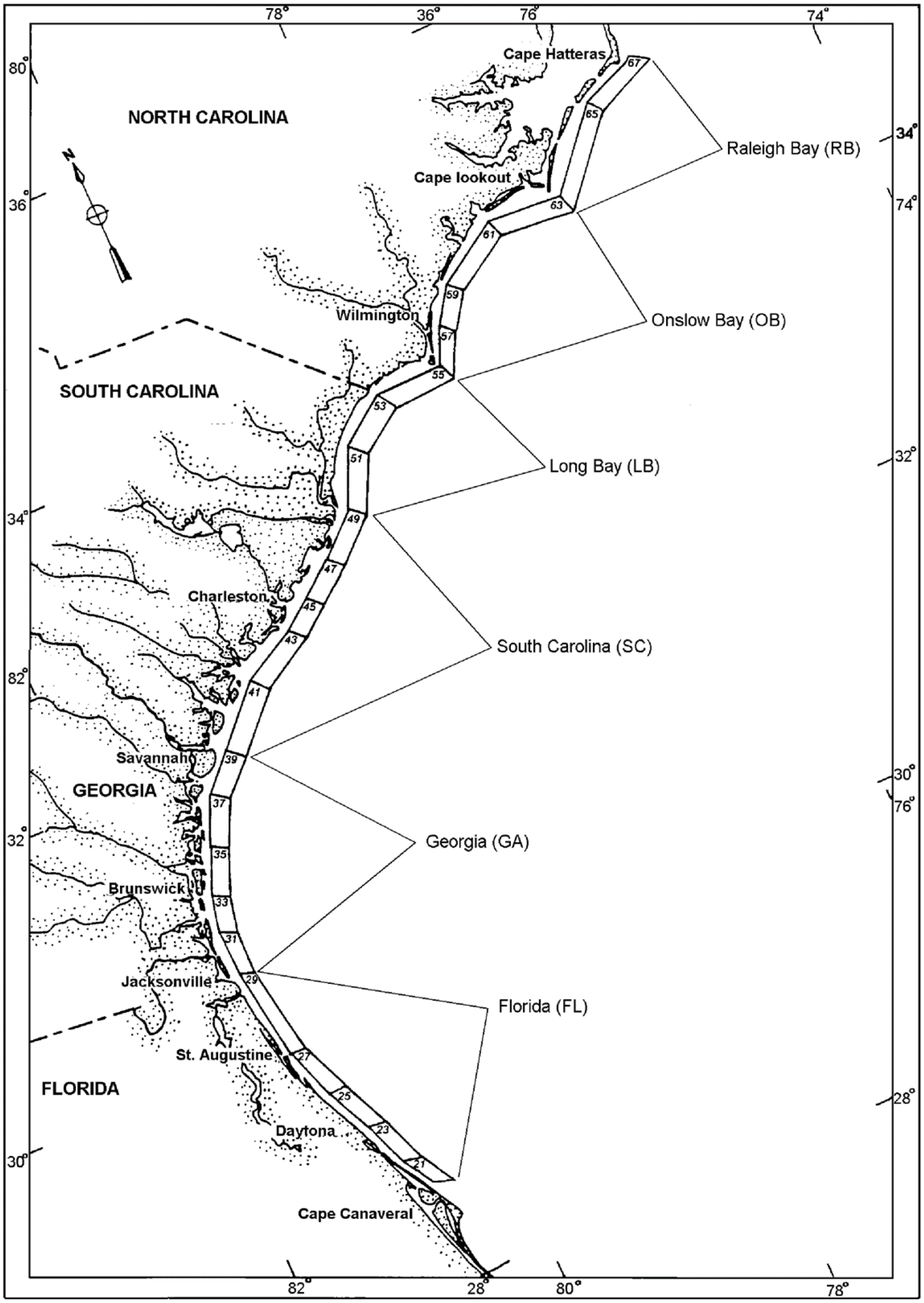

Figure 68. States and stations sampled as part of the SEAMAP trawl survey (map provided by SC DNR and SEAMAP).

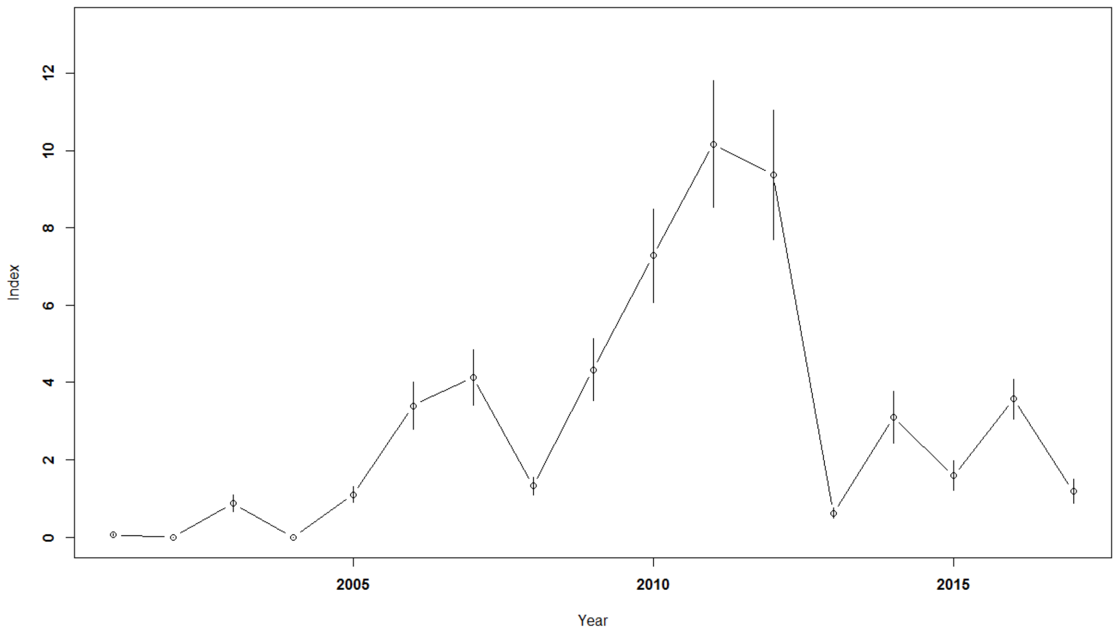

Figure 69. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the South Carolina and fall portion of the SEAMAP survey with 95% confidence intervals.

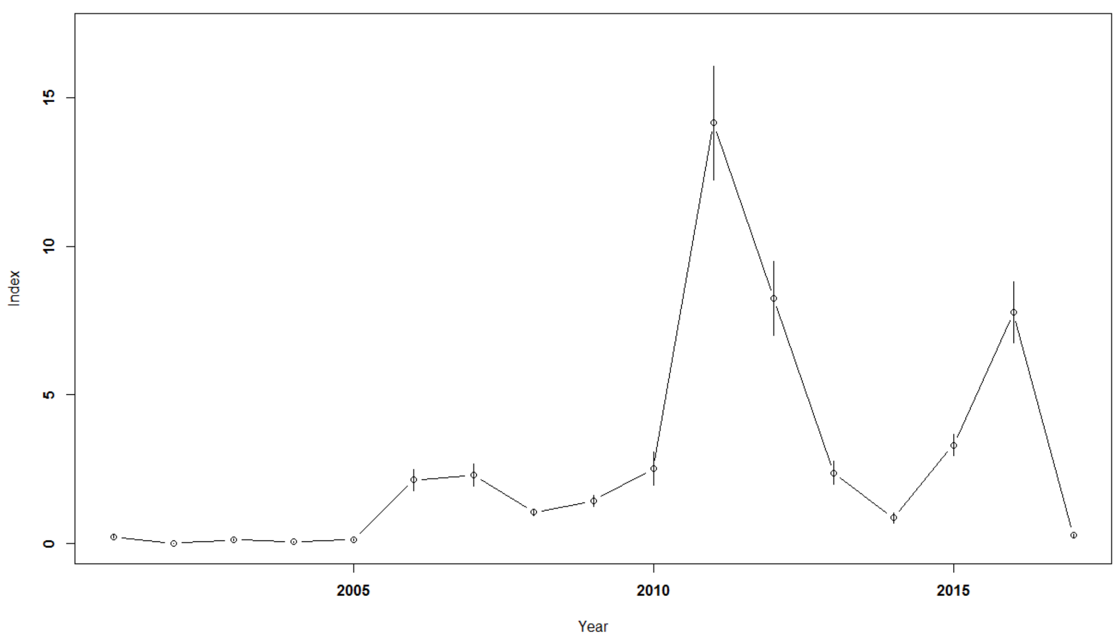

Figure 70. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the Georgia-Florida and fall portion of the SEAMAP survey with 95% confidence intervals.

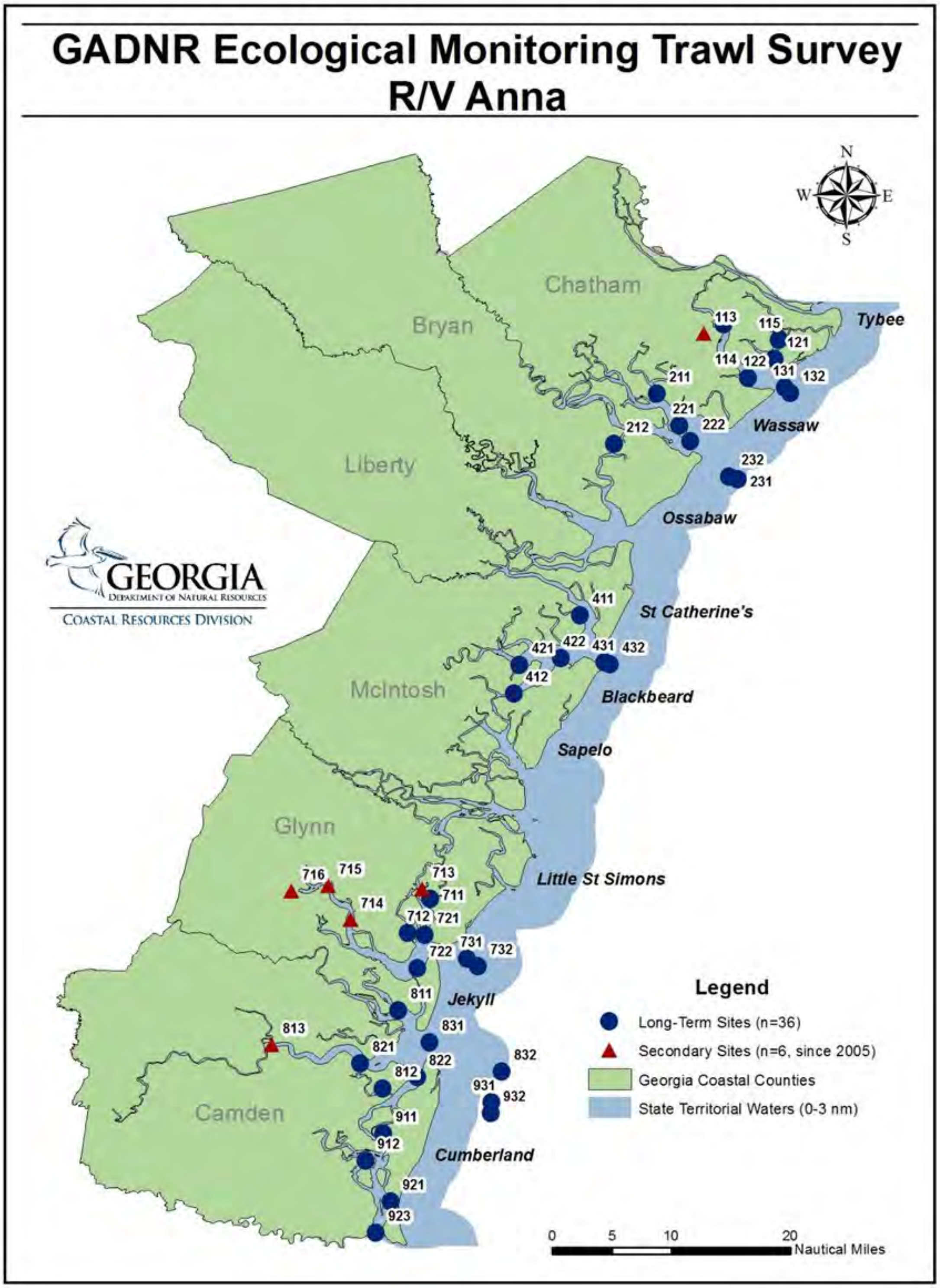

Figure 71. Map of the survey sites for Georgia's Ecological Monitoring Trawl Survey (map provided by GA DNR).

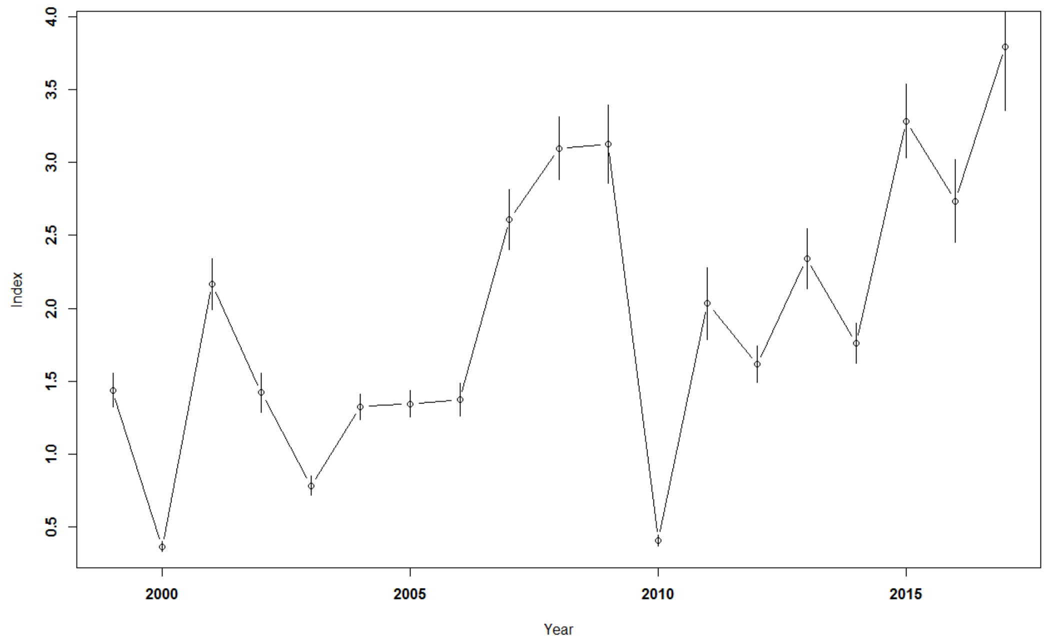

Figure 72. Index of relative abundance of horseshoe crab (delta mean catch per tow) developed from the Georgia Trawl survey with 95% confidence intervals.

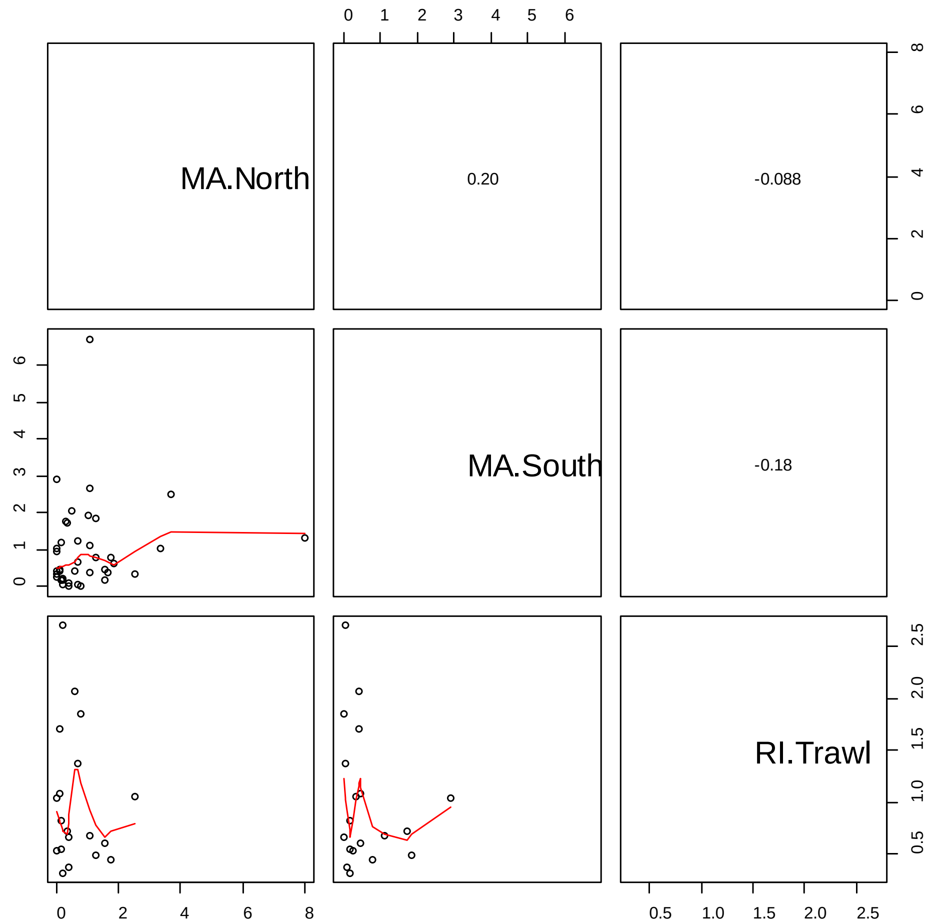

Figure 73. Correlation coefficients and scatter plots for the horseshoe crab abundance indices in the Northeast Region for 1978-2017. All correlations are insignificant (*P*>0.05).

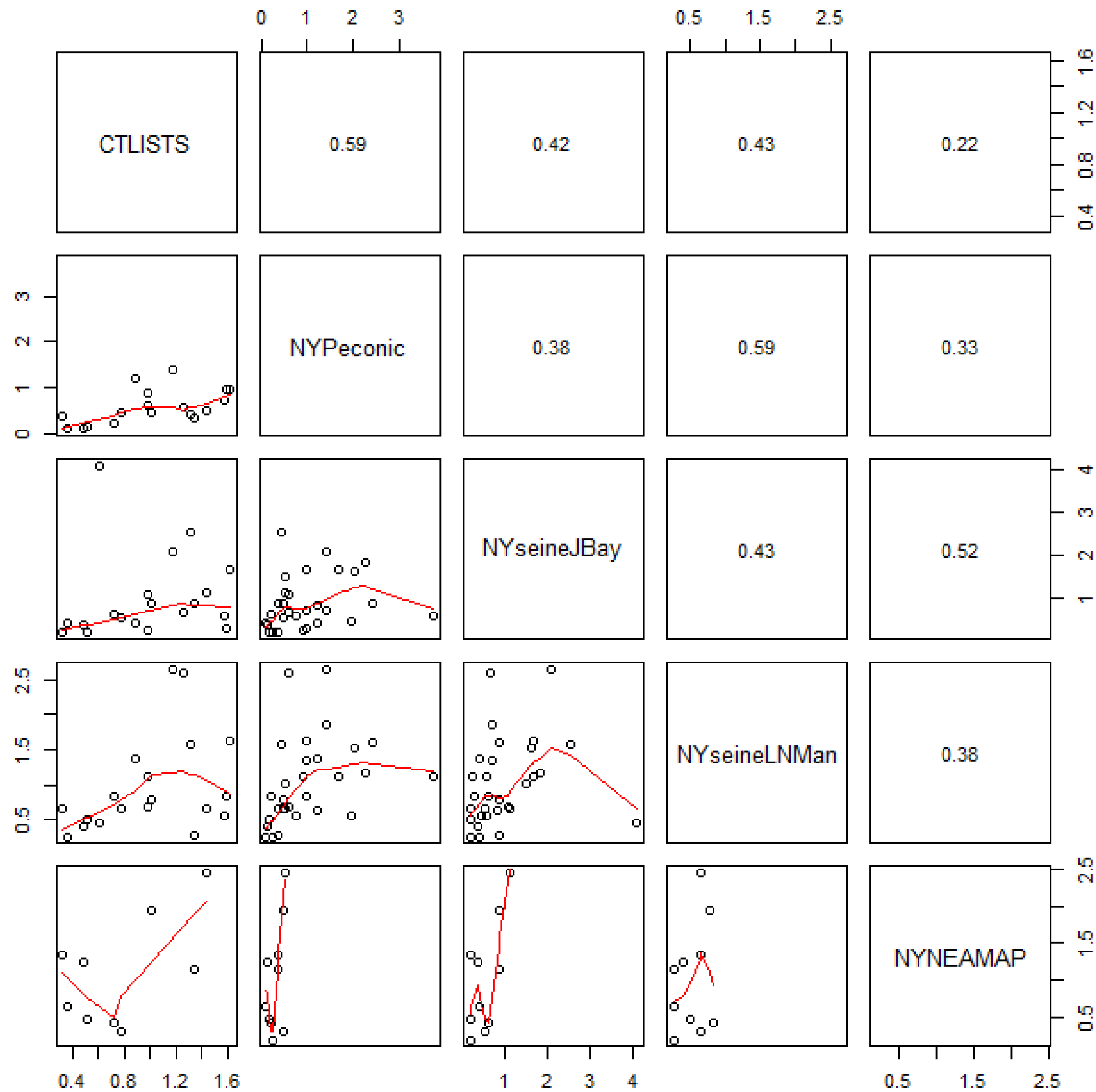

Figure 74. Correlation coefficients and scatter plots for the horseshoe crab abundance indices in the New York Region for 1987-2016. All correlations are insignificant (*P*>0.05) except for the positive correlation between the Connecticut Long Island Sound Trawl Survey and New York's Peconic Bays (*P*=0.020) and New York's NEAMAP portion and the New York Seine Jamaica Bay (*P*=0.026).

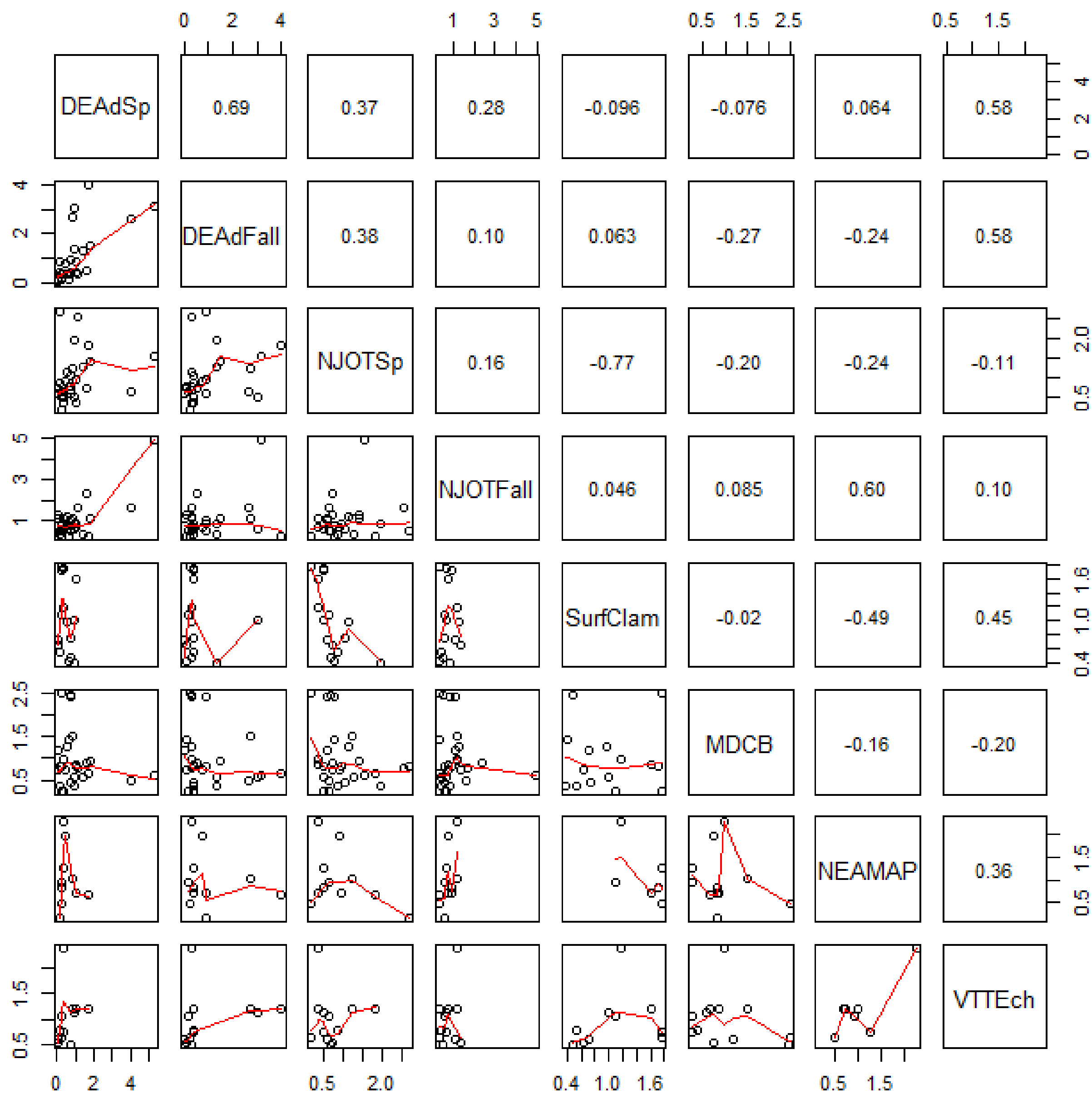

Figure 75. Correlation coefficients and scatter plots for the horseshoe crab abundance indices in the Delaware Bay Region for 1989-2017. All correlations are insignificant (*P*>0.05) except for the correlations between the Delaware Adult Trawl spring and fall indices (*P*<0.001), Delaware Adult Trawl spring and New Jersey Ocean Trawl fall (*P*<0.001), New Jersey Ocean Trawl spring and Surf Clam surveys (*P*=0.011), and NEAMAP and the Virginia Tech Trawl (*P*=0.020).

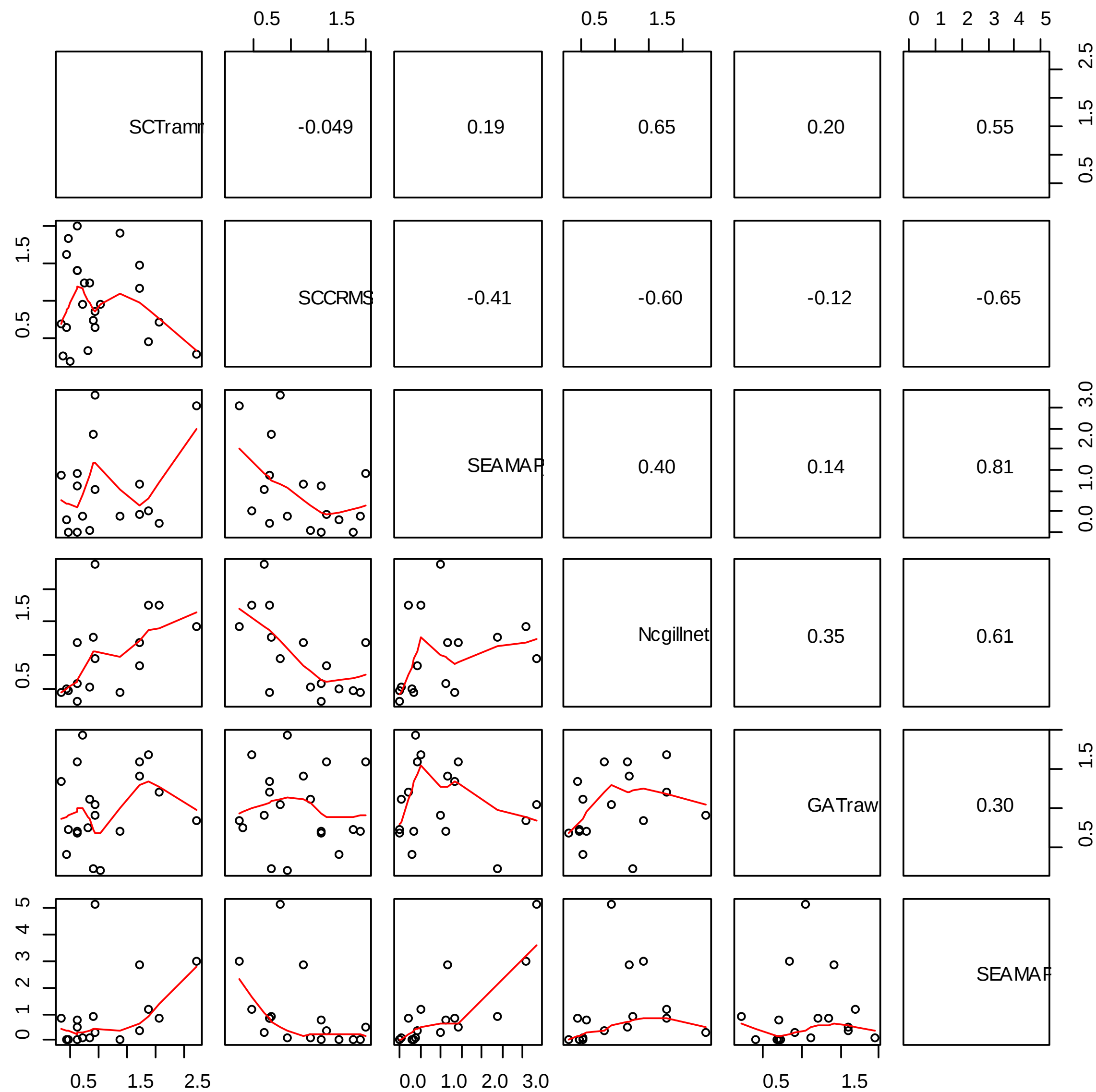

Figure 76. Correlation coefficients and scatter plots for the horseshoe crab abundance indices in the Southeast Region for 1995-2017. All correlations are insignificant (*P*>0.05) except for the correlations between the North Carolina Gill Net and South Carolina Trammel indices (*P*=0.036), the North Carolina Gill Net and South Carolina CRMS indices (*P*=0.010), and SEAMAP's South Carolina and Georgia-Florida indices (*P*<0.001).

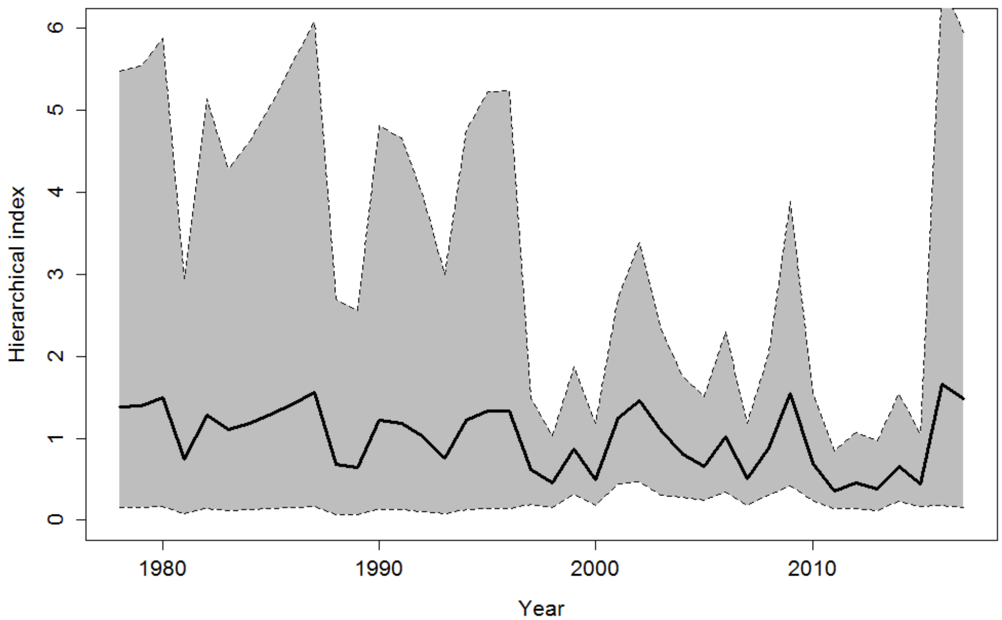

Figure 77. Time series of horseshoe crab relative abundance in the Northeast region as estimated from hierarchical analysis. The black line gives the posterior mean and the grey, shaded area represents a 95% credible interval about the time series.

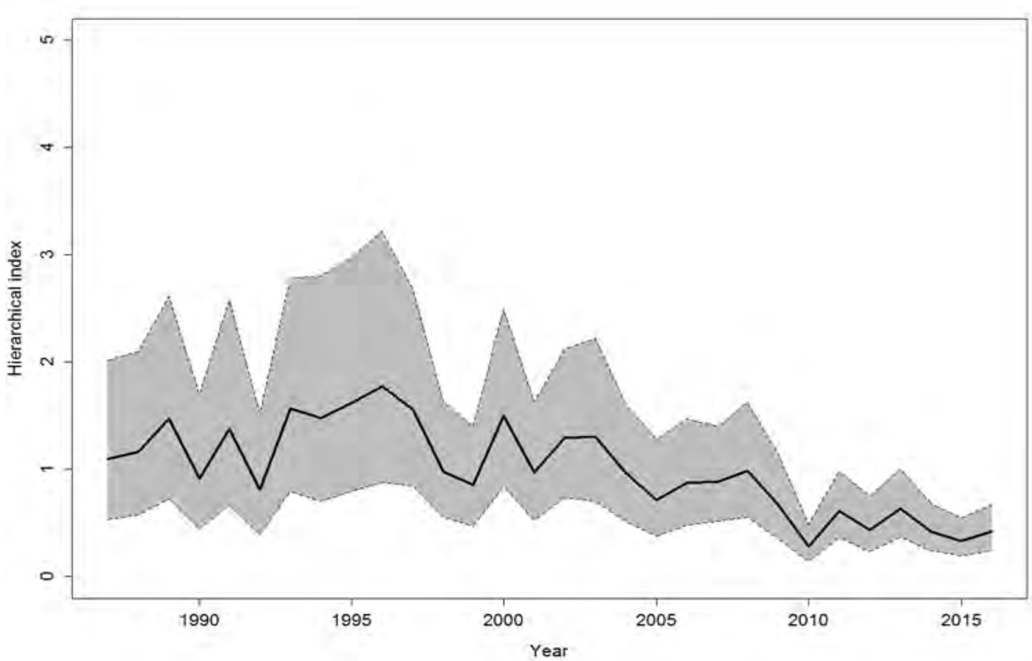

Figure 78. Time series of horseshoe crab relative abundance in the New York region as estimated from hierarchical analysis. The black line gives the posterior mean and the grey, shaded area represents a 95% credible interval about the time series.

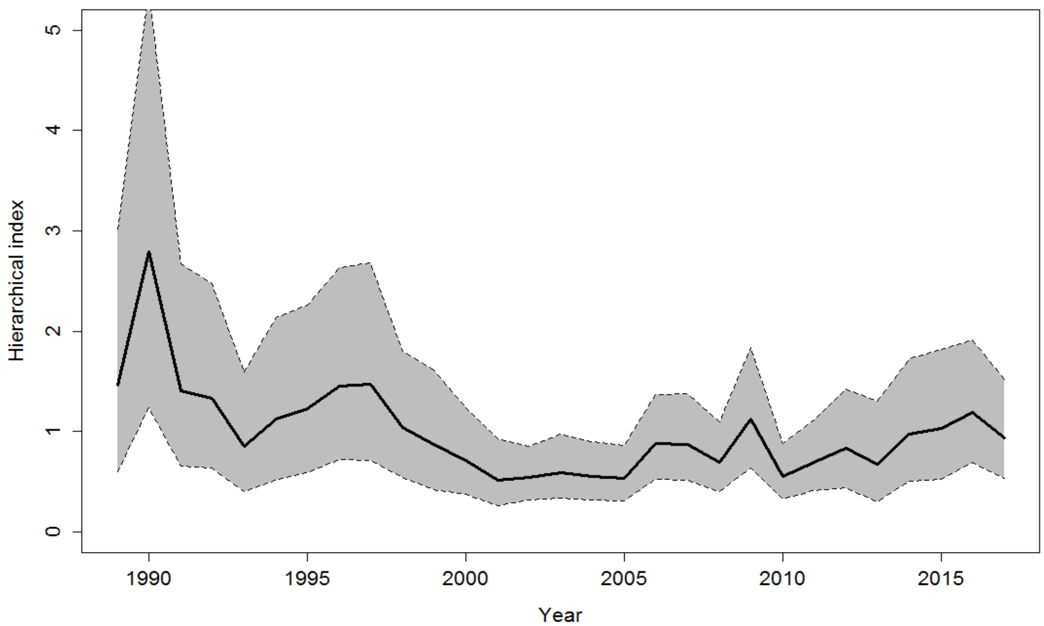

Figure 79. Time series of horseshoe crab relative abundance in the Delaware Bay region as estimated from the hierarchical analysis. The black line gives the posterior mean and the grey, shaded area represents a 95% credible interval about the time series.

Figure 80. Time series of female horseshoe crab relative abundance in the Delaware Bay region as estimated from the hierarchical analysis. The black line gives the posterior mean and the grey, shaded area represents a 95% credible interval about the time series.

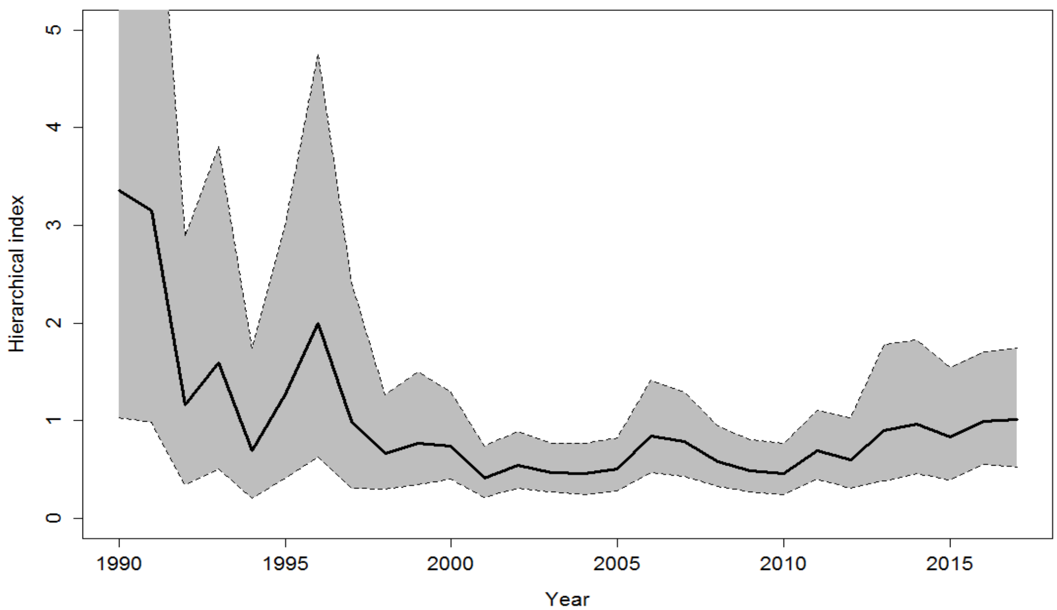

Figure 81. Time series of male horseshoe crab relative abundance in the Delaware Bay region as estimated from the hierarchical analysis. The black line gives the posterior mean and the grey, shaded area represents a 95% credible interval about the time series.

Figure 82. Time series of horseshoe crab relative abundance in the Southeast region as estimated from hierarchical analysis. The black line gives the posterior mean and the grey, shaded area represents a 95% credible interval about the time series.

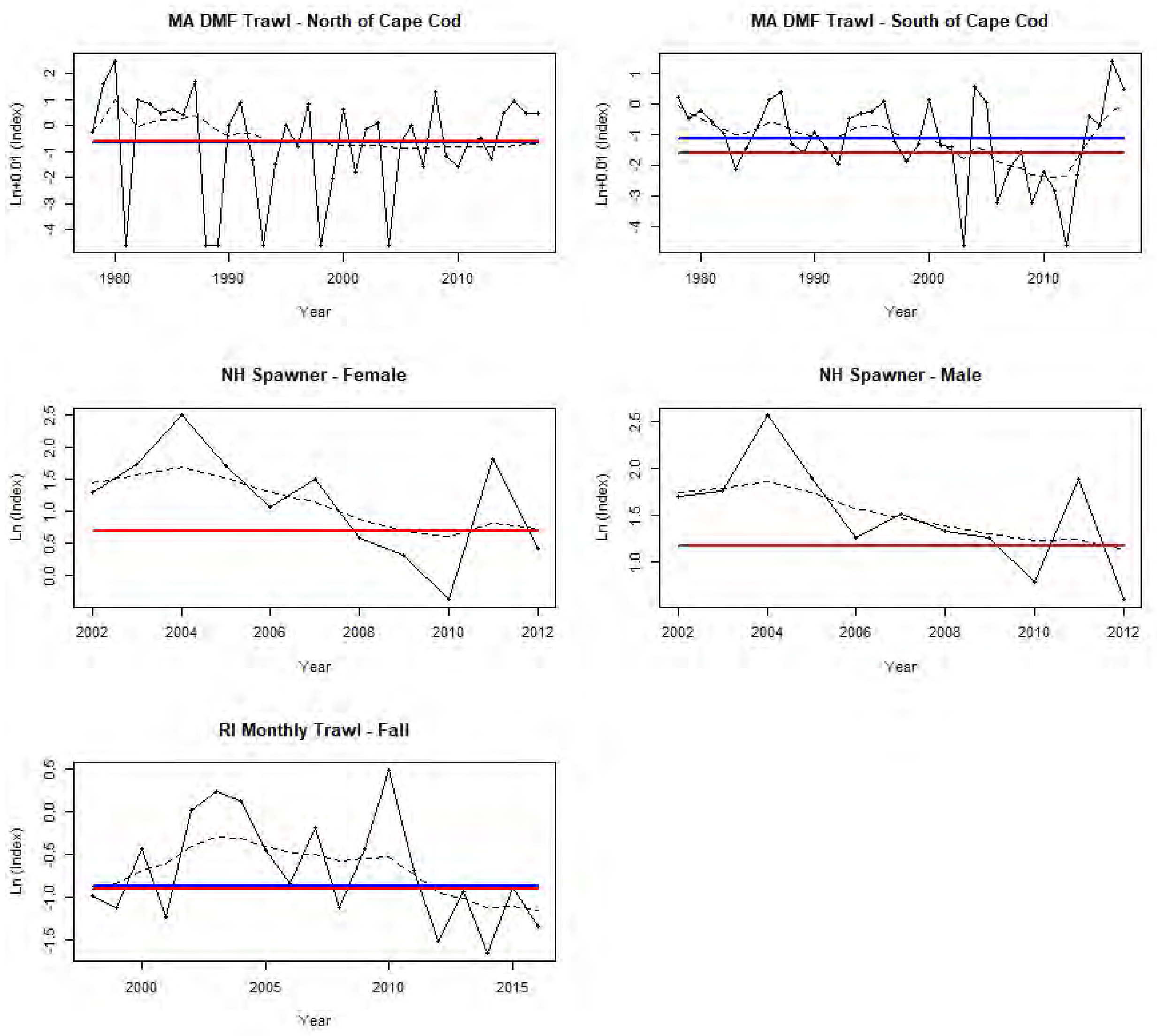

Figure 83. Northeast Region horseshoe crab survey ARIMA model fits. The solid line represents the observed ln transformed indices and the dashed line represents the fitted indices. The red horizontal line represents the Q_{25} reference point and the blue horizontal line represents the 1998 reference point. Note: The residuals from the ARIMA model fit to the MA DMF Trawl – North of Cape Cod were not normally distributed.

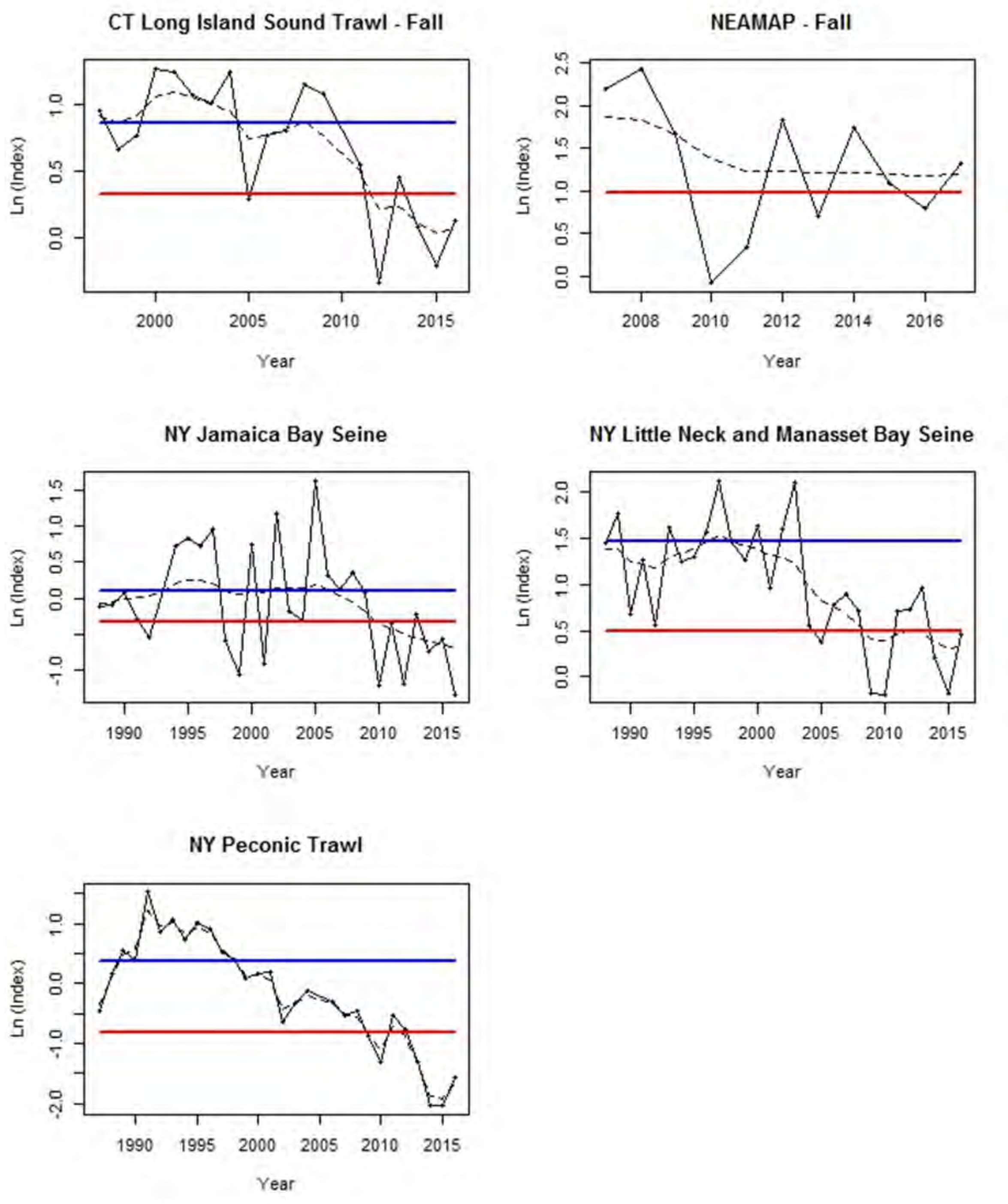

Figure 84. New York Region horseshoe crab survey ARIMA model fits. The solid line represents the observed ln transformed indices and the dashed line represents the fitted indices. The red horizontal line represents the Q_{25} reference point and the blue horizontal line represents the 1998 reference point.

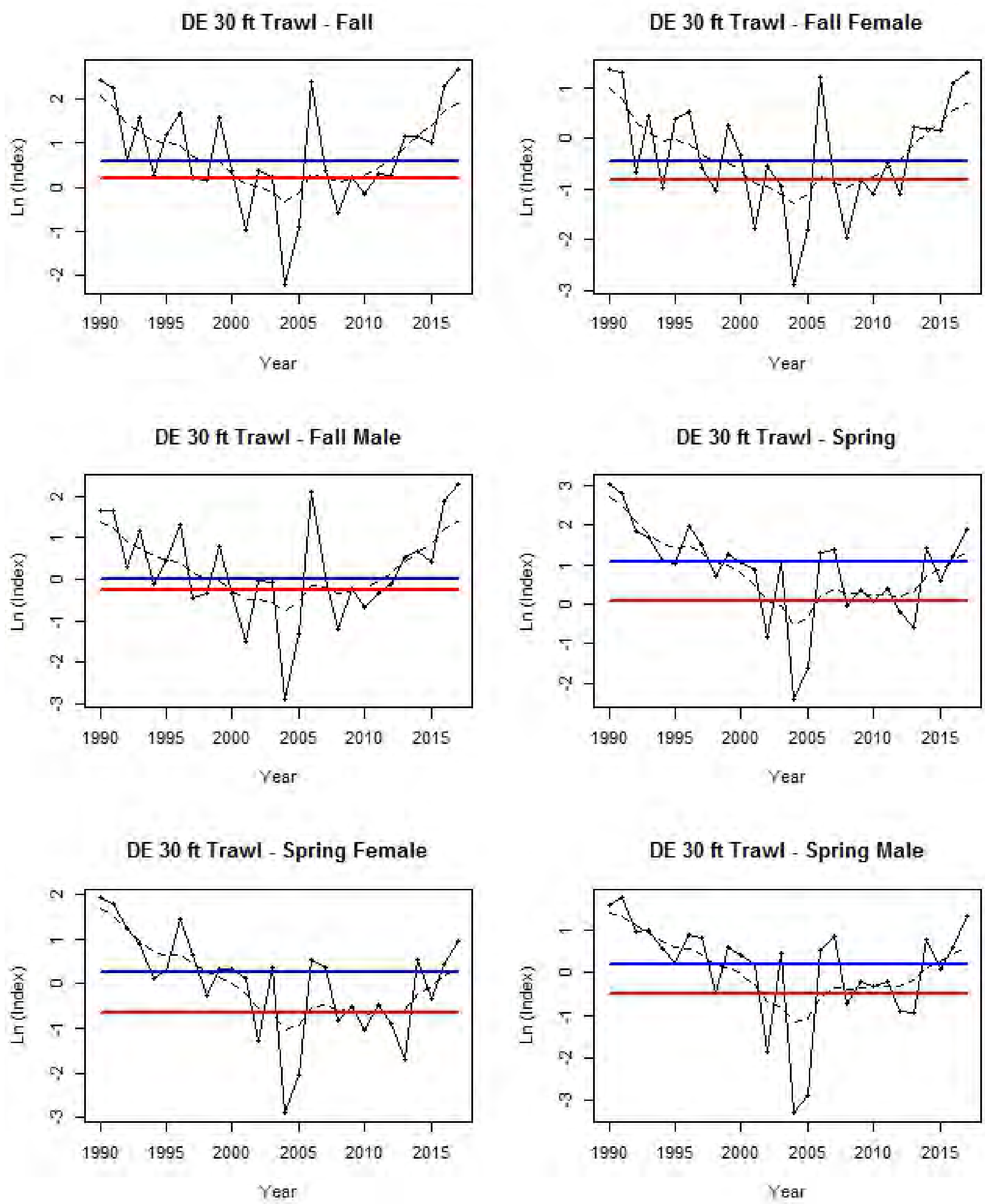

Figure 85. ARIMA model fits to horseshoe crab indices from the DE 30 ft. Trawl survey in the Mid-Atlantic Region. The solid line represents the observed ln transformed indices and the dashed line represents the fitted indices. The red horizontal line represents the Q_{25} reference point and the blue horizontal line represents the 1998 reference point.

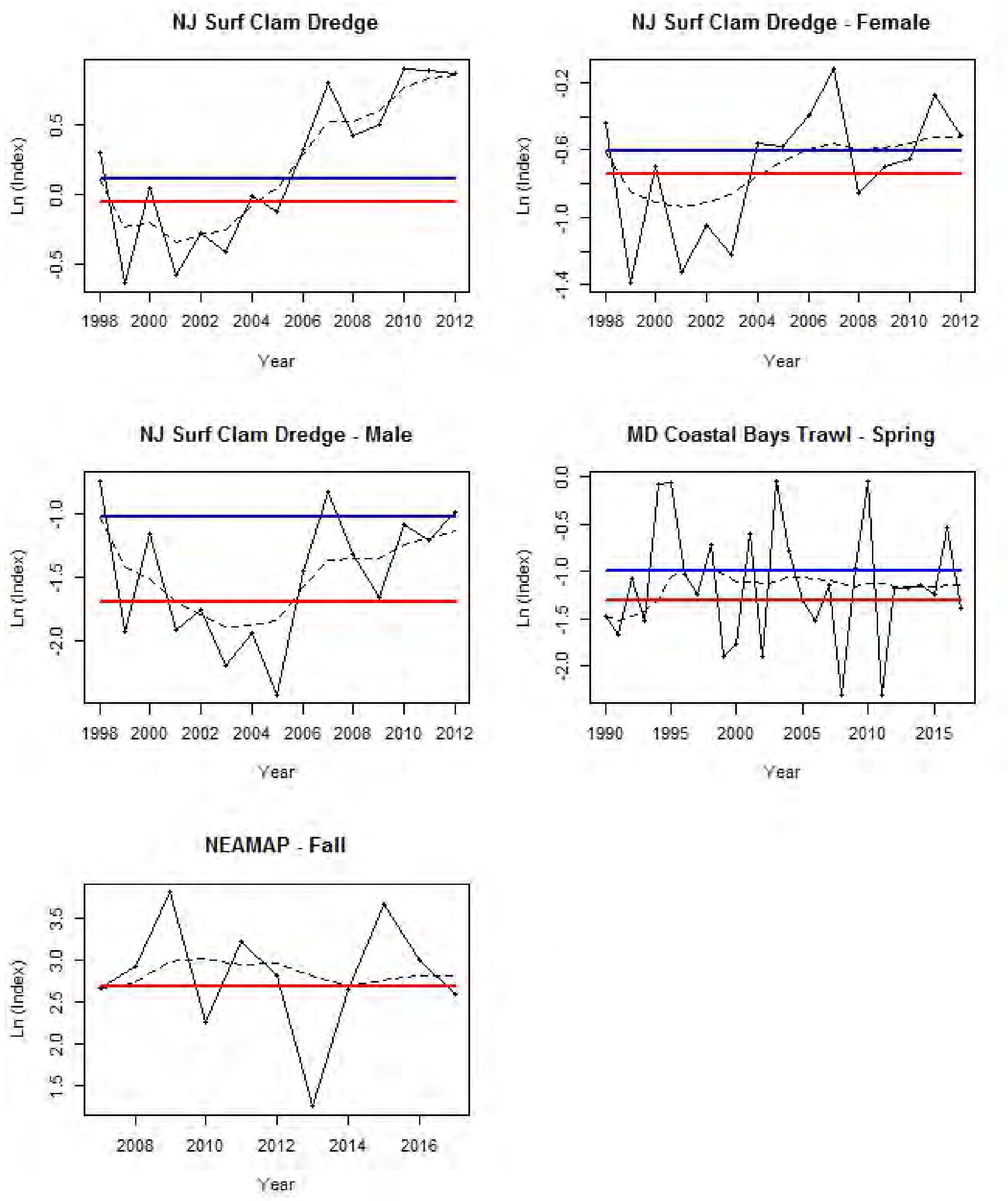

Figure 86. ARIMA model fits to horseshoe crab indices from various surveys in the Mid-Atlantic Region. The solid line represents the observed ln transformed indices and the dashed line represents the fitted indices. The red horizontal line represents the Q_{25} reference point and the blue horizontal line represents the 1998 reference point.

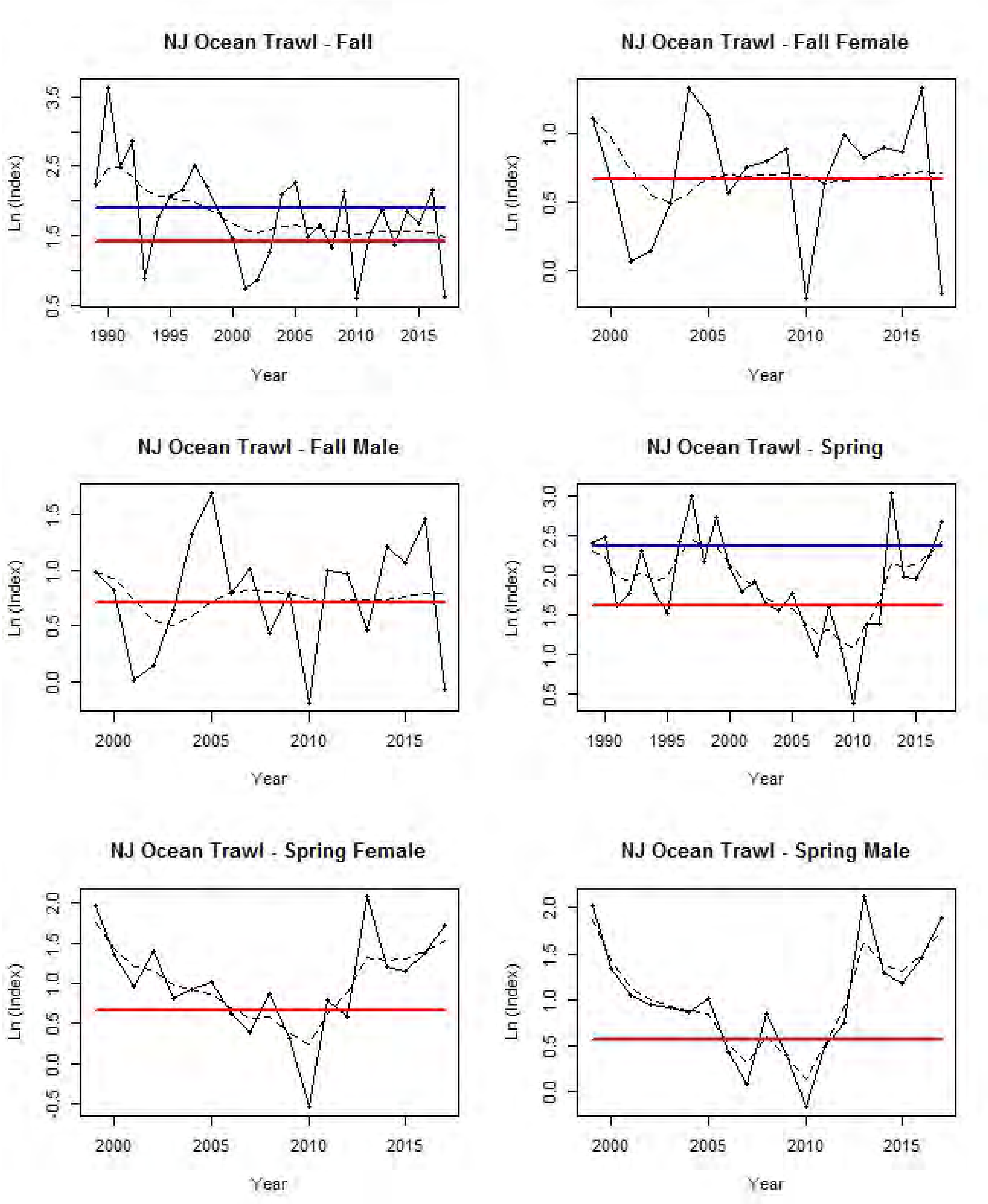

Figure 87. ARIMA model fits to horseshoe crab indices from the NJ Ocean Trawl survey in the Mid-Atlantic Region. The solid line represents the observed ln transformed indices and the dashed line represents the fitted indices. The red horizontal line represents the Q_{25} reference point and the blue horizontal line represents the 1998 reference point.

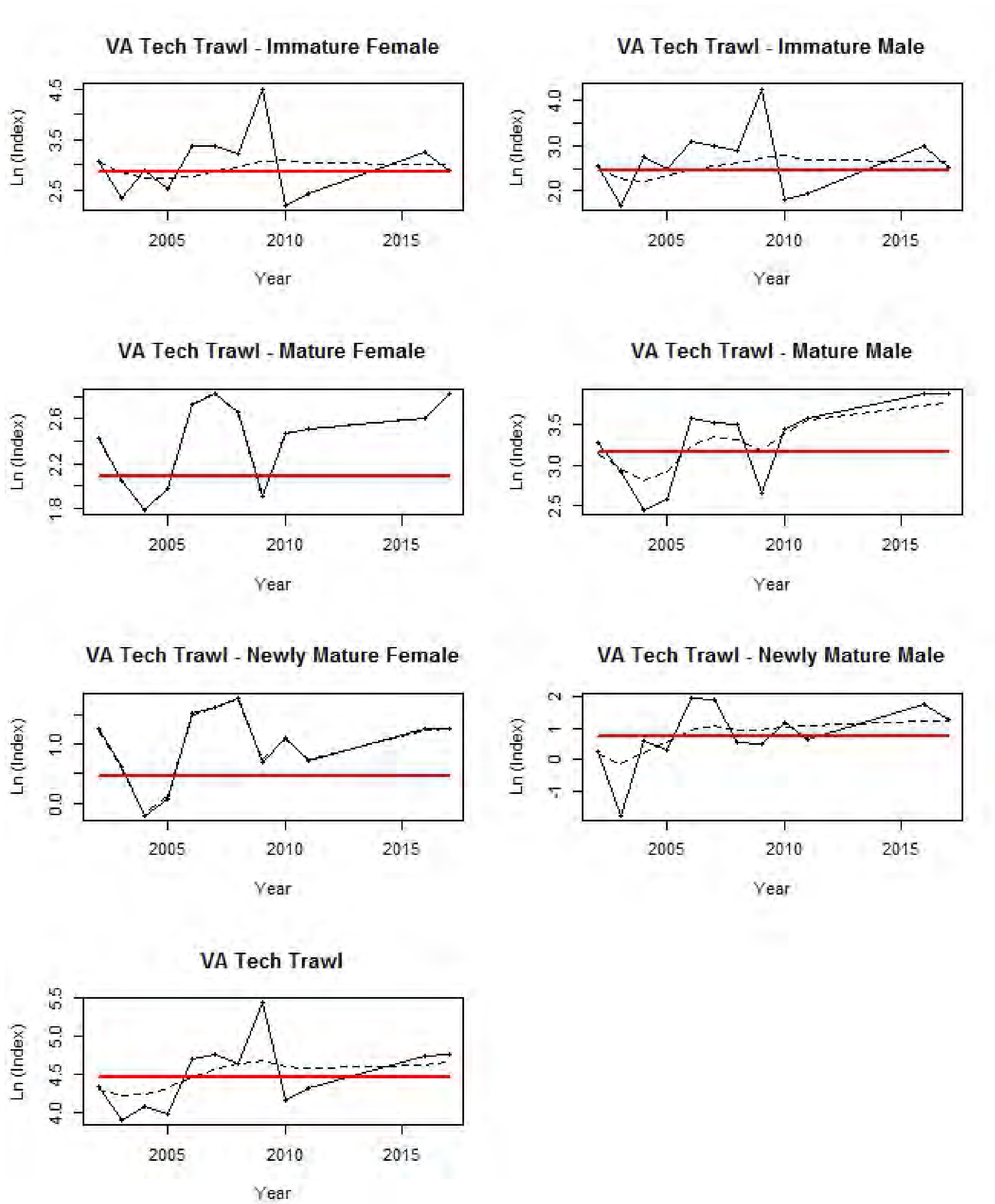

Figure 88. ARIMA model fits to horseshoe crab indices from the VA Tech Trawl survey in the Mid-Atlantic Region. The solid line represents the observed ln transformed indices and the dashed line represents the fitted indices. The red horizontal line represents the Q_{25} reference point and the blue horizontal line represents the 1998 reference point.

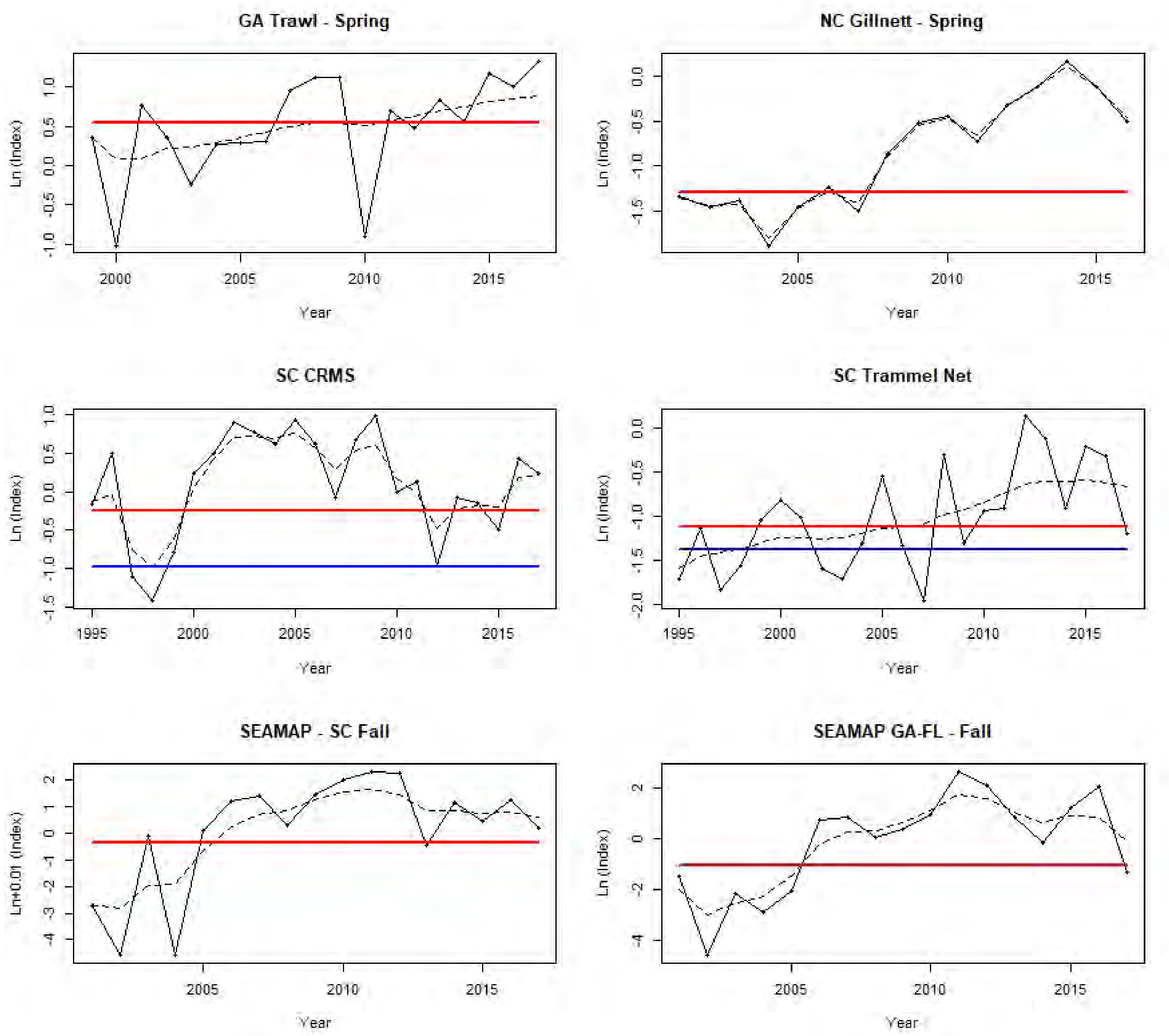

Figure 89. Southeast Region horseshoe crab survey ARIMA model fits. The solid line represents the observed ln transformed indices and the dashed line represents the fitted indices. The red horizontal line represents the Q_{25} reference point and the blue horizontal line represents the 1998 reference point. Note: The residuals from the ARIMA fit to the GA Trawl were not normally distributed.

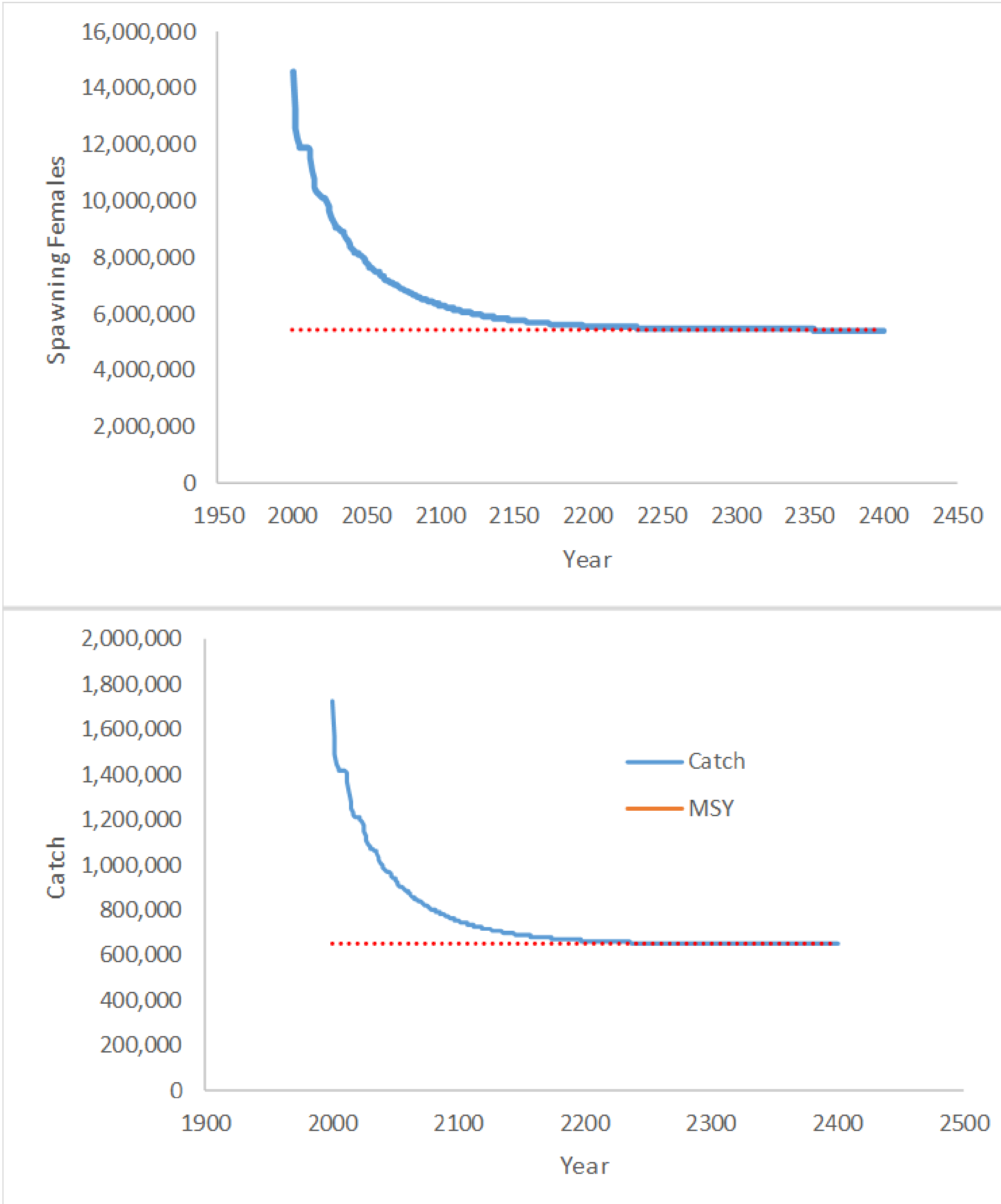

Figure 90. Projections of the horseshoe crab operating model under F_{MSY} (0.1613) showing where the population asymptotes at B_{MSY} (5,433,439) and where catch asymptotes at *MSY* (647,609 crabs).

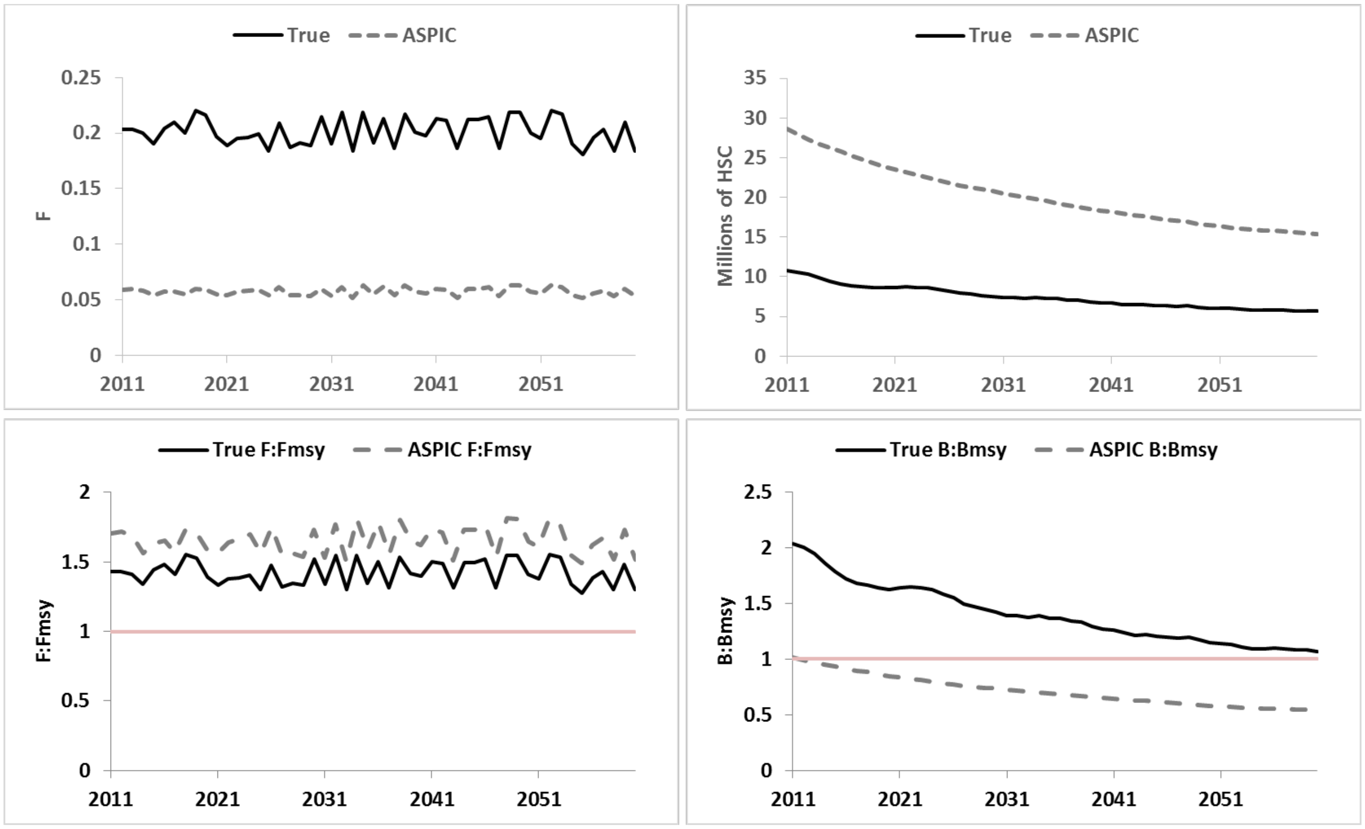

Figure 91. Comparison between simulated "true" data from the operating model and surplus production (ASPIC) results for simulation 1.

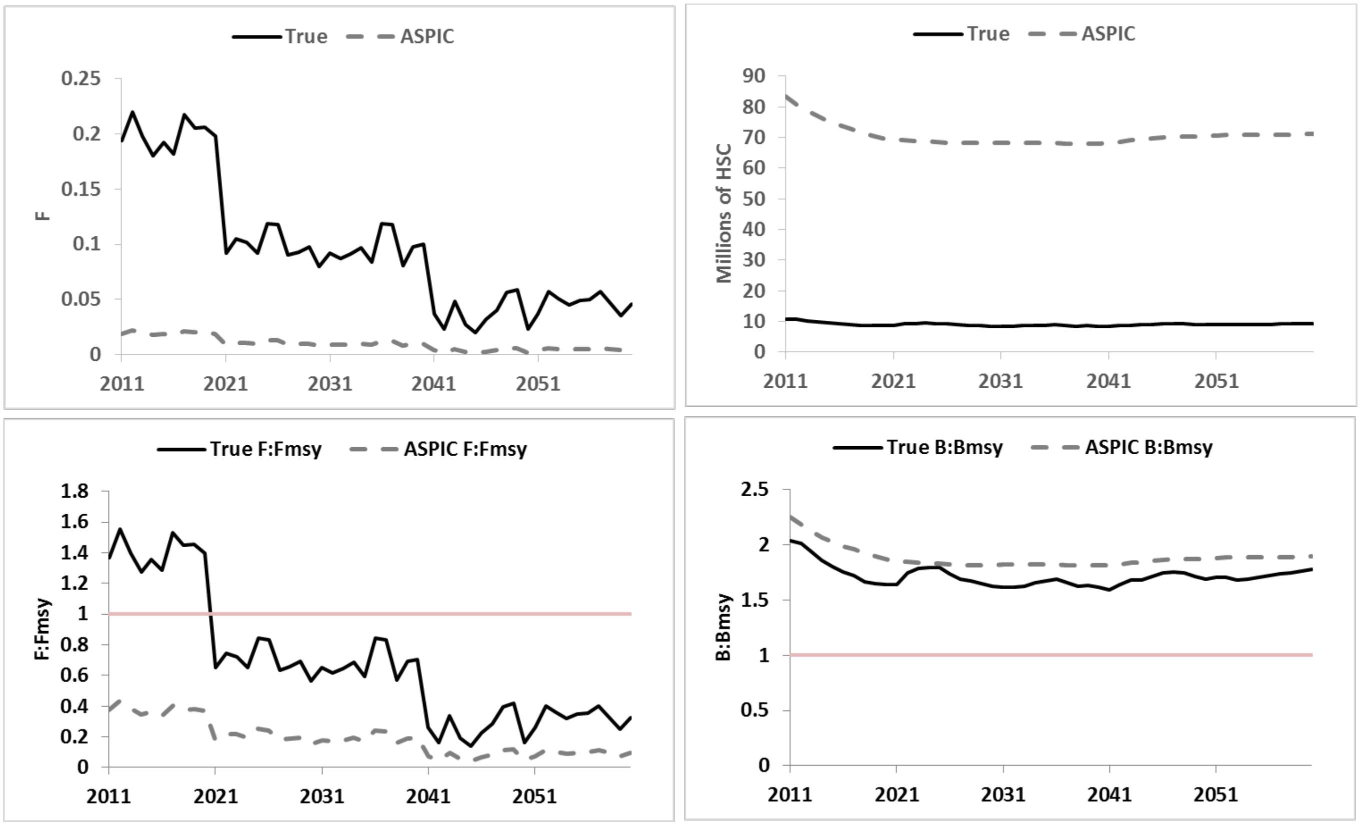

Figure 92. Comparison between simulated "true" data from the operating model and surplus production (ASPIC) results for simulation 2.

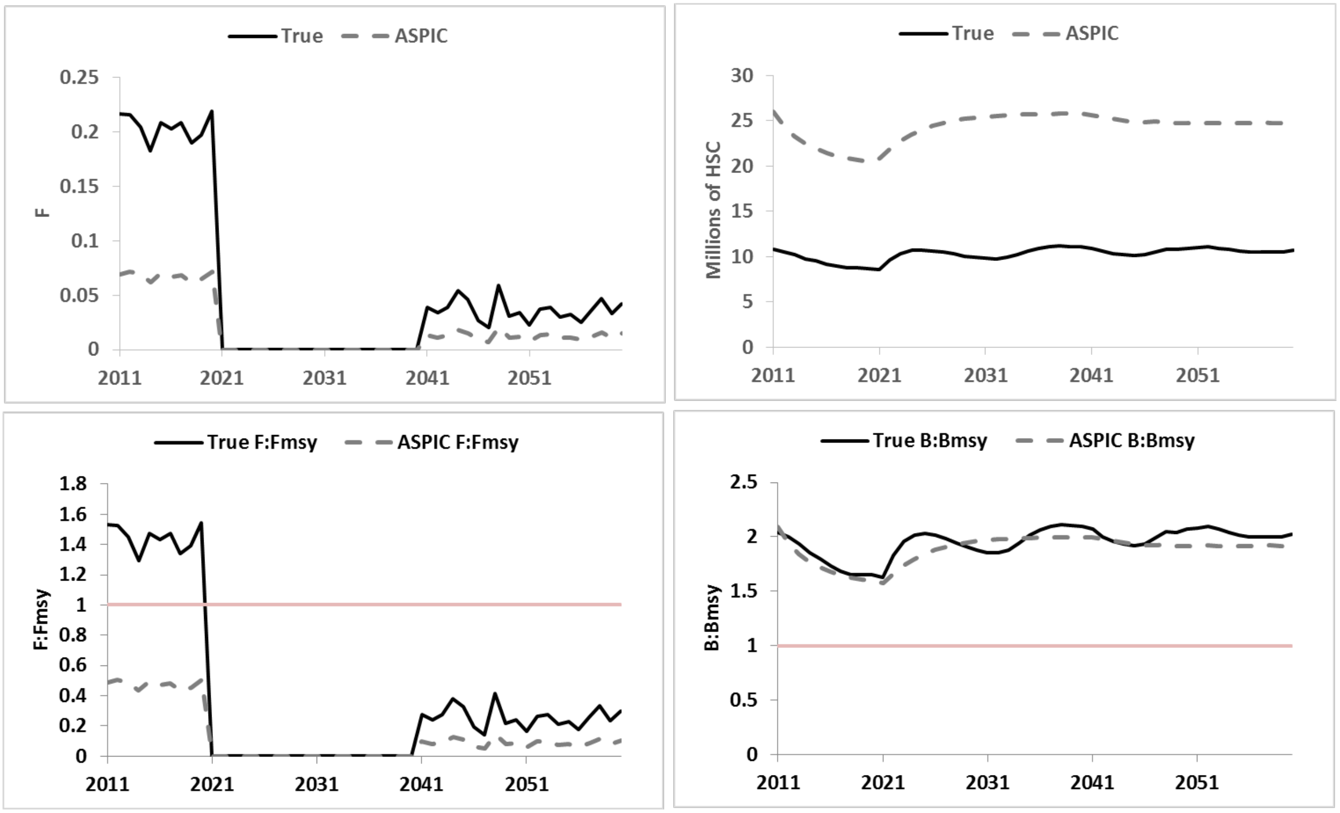

Figure 93. Comparison between simulated "true" data from the operating model and surplus production (ASPIC) results for simulation 3.

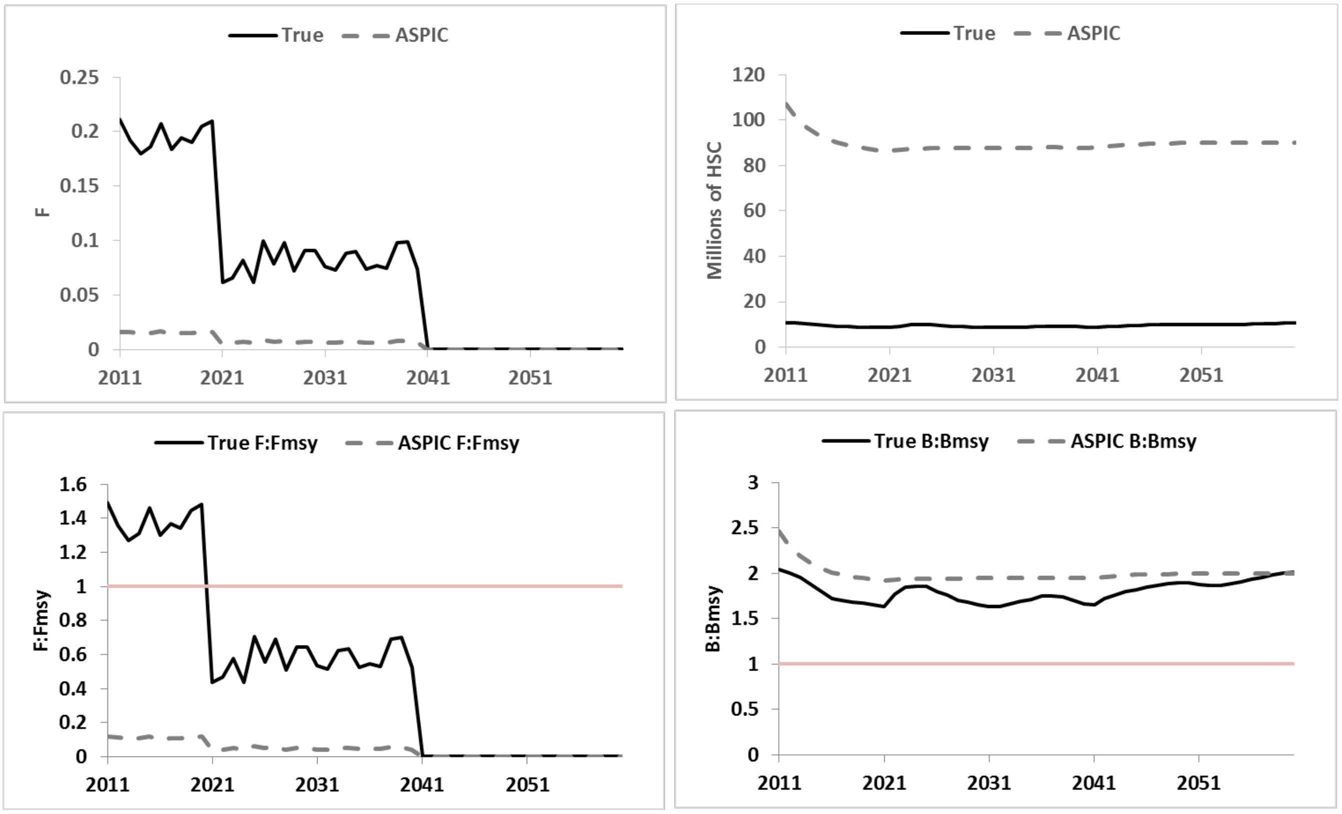

Figure 94. Comparison between simulated "true" data from the operating model and surplus production (ASPIC) results for simulation 4.

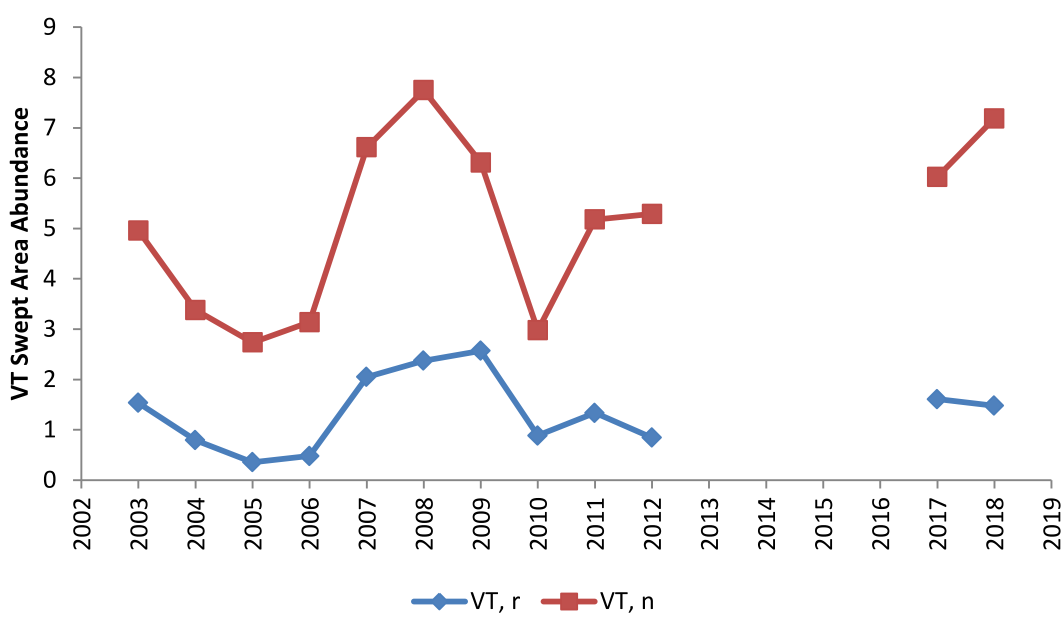

Figure 95. Primiparous and multiparous indices (in millions) from the Virginia Tech Trawl Survey.

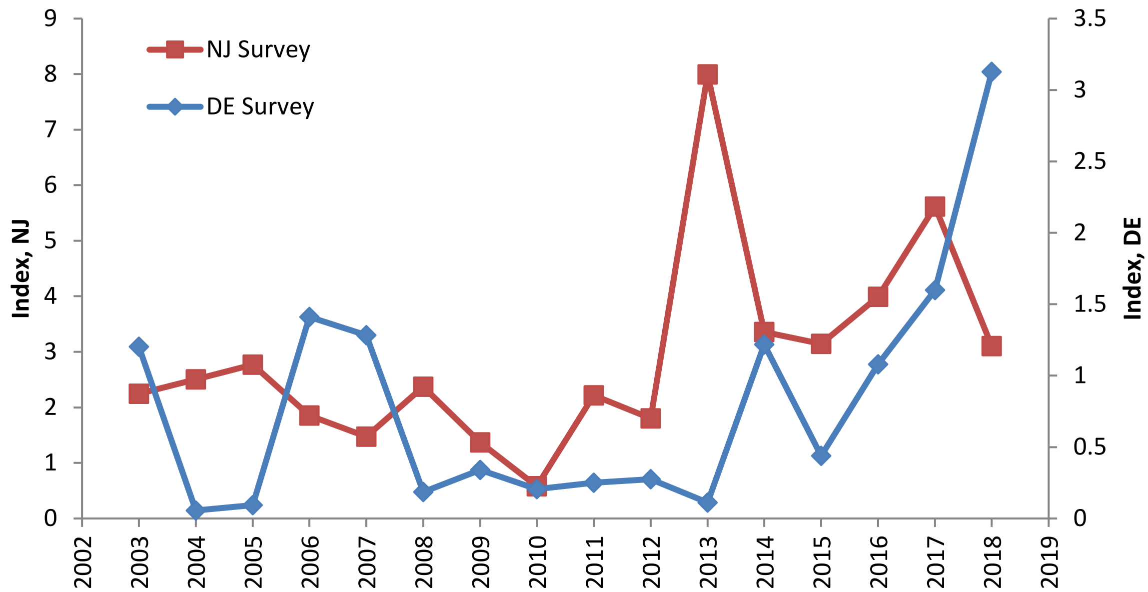

Figure 96. Aggregate stage indices from the Delaware and New Jersey trawl surveys.

[Figure Removed Due to **CONFIDENTIAL** Data]

Figure 97. Catch inputs for the base CMSA model.

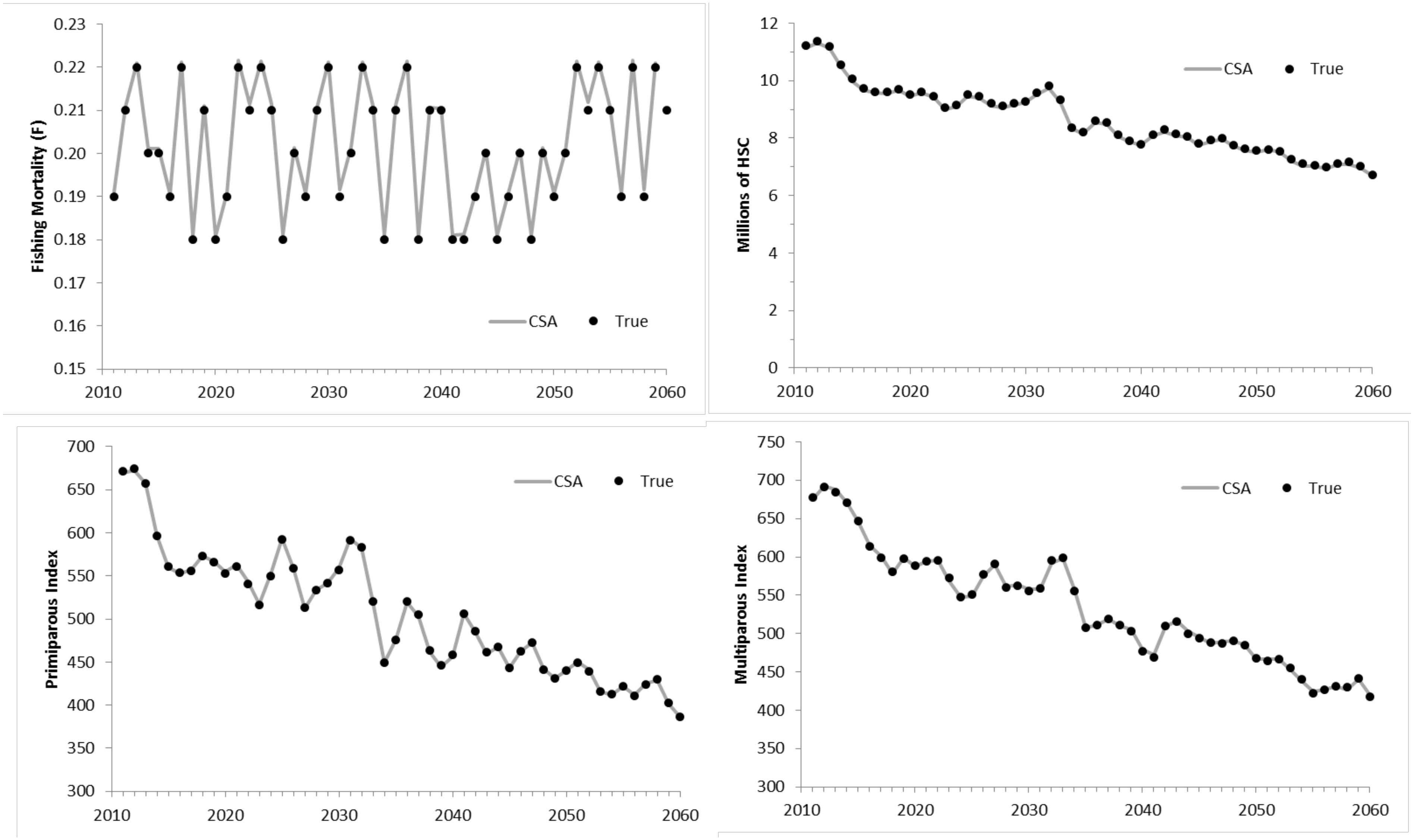

Figure 98. Comparison between simulated "true" data from the operating model and catch survey analysis (CSA) results for simulation 1.

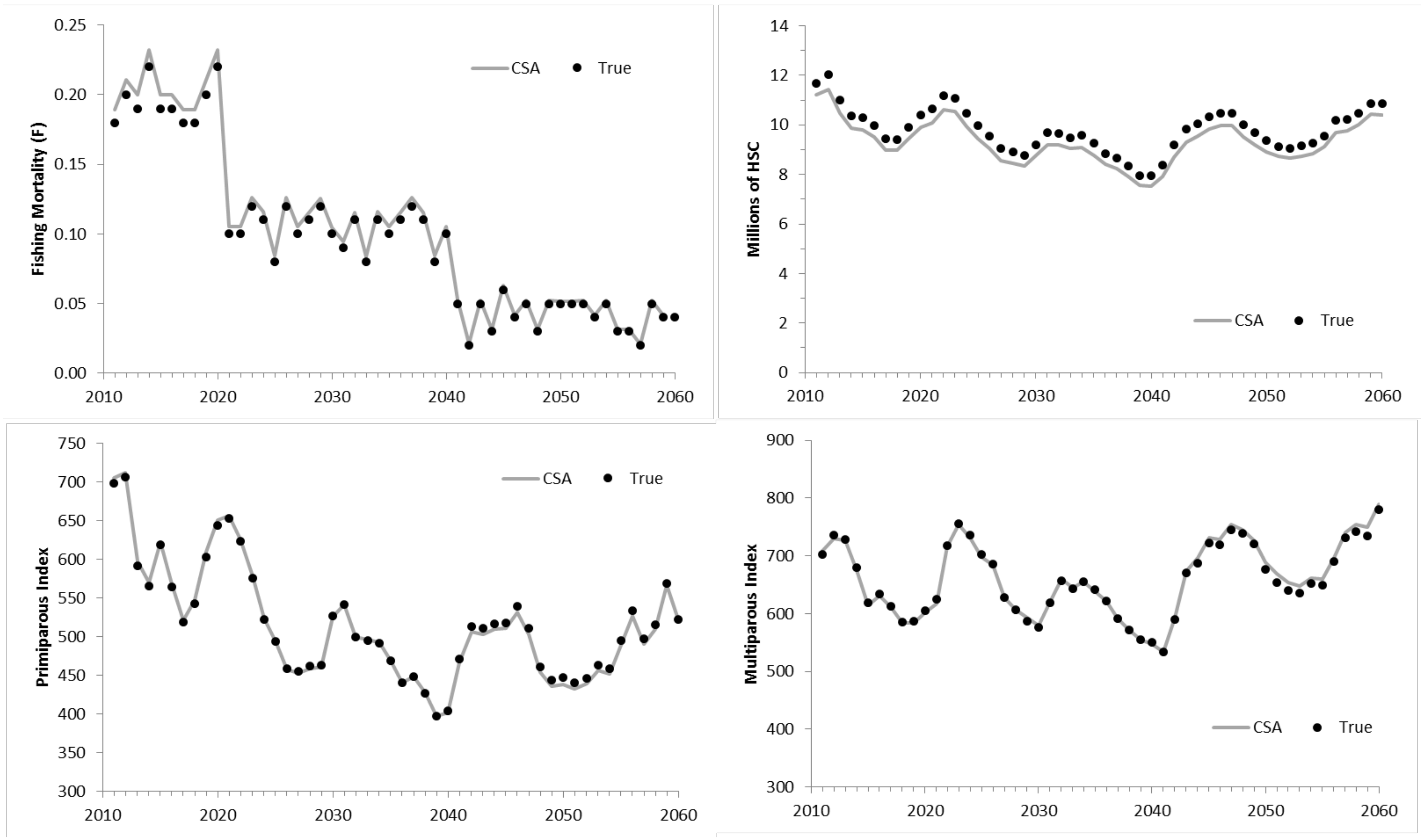

Figure 99. Comparison between simulated "true" data from the operating model and catch survey analysis (CSA) results for simulation 2.

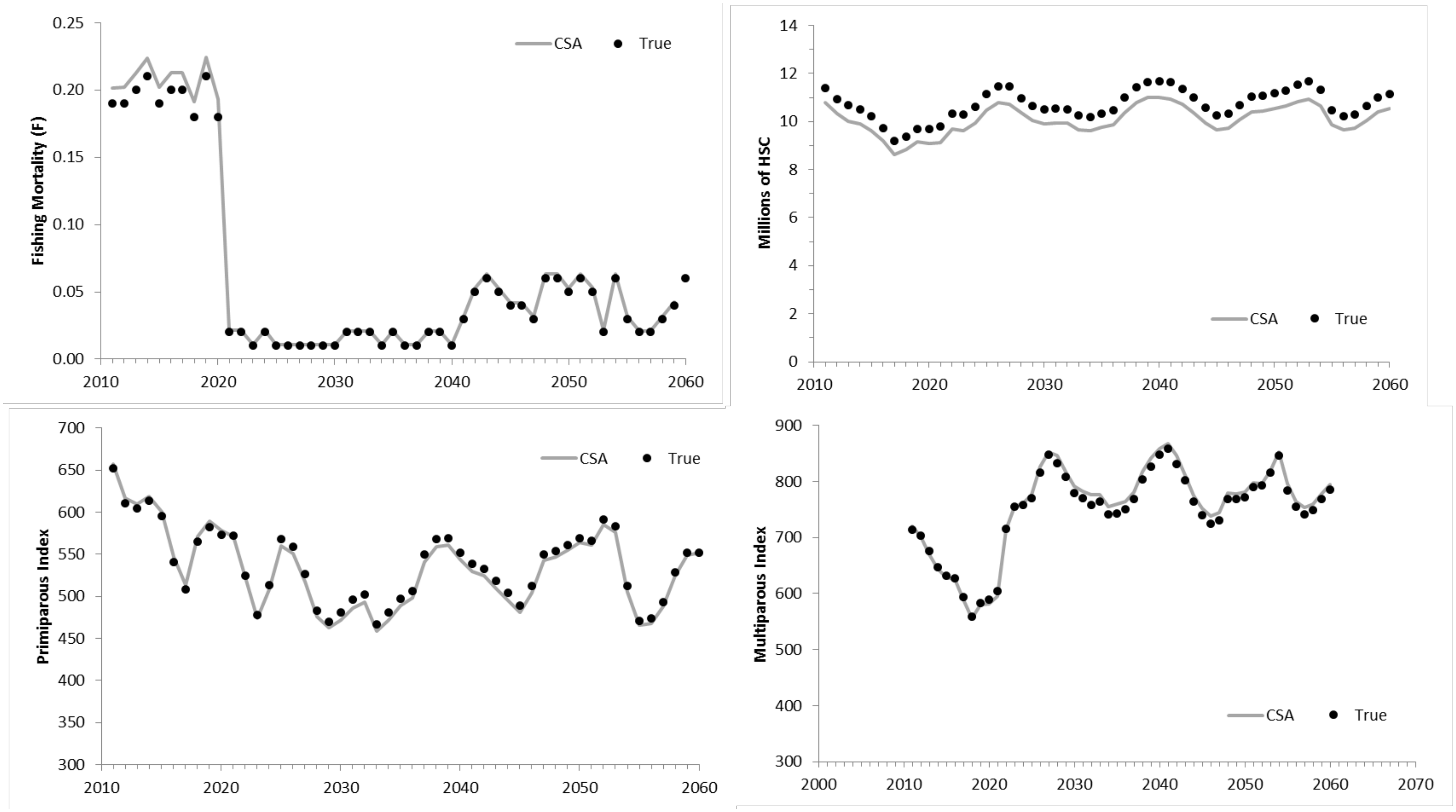

Figure 100. Comparison between simulated "true" data from the operating model and catch survey analysis (CSA) results for simulation 3.

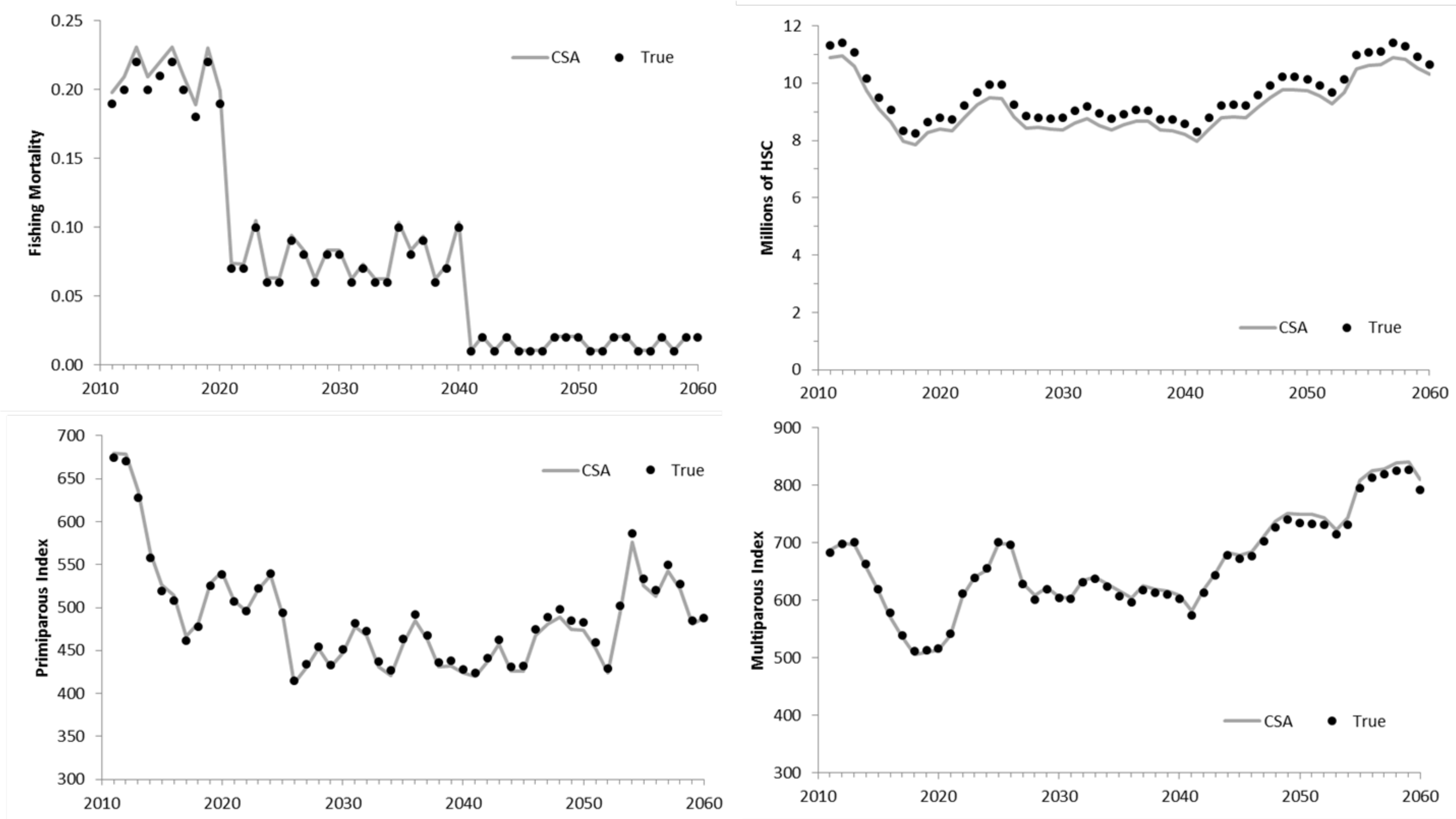

Figure 101. **Comparison between simulated "true" data from the operating model and catch survey analysis (CSA) results for simulation 4.**

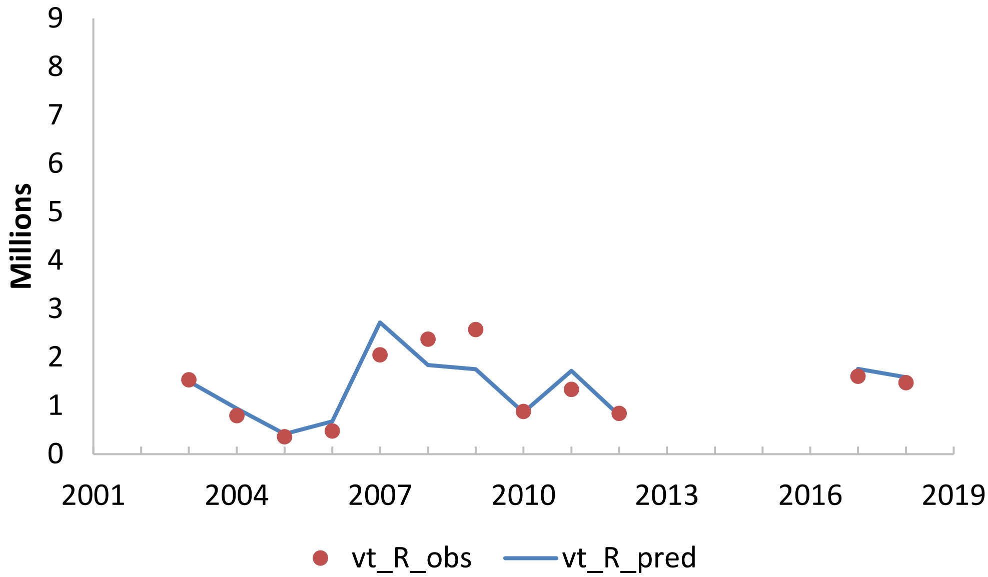

Figure 102. CMSA model fit to the primiparous female index from the Virginia Tech Trawl Survey.

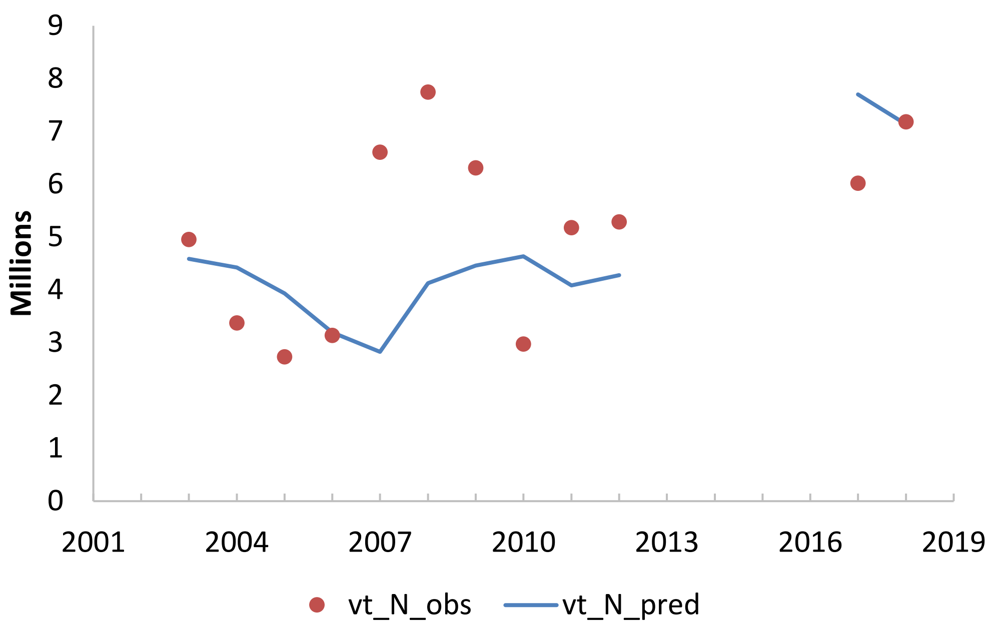

Figure 103. CMSA model fit to multiparous female index from the Virginia Tech Trawl Survey.

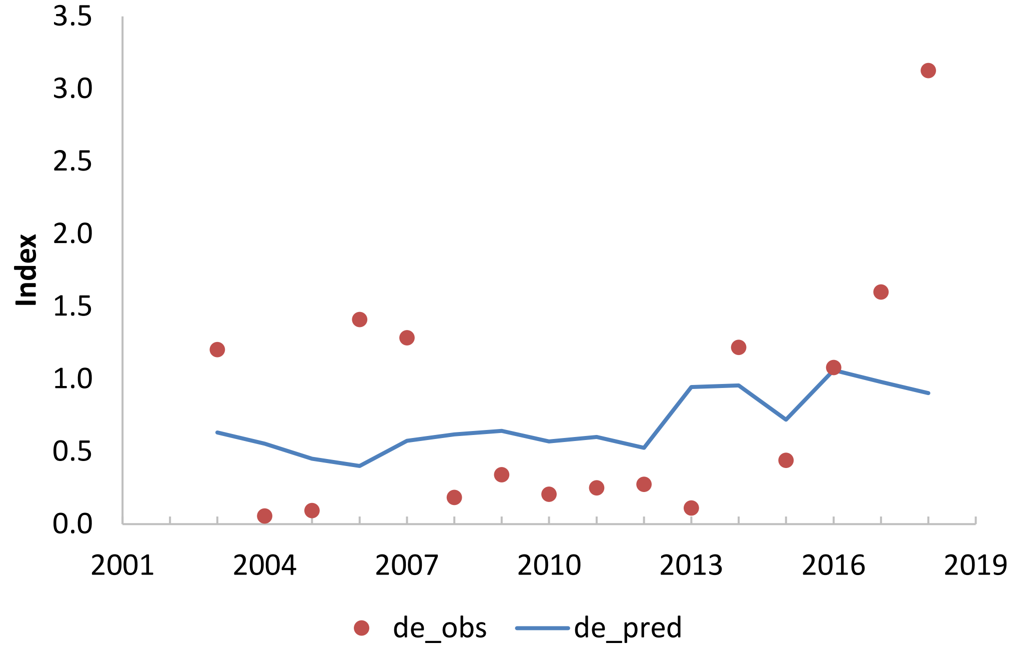

Figure 104. **CMSA model fit to Delaware Bay trawl survey aggregate adult female index.**

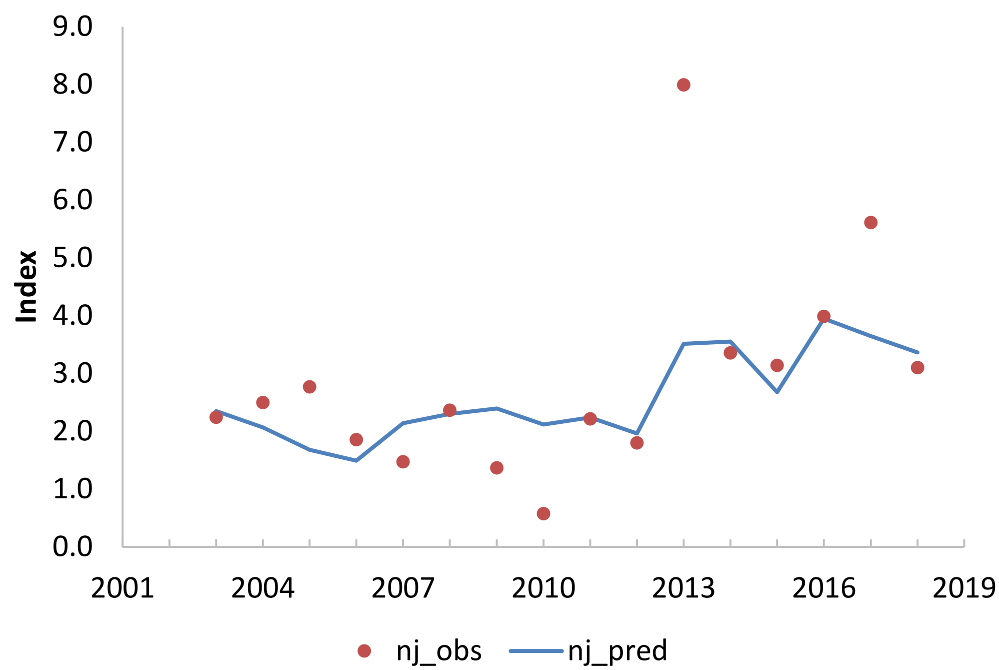

Figure 105. **CMSA model fit to New Jersey Ocean trawl survey aggregate adult female index.**

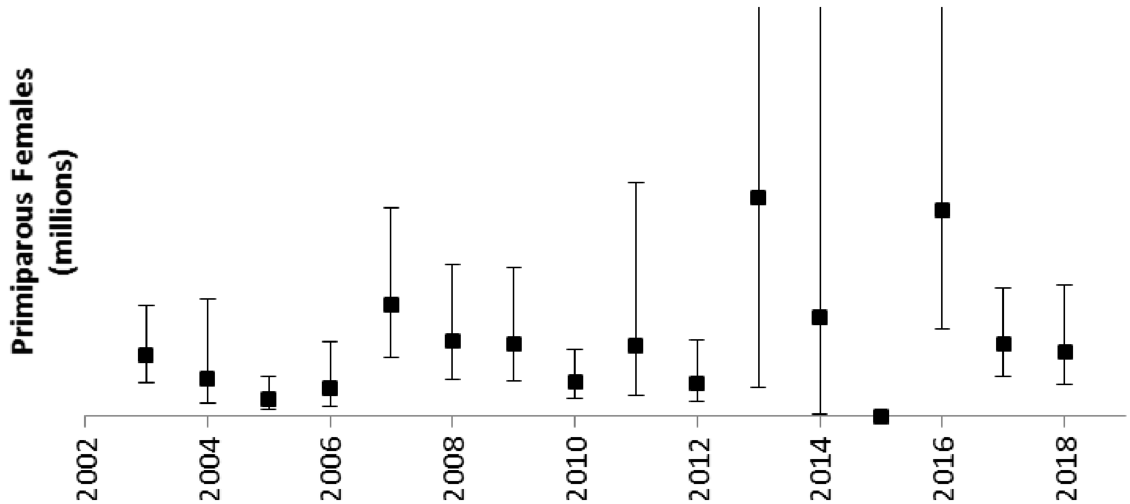

Figure 106. CMSA model estimated primiparous female abundance with lower and upper 95% confidence limits. Upper confidence limits for 2013, 2014, and 2016 extend beyond y-axis with values of CONFIDENTIAL. Y-axis values have been removed due to CONFIDENTIAL data.

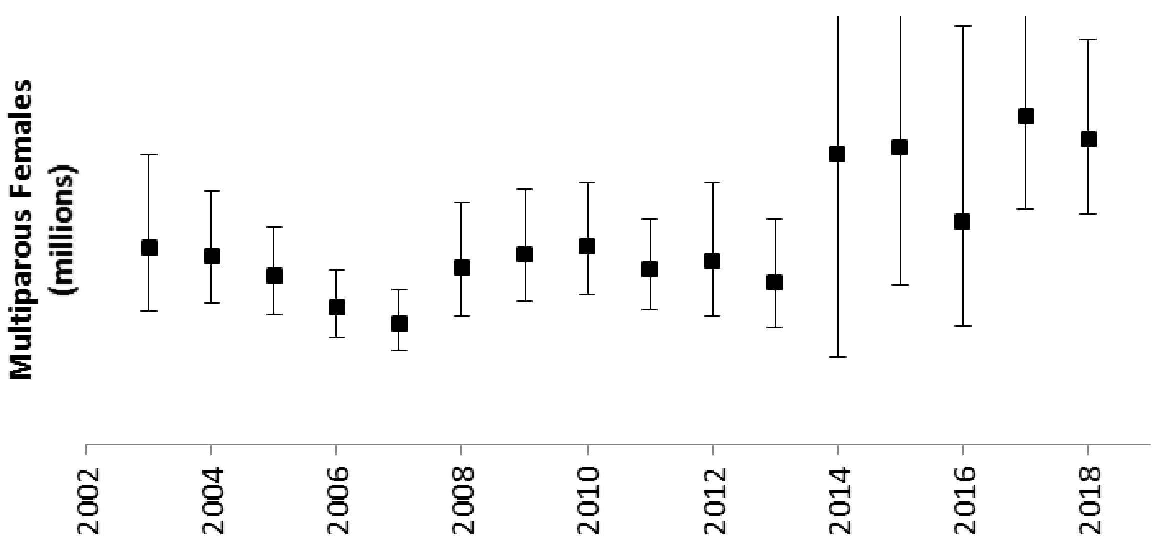

Figure 107. CMSA model estimated multiparous female abundance with lower and upper 95% confidence limits. Upper confidence limits for 2014, 2015, and 2017 extend beyond y-axis with values of CONFIDENTIAL. Y-axis values have been removed due to CONFIDENTIAL data.

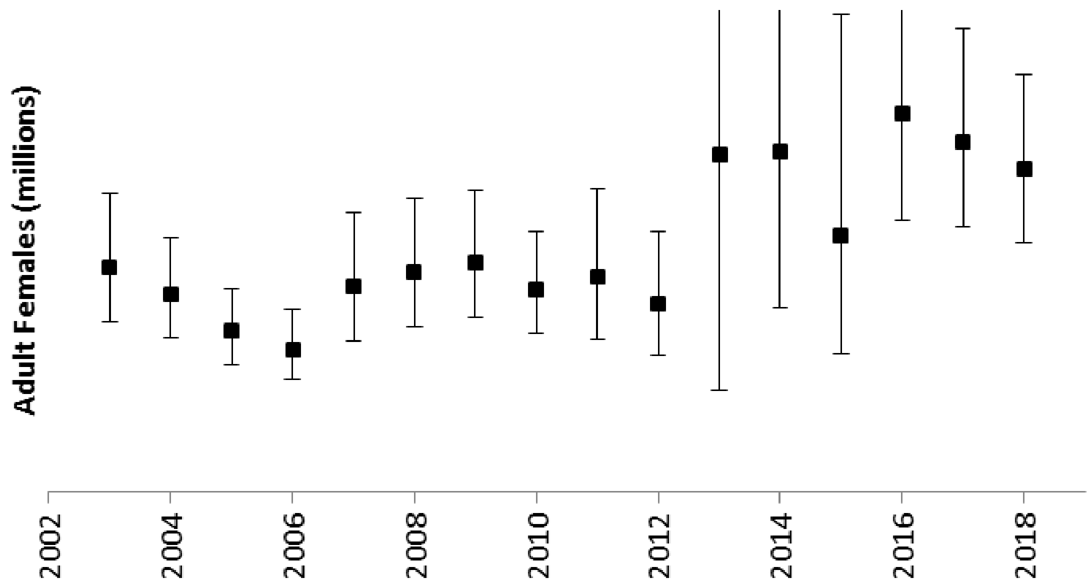

Figure 108. CMSA model estimated adult (primiparous + multiparous) female abundance with lower and upper 95% confidence limits. Upper confidence limits for 2013, 2014, and 2016 extend beyond the y-axis with values of CONFIDENTIAL. Y-axis values have been removed due to CONFIDENTIAL data.

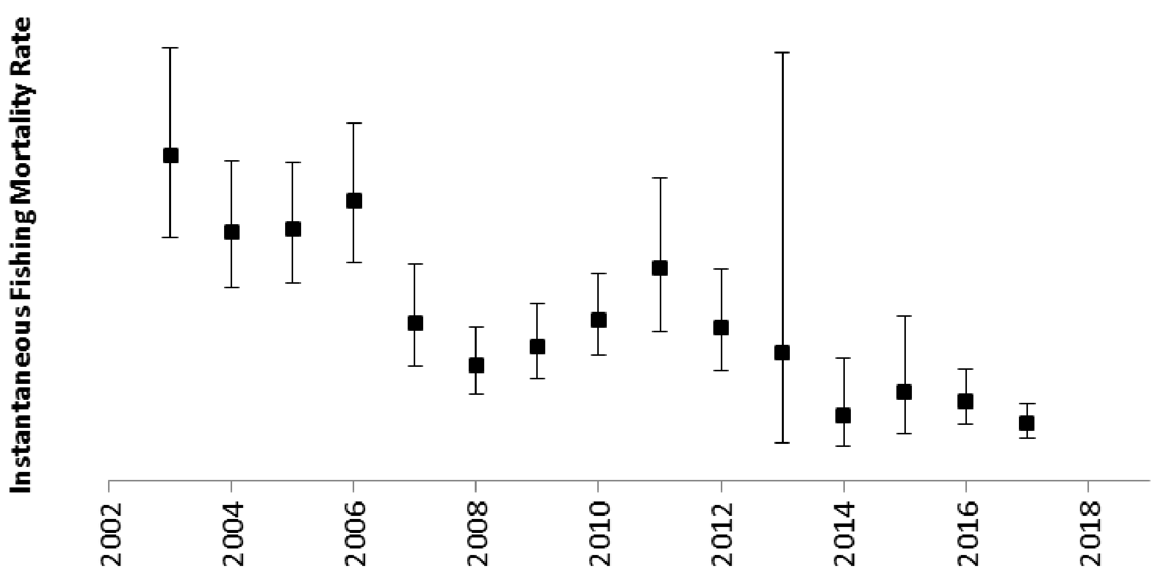

Figure 109. CMSA model estimated instantaneous fishing mortality rate F with lower and upper 95% confidence limits. Y-axis values have been removed due to CONFIDENTIAL data.

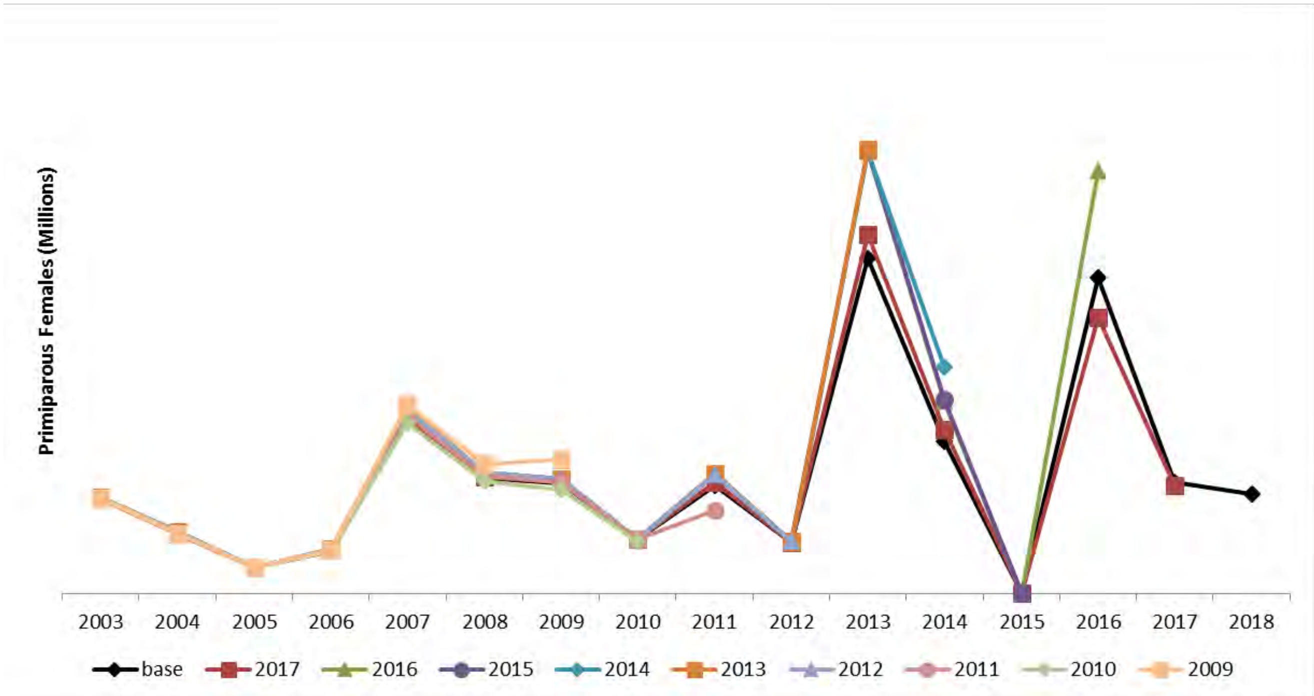

Figure 110. **Retrospective peel of estimated primiparous abundance to 2009. Y-axis values have been removed due to CONFIDENTIAL data.**

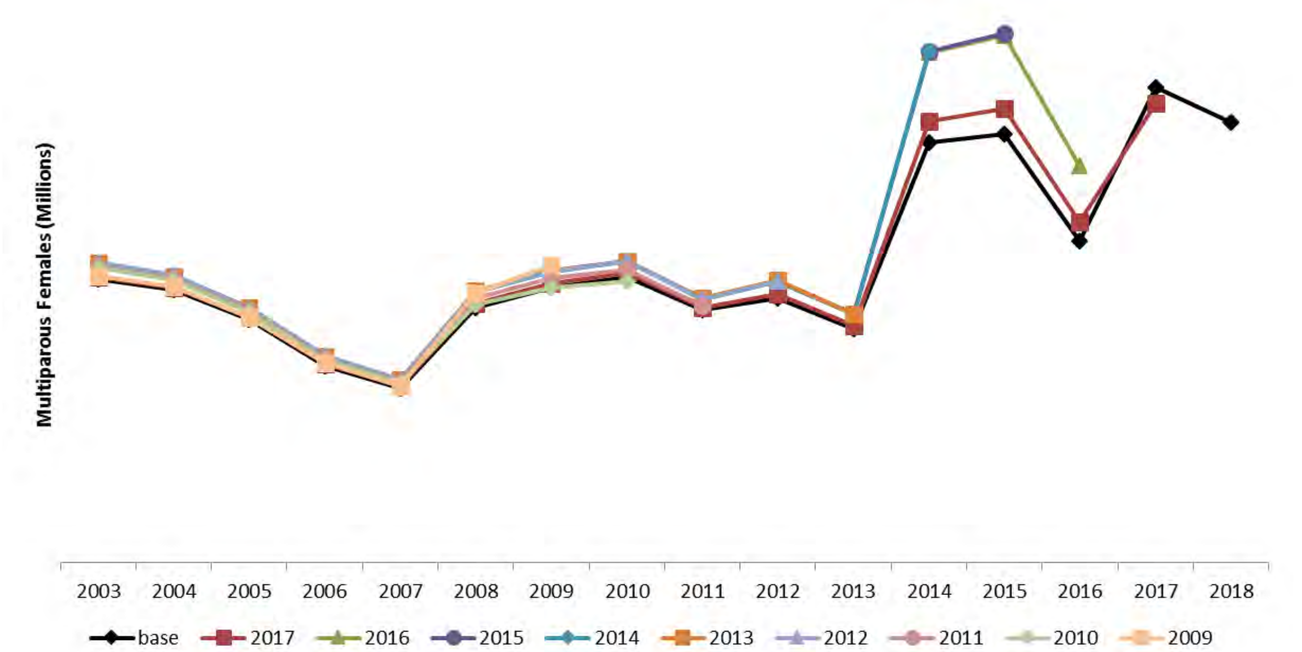

Figure 111. **Retrospective peel of estimated multiparous abundance to 2009. Y-axis values have been removed due to CONFIDENTIAL data.**

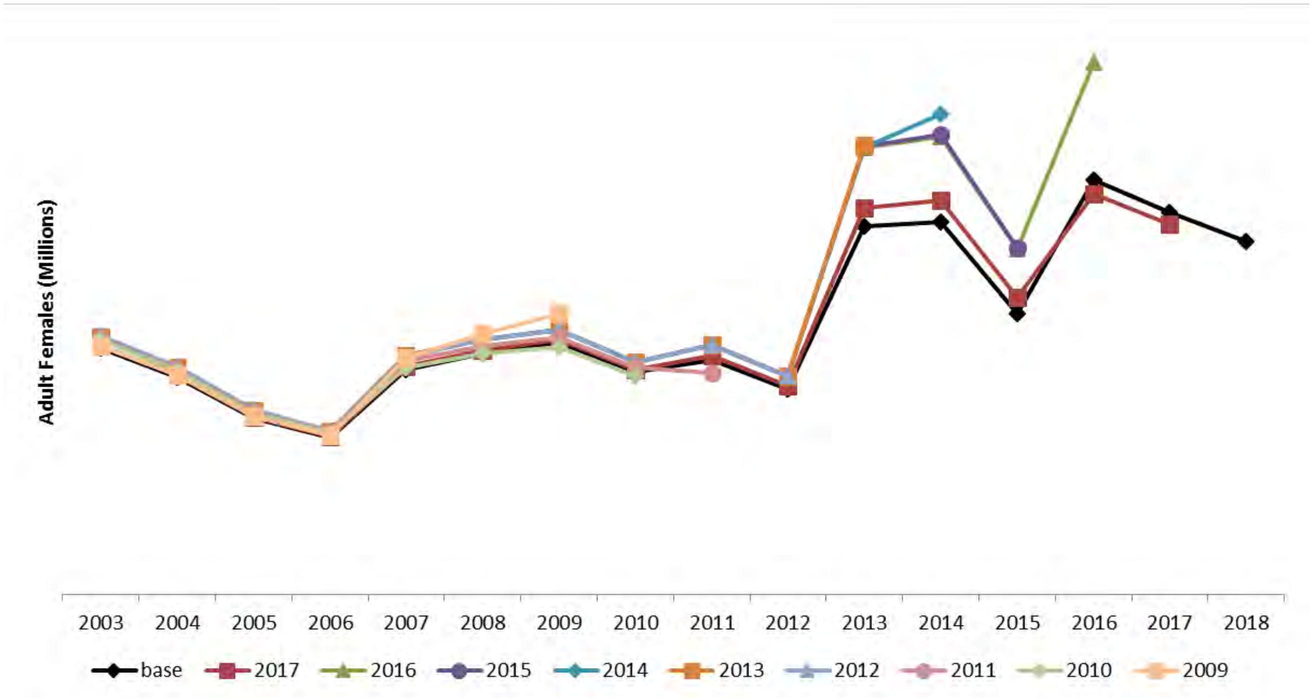

Figure 112. Retrospective peel of estimated total adult female abundance to 2009. Y-axis values have been removed due to CONFIDENTIAL data.

[Figure Removed Due to **CONFIDENTIAL** Data]

Figure 113. Terminal estimates of stock size and instantaneous fishing mortality rate from sensitivity runs.

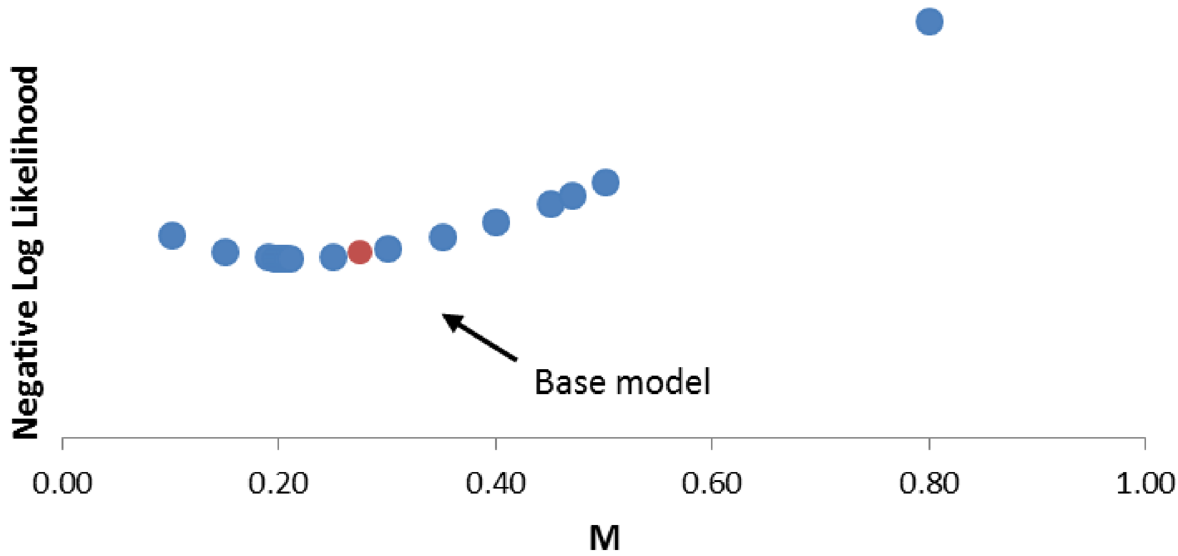

Figure 114. Likelihood profile of base CMSA model runs with varying M inputs. Y-axis values have been removed due to CONFIDENTIAL data.

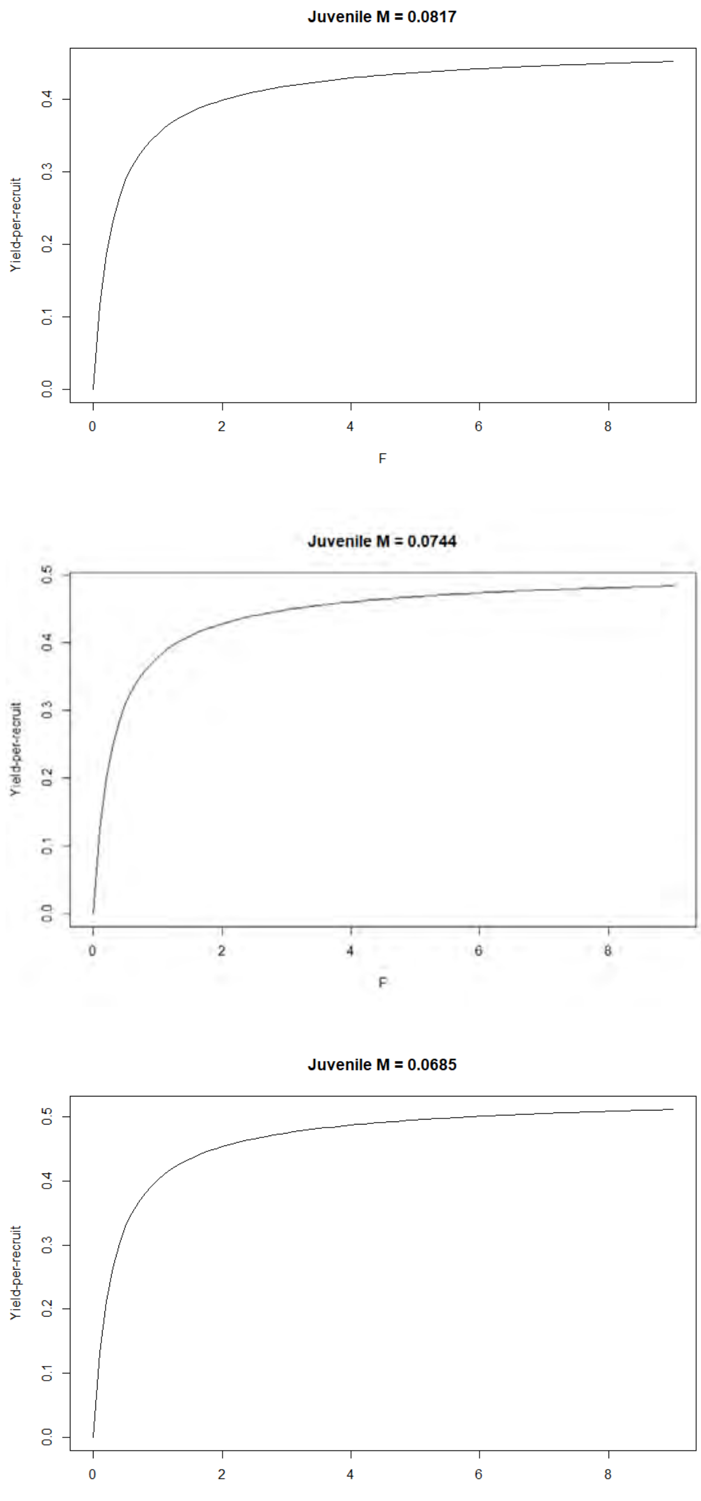

Figure 115. Yield-per-recruit model results for horseshoe crab for each level of juvenile mortality. The estimated YPR did not decline with high levels of F in any case.

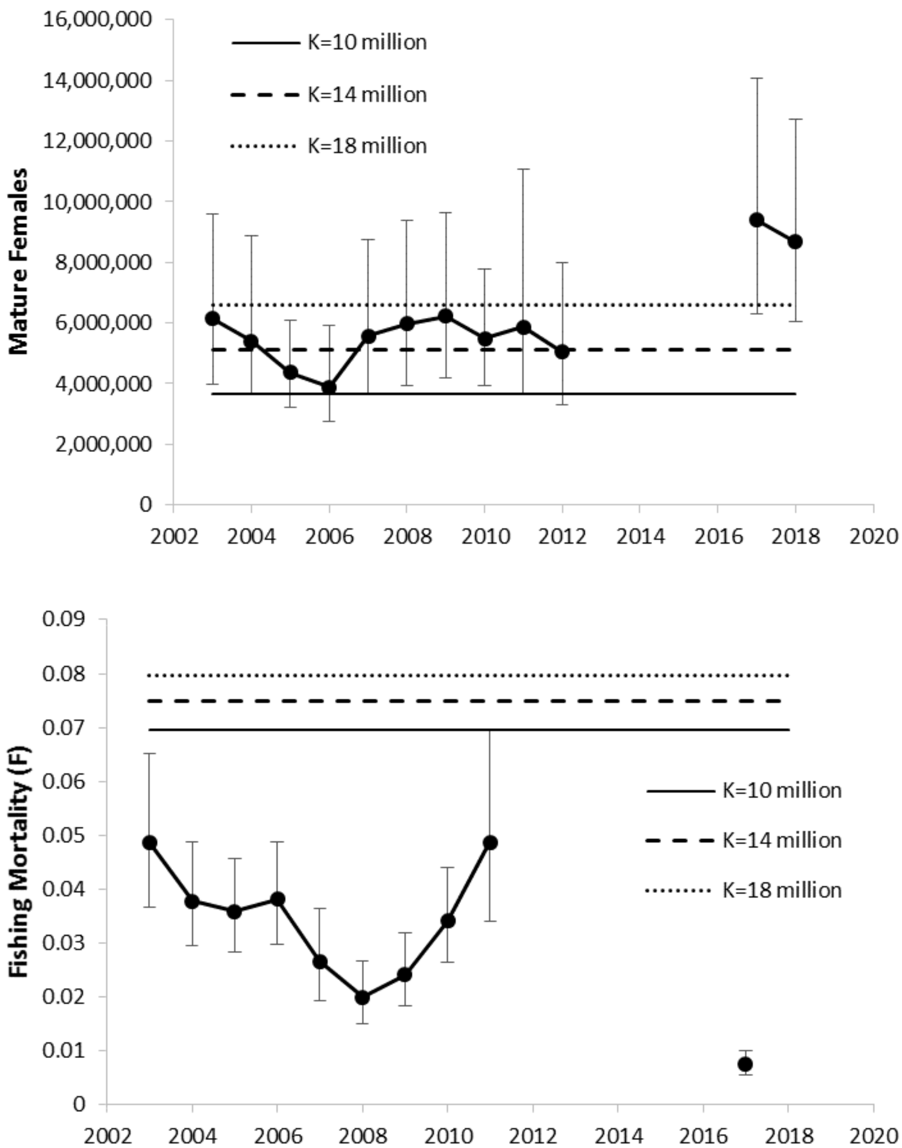

Figure 116. Stock status of female horseshoe crabs in the Delaware Bay with biomedical data is CONFIDENTIAL. Graphs have been replaced with non-confidential data that do not include biomedical data and therefore does not represent the best data for determining stock status. Comparing terminal year estimates of the number of mature females and fishing mortality showed that females are not overfished and overfishing is not occurring. The horizontal lines on the graphs indicate the reference points (B_{MSY} and F_{MSY}) generated from the theoretical population projection model under various assumptions of carrying capacity (K).

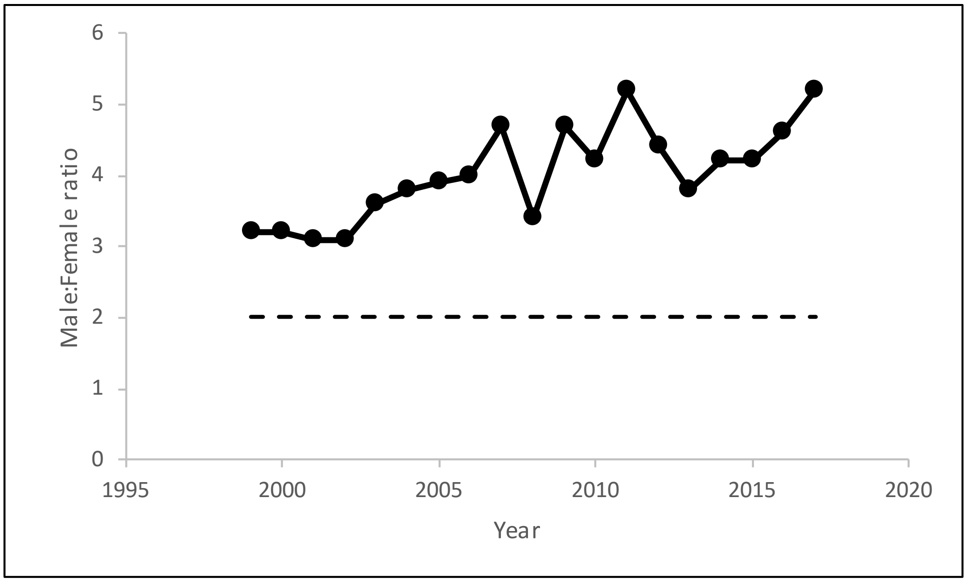

Figure 117. Sex ratio of Delaware Bay horseshoe crabs from the Delaware Bay spawning survey. The terminal year sex ratio was greater than the 2.0 reference point indicating that the male population is not overfished and there was no declining trend in the sex ratio indicating that overfishing was not occurring.

12 APPENDIX A: Biomedical Workgroup Reports

12.1 Biomedical Best Management Practices

The scope of discussion for the best management practices (BMPs) was limited to the collection, bleeding, and release of crabs collected solely for biomedical purposes. However, the WG recognized that these same practices must also be used when collecting crabs that will ultimately go to the bait industry to ensure a quality product for the biomedical and bait industries. However, the focus of this discussion was on biomedical-only crabs.

<u>Collection</u>

- **For targeted horseshoe crab trawl tows, reasonable tow times, recommended at 20-30 minutes bottom time (winches locked)**
- **Proper care and handling of horseshoe crabs while sorting and placing into bins**
- **Avoid exposure to direct sun, extreme temperatures as well as rapid temperature changes**
- **Night harvesting is recommended during periods of excessive heat**
- **During collection, sort out juveniles and do not bleed**
- **Sort out and return to the water individuals that do not appear to be healthy (damaged, slow movement, dull shell/old)**
- **When possible, release juveniles or unhealthy individuals immediately and do not transport to the facility**
- **Educate collectors in proper handling techniques**
- **Specify expectations of collectors in written contracts**
- **Periodically audit horseshoe crab collectors on implementation of BMPs for collecting**

<u>Transport to Facility</u>

- **Maintain temperature between approximately ambient water temperature at time of collection and 10ºF below ambient-water temperature**
- **Maintain good ventilation while stacked in bins**
- **Limit number of horseshoe crabs to a suitable number, dependent on container size and shape, and avoiding over-stacking to minimize damage to other horseshoe crabs**
- **Minimize travel time**
- **Keep bins and horseshoe crabs covered to protect against direct sunlight**
- **Secure containers in transport vehicle**

<u>Holding at Facility/Preparation for bleeding/Bleeding</u>

- **Limit holding time, under normal circumstances, at the facility to less than 24 hours**
- **No prolonged exposure to fresh water**
- **Follow written procedures for proper care and handling when sorting horseshoe crabs and moving them between bins and within the facility**

- **Inspect crabs for health and damage, selecting only undamaged and healthy crabs for bleeding**
- **Maintain clean, sanitary conditions during bleeding**
- **Maintain same level of care for rejected crabs that are not bled while they are being held until released back to sea**
- **Avoid bleeding crabs more than once per year**
- **If crabs are marked to avoid re-bleeding, ensure that the mark is residual and not harmful to the crab**
- **Bleed until rate slows down so that excessive bleeding is prevented**
- **Continue 30-year policy of not attempting to suction additional blood from the horseshoe crabs**
- **Perform internal audits to maintain quality control over written procedures**

<u>Post-Bleeding Holding</u>

- **Recognizing that the horseshoe crabs are now stressed from the bleeding process, maintain the same level of care as that used when transporting horseshoe crabs into the facility for bleeding**
- **Return to the water as soon as possible. If not being returned to the area of capture, ensure that conditions (salinity, water temperature, etc.) are similar to those found at the harvest site**
- **Minimize holding time post-bleeding**
- **While in holding, keep horseshoe crabs in the dark to minimize movement and injury**
- **Keep horseshoe crabs well-ventilated, moist, and allocate only a suitable number of crabs to holding containers**
- **Do not keep crabs out of the water for longer than 36 hours in total**

<u>Return to Sea</u>

- **Use same care in handling and transporting crabs being returned to the water**
- **Include return written instructions and requirements within contract with collectors, if applicable**
- **Periodically audit horseshoe crab collectors on implementation of BMPs for returning**

<u>Overarching practices for all steps</u>

- **Generate written procedures for all handlers of horseshoe crabs, covering all steps in the process from collection to release**
- **Keep horseshoe crabs cool, moist and covered, avoiding direct sunlight**
- **Establish a dialogue among collectors, the biomedical company, and the state regulatory agency to address concerns and challenges**

- **Have a written contract between collectors and the biomedical company, outlining practices and expectations**
- **Perform audits of the various steps and contractors/employees throughout the process**
- **Ensure proper monitoring and recording of mortality at each step in the chain of custody**

Other opportunities-Dual use of bait horseshoe crabs

The WG agreed that dual use of bait horseshoe crabs should be encouraged where possible but not required due to differing state regulations and the challenges of transport, volume, and timing. Depending upon capture and facility location, travel time may exceed what is practicable to maintain the health of the horseshoe crabs during transport to a biomedical facility. Additionally, the bait industry tends to collect a large volume of crabs within a short period, such that a biomedical facility would not be able to keep up with that volume in that time frame. Company representatives felt that licensing issues would not be a major challenge to using more bait crabs in the biomedical process first; rather, it would be the logistics of coordinating harvesters and their volume of catch in order to increase the use of bait crabs.

Review of Bleeding Mortality reports

There was some discussion that given recent findings and the wide variation in testing conditions and mortality results in bleeding studies, a formal peer review of the published studies might be considered. Publication of such a report could reduce some of the conflicting views currently expressed by various interests. Such a report could also frame future research avenues.

Summary

This report establishes BMPs for the various steps throughout the biomedical process, from harvest to release. Many of these practices are already in use by the biomedical companies, in order to sustain the horseshoe crab population and ensure a steady and reliable supply of product to the pharmaceutical market. The WG recommends that biomedical facilities follow these practices and monitor their suppliers. The WG also recommends holding future meetings to discuss opportunities to further decrease mortality. Given the recent and expected future increased demand for LAL, such periodic meetings are essential for continued successful management of the horseshoe crab resource along the Atlantic coast.

12.2 Northeast Region Biomedical Literature Summary

There is only one biomedical facility in the northeast, Associates of Cape Cod (ACC) which is located in Falmouth, Massachusetts. The Massachusetts Division of Marine Fisheries gives ACC a letter of authorization (LOA) each year allowing them to receive horseshoe crabs for biomedical use. These letters follow the Best Management Practices (BMPs) outlined by the ASMFC Biomedical Working Group (http://www.asmfc.org/uploads/file/biomedAdHocWGReport_Oct2011.pdf), and also includes state-level permit requirements. Included in the LOA are specifications as to what temperature the crabs should be held (50-60˚ F during transport, ≤70˚ F in laboratory), a marking requirement to prevent re-bleeding the same crab within the same year, a requirement to keep crabs moist, a limit to how many crabs can be stacked on top of each other while held in barrels, a requirement to release biomedical crabs to the embayment they were collected from, and other requirements. Crabs are typically out of the water for less than 26 hours (personal communication B. Hoffmeister, ACC, March 2018). MA DMF regularly visits ACC to collect data and ensure the terms of the LOA are being followed. Three papers have been published on the impacts of bleeding horseshoe crabs for biomedical purposes in the northeast region; Kurz and James-Pirri (2002), Leschen and Correia (2010), and Anderson et al. (2013). Both male and female crabs are bled by the biomedical industry, but all three papers from the northeast have focused solely on female crabs. The methods and results from these papers have varied (Table 1).

Kurz and James-Pirri (2002) attached an acoustic tag to ten bled and ten non-bled female crabs and released the crabs within half an hour of taking them out of the water. Two bled crabs and one non-bled crab were never detected again. It is unknown if these crabs left the survey area or died out of the water where they could not be detected. Making the assumption that the crabs had left the survey area, the reported mortality rate for bled crabs was 20% and 0% for non-bled crabs (Table 1). The two confirmed mortalities were found dead 28 and 68 days after being bled. There was no significant difference in the amount of movement between bled and un-bled crabs or in the spatial distribution of bled and un-bled crabs. Bled crabs appeared to exhibit more random directional movements compared to un-bled crabs, thus the authors suggested the bled crabs may have been disoriented after bleeding. Crabs in this study were subjected to conditions better than current BMPs. Time out of the water did not exceed half an hour and the crabs spent minimal time being transported to and from the collection site.

Table 1. Summary of three biomedical horseshoe crab bleeding mortality papers from the northeast region. All three studies focused only on female crabs. Control = non-bled crabs.

		Sample Size		Mortality Rate		
Study	Treatment	Control	Bled	Control	Bled	BMPs Followed
Kurz and James-Pirri 2002	1:Control	10		0%		Yes
	2: Bled		10		20%	Yes
Leschen and Corriea 2010	1: Control, 4hr exp.	98		3.1%		Yes
	2: Bled, 6 hr exp		89		22.5%	Yes
	3: Bled, 25 hr exp.		94		29.8%	Yes
Anderson et al. 2013	1: Outdoor ind. enclosures	7	7	Unreported	0%	No
	2: Indoor running wheel	7	7	Unreported	14%	No
	3: Indoor ind. enclosures	7	7	Unreported	14%	No
	4: Outdoor communal	7	7	Unreported	42%	No

Leschen and Correia (2010), in cooperation with ACC, also looked at post-bleeding mortality of female crabs. Three hundred and ten crabs were collected by ACC's supplier, transported to ACC by ACC's staff in an ACC truck, and bled by ACC staff. Crabs with injuries prior to bleeding were removed from the study and current BMP methods were followed. Crabs were then sent to a research laboratory and held in tanks. Mortality rates from this study were 3% for un-bled crabs (control, treatment one), 22.5% for crabs bled and placed in tanks the same day (treatment two), and 29.8% for crabs bled and held overnight before being placed in tanks the next morning (treatment three) (Table 1). Crabs from all three treatments were mixed together amongst six tanks. Within the bled treatments, 84.3% of the mortalities occurred by day six. An analysis of deviance revealed that treatment and tank were significant factors in explaining mortality. While bled crabs had a significantly higher mortality rate than un-bled crabs, the significant tank effect shows that something else also contributed to crab mortality rates.

Anderson et al. (2013) followed the "high stress" methods of Hurton and Berkson (2006) that the authors state "approximated the standard biomedical bleeding procedure". These methods drastically deviate from current BMPs. Fifty-six crabs were collected and split equally among four experiments which were sorted by crab size due to laboratory space restraints. The largest

14 crabs were placed into individual wire enclosures within an outdoor tank under natural light conditions (experiment 1). The smallest 14 crabs were placed on individual running wheels within partitioned indoor tanks (experiment 2). The remaining 28 crabs were split evenly among two experiments, one placed 14 crabs in a communal, indoor tank within individual enclosures (experiment 3), and the final 14 crabs were placed in a communal indoor tank and had 1-2 ml of blood drawn weekly to monitor hemocyanin levels (experiment 4). Half of the crabs in each experiment were bled, the rest were left as a control. Crabs that were bled were exposed to direct sunlight, temperatures reaching 37 ˚C, and held out of the water for 52 hours. Overall post-bleeding mortality rate was 18%. Mortality was highest in the experiment 4, where crabs were held communally at a very high density (27 crabs/m^2) and had hemolymph samples drawn multiple times post-bleeding (42% mortality) compared to experiments that partitioned crabs individually and handled them only once (0-14% mortality). The authors found that bleeding caused the crabs to be more sluggish and impacted their movement patterns when compared to crabs that were not bled and exposed to the "high stress" conditions.

Despite three peer-reviewed papers on the subject, given the wide range of mortality estimates produced there are still many questions as to how the bleeding process affects horseshoe crabs in the northeast region. The work reviewed above was conducted under a wide range of conditions and sample sizes, with varying study goals, making it difficult to compare results. Mortality rates from bled crabs ranged from 0% to 42% while reported mortality rates for un-bled crabs were less than 5%. There is evidence for negative effects of holding conditions (see also Coates et al. 2012), which likely compounded mortality estimates in some cases. There is obviously more work required to accurately estimate bleeding impacts to crabs (both lethal and sublethal). Given the wide range of mortality estimates published in the peer-reviewed literature for this region, any assignment of biomedical mortality rates for the assessment process must incorporate a sensitivity analysis. This would allow the assessment to produce model estimates of stock size over the range of potential biomedical impacts suggested by the best available science.

Literature Cited

Anderson, R. L., W. H. Watson III, and C. C. Chabot. 2013. Sublethal behavioral and physiological effects of the biomedical bleeding process on the American horseshoe crab, *Limulus Polyphemus*. *Biological Bulletin* 225: 137-151.

Coates, C. J., E. L. Bradford, C. A. Krome, and J. Nairn. 2012. Effect of temperature on biochemical and cellular properties of captive *Limulus Polyphemus*. *Aquaculture* 334-337:30-38.

Hurton, L., and J. Berskon. 2006. Potential causes of mortality for horseshoe crabs (*Limulus polyphemus*) during the biomedical bleeding process. *Fisheries Bulletin* 104:293-298.

Kurz, W., and M.J. James-Pirri. 2002. The impact of biomedical bleeding on horseshoe crab, *Limulus Polyphemus*, movement patterns on Cape Cod, Massachusetts. *Marine and Freshwater Behaviour and Physiology* 35(4): 261-268.

Leschen, A. S., and S. J. Correia. 2010. Mortality in female horseshoe crabs (*Limulus polyphemus*) from biomedical bleeding and handling: implications for fisheries management. *Marine and Freshwater Behaviour and Physiology* 43(2):135-147.

12.3 Delaware Bay Region Biomedical Literature Summary

The Delaware Bay region is unfortunately lacking in quantity as far as independent biomedical research projects are concerned. However, the quality of the few papers available is fairly high. The two projects available for review are Hurton's 2003 thesis for VA Polytechnical Institute and Walls' and Berkson's 2003 Fisheries Bulletin entry. It should be noted that Hurton's thesis results were used to publish 3 subsequent papers that were also reviewed.

The most important part of these papers to consider when deciding how to judge the accuracy of mortality rates is the methods section. Hurton's methods were well designed and documented which helps lend credibility to the results. Two groups were analyzed for Hurton's experiment. The first group (n= 200, 100M 100F) was designated as the "low stress." This cohort was treated following BMPs. The second group (n= 195, 110M 85F) was designated as "high stress." This cohort was treated with external pressures beyond bleeding, including temperature fluctuation, salinity fluctuation, and other variables that horseshoe crabs may experience during transport and holding. Both groups were subjected to the same bleeding treatments: a control group of 0% bled, a group of 10% total hemolymph extraction, a group of 20% total hemolymph extraction, a group of 30% total hemolymph extraction, and a group of 40% total hemolymph extraction. In the low stress group, total mortality was 0%. In the high stress group, average mortality was 7.2% for combined males (6.4%) and females (8.24%). The highest recorded value of all five high stress treatments occurred with the 40% bled female group at 29.4%. It should also be noted that this is the only mortality value in the whole data set that is over 15% value currently used as the standard biomedical mortality rate.

The Walls Berkson study had comparable results to Hurton's thesis. Overall mortality for bled crabs was 8% (16 crabs) while unbled crabs had a total mortality of .5% (1 crab). The issue with this study is the lack of description in the methods section. The paper only states that the bled cohort "underwent BioWhittaker's normal bleeding process." Due to how drastically the treatment of crabs can vary I think this would have been an important place to include exact treatments, especially because the mortality levels were so low. The whole 3-year study included 8 separate cohorts resulting in a total of 200 unbled crabs and 200 bled crabs being observed. It should also be noted that all crabs in this study were MALE.

Paper	Reported Mortality Rate	Sample Size	Adherence to BMPs
Hurton, Berkson, Smith 2005	0% in low stress group 7.2% in high stress group (bled) 2.6% in high stress (unbled) 29.4% F crabs bled at 40% volume	Low stress group N = 200, bled crabs= 160 High Stress group N=195 , (110M 85 F) bled crabs = 156	BMPs followed in low stress group, purposely not followed in high stress group
Walls, Berkson 2003	unbled HSC average .5% (0-3.3%) bled HSC average 8% (0-30%)	total unbled N = 200 total bled N = 200	crabs "underwent BioWhittaker's normal bleeding process"

<u>Literature Cited</u>

Hurton, L. and J. Berkson 2005. Potential causes of mortality for horseshoe crabs (*Limulus polyphemus*) during the biomedical bleeding process. Fishery Bulletin 104:293-298.

Hurton, L., J. Berkson, and S. Smith 2005. Estimation of total hemolymph volume in the horseshoe crab *Limulus polyphemus*. Marine and Freshwater Behaviour and Physiology 38(2):139-147.

Walls, E.A. and J. Berkson 2003. Effects of blood extraction on the horseshoe crab, *Limulus polyphemus*. Fish. Bull. 101:457-459.

12.4 Southeast Region Biomedical Literature Summary

A total of 5 studies have been conducted through the South Carolina Department of Natural Resources over a >20-year time-frame to assess the mortality associated with biomedical processing of American horseshoe crabs, *Limulus polyphemus*. Most of these studies were conducted in collaboration with the biomedical bleeding facility located in Charleston, SC (Endosafe, Inc.). For these studies, horseshoe crabs were harvested and handled in accordance with industry standards by Endosafe before SCDNR representatives randomly selected individuals for control groups, which were not bled, and treatment groups, which were bled. Following this process, horseshoe crabs were then followed for 7-14 days to assess mortality. One study, Linesch (2017), did not use crabs provided by Endosafe, but rather collected crabs themselves and independently simulated the biomedical bleeding process including holding of crabs in ponds prior to extraction of hemolymph, and then following crabs for 12 days. Estimates of total mortality from these studies range from 6.6% to 20.4%, with a mean mortality estimate of 12.3%. Additional results from the Linesch (2017) study, as well a study conducted in the northeast region (Owings 2017), show that biomedical processing can reduce the physiological fitness of horseshoe crabs that survive biomedical processing. While the mortality of biomedically-bled horseshoe crabs after 14 days has not been assessed in the southeast, the reduced physiological function associated with biomedical processing suggests that there is an increased risk to mortality that extends beyond this 14-day window of previously-conducted experiments. As such, there does not appear to be sufficient evidence to change the current 15% mortality rate for biomedically-processed horseshoe crabs in the Southeast region.

Table 1. Summary of biomedically-related mortality assessments conducted in South Carolina

Citation	# of Crabs	Mortality	Study Description
SCDNR (1999)	267	6.60%	Selected crabs from biomedical facility (133 un-bled, 134 bled). Tracked for 14 days
Thompson (1999)	40	15.00%	Selected crabs from biomedical facility (20 un-bled, 20 bled). Tracked for 7 days
Wenner & Thompson (2000)	150	8.30%	Selected crabs from biomedical facility (75 un-bled, 75 bled). Tracked for 14 days
DeLancey & Floyd (2012)	100	20.40%	Selected crabs from biomedical facility (50 un-bled, 50 bled). Tracked for 14 days
Linesh (2017)	96	11.00%	Hand-harvested crabs from beach (48 un-bled, 48 bled). Tracked for 12 days

Literature Cited

DeLancey L & Floyd B (2012). Tagging horseshoe crabs*, Limulus polyphemus*, in conjunction with commercial harvesters and the biomedical industry in South Carolina. Final report South Carolina Sea Grant Consortium. Project #: R/CF-14.

Linesch K (2017) Evaluating best management practices in the South Carolina horseshoe crab fishery: A field approach to determine physiological impacts of the biomedical bleeding process. Thesis, College of Charleston.

Owings M (2017) Effect of the biomedical bleeding process on the behavior and physiology of the American horseshoe crab, *Limulus polyphemus*. Thesis, University of New Hampshire.

SCDNR (1999). An evaluation of *Limulus* post-bleeding mortality experiment data.

Thompson (1999) Assessments of the population biology and critical habitat for the horseshoe crab, *Limulus polyphemus*, in South Carolina. Thesis, Medical University of South Carolina.

Wenner E. & Thompson M. (2000). Evaluation of harvesting impacts and population trends for *Limulus polyphemus* in South Carolina. Final report to NOAA, MARFIN Grant #NA87FFO431.

12.5 Biomedical Literature Review by Dr. James Cooper

The LAL Biomedical Industry Impacts Positively on Horseshoe Crab Sustainability

Presented to the Stock Assessment Subcommittee of ASMFC by James F Cooper, PharmD*

About the Author

James Cooper in 1970 pioneered development of the LAL test as a sensitive detector of endotoxin (pyrogen) for injectable drug products. His publications span the history of LAL technology and horseshoe crab (HSC) conservation. He founded Endosafe Inc. in 1987. He is a consultant on endotoxin issues and is a retired Professor of Pharmaceutical Sciences at the Medical University of South Carolina, Charleston. In 1997 he began ASMFC service as a member of the team, headed by Tom O'Connell that drafted the Fisheries Management Plan for HSC. He has served on the HSC Advisory Panel since that time, including position of Chair for the past 12 years.

Introduction

This discussion briefly describes the life cycle of the Horseshoe crab (HSC) and critiques studies that attempt to understand the impact of biomedical bleeding processes upon donor crabs. Our understanding is incomplete, but we know a great deal about where and how HSC live. HSC are significant to the ecology of shallow-water marine life as prey, predators and hosts to a diverse array of epibionts on their shell, appendages and gills (Shuster and Sekiguchi 2003). These hitch-hikers affix to or infest HSC exterior surfaces and are significant factors in the aging and ultimate fate of their hosts. HSC require about nine-to-ten years and 16-18 molts to reach sexual maturity. In their early stages they are highly vulnerable to prey by birds, fish and other crustaceans. Juveniles and adults are prey for loggerhead turtles, sharks and other large sea creatures. Adults that are stranded on the beaches of Delaware Bay are susceptible to attack by laughing gulls. Humans negatively impact by loss of habitat (e.g., commercial and housing development) and exploitation of the resource. During spawning their eggs provide nutrition for a vast array of migratory shorebirds.

Large juveniles and adult HSC are opportunistic foragers in tidal flats and the ocean floor. In tidal flats, they prefer feeding on soft-shell clams and marine worms. A high concentration of large HSC predators, such as in Delaware Bay and the ACE Basin of South Carolina, has great impact on benthic invertebrates. Botton et al. (2003) observed that bivalves were the major diet of HSC in Delaware Bay tidal flats. Their examination of crabs dredged off the New Jersey coast found that their guts were stuffed with an average of 400 blue mussels.

Impact of the LAL Biomedical Industry on Horseshoe Crab Sustainability

The LAL biomedical industry impacts positively on HSC conservation because the importance of LAL makes them extremely valuable to mankind. Cooper and Levin (1971) developed a screening test for bacterial endotoxin in injectable drugs from LAL (*Limulus* amebocyte lysate) reagent. Subsequently, a robust LAL production industry (biomedical) flourished in the 1970s to meet the needs of the pharmaceutical and medical device industry. Five firms currently produce LAL. The LAL producers applied a return-to-sea policy from the outset. In 2011 they met with ASMFC to formalize Best Management Practices (BMPs). Mortality doesn't occur during the bleeding process of donor crabs, which is consistent with human blood donation.

Investigators designed experiments to determine if there was significant post-bleeding mortality after release of donor crabs to the environment. Reported mortality rates varied greatly. (Table 1). Rudloe (1983) observed a 11% loss in a release-and-recapture study in a Gulf Coast bay. Thompson (1998) found 15% mortality in a small study where 40 bled and un-bled HSC were kept for a week in a shallow sea-water tank. Dave Yadon (1999) observed an 8.3% loss where 252 bled and un-bled HSC were retained in a shallow sea-water tank. Walls and Berkson (2003) reported a loss of 8% where 400 HSC were held in replicated flow-through tanks for 2 weeks. Hurton and Berkson (2006) reported no loss under low-stress conditions, but a 8.3% loss under high-stress conditions. The results of these reports prompted the ASMFC to assign 15% as the estimated post-release mortality from biomedical processing.

A robust report by Linesch (2017) is consistent with the above studies. Linesch held 100 bled and 100 un-bled donors in low-density seawater ponds at Waddell Mariculture Center in Bluffton SC for up to 8 weeks. Mortality was 11%. This study generally emulated practices of a South Carolina LAL-production facility. An exception was that Linesch only studied females. In contrast, the LAL facility currently observes a 2.6 male/female ratio so that only 30% of donors are females. She observed that a high carapace epibiont load impacted negatively on physiological health metrics.

Two studies reported mortality significantly greater than previous reports. A small study of 56 crabs reported an 18% loss (Anderson, *et al*., 2013). The excessive stress and containment in multiple small tanks rendered the experimental conditions as not representative of biomedical LAL practices and unaligned with BMPs. For example, specimen were subjected to long periods out of water and high temperatures, methods that are offensive and not justifiable. The report speculated that bleeding suppressed spawning activity, but other reports contradict this claim (Linesch 2017; Spawn 2018; Figure 1).

More puzzling was the study by Leschen and Correia (2010) that reported the effects of two LAL treatment methods on HSC held in salt-water tanks at the MBL (Marine Biological Laboratory) in Woods Hole, MA. Female horseshoe crab were separated into three treatment groups of 99, 89 and 93; treatments were intended to emulate the processing of HSC at a nearby LAL firm.

Group 1 was the control group that was held out of water for 4 hours. Groups 2 and 3 were exposed to conditions mimicking an open boat deck, one-hour drive in a non air conditioned truck, being stored for 24 hours stacked in 30-gallon totes at room temperature, one-hour truck ride and a 15-minute boat ride. The HSC from Group 2 were held for six hours after the biomedical process and the HSC from Group 3 held overnight for 25 hours. Mortality of the un-bled control HSC was low (3%) and differed significantly from that of either bled group (22.5% and 29.8%, respectively).

The methods section specified that three groups of HSC were held in six flow-through seawater tanks that contained 5 cm of sediment. Tanks differed by volume and shared a common source and flow of seawater. A similar number of HSC from each treatment group and control were assigned to each tank. Although the mortality of HSC was similar for the two treatment groups, there was a significant difference in mortality with respect to the six tanks. Mortality did not align with treatment group. Since the author's data in Table 3 obscured the variation by tank, their results were reconfigured to reveal the unexplained variation in mortality by tank (Fig. 2), which the authors admit. The tank rates varied from 8.7% to 48%. There were apparently three populations in the study. The mortality rate for tanks 1 and 4, which contained 55 HSC, was 12.7%. The mortality rate for tanks 2, and 6, which contained 72 HSC, was 26%. The rate for tanks 3 and 5 was 45%; one control crab died in each of these tanks. Mortality was determined by multiplying the predicted mortality rate times the number of crabs per tank per treatment (Table 3 of Leschen and Correia 2010). This unexplained difference in mortality indicated that there was an apparent risk factor in at least two of the tanks, such as a chemical or microbial contaminant, or failure to maintain a condition, such as oxygen, that impacted negatively on female HSC that were stressed by bleeding. The reported 45% mortality rate for tanks 3 and 5 is significantly distinct from the other 4 tanks in the study as well as previously reported estimated mortality studies. In summary, this study encountered unforeseen experimental circumstances that apparently produced falsely-high, post-release mortality estimates. This flawed study should be excluded from reports that are used to define LAL-related mortality estimates.

For an estimated mortality to be applicable to biomedical procedures, it must be consistent with the Best Management Practices (BMPs) accepted by the ASMFC and LAL firms in 2011. These procedures generally describe the collection, inspection, handling, bleeding, training and return policies of biomedical firms. The value of excessive-stress studies that do not follow the BMPs are only indicative of the resilience of donor crabs in the presence of taxing conditions. The great limitation of most HSC mortality studies is that the donor crab is not returned to a preferred foraging site (see above), such as a tidal mud flat, but is retained in an artificial container in a high density. Also, control of ambient salinity, temperature, acidity and oxygen is challenging. HSC are 2-to-5 kg, large animals that generate considerable waste that must be managed. The ideal mortality experiment would require study of recently molted crabs that were returned to a natural environment, a costly and challenging experiment to manage.

Technical advances reduce LAL needs. Charles River Labs attained FDA approval for a LAL-cartridge based system that reduces the need for LAL by 95%. Recombinant LAL products (rFC) are being evaluated for robustness, specificity and sensitivity. The FDA has zero tolerance for endotoxin contamination and will not approve these products until they are validated as equivalent and specific as LAL for endotoxin detection. Several years of product development and costly validation will be required before drug regulators and pharmaceutical industries will rely on a recombinant product.

Finally, the biomedical community has had a positive impact on HSC populations through 45 years of consistent conservation practices. The actual mortality from biomedical procedures is likely in single digits because the reported mortality studies present worst-case estimates. Biomedical efforts have produced either limits or bans for the HSC bait fishery in South Carolina and the Delaware Bay area. Public education is important; by placing a value on HSC for LAL, the public reveres HSC and watermen no longer destroy HSC collected as by-catch.

Conclusions

- Simulated post-bleeding mortality studies that are generally compatible with the biomedical BMPs indicate that the estimated biomedical mortality is less than 15%.
- Post-bleeding mortality studies that are generally incompatible with the biomedical BMPs are irrelevant to a mortality estimate and should not be used for that purpose.
- There is no credible evidence that biomedical use threatens the sustainability of the horseshoe crab or availability of eggs for migratory birds.
- The net effect of the biomedical industry for HSC sustainability is positive because of consistent and unique conservation efforts.

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12.6 Biomedical Literature Review by Benjie Swan

Biomedical Use and Mortality Rates of Horseshoe Crabs, *Limulus polyphemus*

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Introduction

A horseshoe crab fishery has existed since the late 1800's with millions caught and reported, predominately in the Delaware Bay. The early harvests of horseshoe crabs became fertilizer for farm fields and feed for livestock until the 1900's. The large annual harvests of horseshoe crabs eventually dwindled and attention on the horseshoe crabs focused on its study with respect to human physiology and health which earned Dr. Hartline a Nobel Prize for his work. In the 1980's and 1990's, the horseshoe crab fishery grew as more horseshoe crabs were being harvested for eel and conch bait. At the same time, the link was discovered between horseshoe crabs and migratory shorebirds. The monumental importance of the horseshoe crab became apparent and the need for its management was recognized.

In response to the bait harvest of the horseshoe crabs, State regulations were introduced and eventually, a coast wide management plan was adopted in 1998 by the Atlantic States Fisheries Commission (ASMFC). Unlike other fishery plans, the Interstate Fishery Management Plan (FMP)for the Horseshoe Crab considered both the sustainability of the horseshoe crab population and the dietary demands of the migratory shorebirds. (The shorebirds feed on horseshoe crab eggs that are brought to the surface by large numbers of spawning horseshoe crabs.) Focusing primarily on the Delaware Bay region, seven addendums to the FMP followed, reducing the bait harvest of almost 3 million in 1998. Under the FMP, a current quota of 1,587,274 horseshoe crabs is allowed, however the 2016 actual harvest of 787,223 was much lower due to some states being more restrictive.

Another unique component of the horseshoe crab fishery is that horseshoe crabs are collected and used to manufacture, Limulus Amebocyte Lysate (LAL), a product critically connected to human health. This rather obscure product has tested human injectable drugs and medical devices from potentially life threatening bacteria for almost 50 years. LAL is produced from live horseshoe crabs, a marine species and horseshoe crabs, similar to human blood donors, are bled and then released alive in order to make the product.

Horseshoe crabs collected for manufacturing LAL are categorized as "biomedical" and governed separately from the bait fishery due to its critical use and the low mortality associated with the process. From the ASMFC Fishing Year Reports spanning the years 2004 to 2016, the average number of horseshoe crabs collected for biomedical use is 462,670, with 5,086 reported dead. It is presumed that some of the horseshoe crabs may die after bleeding and that average is 58,721 from the same time frame (Table 1).

Table 1. Biomedical horseshoe crab mortality numbers.

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Reported Observed Mortality of Horseshoe Crabs for Biomedical Use	4,391	4,256	4,639	3,599	2,973	6,523	6,447	8,485	7,396	5,485	5,658	5,250	1,015
Estimated Post Bleeding Mortality of Bled Biomedical-Only Crab (15% est.mortality)	41,279	40,574	44,543	59,833	60,312	53,252	65,319	75,117	74,882	65,535	64,846	70,118	47,765
Number of Crabs Brought to Biomedical Facility (bait and biomedical crabs)	343,126	323,149	367,914	500,251	511,478	512,853	552,083	623,680	624,440	554,419	536,798	564,526	426,195*

As more attention is focused and more information is gathered on the horseshoe crab population and harvest numbers, more precise accounting is being called for, specifically for the Stock Assessment. Although the number of horseshoe crabs that die in order to manufacture LAL is a miniscule fraction of the coast wide population of horseshoe crabs, pressure has been placed to continually revisit the mortality rates. The number of horseshoe crabs that die due to biomedical processing is being analyzed as there is a large discrepancy between what the biomedical companies report as dead and the number of horseshoe crabs that are estimated to die because of the "bleeding" process. This paper examines the mortality studies associated with biomedical processing and assesses their applicability (Table 2).

History of LAL

The use of horseshoe crabs to manufacture LAL began with the discovery by Dr. Frederick Bang, a professor at Johns Hopkins University. He observed that the horseshoe crab's blood would clot when injected with live or dead gram negative bacteria (Bang 1956) and, working with Jack Levin, discovered the clotting phenomenon was localized in the amebocytes or white blood cells of the horseshoe crab (Levin and Bang 1964). James Cooper, a graduate student at Johns Hopkins and an employee of the United States Food and Drug Administration (US FDA) applied the horseshoe crab derived product to test radiopharmaceuticals for bacterial contamination. The in vitro (Limulus) test was more sensitive, easier to use and less costly than the in vivo (rabbit) test used at the time (Cooper et al. 1971 and 1972). In 1973, the US FDA declared that LAL was a biological product and was subject to licensing requirements as provided in Section 351 of the Public Health Service and in 1977, issued licensing for LAL production. Once the FDA Draft Guidelines for the LAL test was published in 1987, its use became more widespread and gradually replaced the Rabbit Pyrogen Test.

Table 2. Mortality studies summary.

Study	Year	Type of Study	Collection Time of Year	Total Time Held for Bleeding Process	Time Held After Study	Sample Size	Sample Size Female	Sample Size Male	Number Unbled	Dead Females	Dead Males	Mortality Rate of Unbled HSC	Number Bled	Dead Females	Dead Males	Mortality Rate of Bled HSC
Rudloe	**1983**	Mortality/Tagging	April 28 to May 30th	Time out of water 30 minutes	0	10,259	*	*	5,437	38 Not Sexed	*	*	4,822	47 Not Sexed	*	10% First Year/11% Second Year
Rudloe	**1983**	Behavior/Tank	*	*	30 days	80	40	40	40	2 Not sexed	*	5%	40	1 Not Sexed	*	2.5%
Thompson	**1998**	Mortality/Tank	May	BMP	7 days	40	20	20	20	0	0	0%	20	0	3	15%
Thompson	**1998**	Mortality/ Tagging	May/June	BMP	0	1,328	851	477	734	15	6	2.86%	594	0	0	0.00%
Endosafe	**1999**	Mortality/Pond	20-May	BMP	14 days	267	133	134	120 recaptured	1	1	1.67%	132 recaptured	4	7	8.33%
Kurz and Pirrri	**2002**	Behavior/ Transmitters	July 2 to 8	Time out of Water 30 minutes	0	20 Total	20	0	10	0	0	0%	10	2	0	20%
Walls and Berkson	**2003**	Mortality/Tank	Jul-Aug	BMP	2 weeks	400 Total	*	400	200	*	1	0.5% Average	200	*	16	8.00% Average
		Trial 1	8-Jul	*	Jul 08-22,1999	*	*	20	10	*	0	0.0%	10	*	0	0.0%
		Trial 2	22-Jul	*	Jul 22-Aug 05, 1999	*	*	20	10	*	0	0.0%	10	*	3	30.0%
		Trial 3	19-Jun	*	Jun 19-Jul 03, 2000	*	*	60	30	*	0	0.0%	30	*	0	0.0%
		Trial 4	7-Jul-2000	*	Jul 07-21, 2000	*	*	60	30	*	0	0.0%	30	*	0	0.0%
		Trial 5	1-Aug-2000	*	Aug 01-15, 2000	*	*	60	30	*	1	3.3%	30	*	6	20.0%
		Trial 6	6-Jun-2001	*	Jun 06-20, 2001	*	*	60	30	*	0	0.0%	30	*	0	0.0%
		Trial 7	20-Jun-2001	*	Jun 20-Jul 04, 2001	*	*	60	30	*	0	0.0%	30	*	2	6.7%
		Trial 8	15-Aug-2001	*	Aug 15-29, 2001	*	*	60	30	*	0	0.0%	30	*	5	16.7%

Table 2. *Continued*.

Study	Year	Type of Study	Collection Time of Year	Total Time Held for Bleeding	Time Held After for Study	Sample Size	Sample Size Female	Sample Size Male	Number Unbled	Dead Females	Dead Males	Mortality Rate of Unbled HSC	Number Bled	Dead Females	Dead Males	Mortality Rate of Bled HSC
Hurton and Berkson	**2005**	Mortality/ Tank	9-Jul-2003	15-20 hours	2 weeks	Low Stressed	100	100	40	0	0	0.0%	160	0	0	0% Average
		Trial 1	*	*	*	10% Blood Extraction	*	*	*	*	*	*	40	0	0	0.0%
		Trial 2	*	*	*	20% Blood Extraction	*	*	*	*	*	*	40	0	0	0.0%
		Trial 3	*	*	*	30% Blood Extraction	*	*	*	*	*	*	40	0	0	0.0%
		Trial 4	*	*	*	40% Blood Extraction	*	*	*	*	*	*	40	0	0	0.0%
		Mortality/ Tank	28-Aug-2003	47 hours	2 weeks	High Stressed	85	110	39	0	1	2.6%	156	7	6	8.33% Average
		Trial 1	*	*	*	10% Blood Extraction	*	*	*	*	*	*	39	1	0	2.6%
		Trial 2	*	*	*	20% Blood Extraction	*	*	*	*	*	*	39	0	2	5.1%
		Trial 3	*	*	*	30% Blood Extraction	*	*	*	*	*	*	39	1	3	10.3%
		Trial 4	*	*	*	40% Blood Extraction	*	*	*	*	*	*	39	5	1	15.4%
Leschen, Correia	**2010**	Mortality/ Tank	2-Jun	4 hours out of water	17 days	Group 1-Control (Unbled)	99	*	99	Not Reported	n/a	3% Average	*	*	*	*
		Trial 1	*	*	*	Tank 1	*	*	16	Not Reported	n/a	1.7%	*	*	*	*
		Trial 2	*	*	*	Tank 2	*	*	21	Not Reported	n/a	2.8%	*	*	*	*
		Trial 3	*	*	*	Tank 3	*	*	16	Not Reported	n/a	6.1%	*	*	*	*
		Trial 4	*	*	*	Tank 4	*	*	13	Not Reported	n/a	0.8%	*	*	*	*
		Trial 5	*	*	*	Tank 5	*	*	16	Not Reported	n/a	4.3%	*	*	*	*
		Trial 6	*	*	*	Tank 6	*	*	16	Not Reported	n/a	2.4%	*	*	*	*

Table 2. *Continued*.

Study	Year	Type of Study	Collection Time of Year	Total Time Held for Bleeding	Time Held After for Study	Sample Size	Sample Size Female	Sample Size Male	Number Unbled	Dead Females	Dead Males	Mortality Rate of Unbled HSC	Number Bled	Dead Females	Dead Males	Mortality Rate of Bled HSC
Leschen, Correia	**2010**	Mortality/ Tank	2-Jun	6 hours	17 days	Group 2	89	*	*	*	*	*	89	Not Reported	*	22.5% Average
Continued		Trial 1	*	*	*	Tank 1	*	*	*	*	*	*	15	Not Reported	*	15.2%
		Trial 2	*	*	*	Tank 2	*	*	*	*	*	*	19	Not Reported	*	22.5%
		Trial 3	*	*	*	Tank 3	*	*	*	*	*	*	13	Not Reported	*	40.0%
		Trial 4	*	*	*	Tank 4	*	*	*	*	*	*	14	Not Reported	*	7.2%
		Trial 5	*	*	*	Tank 5	*	*	*	*	*	*	14	Not Reported	*	31.4%
		Trial 6	*	*	*	Tank 6	*	*	*	*	*	*	14	Not Reported	*	20.3%
		Mortality/ Tank	2-Jun	25 hours	17 days	Group 3	93	*	*	*	*	*	93	Not Reported	*	29.8% Average
		Trial 1	*	*	*	Tank 1	*	*	*	*	*	*	17	Not Reported	*	20.3%
		Trial 2	*	*	*	Tank 2	*	*	*	*	*	*	21	Not Reported	*	29.3%
		Trial 3	*	*	*	Tank 3	*	*	*	*	*	*	14	Not Reported	*	48.7%
		Trial 4	*	*	*	Tank 4	*	*	*	*	*	*	9	Not Reported	*	9.9%
		Trial 5	*	*	*	Tank 5	*	*	*	*	*	*	15	Not Reported	*	39.5%
		Trial 6	*	*	*	Tank 6	*	*	*	*	*	*	18	Not Reported	*	26.5%
Anderson, Watson III, Chabot	**2013**	Mortality/ Tank	May 15-23	52 Hours	6 Weeks	56 Total	56	*	28	0	*	0% Average	28	5	*	17.9% Average
		Trial 1	June 06-08 Date of Bleeding	*	*	OU Tank	14	*	7	0	*	0%	7	0	*	0.0%
		Trial 2	June 01-03 Date of Bleeding	*	*	LRW Tank	14	*	7	0	*	0%	7	1	*	14.3%
		Trial 3	June 01-03 Date of Bleeding	*	*	LU Tank	14	*	7	0	*	0%	7	1	*	14.3%
		Trial 4	June 01-03 Date of Bleeding	*	*	LCT Tank	14	*	7	0	*	0%	7	3	*	42.9%

Manufacture of LAL

In August 1978, the Federal Register publication of proposed rules stated “There will be an adequate and available supply of source material, and to guarantee that the manufacture of LAL will not have an adverse impact on existing crab populations, the horseshoe crabs shall be returned alive to their natural environment after a single collection of blood” (Federal Register 1978). Another rule under general requirements regarding handling of the horseshoe crabs read “The horseshoe crabs (Limulus polyphemus) from which blood is collected for production of the lysate, shall be handled in a manner so as to minimize injury to each crab.” (Federal Register 1980).

Prior to obtaining a license to sell LAL, companies enter a Biologic License agreement that adheres to the US FDA rules and requirements. Within that agreement, companies adhere to practices for the collection, handling, transport, bleeding and release of the horseshoe crabs that maximizes their well being and survival. In 2011, LAL companies in conjunction with ASMFC formalized these practices into Best Management Practices (BMPs). The 42 practices are documented in Table 3.

The manufacturing of LAL is entirely dependent on obtaining live and healthy horseshoe crabs. Depending on the location of the company along the eastern seaboard, the "bleeding season" varies in time of the year and duration. Horseshoe crabs are collected by hand when the horseshoe crabs are along the beaches, or by trawling when the crabs migrate to deep water. The horseshoe crabs are only accessible certain times of the year governed by weather and fishery regulations and cannot be stored or frozen for later use.

The health of the horseshoe crab from the collection to its release is of the utmost importance in order to obtain a quality product and a high survival rate of the bled horseshoe crabs. To avoid the hotter temperatures and sun of the day, the vast majority, if not all of the horseshoe crabs, are collected at night and transported in the early morning hours to the Laboratory for the "bleeding" process. The collected horseshoe crabs are carefully inspected for activity levels and injuries. The inspection is important for two reasons, injured or lethargic animals may introduce contamination into the sterile process and/or create a poor quality product and secondly, injured or slow moving horseshoe crabs may not survive the bleeding process. The rejected horseshoe crabs are not bled and returned to the water, to increase their odds of survival.

Only healthy crabs are bled; the blood flow is fast and steady initially and then slows to a drip. The blood is not extracted, but flows freely from the crab's open circulatory system. The actual "bleeding" of the crab takes minutes while the next steps of isolating and breaking open the white blood cells are labor intensive and require a full day. The bleeding process does not result in the death of the horseshoe crabs, and they are returned to the water adhering to the "Return to Sea" policy established from the onset of LAL manufacture.

Table 3. Best Management Practices (BMPs) for Biomedical Horseshoe Crabs.

Collection

 For targeted horseshoe crab trawl tows, reasonable tow times, recommended at 20-30 minutes bottom time (winches locked)

 Proper care and handling of horseshoe crabs while sorting and placing into bins

 Avoid exposure to direct sun, extreme temperatures as well as rapid temperature changes

 Night harvesting is recommended during periods of excessive heat

 During collection, sort out juveniles and do not bleed

 Sort out and return to the water individuals that do not appear to be healthy (damaged, slow movement, dull shell/old)

 When possible, release juveniles or unhealthy individuals immediately and do not transport to the facility

 Educate collectors in proper handling techniques

 Specify expectations of collectors in written contracts

 Periodically audit horseshoe crab collectors on implementation of BMPs for collecting

Transport to Facility

 Maintain temperature between approximately ambient water temperature at time of collection and 10ºF below ambient-water temperature

 Maintain good ventilation while stacked in bins

 Limit number of horseshoe crabs to a suitable number, dependent on container size and shape, and avoiding over-stacking to minimize damage to other horseshoe crabs

 Minimize travel time

 Keep bins and horseshoe crabs covered to protect against direct sunlight

 Secure containers in transport vehicle

Holding at Facility (Preparation for Bleeding/Bleeding)

 Limit holding time, under normal circumstances, at the facility to less than 24 hours

- No prolonged exposure to fresh water
- Follow written procedures for proper care and handling when sorting horseshoe crabs and moving them between bins and within the facility
- Inspect crabs for health and damage, selecting only undamaged and healthy crabs for bleeding
- Maintain clean, sanitary conditions during bleeding
- Maintain same level of care for rejected crabs that are not bled while being held until released back to sea

Holding at Facility (Preparation for Bleeding/Bleeding)(continued)

- Avoid bleeding crabs more than once per year
- If crabs are marked to avoid re-bleeding, ensure that the mark is residual and not harmful to the crab
- Bleed until rate slows down so that excessive bleeding is prevented
- Continue 30-year policy of not attempting to suction additional blood from the horseshoe crabs
- Perform internal audits to maintain quality control over written procedures

Table 3. *Continued*.

Post-Bleeding Holding

- Recognizing that the horseshoe crabs are now stressed from the bleeding process, maintain the same level of care as that used when transporting horseshoe crabs into the facility for bleeding
- Return to the water as soon as possible. If not being returned to the area of capture, ensure that conditions (salinity, water temperature, etc.) are similar to those found at the harvest site
- Minimize holding time post-bleeding
- While in holding, keep horseshoe crabs in the dark to minimize movement and injury
- Keep horseshoe crabs well-ventilated, moist, and allocate only a suitable number of crabs to holding containers
- Do not keep crabs out of the water for longer than 36 hours in total

Return to Sea

- Use same care in handling and transporting crabs being returned to the water

- Include return written instructions and requirements within contract with collectors, if applicable
- Periodically audit horseshoe crab collectors on implementation of BMPs for returning

Overarching practices for all steps

- Generate written procedures for all handlers of horseshoe crabs, covering all steps in the process from collection to release
- Keep horseshoe crabs cool, moist and covered, avoiding direct sunlight
- Establish a dialogue among collectors, the biomedical company, and the state regulatory agency to address concerns and challenges
- Have a written contract between collectors and the biomedical company, outlining practices and expectations
- Perform audits of the various steps and contractors/employees throughout the process
- Ensure proper monitoring and recording of mortality at each step in the chain of custody

Biomedical Numbers

The use of horseshoe crabs for the manufacture of LAL was fully established after the FDA issued Draft Guidelines in 1987. James J. Finn, a lysate manufacturer, located along the Delaware Bay shore, connected the biomedical use of the crab to fishery management and began reporting the number of horseshoe crabs used for LAL production. Finn's 1991 report on the first Delaware Bay spawning survey of horseshoe crabs estimated biomedical use to be about 130,000 in 1989, the onset of LAL manufacturing. About 280,000 crabs were bled in 1998 and 2000 based on a survey conducted by the ASMFC Horseshoe Crab Technical Committee in 2001.

These early estimates of biomedical use relied on yearly reports submitted by the biomedical companies to their respective State. In 2004, the ASMFC adopted Addendum III which required standardized reporting from the states with biomedical collection in order to obtain the number of biomedical horseshoe crabs collected coast wide. The number of horseshoe crabs collected averaged 462,670 during the years 2004 to 2016. However, even with standard reporting, it is difficult to compare yearly numbers as biomedical collection has changed in response to the FMP and its Addendums. For example, there was an increase in the biomedical numbers in 2006 possibly due to Addendum VI which encouraged the use of more males.

In addition to the submitted fishery information, companies are required to track their mortality numbers from collection to release at six steps.

Step 1. The horseshoe crabs are collected by hand or trawl.

Step 2. They are transported to the Laboratory.

Step 3. They are handled prior to bleeding.

Step 4. They are bled.

Step 5. They are handled and transported prior to release.

Step 6. They are released.

Mortality in the biomedical fishery is computed in two steps. First, mortality is determined from actual numbers of horseshoe crabs reported dead by the biomedical companies. The horseshoe crabs for biomedical use are donors, caught alive and released alive. Inherently, in any fisheries there is a mortality rate associated with the catch and release. This number is easily accountable and is part of the scrutiny of the horseshoe crabs used for bleeding. Both slow moving and dead horseshoe crabs are rejected as unresponsive and their numbers are about one percent of the total number of collected horseshoe crabs. The number of horseshoe crabs rejected for unresponsiveness are listed as mortal horseshoe crabs in the ASMFC tables. There is not an additional mortality associated with slow moving horseshoe crabs.

Besides demise, the crabs are carefully inspected for injuries, even the slightest injuries are noted and the horseshoe crabs are not bled. The horseshoe crabs rejected due to minor injuries will survive. Leschen and Correia (2010) worked with 310 collected horseshoe crabs for biomedical use and rejected 12 of the horseshoe crabs for bleeding. The biomedical company inspected the remaining 298 horseshoe crabs and after their scrutiny, rejected an additional 17 crabs for reasons unseen by the untrained eye. Although the horseshoe crabs were deemed not fit for bleeding, their injuries were so minor that Leschen and Corriea (2010) considered the rejected horseshoe crabs as adequate to use for the control group, an indication of their survival.

The second part for computation is a 15% mortality rate applied to all bled crabs assuming there would be some degree of post-bleeding mortality. Initially, the mortality rate of 10% reported by Rudloe in 1983 was used but after additional mortality studies were published, the post bled mortality rate was raised to 15%. However, the post-bleeding mortality that may occur is much harder, almost impossible to decipher.

Mortality Studies

Rudloe (1983)

The effect of bleeding on the horseshoe crab population was first studied by Ann Rudloe, 35 years ago, funded by the US FDA in response to the use of horseshoe crabs for LAL manufacturing. Her work is the most well known and cited for the mortality rate calculated for the horseshoe crabs.

The bulk portion of Rudloe's study focused on the release and recaptures of 10,062 bled and unbled animals within St. Joseph Bay along Florida's Gulf Coast. Both groups of animals were treated in the same manner and out of the water for about 30 minutes. Half of the animals were bled until the flow slowed to an intermittent drip similar to a "trained bleeder". The number of recaptures was 1,415 with 85 dead. Rudloe attributed a 10% greater mortality with bled crabs than unbled the first year and 11% the second year.

Another part of her study was a pen experiment that held the horseshoe crabs after bleeding to determine their survival. During the course of her study, Rudloe realized the difficulty in maintaining horseshoe crabs and designed a small scale tank study. Eighty adult horseshoe crabs were collected and half were bled. Both sets of crabs were placed in a pen and held for 30 days. Two unbled animals died (5%) and one bled female died (2.5%). The dead animals were noted as having "poor eye and shell condition" indicating they may have been older and in questionable health.

Rudloe also investigated the activity of the bled horseshoe crabs. Sixty horseshoe crabs, half bled and half unbled, were placed in a tank and their activity levels were gauged by chart deflections. Sixteen comparisons were performed between the control and the bled groups, in six cases there was no significant difference between the groups, in six cases the bled horseshoe crabs were more active and in four cases the control group was more active. Her tagging study also observed that the movements of unbled and bled horseshoe crabs were almost identical.

Thompson (1998)

The biomedical company in South Carolina, Endosafe, in conjunction with a graduate student from the College of Charleston, conducted a mortality rate study. Prompted by the acceptance of the FMP in 1998, both a tagging study and a preliminary tank study were performed to determine a mortality rate of horseshoe crabs bled by Endosafe.

Thompson tagged 734 unbled (non LAL) and 594 bled (LAL) horseshoe crabs in 1997. The 594 tagged LAL animals were selected from the horseshoe crabs transported, held and bled at the laboratory. The unbled animals were released along the spawning beaches where the study was being conducted and the bled animals were released at their usual release point in a more remote location. The mortality rate of the non LAL animals was 2.86%, 15 dead females and 6 dead males. The mortality rate for the bled animals was 0% with seven live recaptures reported. It should be noted the recapture rate for the LAL animals (1.18%) was much lower than the non-LAL crabs (12.94%) most likely due to their release in a remote area.

Thompson's preliminary tank study in 1996 used 40 horseshoe crabs specifically collected for biomedical use. The forty horseshoe crabs were collected, transported, and handled the same way except twenty crabs, ten males and ten females, were bled by Endosafe. After the bleeding process, both groups of horseshoe crabs were placed in a single tank that was drained daily to clean the water, and they were fed for seven days. Three of the 20 bled females died, resulting in a 15% mortality rate.

Endosafe, Inc. (1999)

Following Thompson's thesis work, Endosafe conducted another mortality study with the approval of South Carolina Department of Natural Resources (SCDNR) and the AMFC Technical Committee in May of 1999. Horseshoe crabs were randomly selected from horseshoe crabs collected for biomedical use and subjected to the same environmental conditions except half were bled and the other half unbled. The animals are marked with paint and a scratch mark and 133 unbled animals and 134 bled animals were released into a pond for a two week holding period. After the holding period, 120 horseshoe crabs from the control group and 132 bled crabs were accounted for. One male and one female died from the control group resulting in an overall mortality rate of 1.67%, and seven males and four females died from the bled group, 8.33% mortality. (It was noted that the bled animals were left out in the sun longer than the control group waiting for the marking paint to dry.)

Kurz and Pirri (2002)

Kurz and Pirri (2002) studied the movements of bled and unbled horseshoe crabs via transmitters upon release into Nauset Estuary, a small embayment in Massachusetts. Twenty female horseshoe crabs that were greater than 200 mm in size and free of epibionts were hand collected during the spawning season from mid May to early July. Ten of the crabs were bled until the blood flow slowed, losing 90 mL of blood. The crabs were not out of the water for longer than 30 minutes and released from July 2nd to July 8th.

Kurz and Pirri reported a more random movement pattern with the bled group than the unbled group but found no difference in their average rate of movement. There was also no significant difference in their spatial distribution with 17 of the 20 crabs, nine control crabs and eight bled crabs, located in the same spawning area.

During their study, Kurz and Pirri found two of the ten bled crabs were deceased after 28 days and 68 days. They reported a mortality rate of 20% and added that it may have been an artifact of low sample size designed for their behavioral study.

Walls and Berkson (2003)

Walls and Berkson (2003) researchers from Virginia Technological University worked directly with a LAL company, BioWhittaker/currently Lonza, to study the mortality rate of their bled horseshoe crabs. The crabs were trawl collected during July and August 1999, 2000 and 2001 in waters off Chincoteague, Virginia or Ocean City, Maryland. A small number of newly matured male horseshoe crabs were selected for study in order to limit any variation between the control and bled groups. The two groups were handled the same way and under the same conditions with the exception that half were bled according to the biomedical company's usual procedure. After the bleeding procedure, the horseshoe crabs were packed in coolers, transported to Hampton, Virginia where equal numbers of control and bled horseshoe crabs were placed in four replicated flow through holding tanks for a two week holding period. This process was repeated eight times over the course of the study.

The combined mortality rate for the eight two week period is 0.5% for the unbled animals (1 unbled crab died of 200) and 8% for the bled crabs (16 bled crabs died of 200). The mortality rates from the 8 periods were varied, ranging from 5 to 30% mortality for the bled individuals. The results from four of the periods resulted in 0% mortality while the other four periods resulted in 3 out of 10 crabs (30%) , 6 of 30 (20%), 2 of 30 (6.67%) and 5 of 30 crabs (16.67%) die.

Hurton and Berkson (2005)

Hurton and Berkson (2005) along with the biomedical company, Cambrex/ currently Lonza, expanded on their 2003 work and studied if mortality was directly related to the amount of blood taken from the horseshoe crabs and/or the stress level of the horseshoe crabs. The crabs were trawl collected from Ocean City, Maryland and transported to Virginia Tech, Blacksburg, Virginia.

During Experiment 1, a group of 100 males and 100 females were left out of the water for 15-20 hours at 21 degrees C and were considered "lower stressed" animals. They were bled with varying amounts of blood taken based on a predicted blood volume calculated using the crab's intraocular distance, The crabs were separated into five groups; a control group and four groups with 10%, 20%, 30%, 40% blood taken. The bled crabs were returned to the water tanks and monitored for 2 weeks. There were no deaths within any of the groups.

During Experiment 2, a "higher stressed" group of 110 males and 85 females were exposed to varying levels of blood loss. The stress included 47 hours out of the water and temperatures reaching 36 degrees C. Fourteen horseshoe crabs died; 1 unbled male died, 1 bled female died at 10%, 2 bled males died at 20%, 4 bled crabs at 30% and 6 bled crabs died at 40%. The overall resultant mortality was 8.3% compared to 2.6% for unbled animals. The study indicated with high stress more deaths may occur as blood loss is increased. Hurton and Berkson noted that the bleeding volume for a biomedical company would be in the range of 10% blood loss and the mortality rate of 10%.

Leschen and Correia (2010)

Leschen and Correia (2010) researched the mortality rates of bled animals in Massachusetts in response to stressful conditions and if their survival rate increased if they are returned to the water quicker. Leschen and Correia's study separated the horseshoe crabs into three treatment groups, Group 1 of 99 crabs, Group 2 of 89 horseshoe crabs and Group 3 of 93 crabs. Group 1 was the control group that was held out of water for 4 hours and Groups 2 and 3 were exposed to conditions mimicking an open boat deck, one hour drive in non air conditioned truck, bleeding until the blood clots (30% blood extraction), being stored for 24 hours stacked in 30 gallon Rubbermaid totes at room temperature, one hour truck drive and a 15 minute boat ride. The crabs from Group 2 were held for six hours after the biomedical process and the crabs from Group 3 held overnight, 25 hours. The three groups were distributed in six different tanks and monitored.

The mortality rates for the control group was 3.01% (reported) and for Group 2, 22.5% (reported) and Group 3 29.8% (reported). There was no significant differences in the number of crabs per tank, ranging from 6.1 to 7.2, dissolved oxygen levels, ranging from 8.6 to 9.1 or the water temperatures, ranging from 15.4 to 15.7. However, the mortality in Tank 3 was greater than the other Tanks for the three groups, followed by the mortality rates in Tank 5. Tank 4 had the lowest mean Dissolved Oxygen (DO) concentration and the lowest mortality while Tank 3 had the highest DO and highest mortality. It is appears although not significantly different, there was a tank effect.

Anderson, Watson III, Chabot (2013)

Anderson, Watson III and Chabot (2013) studied the impact bleeding has on the horseshoe crabs' locomotion and hemocyanin levels. They collected 56 female horseshoe crabs at spawning beaches at Adams Point, Great Bay, Durham, New Hampshire from 15th to 23rd of May 2012. Due to laboratory restraints, the horseshoe crabs were sorted according to size and distributed into four tanks. The tanks were identified as the Outdoor tank - OU with the largest size animals, the Laboratory Running Wheel tank - LRW with the smallest horseshoe crabs and the Laboratory Unrestrained tank - LU and the Laboratory Communal tank - LCT with the medium size animals.

For the bleeding process, the four groups of horseshoe crabs were exposed to a total of 52 hours of varying temperatures and conditions, meant to mimic biomedical practices. During the 52 hours, the LRW, LU and LCT groups were exposed to sunlight for four hours in a barrel and then kept in the barrel after it was covered for an additional four hours and maximum temperatures reaching 37 degrees C. The Outdoor group was not exposed to the direct sunlight and only subjected to maximum temperatures reaching 28 degrees C. The behavior study resulted in five bled horseshoe crabs dying, three on the second day from the LCT tank and two on the third day from the LRW and LU tanks. No bled crabs (0%) died in OU tank.

Anderson et al. found that the bled horseshoe crabs had decreased activity and expressions of tidal rhythms after two weeks of bleeding. The bled crabs also exhibited decreased linear and angular velocities in the first week after bleeding but resumed normal linear velocities after 3 weeks. The greatest effect of the bleeding process was the long term declines in the hemocyanin concentrations.

Assessing the Mortality Studies

The papers provide differing estimates for the mortality rates associated with unbled and bled horseshoe crabs. Some of the papers reported the average mortality rate from a number of experiments. There were 25 separate mortality rates for the control or unbled groups from the reviewed studies and their individual experiments. Assigning no relevance to the 25 estimates, the mortality rate for the unbled horseshoe crabs averaged 1.34% with 14 rates having zero deaths and the remaining rates ranging from 0.8% to 6.10%. If the average ten mortality rates are used, the average mortality rate was 1.56%, with four zero rates and the remaining rates ranging from 0.5% to 5%.

For bled animals, there were 39 individual rates and 13 estimates that were stated or averaged. The average of the 39 individual experimental rates was 14.25% with 10 rates that were zero and the rest ranging from 2.5% to 48.7%. If the 13 average estimates and stated were averaged, the resultant mortality rate is 11.80% with rates ranging from 2.5% to 29.80%. Nine of the 13 rates were below 15% mortality. The highest rates were from the studies conducted in Massachusetts meant to mimic the biomedical practices. The highest average rates reported were 17.9 % from Anderson et al. (2013), 20% from Kurz and Pirri (2002), and 22.5% and 29.8% from Leschen and Corriea (2010). The estimates illustrate the variability in the mortality rate of control and bled animals and its dependence on many factors.

The most well known and cited mortality rate of 10% is from Rudloe's tagging study. The greatest benefit of the study was the fact that the animals were released into their natural environment after bleeding. The practice most closely resembles the biomedical's "Return to Sea" policy. A policy established 40 years ago that greatly contributes to the survival rate of the bled individuals. Thompson's work also involved a tagging study and found a 0% mortality rate for the bled animals, however recaptures were minimal since the bled animals were released in a remote area. Seven live bled recoveries were found and no dead recoveries were found for the bled horseshoe crabs.

Although Kurz and Pirri's tracking study was similar to a tagging study, its design was set up to study behavior and had a very small sample size. They focused on the movements of twenty horseshoe crabs and found two bled horseshoe crabs dead and noted a mortality rate of 20% adding "However, the slightly higher mortality rate observed in this study may have been an artifact of low sample size."

Another variable to consider with the tagging studies is the natural mortality rate associated with spawning. If the tagging studies are conducted during the spawning season, the natural mortality rate is estimated to be 10% due to stranding (Botton and Loveland 1989). Stranding occurs when the horseshoe crab is overturned by the water and is exposed upside down to predation and the environment. Kurz and Pirri's study conducted during the spawning season found two dead crabs 28 days and 68 days after bleeding. Their death could have been attributed to the 10% spawning risk.

Most of the mortality studies are non tagging studies that held the horseshoe crab specimens in tanks for weeks prior to and after the bleeding process. The control group was kept the same amount of time for comparison, but the multiple stressors on the crabs would make the resultant mortality rate higher. Rudloe established the difficulty in keeping large numbers of horseshoe crabs in a confined area. More recently, Mattei (2011), while studying tag induced mortality penned 105 horseshoe crabs for 44 days and found a mortality rate of 4% for the untagged horseshoe crabs. Her work confirms the difficulty in maintaining horseshoe crabs.

The researchers attempted to combat the challenge of maintaining the horseshoe crabs by using small sample sizes, multiple study periods and/or many holding areas (tanks). Leschen and Correia used multiple tanks, distributing both the control crabs and the bled crabs between six tanks. Based on the mortalities, there was a difference between the Tanks with Tank 4 and

Tank 5 having the greatest mortalities even for the control group. Although, they state there were no significant differences between the tanks, the resultant data strongly suggest the tanks did influence the mortality rate. Anderson et al.'s study also used multiple tanks to keep the horseshoe crabs. The tanks were quite different in size and volume affecting the environmental conditions the horseshoe crabs were exposed to. The difference in tank volumes is listed in the Chart below.

Tank	Number of Tanks	Size	Volume
Outdoor (OU)	7	183 cm x 92 cm x 50 cm	5.89 cubic meters
Laboratory Running Wheel (LRW)	4	80 cm x 65 cm x 32 cm	0.67 cubic meters
Laboratory Unrestrained (LU)	2	1.7 m x 0.9 m x 0.75 m	2.30 cubic meters
Laboratory Communal (LCT)	1	80 cm x 65 cm x 32 cm	0.17 cubic meters

The Outdoor Tank with the least mortalities had the greatest volume, whereas the Laboratory Communal Tank had the least volume and the greatest mortality. The two other Tanks had volumes between the Outdoor tank and the Laboratory Communal Tank and resulted in a mortality rate in the midrange of the other tanks.

In addition to using multiple tanks to maintain the horseshoe crabs in captivity, small sample sizes are necessary. Although, horseshoe crabs are the most studied invertebrate because of their hardiness, only a few can be maintained in tanks. However, small sample size diminishes the value of the studies. Anderson, Watson III and Chabot recorded a lesser blood volume taken from the horseshoe crabs in the laboratory tanks compared to the animals in the outdoor tank indicative of the health of the horseshoe crabs. This concurs that healthy animals must be used for bleeding, if not they do not bleed or survive well.

Ignoring flaws in the study designs, it is imperative to note that many of the studies did not adequately mimic biomedical practices. When comparing the BMPs to the studies' practices, many of the studies did not adhere to the same practices that the LAL manufacturers do. Holding time and temperatures as well as exposure to the elements deviate from the BMPs practices with most of the studies mimicking the worst case scenario for these factors. The two documented practices that are most essential for the survival of the bled horseshoe crabs would be to avoid direct exposure to the sun and to return the crabs to the water as soon as possible.

Leschen and Corriea's study demonstrated the importance of the "Return to Sea" policy and found a 7.5% greater survival rate when the bled horseshoe crabs were returned to the water 14 hours sooner. The rate for animals held 8 hours after bleeding (22.3%) was considerably less than the rate for animals held for 22 hours after bleeding (29.8%).

The studies were conducted during the warmer months of the horseshoe crab's spawning and/or bleeding season and are not reflective of the entire "bleeding" season. The "bleeding" season for some companies may not be conducted during the hottest months or only a portion of the season is conducted during those months. For example, in the Mid-Atlantic region the "bleeding" season starts after the horseshoe crabs' spawning season and may last until late October with July and August being the hottest months. All the studies were conducted during the hottest times of the season.

Some of the studies focused on the amount of blood taken and its effect on the survival of the horseshoe crab and also the time needed for the blood concentration to reach prebleeding levels. Rudloe (1983) rebled 26 horseshoe crabs that were recaptured 13 to 36 days after bleeding. The blood levels were only slightly below the initial blood volume, 49 mL compared to 63 mL for the males and 125 mL compared to 137 mL for the females. Twelve of the recaptured horseshoe crabs bled more the second time. Kurz and Pirri (2002) reported an average of 89.9 mL of blood were taken from ten females with an average prosoma width of 232 mm. Hurton, Berkson and Smith (2005) developed an equation relating the size of the horseshoe crab and the amount of blood taken but indicated that blood volume is affected by season, salinity, health and other environmental conditions.

Although blood volume is variable, Hurton and Berkson (2005) studied the effect the amount of blood extraction has on the survival of the horseshoe crabs. Mortality rates were zero if the horseshoe crab was unstressed even at the highest amount of blood loss, however, mortality rates increased as the amount of blood loss increased if in combination with extreme environmental conditions. They found the highest mortality rate of 15.4% for "stressed" animals when the greatest amount of blood is taken (40%). Hurton et al. noted that the blood loss during bleeding was generally less than the calculated 30% volume.

Leschen and Correia (2010) reported that the five mortalities resulting from their study seemed unrelated to the amount of blood loss. The mean percentage of blood taken from the deceased crabs was within the range of the overall amount of 19.8% for all the studied animals. They also reported that the change in activity levels were not related to amount of blood loss.

Anderson, Watson III and Chabot (2013) focused on blood volumes of the groups before and after bleeding. They reported the amount of blood loss ranged from 14% to 21% and did not differ between the live and dead horseshoe crabs. After six weeks, the laboratory animals did not regain their blood volumes, most likely due to poor holding conditions while the Outdoor group exposed to better holding conditions regained 60% of their original volume.

The studies indicate that blood volume is variable and dependent on many factors, however similar to mortality, under good conditions, blood levels return to normal. A biomedical practice is to bleed horseshoe crabs once in a season, enabling the horseshoe crab to regain their blood volume if necessary over a long period of time. In addition, since the horseshoe crabs with lower blood volumes were not deceased after the six weeks, their survival is most likely.

Summary

Overriding all the studies, is the fact that mortality of bled horseshoe crabs is low and survival is high. The tagging studies show minimal mortality and the laboratory studies in conjunction with the biomedical companies present rates similar to the tagging study mortalities. The studies meant to mimic biomedical practices or expose the horseshoe crabs to additional stressors reported much higher mortality rates, however the results are confounded by captivity and/or variable environmental conditions. The studies demonstrated the difficulty in maintaining horseshoe crabs and the effect environmental conditions have on the mortality rate. The mortality rates are variable across the studies, however the survival rate of the horseshoe crabs can be at their maximum if certain conditions are made.

The studies conducted by Leschen and Correia and Anderson, Watson III and Chabot subject the horseshoe crabs to the worst environmental conditions. Leschen and Correia (2010) exposed the bled horseshoe crabs to poor tank conditions evidenced by the high mortality rates for the control animals. Anderson, Watson III and Chabot intentionally placed the horseshoe crabs in barrels exposed to four hours of direct sunlight and then immediately covered the barrels, essentially "cooking" the horseshoe crabs for another four hours. Even under these extremely harsh conditions, the survival rates were between 60% and 70%.

The biggest obstacle to overcome in conducting mortality studies is how to monitor the horseshoe crabs after bleeding. Tagging studies adhere to the most important biomedical practice of releasing the bled horseshoe crabs into their natural environment. However, recapture of the tagged animals may be too minimal to estimate a mortality rate. Rudloe's study conducted in a small embayment had good recapture rates for both control and bled animals. Thompson's tag study had a minimal recovery rate of 1.2% for the bled animals, seven found alive and no crabs found dead.

The alternative to tagging studies is placing the horseshoe crabs in closed tanks and monitoring their survival. Horseshoe crabs need a large space and good water flow to maintain their health and survival. To achieve these needs, researchers used small sample sizes and, either used more tanks or conducted the study on different days. The use of more tanks introduced a new variable and influenced the mortality rates. Running the experiments during separate periods, introduces differences in the environmental conditions. The differences may be reflected in the variability of the results, ranging from 0% to 30% for one study.

Mortality rates for bled horseshoe crabs should be analyzed with caution understanding the complex nature of horseshoe crabs. The studies do demonstrate that adherence to the BMPs will ensure the horseshoe crab's survival after bleeding. Avoiding direct sunlight, extreme temperatures and excessive time out of the water are extremely important for the survival of the horseshoe crabs.

In conclusion, mortality rates are variable and ever changing dependent on many factors. There will never be one set mortality rate and if so, would the number be meaningful and add to our management of the horseshoe crab population. The number of horseshoe crabs estimated to die due to the bleeding process (average 58,721) is about 7% of the horseshoe crabs that die as bait for eel and conch (787,223 reported 2016 harvest) and a miniscule fraction, 0.2%, of the estimated number of horseshoe crabs in Delaware Bay alone (24,000,000).

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Atlantic States Marine Fisheries Commission

Atlantic Menhaden Management Board

August 6, 2019
3:45 – 5:15 p.m.
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Call to Order *(N. Meserve)*	3:45 p.m.
2.	Board Consent • Approval of Agenda • Approval of Proceedings from February 2019	3:45 p.m.
3.	Public Comment	3:50 p.m.
4.	Progress Update on 2019 Menhaden Single-Species and Ecological Reference Point Benchmark Stock Assessments *(K. Anstead, K. Drew)*	4:00 p.m.
5.	Consider Approval of 2019 Fishery Management Plan Review and State Compliance *(M. Appelman)* **Action**	4:15 p.m.
6.	Set 2020 Atlantic Menhaden Specifications *(N. Meserve)* **Final Action**	4:45 p.m.
7.	Other Business/Adjourn	5:15 p.m.

The meeting will be held at the Westin Crystal City; 1800 S. Eads Street, Arlington, Virginia 22202; 703.486.1111

MEETING OVERVIEW

Atlantic Menhaden Management Board Meeting
August 6, 2019
3:45 – 5:15 p.m.
Arlington, Virginia

Chair: Nichola Meserve (MA) Assumed Chair: 05/18	Technical Committee Chair: Joey Ballenger (RI)	Law Enforcement Committee Representative: Maj. Robert Kersey (MD)
Vice Chair: Spud Woodward (GA)	Advisory Panel Chair: Jeff Kaelin (NJ)	Previous Board Meeting: February 7, 2019
Voting Members: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, PRFC, VA, NC, SC, GA, FL, NMFS, USFWS (18 votes)		

2. Board Consent
- Approval of Agenda
- Approval of Proceedings from February 2019

3. Public Comment – At the beginning of the meeting public comment will be taken on items not on the agenda. Individuals that wish to speak at this time must sign-in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Progress Update on 2019 Menhaden Single-Species and Ecological Reference Point Benchmark Stock Assessments (4:00-4:15 p.m.)
Background • Two Atlantic menhaden-specific benchmark assessments are currently underway; a single-species assessment and an ecosystem-based assessment. The assessments will be used to evaluate the health of the stock and inform the management of the species in an ecological context. • A tentative timeline for both benchmarks is included in **Briefing Materials.**
Presentations • Benchmark stock assessment progress update by K. Anstead and K. Drew

5. Consider Approval of 2019 Fishery Management Plan and State Compliance (4:15-4:45 p.m.) Action
Background • Annual state compliance reports for Atlantic menhaden are due April 1st • The Plan Review Team (PRT) reviewed the reports and drafted the 2019 Fishery Management Plan (FMP) Review (**Briefing Materials**)

Presentations

- 2018 FMP Review report by M. Appelman

Board Actions for Consideration

- Consider the 2019 Fishery Management Plan Review and State Compliance

6. Set 2020 Atlantic Menhaden Specifications (4:45-5:15 p.m.) Final Action

Background

- The Board sets an annual or multi-year TAC using the best available science.
- In 2017, the Board set the TAC at 216,000 metric tons for 2018 and 2019 with the expectation that setting of the TAC for subsequent years will be guided by menhaden-specific ecological reference points.
- However, the 2019 benchmark stock assessment and peer review reports will not be available for Board review until the Commission's February 2020 meeting.
- Memo 19-053 (**Briefing Material**) reviews the fishery specifications process and details the Boards options regarding the 2020 TAC.

Presentations

- Review of fishery specifications process by M. Appelman

Board actions for consideration at this meeting

- Approve fishery specifications for 2020

7. Other Business/Adjourn

Atlantic Menhaden

Activity level: High

Committee Overlap Score: High (SAS, ERP WG overlaps with American eel, striped bass, northern shrimp, Atlantic herring, horseshoe crab, weakfish)

Committee Task List
• TC, SAS, ERP WG – January-October – monthly conference calls/webinars for 2019 Benchmark stock assessment • TC – April 1st: Annual compliance reports due • SAS, ERP WG – April 1-5 – Assessment Workshop I • SAS, ERP WG – June 24-28 – Assessment Workshop II • Peer-Review Workshop – week of November 4

TC Members: Joey Ballenger (SC, TC Chair), Jason McNamee (RI), Lindsey Aubart (GA), Jeff Brust (NJ), Matt Cieri (ME), Ellen Cosby (PRFC), Micah Dean (MA), Corrin Flora (NC), Kurt Gottschall (CT), Jesse Hornstein (NY), Rob Latour (VIMS), Behzad Mahmoudi (FL), Ray Mroch (NMFS), Josh Newhard (USFWS), Derek Orner (NMFS), Amy Schueller (NMFS), Alexei Sharov (MD), Jeff Tinsman (DE), Kristen Anstead (ASMFC), Max Appelman (ASMFC)

SAS Members: Amy Schueller (NMFS, SAS Chair), Matt Cieri (ME), Micah Dean (MA), Robert Latour (VIMS), Chris Swanson (FL), Ray Mroch (NMFS), Jason McNamee (RI), Alexei Sharov (MD), Jeff Brust (NJ) Kristen Anstead (ASMFC), Max Appelman (ASMFC), Joey Ballenger (SC, TC chair)

ERP WG Members: Matt Cieri (ME, BERP Chair), Jeff Brust (NJ), Michael Celestino (NJ), David Chagaris (FL), Micah Dean (MA), Rob Latour (VIMS), Jason McNamee (RI), Amy Schueller (NFMS), Alexei Sharov (MD), Howard Townsend (NFMS), Jim Uphoff (MD), Kristen Anstead (ASMFC), Katie Drew (ASMFC), Sara Murray (ASMFC)

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

ATLANTIC MENHADEN MANAGEMENT BOARD

The Westin Crystal City
Arlington, Virginia
February 7, 2019

These minutes are draft and subject to approval by the Atlantic Menhaden Management Board
The Board will review the minutes during its next meeting

TABLE OF CONTENTS

INDEX OF MOTIONS

1. **Approval of Agenda** by Consent (Page 1).

2. **Approval of Proceedings of August 2018** by Consent (Page 1).

Postponed Motion from August, 2018
Move the Atlantic Menhaden Board recommend to the ISFMP Policy Board that the Commonwealth of Virginia be found out of compliance for not fully and effectively implementing and enforcing Amendment 3 to the Atlantic Menhaden Fishery Management Plan if the State does not implement the following measure from section 4.3.7 (Chesapeake Bay Reduction Fishery Cap) of Amendment 3; the annual total allowable harvest from the Chesapeake Bay by the reduction fishery is limited to no more than 51,000 mt. Motion made by Chris Batsavage and seconded by Jim Estes. Motion postponed indefinitely.

3. **Move to postpone indefinitely a recommendation to the ISFMP Policy Board to find the Commonwealth of Virginia out of compliance with Amendment 3 of the Atlantic Menhaden FMP for failure to implement a reduced cap on harvest from the Chesapeake Bay provided the annual catch from the Chesapeake Bay reduction fishery does not exceed that established by Amendment 3. The Board will consider action to modify the Bay Cap after it completes action on ecological-based reference points** (Page 12). Motion by Robert Boyles; second by Jim Gilmore. Motion carried (Page 18).

4. **Motion to adjourn** by Consent (Page 18).

ATTENDANCE

Board Members

Pat Keliher, ME (AA)
Steve Train, ME (GA)
Doug Grout, NH (AA)
Cheri Patterson, NH, Administrative proxy
Ritchie White, NH
Dennis Abbott, NH, proxy for Sen. Watters (LA)
Nichola Meserve, MA, Administrative proxy (Chair)
Raymond Kane, MA (GA)
Jason McNamee, RI (AA)
Bob Ballou, RI, Administrative proxy
David Borden, RI (GA)
Eric Reid, RI, proxy for Rep. Sosnowski (LA)
Justin Davis, CT (AA)
Sen. Craig Miner, CT (LA)
Bill Hyatt, CT (GA)
Jim Gilmore, NY (AA)
Maureen Davidson, NY, Administrative proxy
Emerson Hasbrouck, NY (GA)
John McMurray, NY, proxy for Sen. Kaminsky (LA)
Heather Corbett, NJ, proxy for L. Herrighty (AA)
Russ Allen, NJ, proxy for T. Fote (GA)
Adam Nowalsky, NJ, proxy for Sen. Andrzejczak (LA)
Andy Shiels, PA, proxy for T. Schaeffer (AA)
Loren Lustig, PA (GA)
Roy Miller, DE (GA)
John Clark, DE, proxy for D. Saveikis (AA)
Craig Pugh, DE, proxy for Rep. Carson (LA)
Dave Blazer, MD (AA)
Russell Dize, MD (GA)
Allison Colden, MD, proxy for Del. Stein (LA)
Steve Bowman, VA (AA)
Bryan Plumlee, VA (GA)
Rob O'Reilly, VA, Administrative proxy
Steve Murphey, NC (AA)
Chris Batsavage, NC, Administrative Proxy
Doug Brady, NC (GA)
Mike Blanton, NC, proxy for Rep. Steinburg (LA)
Robert Boyles, SC (AA)
Spud Woodward, GA (GA)
Doug Haymans, GA (AA)
Jim Estes, FL, proxy for J. McCawley (AA)
Martin Gary, PRFC
Derek Orner, NMFS
Mike Millard, USFWS

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Jeff Kaelin, Advisory Panel Chair

Staff

Bob Beal
Toni Kerns
Max Appelman
Jessica Kuesel
Katie Drew

Guests

Karl Blankenship, Bay Journal
Jordan Brown, Saving Seafood
Josey Cline, ASA
Pat Geer, VMRC
Matt Cieri, ME DMR
Jeff Deem, VMRC
Monty Deihl, Omega Protein
Michelle Duval, MAFMC Contr.
Lynn Fegley, MD DNR
David Frulla, KDW
Shaun Gehan, Omega Protein
Joseph Gordon, PEW
Zach Greenberg, PEW
Ken Hastings, Mason Springs Cons.
Sarah Heil, NMFS
Pete Himchak, Omega Protein
Aaron Kornbluth, PEW Trusts
Ben Landry, Omega Protein
Arnold Leo, E. Hampton, NY
Thomas Lilly, Salisbury, MD
Chip Lynch, NOAA
Dan McKiernan, MA DMF
Chris Moore, CBF
Mike Millard, USFWS
Ed O'Brien, MD, Adm. Proxy
Patrick Paquette, MSBA
Nick Popoff, ME DMR
Sam Rauch, NOAA
Alan Risenhoover, NMFS
Bret Scholtes, Omega Protein
Dave Sikorski, CCA MD
Stan Sutliff, VSSA
Jack Travelstead, CCA
Bob Vanasse, Saving Seafood
Mike Waine, ASA
Kevin Wark, Orstal, GSSA
Kate Wilke, TNC

The Atlantic Menhaden Management Board of the Atlantic States Marine Fisheries Commission convened in the Jefferson Ballroom of the Westin Crystal City Hotel, Arlington, Virginia; Thursday, February 7, 2018, and was called to order at 8:00 o'clock a.m. by Chairman Nichola Meserve.

CALL TO ORDER

CHAIRMAN NICHOLA MESERVE: Meeting in Session. Are there any modifications to the agenda this morning?

APPROVAL OF AGENDA

CHAIRMAN MESERVE: The only thing I would note is that I do not plan to give half an hour worth of introductory remarks before moving on to the next item. Small typo there; so seeing none, we'll consider the agenda approved.

APPROVAL OF PROCEEDINGS

CHAIRMAN MESERVE: Next are the proceedings from our August, 2018 meeting. Are there any modifications? One more note from me on that. On Page 15 it suggests that I offered Derek Orner one more trauma at the microphone. While it can feel that way sometimes; I think I meant turn at the microphone. If Max can make that correction, if there is anything else we'll consider those approved as well.

PUBLIC COMMENT

CHAIRMAN MESERVE: Moving on to public comment, is there anyone in the audience that would like to make a comment on an item that is not on the agenda this morning? Seeing none; the sign in sheet is also empty.

PROGRESS UPDATE ON THE MENHADEN STOCK ASSESSMENT TIMELINE

CHAIRMAN MESERVE: We will move on to a Progress Update on the Menhaden Stock Assessment timeline. This was added to the agenda; so we could get an update on primarily whether or not the federal shutdown has had an impact on the timeline for the stock assessment. We'll turn to Katie Drew for that.

DR. KIRSTEN ANSTEAD: I'm actually going to update you on the single species assessment first. The government shutdown did happen during our main modeling time; and our lead modeler is Amy Schuler from NOAA; so that was unfortunate. But we hope to still come in on time. She's going to work really hard for I guess the next week; and then we'll cross our fingers.

If there is another shutdown that could delay our timeline, but for now we're still on track. We have a modeling workshop in April; and we will have, we hope, a full base run of BAM to review and talk about and start talking about some sensitivity runs. We're doing pretty well in staying on our timeline for the single-species benchmark.

DR. KATIE DREW: The story is the same with the Ecological Reference Point Group. We do rely on some federal data and federal partners as part of that assessment workgroup; but we remain on track. However, if the government is shut down again for any length of time that may end up pushing us back. The SEDAR schedule is still the same for us; so we will have the review the first week of November. But again, any kind of delays or shutdowns further may also impact the SEDARs ability to get us on the review schedule with that. So far so good; but we'll see.

CHAIRMAN MESERVE: Are there any questions from the Board about the timeline or the assessment? Seeing none; that's good news. Thank you both for that update.

REVIEW SYNTHESIS OF SCIENTIFIC FINDINGS OF ATLANTIC MENHADEN'S ROLE IN THE CHESAPEAKE BAY ECOSYSTEM

CHAIRMAN MESERVE: And we will move on to Agenda Item 5, to review a synthesis of scientific findings of Atlantic menhaden's role in the Chesapeake Bay ecosystem.

Katie Drew prepared a document, which was in your briefing materials. That document clearly states that this is not a product of the ERP or the assessment. It was a result of our last couple meetings; and an ASMFC leadership request to summarize our current knowledge of menhaden's ecological role in the Bay that's going to help frame the next discussion on the agenda related to the Bay cap and potential of noncompliance with that.

I believe the request does reflect some comments from NOAA General Counsel at the last meeting; that put down the need for the ASMFC to develop the record of how failure to implement the cap would be a conservation risk for the species. Katie will give us a presentation and we'll move on from there.

DR. DREW: Our Chair did give us the background; so I'm just going to skip quickly over this slide. Just to point out again, we want to emphasize that this was conducted by ASMFC staff; and it's not a product of the TC, the SAS, or the ERP Workgroup, because they are in the middle of this assessment right now, and we didn't want to burden them with what is essentially a review of the existing literature.

We looked at things that went into the background of the last benchmark assessment and Amendment 3; as things that the Board has seen before, but obviously in a much larger format. Rather than making you guys read several thousand pages of assessment and management documents; we tried to boil some of this existing literature down into something more comprehensive.

Again, it doesn't reflect the current ongoing work of the ERP group, which is still on track for that 2019 Benchmark Assessment. Kind of to frame the issue, I just wanted to give you guys a quick overview of the Bay cap; and point out that sort of the impetus for this cap development was really the fact that through the late 1990s, in fact even up to today, we've seen the reduction plants closing along the Atlantic coast, and the number of vessels in the reduction fleet declining.

What that resulted in is kind of a concentration of effort in the Chesapeake Bay area. You got overall landings declined both in the Bay and in the coast. But the overall proportion of landings coming from the Bay was increasing. That led to concerns about this concept of localized depletion within that Bay that even if we're taking a sustainable amount on the coast, are we taking too much from one specific area?

In 2005 through Addendum II, we implemented this Bay cap; a cap on the removals of Atlantic menhaden from the Bay, specifically for reduction. That cap site has varied over time. As it was originally implemented in 2006 that first year of actual implementation, it was about 109,000 metric tons based on landings from 2001 to 2005. In 2013, when the coast took a cut in response to the assessment that Bay cap was also reduced to 87,000 metric tons, and in 2018 with Amendment 3, it went down to 51,000 metric tons; which was about the average of landings from 2012 to 2016. Reduction landings from the Bay have not really exceeded 51,000 metric tons since 2012; even under that higher cap from 2013 to 2018.

The question is in a sense of what the Board wanted to get some information on is what is menhaden's role in the ecosystem; and what does that say about an appropriate level of removals from the Bay? What' I'm going to review today are some items that the Board in Amendment 2 identified as potential research areas that could help you figure out if localized depletion is occurring.

In order to do that some of the things we need to understand are menhaden recruitment dynamics, how are they getting into the Bay? What is Menhaden's role sort of as a consumer of production; and what is menhaden's role as forage within the Bay? I'm going to briefly go over all of these topics.

Obviously again, this is something you could do multiple dissertations on; so we're trying to boil it down to some quick key talking points here, rather than really get into the depth of what this all means. To start out with recruitment, as you all know Atlantic menhaden based on genetic studies are a single stock.

Unlike a lot of our species, which spawn in the bays and estuaries that act as nursery areas; Atlantic menhaden spawn in the ocean all along the coast as they migrate. As they're moving up and down the coast in the ocean they're spawning; and then those larvae are carried into bays and estuaries, where they settle as new recruits.

What this means is that recruitment to the Bay is driven by a number of different factors; and that includes both large scale climactic factors like the Atlantic Multidecadal Oscillation, where it seems like we get higher recruitment during some phases of this oscillation within Chesapeake Bay, and then during other phases you get higher recruitment in other areas along the coast, and lower recruitment within the Bay.

But you also get annual variability in the ocean currents that bring those larvae into the Bay; as well as water conditions within the Bay, the abundance of plankton for them to feed on within the Bay, and so forth. Obviously coastwide SSB also is a factor here. You need some kind of SSB out there to produce recruitment.

However, the relationship overall between SSB and recruitment is weak; so that these environmental factors are playing a significant role in getting recruitment into the Bay, as long as you have some kind of recruitment fecundity along the coast. As larvae, menhaden are really feeding on zooplankton; but then transition over to be filter feeders, feeding on phytoplankton in the Bay.

As consumers, some of the modeling work that's been done suggests that they can reduce the extent of algal blooms by feeding on those algal blooms; but they're not really removing nitrogen from the Bay, sort of in the net, in overall. That is they excrete a lot of that nitrogen back into the Bay; and they also themselves are consumed by predators within the Bay who return that nitrogen to the Bay. They're not really a way to get nitrogen out of the Bay; if that's a concern. Obviously a lot of our concern for menhaden is focused on their role as prey, as forage.

There have been extensive studies on fish diets within the Chesapeake Bay; both short term studies and long term monitoring programs like NEMAP and CHESMAP. When you go through this literature, it is difficult to directly compare across studies; because they occur in different years, in different seasons.

They cover different age ranges and focus on different predators; and they even use different metrics to estimate diet composition, and how much is actually being consumed. To just take one study and say well this is the percentage of menhaden in the diet here; and you compare it to another study and it looks completely different.

The menhaden TC actually did a tremendous amount of work synthesizing all of those existing diet data for Atlantic menhaden; by season and region for several key predators for the last benchmark assessment. I'm pulling on their work and showing you their work here; rather than going through an exhaustive literature review, because that has essentially already been done.

I'm showing you right now the percent by weight of menhaden and striped bass diet that the menhaden TC developed by season and age class; from data pooled over multiple different studies, as well as ongoing monitoring programs like the Northeast Fisheries Science Center database, CHESMAP and NEMAP.

What I want you to kind of take away from this graph, even if you can't read the actual numbers is that the proportion of menhaden in the diet is extremely variable over time, and also over age classes. You can see it ranges from almost no contributions to the youngest ages across seasons, to making up a large proportion of the diet in certain seasons for the oldest age classes.

There is a tremendous amount of variability within a predator's diet; and this is pooled over time. It's not even getting into some of the variability you get as menhaden abundance changes over time. There is a lot of variability in the prevalence of menhaden within diets. This is for striped bass. We have a couple of other species within your briefing materials.

Obviously I just focused on kind of the key predators; in terms of fin fish species. But you see similar patterns for different fin fish species; and you see to a certain extent similar patterns for other non-fish predators. But unfortunately the diet studies of non-fish predators within Chesapeake Bay are much less extensive.

It's a lot harder to justify capturing a bald eagle and cutting its stomach open; then it is to capture a striped bass and take a look. There has been some work on predator species within the Bay; for example, there was a thesis on bald eagle diets within the Bay, and a lot of the fish diets are based on sitting there and watching what's being brought back to the nest or looking at droppings, and things like that in the nest itself. The bald eagles for example; they found that you had high prevalence in the summer, so they were eating predominantly fish in the summer, and most of that fish was menhaden and gizzard shad. Whereas in the winter you had a very low occurrence of fish; mostly it was carrion that they were eating. The menhaden is important in the summer; but not in the winter. For osprey, the menhaden was important when you are in the high salinity sites; whereas for menhaden that are nesting in the lower salinity regions of the Chesapeake Bay, you had a lot more gizzard shad and almost no menhaden in the diets.

There is a question of availability and access as well; in terms of trying to assess how important the menhaden are in various diets. Overall what we can kind of take away from some of this is that Atlantic menhaden can make up a significant proportion of many predators diets for specific seasons, for specific size and age classes, and even for specific locations within the Bay.

There is a tremendous amount of variability; and even if you probably averaged it, it may be lower or higher across everything. But in certain seasons, certain age classes, they are very important. The other thing to note is that the prevalence of Atlantic menhaden in the diet does change depending on how abundant menhaden are.

Studies that occurred during periods of high menhaden abundance show a much higher prevalence of menhaden in the diet than studies that occurred during periods of lower menhaden abundance. When menhaden are there the predators are capable of consuming them. When they're not there, they switch over to other prey items.

We know they are an important part of the diet; but what does that say about the impact of reduced menhaden abundance on predator populations? I think that is unfortunately the big question that we're still struggling to deal with. This is the question that the ERP Workgroup is right now trying to deal with on a larger, coastwide scale.

Modeling work does provide estimates of predatory demand. You can do that for one or more predators within the Bay; to say striped bass need this amount of menhaden within the

Bay, based on the population size that we're estimating. But there are no estimates of menhaden abundance specifically within the Bay.

Our assessment model is a coastwide model. We can't say how much are in the Bay in any given year; compared to how much are on the coast. As a result, we don't have a way to measure whether those estimates of single species or multispecies predatory demand can be met by what's available in the Bay.

We can look and say, so we've seen some negative population metrics that you can correlate with low menhaden abundance for some species, For example, things like a current outbreak of mycobacteriosis in striped bass within the Bay has been linked to lower menhaden abundance and higher striped bass abundance.

There is some hypothesis that the increasing natural mortality we're seeing in weakfish may be linked to declining levels of menhaden abundance in the Bay; that if you look at population growth rates for osprey over time, you see slightly lower growth rates during periods of lower menhaden abundance than you see when you have periods of higher menhaden abundance. But the flip side of this is this is an incredibly complicated system. There are other factors that are linked to these negative population metrics. This increased mycobacteriosis prevalence has also been associated with warmer water temperatures and poorer water condition within the Chesapeake Bay. We know environmental factors and shrimp trawl bycatch may also be contributing to weakfish population declines.

The osprey population growth rates are actually higher in low salinity areas; where you don't see as much menhaden in the diet as in the higher salinity areas, as well as being driven by again, environmental factors and even the availability of nesting sites are going to impact the ability of that population to grow.

Overall, what we can say about this is that the Chesapeake Bay is an incredibly complex ecosystem; both in terms of the food web, and then how that is interacting with a changing environment, and the population dynamics of all of these species. We can't prove, at this point we can't say lower levels of menhaden are directly causing these negative population consequences that we're seeing in some of our predators.

But the flip side of that is we also can't say they're unrelated. It probably is a combination of all of these factors that are driving the dynamics of this system. We can say that recruitment to Chesapeake Bay does not appear to be correlated with the abundance of Age 2 and Age 3 menhaden within the Bay.

As long as we have favorable environmental conditions, and favorable coastwide fecundity, we can get recruitment to the Bay. Depletion within the Bay is not going to keep the Bay depleted; but we need that coastwide fecundity and coastwide environmental conditions to remain favorable to continue to supply the Bay.

From a single species perspective, which is a little jarring, but just to point out that when we're deciding how much fecundity is favorable coastwide, and how that catch is impacting that level of abundance or fecundity. The projections we used in the single species model are done with the assumption that the proportion of removals from the Bay is going to stay at their current levels, because the selectivity between the Bay and between the more northern reductions fleets is different.

The Bay has a higher proportion of smaller fish; compared to the more northern regions, which have a higher proportion of larger fish in the catch. Even if the total population removals, the total coastwide quota is not exceeded, the having more or less removals from the Bay can impact the effect of those removals on the overall population, because the overall selectivity pattern will be different from the assumptions that we used when we did these projections.

Overall there is no current estimate of menhaden abundance within the Bay; and there is no quantitative determination of what an appropriate depletion threshold is, either within the Bay or along the coast. Again, this is what the ERP Workgroup is trying to do on a coastwide level is come up with this hard number.

We don't' have a quantitative determination of whether or not localized depletion is occurring. The Board's decision on this is going to have to come from a more qualitative assessment of what we know about the ecosystem and the complexity, and the role of menhaden within that larger overall ecosystem. I'm going to pause here and take specific questions about anything I've presented today. But I think there are also the larger questions, maybe more Board of management decision questions, in terms of how you interpret the extreme body of evidence that we have here.

CHAIRMAN MESERVE: That's very helpful to have that all put together in a more easily digestible format for the Board. I'll turn to questions; and I see Ritchie White's hand first.

MR. G. RITCHIE WHITE: Katie, seemingly the spawning stock biomass of menhaden seems to be moving north. I'm wondering whether that could affect recruitment in Chesapeake Bay. If they're spawning farther to the north in the ocean, then might that settle in to the north of Chesapeake Bay?

DR. DREW: Well we know that is the thing. The adults always move further north. The fact that we're seeing more of them to the north may just mean we're seeing more of a population expansion; rather than that the population is itself moving further north. I think it's probably less likely of a function.

Well it is where they're spawning; but also then is the current environmental climate favorable for bringing those larvae into the Bay, versus are they spawning down here and they're just not making it into the Bay at the same rate as they're making it into the bays and estuaries further north, which may be more of a function of those larger, climactic events rather than where they're spawning?

CHAIRMAN MESERVE: Andy Shiels.

MR. ANDREW SHIELS: Katie, could you speak to the energetic of menhaden; if you're able to do that. For instance, not all forage is created equal. If you deplete the highest quality forage, they will eat whatever is left; which I think is what was clear in one of your statements. Can you give us any sort of sense on the quality of menhaden as forage; compared to other forage that might be available in the Bay?

DR. DREW: Sure, I think menhaden are definitely high on the favorability list; both for their own internal energetic components, but also because they're more of a soft rayed fish, rather than some of the bonier fish that are harder to consume. Some studies do suggest that even if the, I think it was done with striped bass, comparing sort of the energetic content of diets across different time periods, even if you still are getting full stomachs, depending on the makeup of those, you may get better quality nutrition; depending on if you have more menhaden in the diet, compared to some of the other species. That is certainly something to keep in mind; I think as well as sort of the age range or the size range of what's available to the fish, and what the fish can actually eat. Whereas the birds and the largest of the fin fish predators can eat those very large menhaden; but a lot of the focus is also on those small Age 0 and Age 1 menhaden, so if those are abundant that is better for the population as well.

CHAIRMAN MESERVE: John Clark.

MR. JOHN CLARK: Thanks for the presentation, Katie. Kind of a follow up on the same thing, I was wondering if any of the studies you looked at had the condition factor of striped bass under different diets. I know that we've been looking at the stomach contents of striped bass caught in the recreational fishery in lower Delaware Bay for about the past ten years.

When they can get bunker they've always got a higher condition factor. I remember one year in particular the top prey item was lady crabs. The condition factor was around 0.9, whereas when they get the bunker like your chart showed there, much higher condition factor. It makes sense that they are loading up before the spawning season too.

DR. DREW: Yes there is not as much. I think that is one of the things we would definitely want to implement in terms of a monitoring program is trying to associate body condition with what is being consumed. Definitely some of the studies seem to be you get better body condition when you have more abundant menhaden. But there can be a lot of other factors that are also contributing to the ability to put on or retain weight, in prey as well. But it is certainly something that looks like one of the correlations there.

CHAIRMAN MESERVE: Allison Colden.

DR. ALLISON COLDEN: Katie, could you remind me what was the estimate of the contribution to the coastwide stock that comes from the Bay?

DR. DREW: It's hard to tell exactly. We do have some otolith microchemistry data that suggested it was about 30 to 40 percent of the exploitable menhaden on the coast were coming from the Chesapeake Bay when those studies were conducted. Likely that was something that would provide change over time; depending on the strength of recruitment in those various regions. But it was about 30 to 40 percent when we did the study.

DR. COLDEN: You mention that there wasn't a strong correlation between the Age 2s and the Age 3s within the Bay in recruitment; which kind of makes sense. But obviously those are going to go on to contribute to that total coastwide fecundity that you were saying is driving that.

DR. DREW: Right. You would not want to. I guess the question is does it matter from the population perspective of if you harvest them all in the Bay versus if you harvest them when they're all out on the coast; if you're taking sort of the same amount overall for the population out. I think that is where trying to balance is localized depletion happening, or is it happening on the coastwide scale?

For sure you wouldn't want to deplete the fecundity overall to such a point that the population is going to struggle to produce enough eggs. Does it matter if that removal is coming from the Chesapeake Bay; as long as you preserve say the New Jersey fish in the ocean to spawn? You could still get recruitment back into the Bay; it seems based on the dynamics, as far as we understand the dynamics of recruitment. But you wouldn't want to overall deplete that coastwide spawning stock by removing too much of the whole population.

CHAIRMAN MESERVE: Rob O'Reilly.

MR. ROB O'REILLY: Thank you for the report, Katie. Close to the end of your presentation, maybe three or four slides before the end. There was sort of a cautionary slide about removals, and when the TAC changes if the removals from the Bay can have a greater impact than when you look overall.

I think we'll have to wait for the landings; but we built a conservation plan with Amendment 3. You know the main idea of Amendment 3 for many of us was to look forward to the biological and ecological reference points. Allocation was part of Amendment 3. But when allocation was finished, we're probably going to find that of the 216,000 metric tons, many of those tons aren't going to be in the landings.

Virginia is frozen at 2017 quota. In the Bay itself Maryland and Potomac River Fisheries Commission were recipients of quite a bit of quota that will be unused; because they are pound net fisheries, they are not going to change. There is quota that is being held for whatever reasons, and there is relinquished quota which couldn't be used as well. When you talk about equal to current levels, are you referring to 2017, or are you referring to the end of Amendment 3?

DR. DREW: Ah, 2016 would be the values that were used in the projections. Again, this is also the cap is specifically for a reduction harvest; you can still have bait harvest that would exceed that cap within the Bay, as well. But it was based on 2016 levels that we did all these calculations.

CHAIRMAN MESERVE: Go ahead, Rob.

MR. O'REILLY: I understand that; but I mean I want everyone to understand that forage is also what we're really looking at as well at the same time, and it should be clear that there is forage that is available that many expected not to be available once we finished Amendment 3. That is by virtue of the way the allocation went.

But again, I think we have to wait for the landings; get a report back, and although the Bay is important, I think overall the forage aspect is something that is very important and moves right into our biological and ecological reference point scenarios that will be developed later.

CHAIRMAN MESERVE: Bob Ballou.

MR. ROBERT BALLOU: Katie, as I'm sure you know Rhode Island has had a menhaden management plan in effect for many years for Narragansett Bay; and it includes both a floor and ceiling biomass levels of menhaden are monitored and the Bay is opened and closed depending on those levels.

The upper level is essentially a cap. Are you familiar with the modeling work that was undertaken; I believe Mark Gibson was the lead, and he may have been assisted by a young whippersnapper named Jason McNamee. I'm not sure. Again, this dates back to the 2000s. Are you familiar with that modeling work; and if so does it have any applicability to your analysis of the Chesapeake Bay situation?

DR. DREW: I'm not familiar with that work enough to say whether or not it would be applicable here. I think we're probably still struggling with the same issue of turning sort of qualitative information into quantitative information; in that sense of what an actual hard cap would be. But I would have to talk to the authors to get more detail on that.

CHAIRMAN MESERVE: Katie, one question. You mentioned of course that we don't have estimates of menhaden in the Bay right now. Could you give the Board a quick update on the RFP for the aerial survey design?

DR. DREW: We did receive, if the Board remembers we've dedicated some funds to doing an aerial survey of the Chesapeake Bay to try to, well dedicated some funds to develop a design for an aerial survey of the Chesapeake Bay, in order to help provide some of this information. We've received two proposals; and they're in the process of being evaluated right now to determine which, if any, we would like to actually fund.

However, I would just like to sort of temper expectations to say the money that we've dedicated is really for just coming up with the design, and potentially a little bit of pilot testing. It wouldn't be for a full aerial survey. Even if we had a full aerial surveys, we would still need several years of data in order to be able to turn that sort of relative abundance concept into an understanding of trends within the Bay, and how that relates to the larger coastwide assessment.

CHAIRMAN MESERVE: Are there any further questions? Justin Davis.

DR. JUSTIN DAVIS: I'm curious; based on the review of the different diet studies in the Chesapeake Bay, whether you can comment on some of the other species that are important prey items for fish predators, like striped bass and weakfish, which as alluded to earlier they are kind of classic generalist predators when their preferred prey item menhaden isn't there they will go find something else to eat.

I'm thinking about this in the context of the potential problem that localized depletion could cause. I understand we can't prove it is happening. But it doesn't mean that it shouldn't be a concern. Are any of the other prey species that striped bass or weakfish or some of these other fish that they're likely to prey on?

Do those species either support important fisheries or are they of conservation concern? I know up in New England at times there have been concerns about striped bass impacts on winter flounder, lobster, river herring; that kind of thing. I'm wondering if there are some of those same concerns down in the Bay.

DR. DREW: Some of the alternate prey items that they would consume; bay anchovy is a big one. I think certainly the concern with that is that is not something that we monitor or assess at the moment. It is an important forage species as an alternate; but we don't have a good sense of how that population is doing either at the Bay or at the coastwide level as much. We do have some indices for it; but it's not something we monitor or assess. They also consume a lot of invertebrates; including blue crabs at small sizes, as well as shad and river herring, which we have concerns about for their low population levels and things like that and of course juveniles of other species.

Weakfish do show some signs of cannibalism as well on those small, young individuals. For sure the lack of menhaden is going to change how much they are consuming of some of these other things that either we don't monitor; or that do have some relevance for ASMFC or the states, in terms of being important consumption items for humans.

CHAIRMAN MESERVE: John McMurray.

MR. JOHN G. McMURRAY: Given what we've heard about the quality and favorability of menhaden over other baits; and I could speak to that personally, being out on the water. Predators aggregate around menhaden in a way they do not around bay anchovies and other small baits.

My question is; has there been any analysis of what an increase over the 51,000 metric tons cap would mean for striped bass in the context of what we heard yesterday that the stock is overfished and overfishing is occurring, and the Chesapeake Bay is the primary spawning area. Has there been any analysis or just discussion about that?

DR. DREW: No, because essentially that is the work that the ERP group is trying to do right now. I think in terms of the whole ERP assessment is really focused on taking all of this information and turning it into a number; at least at the coastwide level. In terms of saying more than 51,000 are going to have this percent effect on striped bass. We certainly can't say that right now.

CHAIRMAN MESERVE: Follow up.

MR. McMURRAY: Will the ERP group look specifically at the Chesapeake Bay; or are they just doing coastwide, because I would think it would be intuitive that you would look at the biggest producer area on the coast. That's it.

DR. DREW: Right now the model is coastwide. I think there is the ability to have a little bit of spatial scale in terms of again, the selectivity of these fisheries to say the Bay has this kind of a selectivity and is focused on this size range. But right now we don't have the data to support a fully spatially explicit model; in terms of understanding how menhaden in the Bay are related to menhaden on the coast, and likewise how striped bass in the bay and their predatory demands compare to the coast are falling out.

We may be able to do some follow up work; in the sense of looking at things like that otolith micro chemistry, to say how much of the stock is in the Bay versus on the coast, based on some stuff. But for right now the ERP Workgroup is really a coastwide project.

CHAIRMAN MESERVE: Dave Blazer.

MR. DAVID BLAZER: Katie, thank you and excellent job on the report; a lot of good stuff, and this is a great dialogue this morning. I greatly appreciate it. I want to build I guess a little bit off of John's question related to kind of where do we go from here? The ERP group as you've mentioned is looking at some of the aspects of this more on a coastwide basis. I don't see us resolving some of the questions or issues here.

My question is twofold, I guess. What do we need to do to try and answer this question a little bit more diligently than maybe we have at this point? Is the ERP group going to look at that and make some recommendations specifically; or can we task the TC to do that? I'm just trying to figure out, you know where we're going to resolve this in a year, two years, five years, ten years, and what do we need to be doing now to try and get to that point?

DR. DREW: That is an excellent question; and we will have a number of research recommendations I am sure coming out of this assessment for the long term, in terms of I think for sure this is what the ERP Workgroup is working on now is a coastwide project. But we see this as the first step towards ecosystem management for this species; and for all the species involved, in that as we go forward we would like to build more spatial complexity into this model, because it probably is important for the dynamics on a larger scale.

I think developing then research programs to get at some of this; how are menhaden moving in and out of the Bay and along the coast, and contributing to those things? How does that interact with striped bass and other migratory species; are things we need to collect more data on in the long term. That I think is definitely a five year, a ten year project.

In the short term I think we can look at like I said, some of these things about the proportion of menhaden from the Chesapeake Bay in the exploitable classes. What does that say about and where were they relative to the assessment at that point? When both the single species and the multispecies are done, we can look at kind of changing some of the selectivity assumptions about the fishery.

If the fishery is focused on the smaller ones, more in the Bay, what does that do to the larger overall population? But I think some of this decisions about what is the correct amount of harvest for the Bay, should we be managing the Bay differently than the rest of the coast is going to come down to more of a qualitative assessment of risk on the Board's part. The Board has chosen to be more conservative on a coastwide scale; then the single species model would have suggested.

We set a lower quota than what the single species model would have suggested; in order to preserve on a qualitative level, some of that forage importance. I think that is the kind of conversation the Board has to have about the Bay; as well is are you comfortable making qualitative assessments of risk and levels of harvest from the Bay specifically, versus the coast, in the absence of more concrete, quantitative numbers about what the appropriate level is.

CHAIRMAN MESERVE: I'm not seeing any more hands for questions. We could begin a discussion about this or move to our next agenda item; which I think the two are going to be closely tied together.

CONSIDER POSTPONED MOTION FROM THE AUGUST, 2018 MEETING

CHAIRMAN MESERVE: If the Board is okay, I think we'll do that and move to Item 6, which is to consider a postponed motion From the August, 2018 meeting. This was a motion that was initially introduced at the May, 2018 meeting, postponed then. It was also postponed in August. I'll read it to get us going. Move the Atlantic Menhaden Board recommend to the ISFMP Policy Board that the Commonwealth of Virginia be found out of compliance for not fully and effectively implementing and enforcing Amendment 3 to the Atlantic Menhaden Fishery Management Plan.

If the State does not implement the following measure from Section 4.3.7 (Chesapeake Bay Reduction Fishery Cap) of Amendment 3: The annual total allowable harvest from the Chesapeake Bay by the reduction fishery is limited to no more than 51,000 metric tons; the motion by Mr. Batsavage and seconded by Mr. Estes.

That motion is brought back to the table; it's a little bit of Groundhog Day here for me. I do see your hand, Robert Boyles, but I was hoping if we could maybe turn to Virginia to get any update on legislative action or landings in the Bay to start our discussion.

MR. STEVEN G. BOWMAN: The Commonwealth of Virginia once again through legislation, attempted to have the Virginia Marine Resources Commission manage the menhaden issue in the Commonwealth of Virginia. Measures were sponsored by both the delegate and Senator. Both were heard by Committee, and both failed unanimously in Committee.

Therefore, to come here today and indicate that that is a viable alternative as we thought previously would not be appropriate at this time; nor do I anticipate it based on the history that I've seen throughout, it occurring any time in the near future. I may be wrong; but that is just based on my experience.

As far as the landings; I'm not going to give the specific poundage; because that's not appropriate. But I will tell you this that we very closely, and that motion deals with enforcement, which is somewhat a broad term when you're dealing with this. We monitored the catch from the Bay; data provided by the National Marine Fisheries Service, at every opportunity that that data became available, very closely.

I had Rob do that and provided a report. I will tell you that based on our observations, surveillance by aerial law enforcement that there was not, again the cap was not exceeded, and as a matter of fact it did not come close to being exceeded based on the data that we were provided. Omega was cooperative with us; as well as providing any other data that we requested.

At this juncture, I can just tell you that again now since 2012 through 2018, the cap was not exceeded. We do have also evidence based on dialogue with Omega that they spent a significant time out in the ocean instead of in the Bay; which of course as we all know is beneficial to both their business management plan as well as ecological situation within the Bay. That is pretty much the overall scenario from the Commonwealth; and I'll be glad to answer any questions.

CHAIRMAN MESERVE: Thank you for that update, Steve. Sorry to put you in the hot seat.

MR. BOWMAN: I'm used to it, believe me. I've been down the road, so yes.

CHAIRMAN MESERVE: Robert Boyles.

MR. ROBERT H. BOYLES, JR.: It may not be Groundhog Day, but I would like to take us to the Magic Kingdom, if you could. Roy Disney, Walt's lesser known brother said; "It's not hard to make a decision when you know what your values are." I repeat that for the record. "It's not hard to make a decision when you know what your values are." Later today after this meeting, should we conclude this meeting today; we are going to talk about a strategic plan, and developing a strategic plan for the next five years.

But we are operating under a current Strategic Plan that has words that I would like to remind the Board of; words like cooperative, words like stewardship, phrases like sound science, and important words like honesty, and integrity. I think that I would suggest that those last two really reflect that we are a nation of laws and not a nation of men. With the late Mr. Disney's admonition to us, I would like to make a motion if it pleases the Board and pleases you, Madam Chair.

That motion is; move to postpone indefinitely a recommendation to the ISFMP Policy Board to find the Commonwealth of Virginia out of compliance with Amendment 3 of the Atlantic menhaden fishery management plan, for failure to implement a reduced cap on harvest from the Chesapeake Bay provided the annual catch from the Chesapeake Bay reduction fishery does not exceed that established by Amendment 3. The Board will consider action to modify the Bay Cap after it completes action on ecological-based reference points.

CHAIRMAN MESERVE: Is that a second? Jim Gilmore seconds the motion; further discussion, Robert?

MR. BOYLES: Just one more quote; and this one I can't attribute, but it's not mine. "When one bases his life on principle, 99 percent of his decisions are already made." Thank you.

CHAIRMAN MESERVE: A clarifying question about the motion. If the Bay Cap were exceeded that would be triggering the Board to reconvene and have a discussion about it; not triggering a noncompliance finding, correct?

MR. BOYLES: That's correct, yes Ma'am.

CHAIRMAN MESERVE: Thank you for that clarification; discussion on the motion, Jim Gilmore.

MR. JAMES J. GILMORE: It's always tough following Robert; he just speaks so eloquently. But I just wanted to add to his comments that on this motion and the situation we're in, I think is rather unique. I think that is what maybe Robert was getting at that actually if we just had a simple rule book, and we had black and white decisions on everything, we wouldn't need to sit around the table, everything would be automatic.

But because of the complexity of what we do it gets us into these situations now; the fact that we are going into new territory. We're going to have ecosystem-based management coming up. We're in that crossroads between the old standard of single species going into ecosystem, it makes this very unique. We have a new frontier with old sets of rules. That is what has complicated this quite a bit. I think the best way I can put it is that we've got to get into old fashioned management; maybe it's seat of the pants, maybe it's not following the rules exactly. But I think it's the smart thing to do at this point. I'll just quote Porky Pig; I hope "that's all folks."

CHAIRMAN MESERVE: The quote of the day, thank you. David Borden.

MR. DAVID V. BORDEN: I'll be brief. I support the motion. I would offer the view that I think the Commission representatives from Virginia basically have done due diligence; and made a valid attempt to try to bring the state into compliance. They should be complemented for that. Although I personally feel that because they haven't adopted the rules they are technically out of compliance.

Where I end up on this is that I basically don't think it's worth fighting over this. We're going to move to ecological reference points in a fairly short period of time. I have no question in my mind that our understanding of the menhaden resources is going to significantly change when we do that. In fact, I could anticipate that the numbers, in terms of regional numbers, gear specific numbers and so forth are all going to change in the future.

Where I end up on this is that I don't think it's worth fighting over; and burdening the Commission and the staff with this. If we're going to change the numbers in a couple of years, let's just get on. Keep the objective of getting the ecological reference points as soon as we can in mind; and not burden anyone with fighting with a noncompliance finding.

CHAIRMAN MESERVE: Steve Bowman.

MR. BOWMAN: Very briefly, Madam Chair. I would just like to take the opportunity to thank everyone that has been, although the vote has not been taken, everyone for the understanding. It has been a difficult situation. We believe that we have done our best; as far as doing what is the intent of the Commission.

We very much respect in the Commonwealth this established body. We look forward to working diligently with this organization; to come to a time where we all have reference points and science that can be used in making good, informed decision as we address this species, so thank you very much for your time.

CHAIRMAN MESERVE: Pat Keliher.

MR. PATRICK C. KELIHER: I too want to comment the Commonwealth of Virginia; they have as the Executive Branch has done its work in due diligence to try to rectify this with the Legislative Branch. They have not been able to do so. I don't think we should be holding them hostage on this. I have been kept up to date from Commissioner Bowman; along with Commission leadership. It's clear that they've worked hard to try to resolve it; and have not been able to do so. I think it is time to move on, and I think this motion will allow us to do that.

CHAIRMAN MESERVE: Steve Murphey.

MR. STEVE MURPHEY: I would like to also congratulate the MRC; I think they've done yeoman's work on this. I think they were in a tight spot on this. I think they have done about everything you could do to try to address this. I support the motion; and I think my mind was really changed on this after listening to, I believe it was National Marine Fisheries talk about really the science behind this or the lack thereof.

I think it is a reminder to us as we move with not only this plan; but other plans that we need to remain vigilant that our management recommendations are science based and not pushed one way or the other by something that appeals to one group or the other. I support this motion.

CHAIRMAN MESERVE: Andy Shiels.

MR. SHIELS: I'm not opposed to this motion. But what concerns me is the final sentence; and I would like to at least open up for further discussion what that means. It says the Board will consider action to modify the Bay Cap after it completes action on ecological-based reference points. In the previous presentation we heard that at least at this time there is no plan to address the Bay separately in developing ecological reference points. We heard it was a coastwide, population-wide development of ecological reference points.

I believe that is what I heard. Whether it's in this motion or whether it is reserved for further discussion, what would make me comfortable is specifically calling out that that study on ecological reference points will include the Bay proper. That way when we get to this point where a decision needs to be made, the Board will have all the information it needs to determine whether there is an impact coastwide, or within the Bay, or combined.

CHAIRMAN MESERVE: My take on the motion is that following the conclusion of the assessments, the next document be it an amendment or addendum, would deal with considering adoption of ecological-based reference points. Following that a subsequent action would deal with the Bay Cap. That is the intent of the maker of the motion, I believe. Did you want to clarify further that? No, okay. I'm going to stick with my list, unless Andy, you wanted to see further changes.

MR. SHIELS: I didn't feel that what I said was captured there. I want to make sure that based on the previous presentation, where it seemed clear to me that we were looking at the population coastwide as a whole. That we, because this motion and what's brought us here today is what's going on in the Bay; that may be more important than the coastwide analysis as a whole is the component of the Bay, and what it does to striped bass and nursery water for the entire population of menhaden, and for striped bass. Either here or some sort of assurance before we leave this item that we're going to address the Bay as its own part of the ecological reference points.

CHAIRMAN MESERVE: Robert Boyles.

MR. BOYLES: Andy, I certainly understand your concern. The intent when making the motion, you know recognizes in my mind at least that the golden ring for the Commission is this development of these ecological reference points. That is a heavy, heavy, heavy lift. Brave new world, a lot of new ground, and I think that for me at least, from my perspective that is my interest with respect to South Carolina is making sure we can focus on that golden ring.
The reason that I put this in the motion is; I think it is important that we remind ourselves that we have talked about the concept of localized depletion for the past decade plus. The reason here was an attempt to build consensus that yes we are not dismissing this issue. The Amendment in place is still a 51,000 metric ton cap.

We've heard from the Commonwealth that that cap during fishing year 2018 was not exceeded. I think what I would suggest to you, Andy, is I'm very interested in revisiting this issue of the Bay Cap, not necessarily as part of Amendment 4. Let me be clear about that; not as part of the ecological reference points.

CHAIRMAN MESERVE: Bob Ballou.

MR. BALLOU: I do support the motion; but I do want to note that my support is wholly dependent on the report out from Virginia that the cap as set forth in Amendment 3 has not been exceeded. In fact I think it was represented that it didn't even come close to being exceeded; and that this motion is conditioned on continuing to ensure that that cap is not exceeded.

With those two data points, I feel that we do have a good basis, a good sound policy basis, if you will, to support this particular motion. But I do want to note those two points for the record; because I really think they're hugely important. If the cap had been exceeded, I would have a much different take on the status of this issue.

CHAIRMAN MESERVE: That is on the record. We're going to continue to get regular updates on the reduction fishery landings in the Bay; and the Board would have another, based on this motion we would have another discussion about it were the cap to be exceeded. Next is Ritchie White.

MR. WHITE: I also support this motion. I believe it provides an opportunity for Omega Protein to partner with the Commission; with the management of menhaden in Chesapeake Bay. I think it's a great opportunity for them and for us. I clearly hope that it goes as it has in the past.

CHAIRMAN MESERVE: John McMurray.

MR. McMURRAY: I want to go back to Andy's question; because I don't think it was properly addressed. How are we going to deal with the Bay Cap after we have the reference points? My question earlier and the response given was that we're not going to look at the Bay specific. We don't have the resources to do that right now.

What's the plan? I mean this is the burning question. I still don't understand why this Commission can't make precautionary policy decisions based on something that is to me intuitive. I think Andy was asking how we're going to address that. I mean it's nice that we put it in the motion. But it doesn't really mean much to me anyway.

CHAIRMAN MESERVE: I think there are some uncertainties; and part of it will be contingent upon what comes out of the assessment. It's hard to say with clarity where we're going to be; although Katie has indicated that there may be some information within the latest assessments that would lead us to look at, to consider the appropriateness of the cap level. But we are in a bit of a wait and see, but it is clearly expressed in the motion that we plan to revisit it.

DR. DREW: Yes, I would say that for sure the final results of the formal models will be on the coastwide level. We may be able to provide some sort of follow up post hoc analyses; to help provide some additional information on the Bay, relative to the rest of the coast. But it will not be the same. It will not be a fully spatially explicit model.

Then it becomes up to the Board to, as you say, determine how precautionary you want to be on this specific regional management questions, when we don't have a fully regional model. That I think is something that you will have to address; based on what we can provide you through the ERP assessment, and whether that satisfies your need to make decisions.

CHAIRMAN MESERVE: John, go ahead.

MR. McMURRAY: Sorry, I don't want to extend this any more than it has to be. I mean the bigger question in my mind, and maybe you could answer this, but I'm guessing that you can't is can this Commission without rock solid science, which we'll probably never have, make a policy decision based on what we know and what our constituents want us to do with the public resource? I guess that's it.

CHAIRMAN MESERVE: Robert.

MR. BOYLES: Yes John, I think that's a great question. We heard from NOAA Fisheries in August; who reminded us of the requirements of the law for enforcing compliance, to create the conditions by which the Secretary could enforce compliance. You all bluntly, we've outkicked our coverage with this particular action. There is by my read of the law, there is one requirement for this Commission to find a jurisdiction out of compliance; and that is they are not fully and faithfully executing the provisions of the plan.

There you all, I think we've been briefed, but just to refresh our memory should this Board and the Commission find the jurisdiction out of compliance. There is the provision by which we notify the Secretary of Commerce; that sets in a very prescribed review of what is required for the Secretary to enforce that noncompliance.

Chip Lynch did a great job of reminding us of those requirements back in August.

I think it's important to recognize that there are two conditions that the Secretary must find; in order to enforce that compliance. There is a disconnect between what this Commission is required to do, and the standards by which the Commissioner must act. That is the reality of the situation. I'm not happy about it, don't like it. But I go back to those values. We must conduct ourselves according to the law. I think at the end of the day, I go back to one of the first values listed in our Strategic Plan; and I think it's an important one, and that is cooperative. This is a very difficult amendment. We all struggle with it. But I think it's important to note that the law doesn't support a noncompliance finding here. That is the hard and fast fact.

I think it's really, really important that we keep these decisions about these resources around this table. Quite honestly, perhaps some days I would feel better about myself, about for a day, if we just said let's kick this up to the Secretary of Commerce. But I think we know enough. We've heard enough from our attorneys; we've heard enough from NOAA, with respect to what the law requires, and this is the situation we find ourselves in.

I'll note for the record to remind you. Virginia did prepare, did prepare an appeal to this action, and that appeal was withdrawn. We've found ourselves a little bit in a corner; and I think this is the most prudent course of action. I think it is important that we recognize the concept, and keep alive the concept of localized depletion.

Let's try to learn more about this. My folks back home are concerned about weakfish. Some of your folks are concerned about striped bass. Some of your folks are concerned about bluefish or sharks. Let's do what we can to keep focused on the matter at hand; in developing ecological reference points.

Bay Cap, I mean the Chesapeake Bay is a wonderful, wonderful system. Those of you who were charged with its stewardship; I'm somewhat envious of, beautiful place to live, and to work, and to play. We'll get there, but we've outkicked our coverage right now. Thanks.

CHAIRMAN MESERVE: John Clark and then Eric Reid.

MR. CLARK: The Board is clearly in a tough spot today. This is putting lipstick on a pig here, but I would just like to say as to actions the Board can take. As long as we look at this as a compliance action we are very limited; we're between the rock of the corporation and its friends in Richmond, and on the other hand the Secretary of Commerce, whom the less said about the better. But we could also look at this as an allocation issue. Under Amendment 3 we have adaptive management.

Whether there is a scientific basis for the 51,000 metric ton cap for the Bay is beside the point. It's in the Amendment. It was taken out to the public; the public overwhelmingly supports the cap. We as a Board, I think do have power through the adaptive management, to take actions that could make Virginia see that it's in their interest to put the cap into place. I'll just leave it at that.

CHAIRAMN MESERVE: Eric.

MR. ERIC REID: As far as the original motion goes. To me it's a dead end, it's a no win, you call it whatever you want. It's going nowhere. I would prefer to support this motion. We could find the Virginia Legislature out of compliance, because they're out of compliance. As far as our fellow Commissioners, which one of them may be governor here in the next couple of days. I prefer to support the future governors of the state of Virginia in their efforts; and also you know support industry as well. Industry is in compliance. Our Commissioners have done everything they possibly can to do what is right.

My preference is to support this motion, support the industry, and support our fellow Commissioners in the spirit of cooperation.

CHAIRMAN MESERVE: Ray Kane, last comment.

MR. RAYMOND W. KANE: I would like to thank Katie, first of all, for a very comprehensive presentation to the lay people sitting around this table. Let's have some solace in the fact that we are going to do a biomass survey in the Chesapeake Bay by way of an aerial survey, which have proven to be very effective in other fisheries.

I know we don't have a timeframe when Katie and her staff can come back and say this is what we learned from the aerial surveys. I'm sure it's five or six years down the road, because vessels have to be integrated with aerial survey and what not. But I would speak in favor of this motion; knowing that once we have an aerial survey completed, and we have our ERPs in place, we can move forward.

CHAIRMAN MESERVE: I just want to clarify that the survey is not a given yet. It's very contingent upon funding a successful survey design long term plan. Yes, Marty Gary.

MR. MARTIN GARY: I purposefully held off to listen to other folks around the table; everybody is vested in this issue. Not that PRFC is more vested than anybody else, but we are geographically, demographically, politically as close to this issue as any jurisdiction sitting around the table.

Our jurisdiction, our community wants an abundance of menhaden in the river for our pound netters, for our charterboat operators that rely on menhaden for bait, for our crabbers, for our sport fishermen that want an abundant pretty species in the river for predatory species like striped bass. That is why we supported the Cap. But we've also seen since 2012 the Cap hasn't been raised. We know the uncertainty around the science. We know the political landscape and the trajectory through an appeal process.

It's all been stated well. I think Robert hit the key word; and I just really appreciate it, cooperation. I get to experience that with my sister jurisdictions, the Commonwealth and Maryland day in and day out, and I could tell you first hand this is exemplary what they've done with menhaden, and their cooperation. I support the motion. I just wanted you all to hear it. We're right at the epicenter of this; it's as meaningful to us as anybody at the table, and we support the motion.

CHAIRMAN MESERVE: I think we're at a place. Does the Board need a moment to caucus? Let's just take one minute to caucus. Is the Board ready; question, Roy Miller?

MR. ROY W. MILLER: Madam Chair, could you or perhaps someone on staff review for us exactly what is meant by postpone indefinitely? Does that mean the item could come up again for discussion if the cap were exceeded; or does it mean it can never come up again for discussion?

CHAIRMAN MESERVE: I did ask staff for some clarification on this in advance. Postpone indefinitely means that this could come back up; but it would take a new noncompliance motion to bring it back. It's different from tabling or postponing in that way; but it could be reintroduced with a new motion.

With that clarification let's give this a try. Is there any opposition to the motion? Seeing one; we will start from the top then. **All those in favor of the motion please raise your right hand. All those opposed like sign. Are there any null votes or abstentions**?

MR. BOWMAN: Madam Chair, a question. This is a final action; should a roll call vote be taken or not?

CHAIRMAN MESERVE: Staff is indicating it's not considered a final action; but a roll call could be requested if desired.

MR. BOWMAN: No, thank you.

CHAIRMAN MESERVE: **With no nulls and no abstentions, the motion passes 17 to 1; and that is our final agenda item, and I appreciate the Board's brevity today**.

ADJOURNMENT

CHAIRMAN MESERVE: If there is no other business to come before the Board, we are adjourned. Thank you very much.

(Whereupon the meeting adjourned at 9:15 o'clock a.m. on February 7, 2019)

Tentative Timeline:

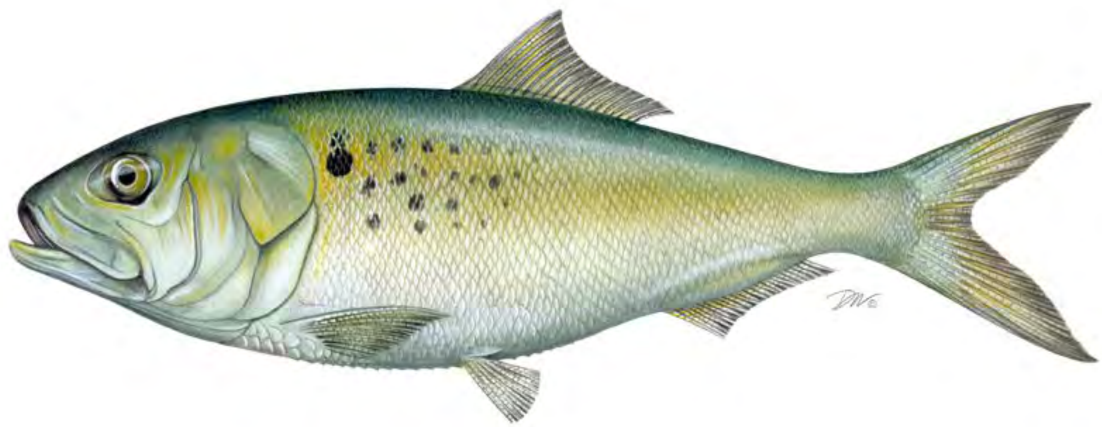
2019 ASMFC Atlantic Menhaden Single-Species and ERP Benchmark Stock Assessments

Meeting Description	*Committee	Meeting Dates/ Deadlines
2018		
Pre-Assessment Webinar	TC, SAS, ERP	✓ Feb 2
Data Template Submission Deadline	TC	✓March 23
Pre-Data Workshop Webinar	TC, SAS, ERP	✓April 2
Data Workshop I	TC, SAS, ERP	✓April 23-25 (ATM) ✓April 25-27 (ERP)
Board Approval of TOR's	Board	✓May
Submission Deadline for Alternate Multi-Species Model(s)	PUBLIC	✓ June 1
Data Workshop Follow-up Tasks Webinar – progress update	SAS ERP	✓ July 24, ✓ August 31 ✓ August 30
Data Workshop II	SAS ERP	✓ October 9-10 ✓ October 11-12
~~Board Meeting – progress update (canceled)~~	~~Board~~	~~October~~
Submission Deadline for Alternate Single-Species Model(s)	PUBLIC	✓ Nov 1
Check-In Call – progress update on DWII follow-up tasks	SAS, ERP	✓ December 13
2019		
Pre-Modeling Workshop Check-In Call – progress update on follow-up tasks	ERP SAS	✓January 23 ✓January 24
Production model review call	ERP	✓March 28
Assessment/Modeling Workshop I	ERP SAS	✓April 1-3 ✓April 3-5
Modeling Workshop Follow-up Tasks Webinar – progress update	SAS, ERP	✓May/June
Assessment/Modeling Workshop II	SAS, ERP	✓June 24-28
Modeling Workshop Follow-up webinar(s)	SAS, ERP	✓July
Final webinar to approve stock status determination	SAS, ERP	August 19
TC to discuss assessment findings & approve single-species assessment for peer review	TC	September 17-19
Submit report to external peer-review panel	ASMFC	October 21
Board Meeting – progress update on benchmarks	Board	Annual Meeting (October 28-31)
Peer Review	SEDAR	November 4

* TC – Atlantic Menhaden Technical Committee; SAS – Atlantic Menhaden Stock Assessment Subcommittee; ERP – Ecological Reference Point Workgroup

DRAFT 2019 REVIEW OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION FISHERY MANAGEMENT PLAN AND STATE COMPLIANCE FOR ATLANTIC MENHADEN (Brevoortia tyrannus)

2018 Fishery



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Drafted May 2019

DRAFT REVIEW OF THE ASMFC FISHERY MANAGEMENT PLAN AND STATE COMPLIANCE FOR ATLANTIC MENHADEN *(Brevoortia tyrannus)* FOR THE 2018 FISHERY

Management Summary

Date of FMP:	Original FMP: August 1981
Amendments:	Plan Revision: September 1992 Amendment 1: July 2001 Amendment 2: December 2012 Amendment 3: November 2017
Management Unit:	The range of Atlantic menhaden within U.S. waters of the Northwest Atlantic Ocean, from the estuaries eastward to the offshore boundary of the Exclusive Economic Zone (EEZ).
States With Declared Interest:	Maine – Florida, including Pennsylvania
Additional Jurisdictions:	Potomac River Fisheries Commission, National Marine Fisheries Service, United States Fish and Wildlife Service
Active Boards/Committees:	Atlantic Menhaden Management Board, Advisory Panel, Technical Committee, Stock Assessment Subcommittee, Plan Review Team, Plan Development Team, Ecological Reference Point Work Group
Stock Status:	Not overfished, and overfishing is not occurring (2017 stock assessment update)

I. Status of the Fishery Management Plan

Atlantic menhaden management authority is vested in the states because the vast majority of landings come from state waters. All Atlantic coast states and jurisdictions, with the exception of the District of Columbia, have declared an interest in the Atlantic menhaden management program.

The first coastwide fishery management plan (FMP) for Atlantic menhaden was passed in 1981 (ASMFC 1981). The 1981 FMP did not recommend or require specific management actions, but provided a suite of options should they be needed. In 1992, the plan was revised to include a suite of objectives intended to improve data collection and promote awareness of the fishery and its research needs (ASMFC 1992).

Amendment 1 was implemented in 2001 and provided specific biological, ecological and socioeconomic management objectives for Atlantic menhaden (ASMFC 2001). No recreational or commercial management measures were implemented as a result of Amendment 1; however, subsequent addenda instituted a harvest cap[1] on the reduction fishery in the Chesapeake Bay, based on average landings from 2001-2005. Addendum I and V revised the biological reference points for menhaden and specified that stock assessments are to occur every three years (ASMFC 2004; ASMFC 2011).

Amendment 2, approved in 2012, established a 170,800 metric ton (mt) total allowable catch (TAC) for the commercial fishery beginning in 2013 (ASMFC 2012). This TAC represented a 20% reduction from average landings between 2009 and 2011. The 2009-2011 time period was also used to allocate the TAC among the jurisdictions. Additionally, the Amendment established timely reporting requirements for commercial landings and required states to be accountable for their respective quotas by paying back any overages the following year. Amendment 2 also included provisions that allowed for the transfer of quota between jurisdictions and a bycatch allowance of 6,000 pounds per day[2] for non-directed fisheries that operate after a jurisdiction's quota has been landed. The Amendment also reduced the Chesapeake Bay reduction fishery harvest cap by 20% to 87,216 mt.

Amendment 2 also established an episodic events set aside program. This program set aside 1% of the coastwide TAC for the New England states (Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut) to harvest Atlantic menhaden when they occur in higher abundance than normal. Technical Addendum I to Amendment 2 established a mechanism for New England states to use the set aside (ASMFC 2013). In order to participate in the program, a state must reach its individual quota prior to September 1, implement daily trip level harvester reporting, restrict harvest to state waters, and implement a daily trip limit no greater than 120,000 pounds/vessel. At its October 2013 meeting, the Board extended the episodic event set aside program through 2015, adding a provision that re-allocated unused set aside to the coastwide states based on the same allocation percentages included in Amendment 2. At its May 2016 meeting, the Board again extended the episodic events program until final action on Amendment 3 and added New York as an eligible state to harvest under the program.

At its May 2015 meeting, the Board established a TAC of 187,880 mt for the 2015 and 2016 fishing years. This represented a 10% increase from the 2013 and 2014 TAC. In October 2016, the Board approved a TAC of 200,000 mt for the 2017 fishing year, representing a 6.45% increase from the 2015 and 2016 TAC.

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[1] Addendum II to Amendment 1 initially implemented a harvest cap for 2006-2010 seasons; Addendum III revised the harvest cap amount before the 2006 season commenced; Addendum IV extended the harvest cap through 2013 at the same level established in Addendum III (ASMFC 2005; ASMFC 2006; ASMFC 2009; ASMFC 2009).

[2] Addendum 1 to Amendment 2 allows two licensed individuals to harvest up to 12,000 pounds of menhaden bycatch when working from the same vessel using stationary multi-species gear (ASMFC 2016). The intent of this Addendum was to accommodate cooperative fishing practices that traditionally take place in Chesapeake Bay.

At its February 2014 meeting, the Board passed a motion to manage cast net fisheries for Atlantic menhaden under the bycatch allowance for 2014 and 2015, with the states bearing responsibility for reporting. In November 2015, the Board approved a motion to continue the management of cast net fisheries under the bycatch allowance for 2016, and in February 2017, the Board extended management of the cast net fishery under the bycatch provision until implementation of Amendment 3.

Atlantic menhaden are currently managed under the provisions of Amendment 3. Approved in November 2017, the Amendment continues to manage menhaden via single-species biological reference points until the review and adoption of menhaden-specific ecological reference points (ERPs) as part of the 2019 ecosystem-based benchmark stock assessment process (see *Section II*). In doing so, the Board placed the development of menhaden-specific ERPs as its highest priority and supports the efforts of the Ecological Reference Point Work Group to reach that goal. Amendment 3 also changes commercial quota allocations in order to strike an improved balance between gear types and jurisdictions, and to facilitate future growth opportunities. The Amendment allocates a baseline quota of 0.5% to each jurisdiction, and then allocates the rest of the TAC based on historic landings between 2009 and 2011. This measure provides fishing opportunities to states which had little quota under Amendment 2, while still recognizing historic landings in the fishery. States also have the option to relinquish all or part of its quota which is then redistributed to the other jurisdictions based on the historic landings period (2009-2011). The Amendment prohibits the rollover of unused quota; maintains the quota transfer process; maintains the incidental catch provision[3] and the episodic events program for the states of Maine – New York. Finally, the Amendment reduces the Chesapeake Bay cap to 51,000 mt, recognizing the importance of the Chesapeake Bay as nursery grounds for many species by capping recent reduction landings from the Bay at current levels.

In addition to its Amendment 3 deliberations, the Board set the TAC for the 2018 and 2019 fishing seasons at 216,000 mt (an 8% increase from 2017) with the expectation that setting of the TAC for subsequent years would be guided by menhaden-specific ERPs.

In 2018, the Board approved state implementation plans for Amendment 3 and postponed action indefinitely to find the Commonwealth of Virginia out of compliance for not implementing the Chesapeake Bay reduction fishery cap of 51,000 mt. In making its decision, the Board took into account the fact that reduction fishery harvest within the Chesapeake Bay has been below the cap level since 2012, including 2018 harvest (see *Section VII*). This action is contingent upon the Chesapeake Bay reduction fishery not exceeding the cap. If the cap is exceeded, the Board can reconsider the issue of compliance.

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[3] The bycatch provision under Amendment 2 was rebranded under Amendment 3 as the incidental catch and small scale fisheries provision. Under the provision, small-scale and non-directed gears, as defined in the amendment, may land up to 6,000 pounds of menhaden per trip per day after the quota in a given jurisdiction is met.

II. Status of the Stock

Threshold reference points are the basis for determining stock status. When the fishing mortality rate (*F*) exceeds the *F*-threshold, overfishing is occurring. When the reproductive output measure, in this case population fecundity (*FEC*), falls below its threshold, then the stock is overfished, meaning there is insufficient egg production to replenish the stock.

Amendment 2 implemented maximum spawning potential (MSP) based reference points that relate current stock conditions as a percent of unfished conditions. Considering the modeling and data input changes that occurred in the 2015 Benchmark Stock Assessment, the Technical Committee (TC) and Peer Review Panel recommended new MSP-based reference points that are applicable to the results of the assessment (SEDAR 2015). These new reference points were accepted by the Board in 2015 and continue to be used under Amendment 3.

As recommended by the Peer Review Panel, and accepted by the TC, the values of the threshold and target fishing mortality reference points are calculated as the maximum and median geometric mean fishing mortality rate for ages-2 to -4 during the reference period of 1960-2012. These ages represent the fully selected fishing mortality rates depending upon the year and fishery (i.e., bait and reduction). The fecundity (FEC) reference points match the F reference points meaning they are equal to the fecundity estimated when F reaches equilibrium at its target and threshold MSP levels, respectively.

According to the 2017 stock assessment update (ASMFC 2017), the fishing mortality reference points are $F_{\text{target}} = F_{36\%\text{ MSP}} = 0.80$ and $F_{\text{threshold}} = F_{21\%\text{ MSP}} = 1.85$. Associated reference points for population fecundity are $FEC_{\text{target}} = FEC_{36\%\text{MSP}} = 99{,}467$ (billions of eggs), and $FEC_{\text{threshold}} = FEC_{21\%\text{MSP}} = 57{,}295$ (billions of eggs). Based on the 2017 stock assessment, overfishing is not occurring because fishing mortality for the terminal year (2016) is estimated to be $F = 0.51$ ($F_{48\%MSP}$), below both the target and the threshold (Figure 1). Additionally, the stock is not overfished because fecundity for 2016 is estimated to be $FEC = 83{,}486$ billion eggs, above the threshold but below the target (Figure 2). A benchmark assessment is expected to be completed and peer-reviewed in November 2019 at SEDAR-69.

Progress of the Ecological Reference Point Work Group

The Ecological Reference Point Work Group (ERP WG; formerly known as the BERP WG) has been tasked with developing menhaden-specific ERPs. The intent of menhaden-specific ERPs is to provide a method to assess the status of menhaden not only in regard to their own sustainability, but also in regard to their interactions with predators and the status of other prey species. The benefit of this approach is that it allows fishery managers to consider the harvest of menhaden within a broad ecosystem context, which includes other fish, birds, mammals, and humans who utilize and depend on marine resources.

In 2017, the ERP WG held three workshops to review candidate ERP models. The candidate models include a Bayesian surplus production model with a time-varying population growth rate, a Steele-Henderson model which permits non-fisheries effects (predation and environment) to be quantified and incorporated into the single-species stock assessments, and a multispecies statistical catch-at-age model in which single-species models are linked to provide a predator-prey feedback between the population models. An Ecopath with Ecosim model is also being evaluated for strategic planning purposes and exploring tradeoffs.

In 2018, the ERP WG held two data workshops to review all available data for menhaden, and other candidate predator and prey species for the ERP models. An Assessment Workshop was recently held in April 2019 to identify base runs for each of the models as well. Peer-review of the menhaden-specific ERP model(s) will coincide with the peer-review of the singles-species benchmark assessment at SEDAR-69 in November 2019.

V. Status of the Fishery

Commercial

Total commercial Atlantic menhaden landings in 2018, including directed, incidental catch, and episodic event set aside (EESA) landings, are estimated at 421.5 million pounds (191,202 mt), approximately an 11% increase relative to 2017 (Table 1). The non-incidental catch fishery landings (directed landings plus landings under the EESA) total for 2018 is estimated at 418.3 million pounds (189,744 mt) and represents an 12% underage of the coastwide commercial TAC of 476.2 million pounds (216,000 mt). Landings from the incidental catch fishery are estimated at 3.21 million pounds (1,458 mt) and do not count towards the coastwide TAC.

Reduction Fishery

The 2018 harvest for reduction purposes is estimated at 311.6 million pounds (141,317 mt), a 10% increase from 2017 and 5% above the previous 5-year average of 296.2 million pounds (134,373 mt) (Table 2; Figure 3). Omega Protein's plant in Reedville, Virginia, is the only active Atlantic menhaden reduction factory on the Atlantic coast.

Bait Fishery

The coastwide bait harvest estimate for 2018, including directed, incidental catch, and EESA landings, is 110.0 million pounds (49,885 mt). This represents a 14% increase relative to 2017 and an 18% increase compared to the previous 5-year average (Table 2; Figure 3). New Jersey (46%), Virginia (27%), Maine (13%), and Massachusetts (5%) landed the four largest shares in 2018.

Incidental Catch and Small Scale Fisheries Landings

Incidental catch landings in 2018 are estimated at 3.21 million pounds (1,458 mt), which is an 18% increase relative to 2017 but well below the time series average (Table 3). Three states reported incidental catch landings in 2018; Maine, New Jersey, and Virginia (Table 4). Maine accounted for 90% of total incidental fishery landings in 2018 (73% from purse seines and 17% from gill nets). 2018 also marked the lowest number of trips occurring under the provision since its inception (Table 4).

Episodic Events Set Aside Program (EESA)

One percent of the TAC is set aside for episodic events. Episodic events are defined as any instance when a qualified state has reached its individual state quota prior to September 1, and has information indicating the presence of unusually large amounts of menhaden in its state waters. The 2018 EESA quota was 4.48 million pounds (2,031 mt) and accounts for the 285,398 pound overage from the 2017 season. Maine declared participation in the EESA on July 23, 2018, and closed the fishery on August 11. The preliminary EESA landings estimate for 2018 is 4.64 million pounds (2,103 mt) which is 3.6% above the quota. Maine transferred 159,433 pounds of 2018 quota to reconcile the overage. The resulting EESA quota for 2019 is 4.76 million pounds. Table 5 details the EESA fishery by year.

Recreational

Menhaden are important bait in many recreational fisheries; some recreational fishermen employ cast nets to capture menhaden or snag them with hook and line for use as bait, both dead and live. Recreational harvest is not well captured by the Marine Recreational Information Program (MRIP) because there is not a known identified direct harvest for menhaden, other than for bait. MRIP intercepts typically capture the landed fish from recreational trips as fishermen come to the dock or on the beach. However, since menhaden caught by recreational fishermen are used as bait during their trip, they are typically not a part of the catch that is seen by the surveyor completing the intercept.

The MRIP estimate of Atlantic menhaden harvest (A + B1) in 2018 is 3,457,987 pounds. This is an 8% decrease from 2017 (3,756,722 pounds), but a 9% increase when compared to the previous 5-year average (3,174,751 pounds).

VI. Status of Research and Monitoring

Commercial fisheries monitoring

Reduction fishery - The NMFS Southeast Fisheries Science Center Beaufort Laboratory in Beaufort, North Carolina, continues to monitor landings from the Atlantic menhaden purse-seine reduction fishery and collect biological samples. The Beaufort Laboratory processes and ages all reduction samples collected on the East Coast. In addition, the purse-seine reduction fishery continues to provide Captains Daily Fishing Reports (CDFRs) to the Beaufort Laboratory where NMFS personnel enter data into a database for storage and analysis.

Bait fishery - Per Amendment 3, states are required to implement a timely quota monitoring system in order to maintain menhaden harvest within the TAC and minimize the potential for overages. The SAFIS daily electronic dealer reporting system allows near real time data acquisition for federally permitted bait dealers in the Mid-Atlantic and Northeast. Landings by Virginia's purse-seine for-bait vessels (snapper rigs) in Chesapeake Bay are tabulated at season's end using CDFRs maintained on each vessel during the fishing season. A bait-fishery sampling program for size and age composition has also been conducted since 1994. The Beaufort Laboratory, and some states, age the bait samples collected. See *Section VII* for more information on quota monitoring and biological sampling requirements.

Atlantic menhaden research

The following studies relevant to menhaden assessment and management have been published within the last year:

- Harrison, J.L., Naumenko, A. and Whitehead, J.C., 2018. Citizen Preferences for Ecosystem-based Fisheries Management: The Case of Atlantic Menhaden (No. 18-10). Department of Economics, Appalachian State University

Theses and Dissertations of Potential Interest:
- Liljestrand, Emily Morgan. 2017. Mortality and Movement of Adult Atlantic Menhaden during 1966-1969. Order No. 10618597 University of Maryland, College Park
- Siple, Margaret Clark. 2017. Implications of Demographic Diversity for Forage Fish, their Fisheries, and Ecosystems. Order No. 10680836 University of Washington

VII. Implementation of FMP Compliance Requirements for 2018

All states are required to submit annual compliance reports by April 1.

Quota Monitoring and Results

Menhaden purse seine and bait seine vessels (or snapper rigs) are required to submit CDFRs. Maine, New York and Virginia fulfilled this requirement in 2018. New Jersey did not require purse seine vessels to fill out the specific CDFR but did require monthly trip level reporting on state forms that include complementary data elements to the CDFR. Rhode Island purse seine vessels must call in daily reports to RI DFW and fill out daily trip level logbooks. Massachusetts and Connecticut require trip level reporting for all commercial fishermen. Menhaden purse seine fisheries do not currently operate in all other jurisdictions in the management unit.

The Board approved timely quota monitoring programs for each state through implementation of Amendment 3. Monitoring programs are intended to minimize the potential for quota overages. Table 6 contains a summary of each state's approved quota monitoring system.

Table 7 contains state-specific quotas and directed harvest that occurred in 2018. The final quotas for 2018 account for 6.70 million pounds of quota relinquished by Delaware, South Carolina, and Georgia, and include an adjustment of eight in-season quota transfers; seven inter-state transfers and one state-to-EESA transfer. The quota transfers occurred as follows:

1. Connecticut transferred 1,000,000 pounds to Maine
2. New York transferred 1,000,000 pounds to Maine
3. Delaware transferred 150,000 pounds to Maine
4. Florida transferred 1,250,000 pounds to Maine
5. Maryland transferred 1,500,000 pounds to Maine
6. Virginia transferred 1,000,000 pounds to Maine
7. Maine transferred 500,000 pounds to Connecticut
8. Maine transferred 159,433 pounds to the EESA quota

These quota transfers were pursued to ameliorate overages, and therefore, no quota overages occurred in 2018. States may also relinquish all or part of its annual quota by December 1st of the previous year. Delaware and Georgia relinquished 4.36 million pounds of quota which was redistributed to the states according to the procedures outlined in Amendment 3 and is reflected in the 2019 Base Quota (Table 7). At their November 2017 meeting, the Board set the 2019 TAC at 216,000 mt (476.2 million pounds).

Biological Monitoring Requirements
Amendment 2 implemented monitoring requirements for non *de minimis* states as follows:

- One 10-fish sample (age and length) per 300 mt landed for bait purposes for ME, NH, MA, RI, CT, NY, NJ, and DE; and
- One 10-fish sample (age and length) per 200 mt landed for bait purposes for MD, PRFC, VA, and NC.

Table 8 provides the number of 10-fish samples required for 2018. These are based on the best available 2018 total bait landings data (including directed, incidental, and EESA landings) provided to the Commission by the states. In 2018, Massachusetts fell short of the eight required samples primarily due to the very short fishing season (the purse seine fishery was only open three weeks). The state was also unable to collect samples from bycatch in the Atlantic herring fishery or other fishery independent sources as was done in previous years. The state indicated plans to more intensely sample the primary purse seine fishery to ensure the sampling requirement is met in the future. All other jurisdictions met the biological monitoring requirements in 2018.

The PRT continued to discuss whether a sufficient number of samples are being collected from different gear types and regions, and whether additional sampling should be conducted from incidental catch fisheries. The 2019 benchmark provides an opportunity for the Technical Committee to evaluate age and length data from commercial bait fishery catches and respond to the PRT's comments.

Adult CPUE Index Requirement
Amendment 3 requires that, at a minimum, each state with a pound net fishery must collect catch and effort data elements for Atlantic menhaden as follows; total pounds landed per day, number of pound nets fished per day. These are harvester trip level ACCSP data requirements. In May of 2013, the Board approved North Carolina's request to omit this information on the basis that it does not have the current reporting structure to require a quantity of gear field by harvesters or dealers[4]. All other states with a pound net fishery met this requirement. New Jersey did note, however, that there appeared to be some confusion in the reporting of effort and that New Jersey personnel are working with industry to clarify the reporting requirement.

Chesapeake Bay Reduction Fishery Cap
Amendment 3 implemented a 51,000 mt harvest cap for the reduction fishery in the Chesapeake Bay, which is roughly the average harvest from the Chesapeake Bay reduction

[4] North Carolina continues to explore developing a proxy for this from existing information collected on permits. The current method estimates a maximum number of pound nets fished per day. A more specific pound net permit data set is being explored to further narrow data.

fishery over the 5-year time period from 2012-2016. Reported reduction landings from the Chesapeake Bay for 2018 was about 32,000 mt which is below the Cap.

De Minimis Status
To be eligible for *de minimis* status, a state's bait landings must be less than 1% of the total coastwide bait landings for the most recent two years. State(s) with a reduction fishery are not eligible for *de minimis* consideration. If granted *de minimis* status by the Board, states are exempt from implementing biological sampling as well as pound net catch and effort data reporting. The Board also approved a *de minimis* exemption for New Hampshire, South Carolina and Georgia from implementation of timely reporting. The states of Pennsylvania, South Carolina, Georgia, and Florida requested and qualify for *de minimis* status for the 2019 fishing season.

IX. Plan Review Team Comments and Recommendations

<u>Plan Review Team Comments</u>
Landings data suggest that Atlantic menhaden have become increasingly available to the Gulf of Maine fishery in recent years (2016-2018). In 2018, the state of Maine reported landings in excess of 14 million pounds, marking a 350% increase relative to the state's 2017 landings. Maine has requested additional quota through in-season transfers each year since 2016. In 2018, Maine tripled its base quota by securing 5.4 million pounds of additional quota to extend the directed fishery. Maine has also opted into the EESA fishery for three consecutive years and fully utilized the EESA quota in 2018. After closing the directed fishery and EESA the fishery, Maine landed an additional 2.9 million pounds in 2018 under the incidental catch provision. The recent increase in landings may also be attributed to the status and availability of other bait fish populations in the region (e.g., Atlantic herring), or social and economic factors.

The 2018 incidental catch fishery cannot be directly compared to previous years due to the implementation of Amendment 3 and the reallocation of the coastwide TAC. With the exception of Maine, however, it appears that the new allocations provided states sufficient quota to keep the directed fisheries open throughout the season. While total incidental catch landings increased in 2018 relative to 2017 (see comments regarding Maine's landings above), the number of trips occurring in 2018 were the lowest on record and the fewest number of states participated in the fishery since 2013 (the first year the provision was implemented).

The incidental catch provision in Amendment 3 states "after a quota allocation is met for a given jurisdiction, the fishery moves to an incidental catch fishery in which small-scale gears and non-directed gear types may land up to 6,000 pounds of menhaden per trip per day" (12,000 pounds per trip per day for two authorized individuals, working from the same vessel fishing stationary multi-species gear). The amendment does not give guidance for the incidental catch provision if a state subdivides its quota to different gear types or sectors. New Jersey and the Commonwealth of Virginia subdivide its quotas and has done so since the Commission implemented state quotas in 2013. Virginia allocates its annual quota to three sectors: the reduction sector, the purse seine bait sector, and the non-purse seine bait sector. New Jersey allocates majority of its annual quota to the purse-seine fishery, and the remaining quota is allocated to all other gear types. Once the non-purse seine bait sector or "other gears" fishery has harvested its portion of the state's allocation, the fishery moves into an incidental catch fishery regardless of whether the entire state's quota has been harvested. This has resulted in Virginia and New Jersey reporting incidental catch landings when they have not met their overall quota allocation for a given year. Since the inception of the incidental catch provision, the PRT has reported landings following the closure of Virginia's non-purse seine bait fishery and New Jersey's "other gears" fishery as incidental catch. The PRT requests guidance from the Board if they would like to see this reported differently. The PRT recommends this issue be addressed in a future management document.

Management Recommendations

- The PRT recommends that the *de minimis* requests from Pennsylvania, South Carolina, Georgia, and Florida, be approved.
- The PRT recommends that the incidental catch fishery provision issue readdressed in a future management document.

IX. Literature Cited

Atlantic States Marine Fisheries Commission (ASMFC). 1981. Fishery Management Plan for Atlantic Menhaden. 146 pp.

ASMFC. 1992. Fishery Management Plan for Atlantic Menhaden 1992 Revision. 170 pp.

ASMFC. 2001. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. 146 pp.

ASMFC. 2004. Addendum I to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. 52 pp.

ASMFC. 2005. Addendum II to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. 30 p.

ASMFC. 2006. Addendum III to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. 6 p.

ASMFC. 2009. Addendum IV to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. 5 p.

ASMFC. 2011. Addendum V to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. 17 pp.

ASMFC. 2012. Amendment 2 to the Interstate Fishery Management Plan for Atlantic Menhaden. 114 pp.

ASMFC. 2013. Technical Addendum I to Amendment 2 to the Interstate Fishery Management Plan for Atlantic Menhaden. 4 pp.

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ASMFC. 2017a. Amendment 3 to the Interstate Fishery Management Plan for Atlantic Menhaden. 111 pp.

ASMFC. 2017b. Atlantic Menhaden Stock Assessment Update. Prepared by the ASMFC Atlantic Menhaden Stock Assessment Subcommittee. 180 pp.

Southeast Data, Assessment, and Review (SEDAR). 2015. SEDAR 40 – Atlantic Menhaden Stock Assessment Report. SEDAR, North Charleston SC. 643 pp.

Table 1. Directed, bycatch, and episodic events set aside landings in pounds for 2018 by jurisdiction. NA = not applicable; C = confidential

State	Directed	Incidental Catch	EESA
ME	6,537,294	2,900,169	4,636,020
NH	C	-	-
MA	5,715,608	-	-
RI	722,388	-	-
CT	821,360	-	-
NY*	909,908	-	-
NJ	50,250,542	204,240	NA
DE	162,838	-	NA
MD	3,112,159	-	NA
PFRC	3,323,014	-	NA
VA	340,965,634	110,281	NA
NC	712,599	-	NA
SC	C	-	NA
GA	-	-	NA
FL	247,260	-	NA

Table 2. Atlantic menhaden reduction and bait landings in thousand metric tons, 1985-2018

	Reduction Landings (1000 mt)	Bait Landings (1000 mt)
1985	307	26.6
1986	238	21.6
1987	310	25.5
1988	278	43.8
1989	284	31.5
1990	343	28.1
1991	330	29.7
1992	270	33.8
1993	310	23.4
1994	260	25.6
1995	340	28.4
1996	293	21.7
1997	259	24.2
1998	246	38.4
1999	171	34.8
2000	167	33.5
2001	234	35.3
2002	174	36.2
2003	166	33.2
2004	183	34.0
2005	147	38.4
2006	157	27.2
2007	174	42.1
2008	141	47.6
2009	144	39.2
2010	183	42.7
2011	174	52.6
2012	161	63.7
2013	131	37.0
2014	131	41.6
2015	143	45.8
2016	137	43.1
2017	129	43.8
2018	141	49.9
Avg 2013-2017	134	42.3

Table 3. Incidental fishery landings by state in pounds, 2013-2018. Only states that have reported incidental catch landings are listed. Average total incidental catch landings for the time series is 4.29 million pounds.

State	2013	2014	2015	2016	2017	2018
ME	-	-	-	506,145	699,874	2,900,169
RI	16,100	98,533	69,947	39,540	135,748	-
CT	-	-	10,469	-	123,666	-
NY	-	324,857	769,312	281,017	807,392	-
NJ	-	625,643	240,922	195,523	-	204,240
DE	75,928	111,944	91,543	20,823	29,285	-
MD	2,864,298	2,200,662	1,949,577	995,698	-	-
PRFC	1,087,410	1,112,343	455,350	105,669	670,447	-
VA	268,215	2,231,708	2,102,529	325,692	-	110,281
FL	64,790	125,772	301,963	111,165	263,643	-
Total	4,376,741	6,831,462	5,991,612	2,581,272	2,730,055	3,214,690

Table 4. Total incidental landings (pounds), number of trips, and number of states reporting landings in the incidental catch fishery, 2013-2018.

Year	Landings (pounds)	Number of Trips	Number of states landing
2013	4,376,741	2,783	6
2014	6,831,462	5,275	8
2015	5,991,612	4,498	9
2016	2,581,272	2,222	9
2017	2,730,055	2,093	7
2018	3,214,690	1,224	3
Total	25,725,832	18,095	

Table 5. Episodic Events Set-Aside (EESA) fishery quota, landings, and participating states by year. *the 2018 EESA is reduced due to an overage in 2017. The 2018 EESA overage was paid back in full by the state of Maine.

Year	States Declared Participation	EESA Quota	Landed (MT)	% EESA Quota Used
2013		1,708	-	-
2014	RI	1,708	134	7.8%
2015	RI	1,879	854	45.5%
2016	ME, RI, NY	1,879	1,728	92.0%
2017	ME, RI, NY	2,000	2,129	106.5%
2018*	ME	2,031	2,103	103.6%

Table 6: State quota reporting timeframes in 2018. The **bold** text indicates which reporting program (dealer or harvesters) the states use to monitor its quotas.

State	Dealer Reporting	Harvester Reporting	Notes
ME	monthly	**monthly/daily**	Harvesters landing greater than 6,000 lbs must report daily during episodic event
NH	**weekly**	monthly	Exempt from timely reporting. Implemented weekly, trip level reporting for state dealers.
MA	**weekly**	monthly/daily	Harvesters landing greater than 6,000 lbs must report daily
RI	**twice weekly**	quarterly/daily	Harvesters using purse seines must report daily
CT	**weekly/monthly**	monthly	CT operates as directed fisheries until 90% of the quota is harvested. Then operates at the 6,000 pound bycatch trip limit.
NY	**Weekly**	monthly	Capability to require weekly harvester reporting if needed
NJ	**weekly**	monthly	All menhaden sold or bartered must be done through a licensed dealer
DE	–	**monthly/daily**	Harvesters landing menhaden report daily using IVR
MD	monthly	**monthly/daily**	PN harvest is reported daily, while other harvest is reported monthly.
PRFC	–	**weekly**	Trip level harvester reports submitted weekly. When 70% of quota is estimated to be reached, then pound netters must call in weekly report of daily catch.
VA	–	**monthly/weekly/daily**	Purse seines submit weekly reports until 97% of quota, then daily reports. Monthly for all other gears until 90% of quota, then reporting every 10 days.
NC	**monthly (combined reports)**		Single trip ticket with dealer and harvester information submitted monthly. Larger dealers (>50,000 lbs of landings annually) can report electronically, updated daily.
SC	**monthly (combined reports)**		Exempt from timely reporting. Single trip ticket with dealer and harvester information.
GA	**monthly (combined reports)**		Exempt from timely reporting. Single trip ticket with dealer and harvester information.
FL	**monthly/weekly (combined reports)**		Monthly until 75% fill of quota triggers implementation of weekly.

Table 7. Results of 2018 quota accounting in pounds. The 2018 landings do not include landings from the incidental catch fishery because they do not count towards the TAC. The 2018 episodic events set aside (EESA) quota was exceeded by 159,433 pounds, and was paid back by Maine (the pay back was deducted from Maine's final 2018 quota). The 2019 quotas account for overages which occurred in the 2018 fishery and the redistribution of relinquished by Delaware (2.0 million pounds) and Georgia (2.4 million pounds). * includes redistributed relinquished quota for that year and any overages from the previous season. ^includes inter-state transfers and transfers to the EESA quota.

State	2018 Base Quota*	Returned Set Aside	Transfers^	Final 2018 Quota	Overages	2019 Base Quota*
ME	2,439,114	Set Aside Exceeded by 159,433 pounds (paid back by ME)	5,240,567	7,679,681	-	2,438,677
NH	2,357,315			2,357,315	-	2,357,314
MA	6,027,724			6,027,724	-	6,045,252
RI	2,366,618			2,366,618	-	2,441,380
CT	2,432,640		(500,000)	1,932,640	-	2,432,238
NY	3,270,675		(1,000,000)	2,270,675	-	3,265,806
NJ	52,013,736			52,013,736	-	51,749,064
PA	2,357,183			2,357,183	-	2,357,183
DE	415,940		(150,000)	265,940	-	416,467
MD	9,002,733		(1,500,000)	7,502,733	-	8,967,312
PRFC	5,102,086			5,102,086	-	5,087,456
VA	376,543,328		(1,000,000)	375,543,328	-	374,548,891
NC	4,540,560			4,540,560	-	4,528,923
SC	10,000			10,000	-	2,357,183
GA	0			0	-	-
FL	2,443,819		(1,250,000)	1,193,819	-	2,443,357
TOTAL	471,323,470			471,164,037	-	471,436,502

Table 8. Biological monitoring results for the 2018 Atlantic menhaden bait fishery.

State	#10-fish samples required	#10-fish samples collected	Age samples collected	Length samples collected	Gear/Comments
ME	21	21	210	210	purse seine
MA	8	3	30	51	30 purse seine, plus 21 midwater trawl lengths
RI	1	4	43	43	floating fish traps
CT	1	1	13	13	
NY	2	4	41	41	cast net
NJ	76	127	1270	1270	118 purse seine, 9 "other gears"
DE	1	1	10	10	gill net
MD	7	16	188	688	pound net ^
PRFC	7	9	90	90	pound net
VA	67	87	870	870	pound net (18), gill net (64), haul seine (5)
NC	2	2	20	20	gill net
Total	**193**	**275**	**2785**	**3306**	

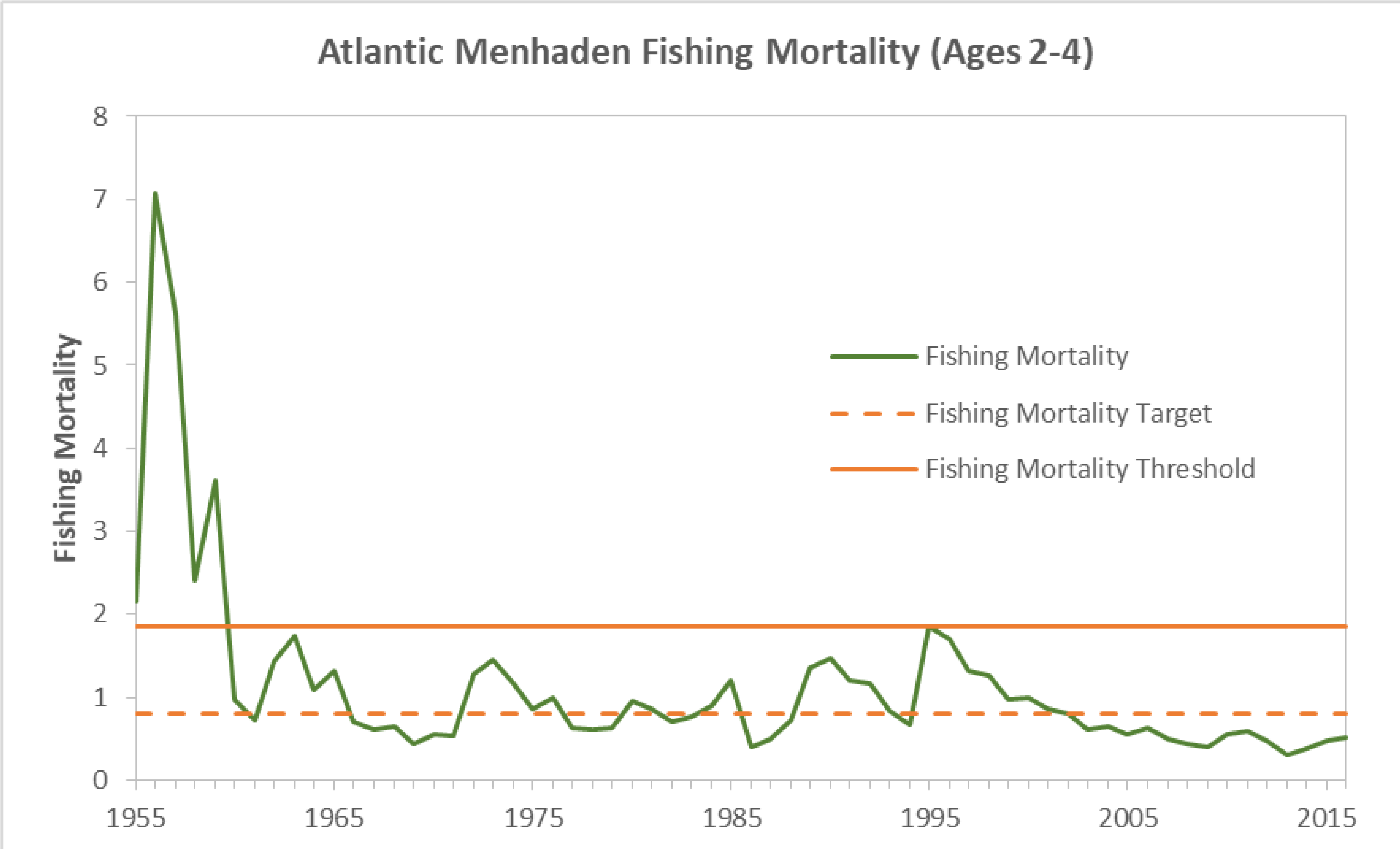

Figure 1. Fishing mortality, 1955-2016. The fishing mortality reference points are F_{target} = $F_{36\%\ MSP}$ = 0.80 and $F_{threshold}$ = $F_{21\%\ MSP}$ = 1.85. F_{2016} = 0.51. Source: ASMFC 2017b.

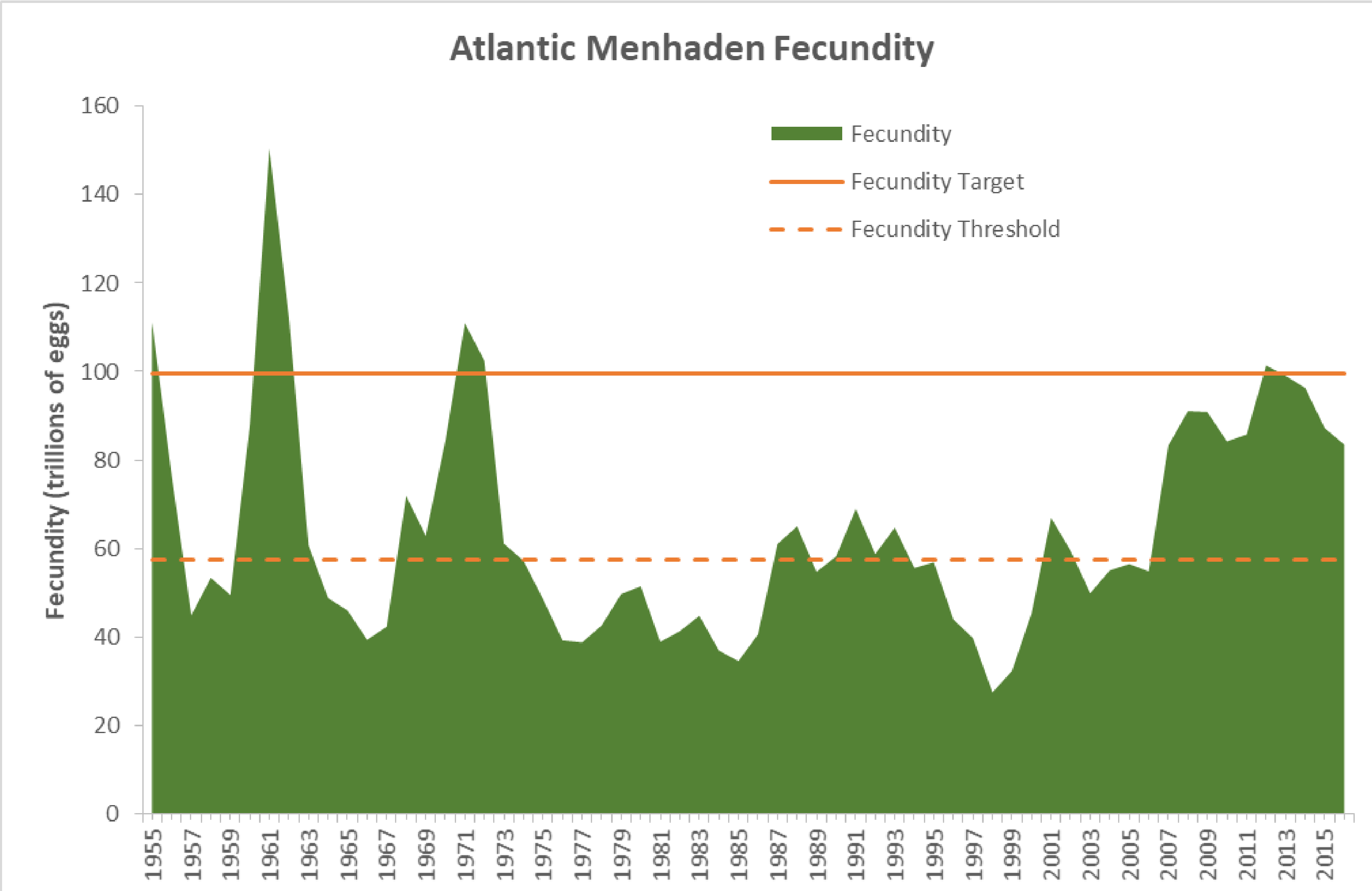

Figure 2. Atlantic menhaden fecundity, 1955-2016. The reference points for population fecundity are $FEC_{target} = FEC_{36\%MSP}$ = 99,467 (billions of eggs), and $FEC_{threshold} = FEC_{21\%MSP}$ = 57,295 (billions of eggs). FEC_{2016} = 83,486 billion eggs.

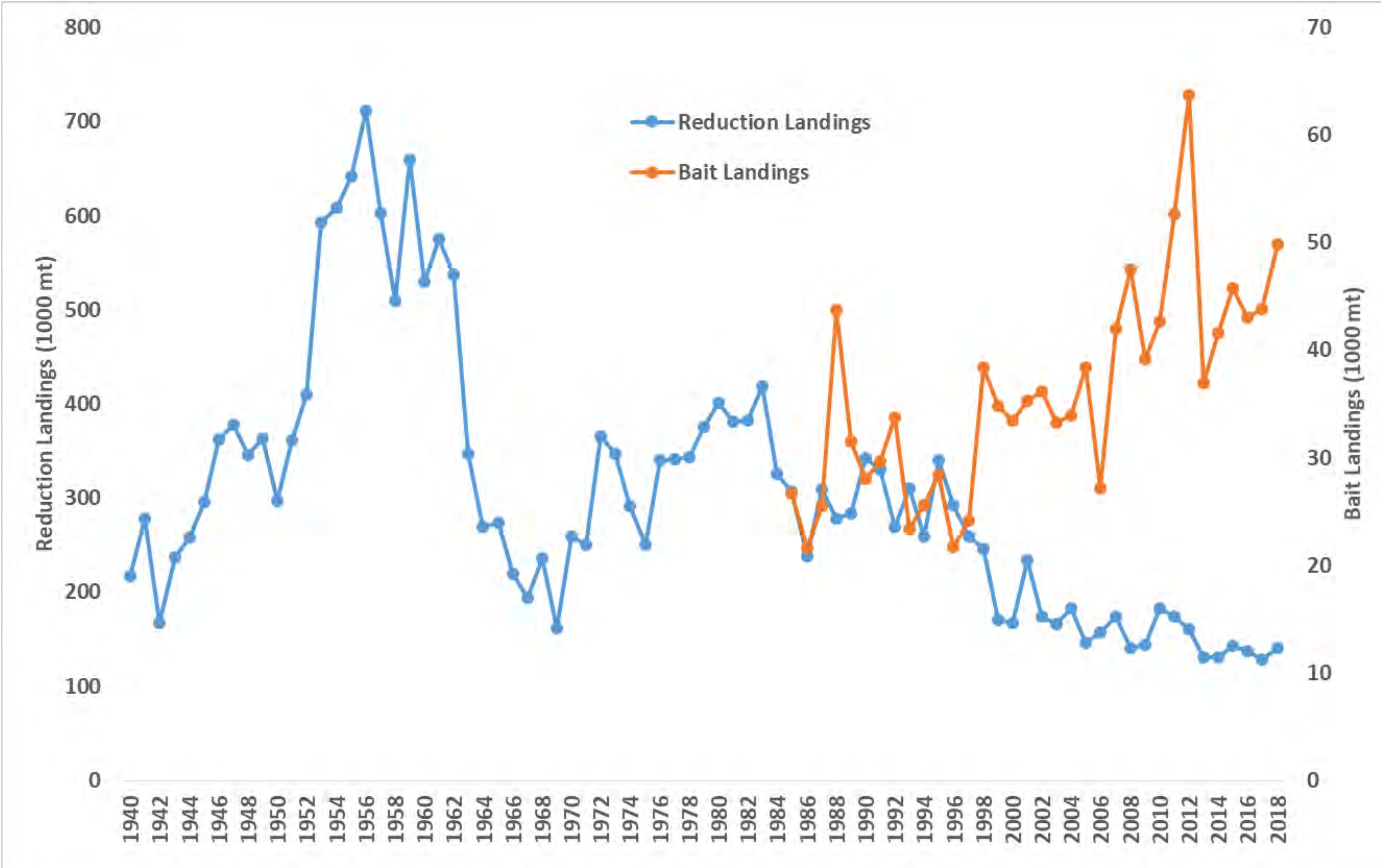

Figure 3. Landings from the reduction purse seine fishery (1940–2018) and bait fishery (1985–2018) for Atlantic menhaden. Note: there are two different scales on the y-axes.

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: Atlantic Menhaden Management Board

FROM: Max Appelman, Fishery Management Plan Coordinator

DATE: July 19, 2019

SUBJECT: Atlantic Menhaden Fishery Specifications Process

The Atlantic Menhaden Management Board (Board) will discuss the 2020 total allowable catch (TAC) for menhaden at its August 2019 meeting. In November 2017, the Board set the TAC for the 2018 and 2019 fishing seasons with the expectation that setting of the TAC for subsequent years would be guided by menhaden-specific ecological reference points. However, the Atlantic menhaden single-species and ecological-based benchmark stock assessments will not be ready for Board review until February of next year and a TAC for 2020 has not yet been set. Per Amendment 3, if the Board does not set a TAC for 2020 by December 31, 2019, next year's TAC will automatically be set at the level of the 2019 TAC.

TAC Setting Process

Per Amendment 3, the TAC is set through Board action, either on an annual basis or for multiple years, based on the best available science; primarily the results of projection analysis which explores a range of TAC alternatives to determine the percent risk of exceeding the F_{target} or the $F_{threshold}$. Monte Carlo Bootstrap runs of the base model run from the Beaufort Assessment Model (BAM) are used as the basis for the projection analysis. Amendment 3 also established the "Indecision Clause" that rolls over the current year's TAC if the Board is unable to approve a TAC by year's end.

Projections were last prepared by the Atlantic Menhaden Technical Committee (TC) in 2017 which guided the Board's setting of the TAC for 2018 and 2019. These explored the effect of a range of TAC alternatives for three years ending in 2020; specifically a 0%, 5%, 10%, 20%, 30%, and 40% increase to the 2017 TAC of 200,000 metric tons, plus identifying the TACs that would result in a 50%, 55%, and 60% probability of being below the F_{target} in 2018 (Table 1). Landings were assumed to be constant at 200,000 metric tons for 2017–2020.

Since the implementation of coastwide quota management the TAC has been set at the following levels: 170,800 metric tons (2013–2014); 187, 880 metric tons (2015–2016); 200,000 metric tons (2017); and 216,000 metric tons (2018–2019).

Options for Setting the 2020 TAC

1. The Board can use the existing projections prepared by the TC in 2017 as the basis for setting the 2020 TAC. Under this option, the Board could take action at the August 2019 meeting to set the 2020 TAC.

2. The Board can request updated projections be prepared by the TC to serve as the basis for setting the 2020 TAC. Under this option, the Board would provide the TC with the range of alternatives to be analyzed in the projection analysis, and action to set the TAC for 2020 could occur at the 2019 Annual Meeting. These updated projections would still be based on the 2017 stock assessment update, but incorporate actual landings estimates for 2017 and 2018.
3. The Board could defer action on the 2020 TAC until the 2019 benchmark stock assessments and peer review reports are presented and new projections based on the best available science at that time are developed. This would cause the 2020 TAC to be set at the 2019 level of 216,000 metric tons in the interim. (The Board could similarly revisit the 2020 TAC if set under Options 1 or 2 above).

While the existing projections could be updated (Option 2 above), it is unlikely that the results would differ significantly from the TC's last projections. Actual landings estimates for 2017 (final) and 2018 (preliminary) are below the 200,000 metric tons assumed level, and the proportions of total landings by sector have not changed significantly. Importantly, the work to update the projections would detract from the ongoing assessments which are at a critical stage of the assessment process. Staff also notes that based on the 2017 projections analysis, there is a 0% chance of exceeding the F_{target} or the $F_{threshold}$ in 2020 at the current TAC (Table 1).

Table 1. Percent risk of exceeding the F_{target} and $F_{threshold}$ for a six different total allowable catch (TAC) projections. Source: Menhaden TC memo to the Board dated June 30, 2017 (subject: projection runs for 2018 fishery specifications). Three additional projections were explored to determine the TAC level that results in a 50% (314,500 mt), 55% (288,500 mt), and 60% (286,000 mt) probability of being below the F_{target} in 2018.

	TAC (mt)	**2018**	**2019**	**2020**
Percent Risk of exceeding F_{target}	200,000	9.5%	0.5%	0%
	210,000	12%	1.5%	0%
	220,000	15.5%	3.5%	0%
	240,000	22.5%	9.5%	2.5%
	260,000	29.5%	20.5%	10.5%
	280,000	37.5%	33%	29%

	TAC (mt)	**2018**	**2019**	**2020**
Percent Risk of exceeding $F_{threshold}$ (Overfishing)	200,000	0%	0%	0%
	210,000	0%	0%	0%
	220,000	0%	0%	0%
	240,000	0.5%	0%	0%
	260,000	1.5%	0%	0%
	280,000	2.5%	0%	0%

Atlantic States Marine Fisheries Commission

ISFMP Policy Board

August 7, 2019
8:30 - 10:30 a.m.
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Call to Order *(J. Gilmore)*	8:30 a.m.
2.	Board Consent *(J. Gilmore)* • Approval of Agenda • Approval of Proceedings from May 2019	8:30 a.m.
3.	Public Comment	8:35 a.m.
4.	Update from Executive Committee and State Director's Meeting (*J. Gilmore*)	8:45 a.m.
5.	Review 2019 Annual Performance of the Stocks (*T. Kerns*)	9:00 a.m.
6.	Review and Consider Changes to Commission Guiding Documents (*T. Kerns*) • ISFMP Charter **Final Action** • Technical Support Group Guidance and Benchmark Stock Assessment Process **Final Action** • Working Group SOPPs **Possible Action**	9:30 a.m.
7.	Update on American Lobster Enforcement Vessel (*R. Beal*)	9:50 a.m.
8.	Atlantic Coastal Fish Habitat Partnership Committee Report (*L. Havel*)	10:00 a.m.
9.	Progress Update on the Shad Benchmark Stock Assessment *(J. Kipp)*	10:10 a.m.
10.	Review Noncompliance Findings, If Necessary **Action**	10:15 a.m.
11.	Other Business	10:20 a.m.
12.	Adjourn	10:30 a.m.

The meeting will be held at the Westin Crystal City, 1800 S. Eads Street, Arlington, Virginia; 703.486.1111

MEETING OVERVIEW

ISFMP Policy Board Meeting
Wednesday August 7, 2019
8:30-10:30 a.m.
Arlington, Virginia

Chair: Jim Gilmore (NY) Assumed Chairmanship: 10/17	Vice Chair: Pat Keliher (ME)	Previous Board Meeting: May 2, 2019
Voting Members: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC, SC, GA, FL, NMFS, USFWS (19 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from May 2, 2019

3. Public Comment – At the beginning of the meeting public comment will be taken on items not on the agenda. Individuals that wish to speak at this time must sign-in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Update from State Director's Meeting and Executive Committee (8:45-9:00 a.m.)
Background • The State Director's will meet with NOAA Fisheries on August 5, 2019 • The Executive Committee will meet on August 6, 2019
Presentations • J. Gilmore will provide an update of the two meetings
Board action for consideration at this meeting • none

5. Review 2019 Annual Performance of the Stocks (9:00-9:30 a.m.)
Background • As part of the ASMFC Strategic Planning process, the Commission agreed to conduct more frequent reviews of stock status and rebuilding progress. • **The ASMFC's 2019 Action Plan tasks the Policy Board with conducting a review of stock rebuilding performance.**
Presentations • A presentation will be given on the stock rebuilding performance for species managed by the Commission by T. Kerns (**Briefing Materials**)

Board discussion at this meeting • Determine if the rebuilding performance for each species is consistent with the Commission Vision and Goals. • If the performance is not consistent with Vision and Goals, what action should be taken.

6. Review and Consider Changes to Commission Guiding Documents 9:30-9:50 a.m.) Final Action/Possible Action
Background • Two of the Commission Guiding Documents have been revised. The ISFMP Charter was revised to reflect the number of public hearings required for an FMP/Amendment in the ACFCMA. The Technical Guidance and Benchmark Stock Assessment document was revised to add ACCSP Committees and provide greater clarity to Commission processes. • A Working Group SOPPs was created to give guidance to Boards forming work groups.
Presentations • T. Kerns will provide an overview of the changes to the Charter and TC Guidance Documents and review the WG SOPPs (**Briefing Materials**)
Board action for consideration at this meeting • **Approve Changes to the ISFMP Charter** • **Approve Changes to the Technical Guidance and Benchmark Stock Assessment** • **Approve the Working Group SOPPs**

7. Update on Lobster Enforcement Vessel (9:50-10:00 a.m.)
Background • The ASMFC LEC has been discussing way to improve enforcement capabilities of the offshore lobster fishery. A WG was formed to develop a plan for logistic support and staffing of an offshore enforcement vessel • The Committee met via conference call to discuss next steps
Presentations • R. Beal will present next steps for an offshore enforcement vessel.
Board action for consideration at this meeting • **None**

8. Atlantic Coastal Fish Habitat Partnership Reports (10:00-10:10 a.m.)
Background • The ACFHP Steering Committee met on May 15 – 16, 2019 • FY2020 USFWS-NFHP funding RFP is currently open • ACFHP recently endorsed projects in Brookhaven, NY and Atlantic County, NJ • Black sea bass research project in Mid-Atlantic Bight was completed. Presentation provided to the black sea bass management board on Wednesday by Dr. Brad Stevens.
Presentations • L. Havel will present an overview of the ACFHP activities

Board action for consideration at this meeting
• None

9. Progress Update on Benchmark Stock Assessments (10:10-10:15 a.m.)
Background • The next American shad benchmark stock assessment is scheduled to be completed in the summer of 2020.
Presentations • Jeff Kipp will provide a progress report on the shad assessment.
Board action for consideration at this meeting • None

10. Review Non-Compliance Findings, if Necessary Action

11. Other Business

12. Adjourn

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

ISFMP POLICY BOARD

The Westin Crystal City
Arlington, Virginia
May 2, 2019

These minutes are draft and subject to approval by the ISFMP Policy Board
The Board will review the minutes during its next meeting

TABLE OF CONTENTS

TABLE OF MOTIONS

1. **Approval of Agenda by Consent** (Page 1).

2. **Approval of Proceedings of February 2019** by Consent (Page 1).

3. **Move to direct the Spiny Dogfish Management Board to initiate an Addendum to allow unused quota allocated to the northern states collectively to be transferred in the second half of the fishing year to the states that have state-specific allocations. This action is intended to promote full utilization of the overall commercial quota.**

   It is intended that these proposed transfers shall only be allowed if there is unanimous consent among the northern states regarding the timing and the amount. Also, the Board shall include quota overage forgiveness language similar to that in Addendum XX of the Summer Flounder, Scup, and Black Sea Bass FMP where in the event the overall annual quota of black sea bass and scup (during the summer) among the states is not exceeded, then individual state overages are forgiven. (Page 13). Motion by Dan McKiernan; second by Justin Davis. Motion carried (Page 16).

4. **On behalf of the Atlantic Striped Bass Board, move to forward the Block Island Transit Zone letter to NOAA Fisheries** (Page 17). Motion carried (Page 17).

5. **Motion to Adjourn** by consent (Page 24).

ATTENDANCE

Board Members

Doug Grout, NH (AA)
Dennis Abbott, NH, proxy for Sen. Watters (LA)
Dan McKiernan, MA, proxy for D. Pierce (AA)
Ray Kane, MA (GA)
Jason McNamee, RI (AA)
Eric Reid, RI, proxy for Sen. Sosnowski (LA)
Justin Davis, CT (AA)
William Hyatt, CT (GA)
Jim Gilmore, NY (AA)
Maureen Davidson, NY, Administrative proxy
Emerson Hasbrouck, NY (GA)
John McMurray, NY, proxy for Sen. Kaminsky (LA)
Joe Cimino, NJ (AA)
Tom Fote, NJ (GA)
Adam Nowalsky, NJ, proxy for Sen. Andrzejczak (LA)
Andy Shiels, PA, proxy for T. Schaeffer (AA)
John Clark, DE, proxy for D. Saveikis (AA)
Roy Miller, DE (GA)
Craig Pugh, DE, proxy for Rep. Carson (LA)
Lynn Fegley, MD, proxy for D. Blazer (AA)
Russell Dize, MD (GA)
Phil Langley, MD, proxy for Del. Stein (LA)
Rob O'Reilly, VA, proxy for S. Bowman (AA)
Steve Murphey, NC (AA)
Robert Boyles, SC (AA)
Mel Bell, SC, proxy for Sen. Cromer (LA)
Spud Woodward, GA (AA)
Doug Haymans, GA (GA)
Erika Burgess, FL, proxy for J. McCawley (AA)
Marty Gary, PRFC
Casey Brennan, NMFS

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Staff

Bob Beal
Toni Kerns
Mark Robson
Caitlin Starks
Jessica Kuesel

Guests

Richard Cody, NOAA
Catherine Krikstan, ECS, NOAA
Arnold Leo, E. Hampton, NY
Chip Lynch, NOAA
Jack Travelstead, CCA
John Whiteside, SFA

The ISFMP Policy Board of the Atlantic States Marine Fisheries Commission convened in the Jefferson Ballroom of the Westin Crystal City Hotel, Arlington, Virginia; Thursday, May 2, 2019, and was called to order at 8:00 o'clock a.m. by Chairman James J Gilmore.

CALL TO ORDER

CHAIRMAN JAMES J. GILMORE: Good morning everyone. Welcome to the ISFMP Policy Board, I'm Jim Gilmore; I'll be Chairing the meeting today. Thank you everybody for getting up early. The coffee is flowing, so please help yourself.

APPROVAL OF AGENDA

CHAIRMAN GILMORE: We have several items on the agenda today, so we'll just get right into it. First off we have Approval of the Agenda. Are there any additions to the agenda? Dan McKiernan.

MR. DANIEL McKIERNAN: Yes, under Other Business I would like to discuss the possibility of a Policy Board tasking the Spiny Dogfish Board between the next two meetings to develop a draft addendum to facilitate transfers of quota that would be essentially underages midyear, to the southern states collectively, because at this point there isn't an opportunity if there is an underage in the north to get that fish into the hands of the states that still have fisheries.

CHAIRMAN GILMORE: Okay Dan, I'll add that. Are there any other additions, Ray Kane?

MR. RAYMOND W. KANE: I would like to address state allocations under Other Business.

CHAIRMAN GILMORE: Okay Ray, I'll add that to it. We also have two other items. We have to talk about a lobster letter, and also a striped bass letter probably, so I'm going to add those two. Are there any other additions to the agenda? Okay seeing none, we will adopt the agenda.

APPROVAL OF PROCEEDINGS

CHAIRMAN GILMORE: The next item is the approval of the proceedings from the February, 2019 meeting.

That information was in your briefing documents. Are there any changes to the proceedings from the last meeting? Okay seeing none, we will adopt those by unanimous consent.

PUBLIC COMMENT

CHAIRMAN GILMORE: Before every meeting we have public comments on items not on the agenda. Is there any public comment today?

UPDATE FROM THE EXECUTIVE COMMITTEE

CHAIRMAN GILMORE: Okay seeing none, we will move right into an Update from the Executive Committee, which is actually me. Our Executive Committee met yesterday morning at 7:30, so you know you guys slept in today.

We essentially went through several items, and I'll do a brief summary on those. First off the FY2020 budget was discussed. Pat Keliher, who is Chairman of the Administrative Oversight Committee, led that discussion, but Laura Leach had given us kind of a brief overview of the detailed document. There was generally a modest increase from the previous year, so everything pretty much stayed the same. There was some discussion about it, but very minimal, and the Executive Committee approved the budget for 2020 by unanimous consent. We can go into detail if anybody has any questions on it, and Toni has got more detail. Does anybody have any questions on the budget? Go ahead, Adam.

MR. ADAM NOWALSKY: Do you have any update on Plus-up funds and availability, and what the Executive Committee would intend to do with them for this year?

CHAIRMAN GILMORE: We're getting to that Adam, a couple of items down. Are there any other questions on the budget? Okay, so in any event the budget has been adopted for 2020. The next item was an issue about some, particularly Pennsylvania, there are some dues issues that were discussed about Pennsylvania has a rather unique situation, and our Rep at the table has proudly paid his dues every year.

However, the other two Commissioners, they pay them independently and they're a little bit in arrears right now to the tune of several years, so we are going to write a letter to the Governor, instructing them that the longstanding since 1942 issue about paying dues to sit at the table needs to be addressed. We'll be sending a letter off on that and hopefully correcting that.

Next item was, Bob did go over the APAIS budget and a little bit more detail on that as to what was going on, and that was just sort of an update, so if anybody has any questions on that we can get into it. But, generally it was just an update on what we're doing for 2019 and 2020. Are there any questions on the APAIS budget?

Seeing none, now we've got to the allocation of the Atlantic Coastal Plus-up Funding. As you realize, and it's been discussed by Bob for the last few meetings is that we have additional funds, and we had talked about some different options on how we were going to use that money. It was delayed because of the federal shutdown, initially.

Then we finally got numbers, and Laura and Derek from NOAA Fisheries went over them and agreed with the numbers. There were some small projects that were approved, but it was decided that we were just going to add the additional funding and spread it among the states, based upon the distribution that's under the Commission charter.

That motion was put up and unanimously approved that any of the additional funding will be distributed to the states according to the distribution. Are there any questions on that and Adam, does that answer your question, or do you have additional comments on that?

MR. NOWALSKY: Those small projects then, they're all funded. The rest of the money is going to the states, so that allocates what there was to allocate.

MS. TONI KERNS: Adam, I believe there is roughly a little over $200,000.00 left from the Plus-up money from this year, and the states have not determined what projects to use those for. I believe when they were talking that because there is some uncertainty in the 2020 budget, due to that being a census year that that money will sit on the table, and if there are projects that come up that folks think we should work on, then we can use those funds. But those funds can last for another three years.

CHAIRMAN GILMORE: Is there any other question on the Plus-up funding? Okay seeing none we'll move along. The next item was, at the February meeting, because of some of the work groups and some of the issues that had come out of some of the working groups we had; we had tasked staff to come up with a standard operating set of procedures and policies for the management board working groups.

Toni had taken that task on, and developed a draft that we discussed yesterday. There were some changes that were discussed during the Executive Committee that were incorporated into the document, and then at the end the new Standard Operating Procedures and Policies were adopted by the EC by unanimous decision.

We'll be distributing that I guess soon. Essentially it's a good set of rules. It really does give some guidance as to some sideboards on how the work group should operate, and if there are some decisions that need to be made, it gives a bunch of authority to the Board Chairs to make decisions. But Toni could add anything.

MS. KERNS: Once the Executive Committee finalizes the document, I will review those policies and procedures with the Policy Board at the August Board meeting.

CHAIRMAN GILMORE: Okay any questions on that? Seeing none, we will move next to the future annual meetings. For 2019 for all of you who have not been paying attention, the next meeting will be in New Hampshire, October 28th through the 31st. I don't know if Doug or Dennis wants to say anything about that. But they're planning a wonderful good time, better than New York, if you can believe that. Do you guys have anything to add on that?

DOUGLAS E. GROUT: I'll just say it's going to be a beautiful time of year in the fall. There is fishing opportunities, but the Laura Leach tournament will probably be indoors, just in case. We're planning a lobster bake. The dress will be casual, not business casual, casual. Come prepared to have a delicious meal, and please take advantage of our beautiful nearby town, the city of Portsmouth. You'll really enjoy it.

CHAIRMAN GILMORE: I understand there was a move to have host Commissioner's wives were not allowed to participate, after my wife won in the New York one. But, I don't know if that's true or not, but anyway. Then Laura went in too, so in 2020 it will be in New Jersey. I don't think they've picked a venue yet.

But, we were talking about that at dinner last night, so we've got a bunch of suggestions for you folks if you're running out of ideas. In 2021 we'll be back to North Carolina, and then 2022 we'll be back at Maryland, so we will be planning those. In 2021, I will be my full cycle. I will have done 15 annual meetings, so back to Annapolis, or hopefully in Annapolis to start over again. Yes, Dennis.

MR. DENNIS ABBOTT: Yes, back to the New Hampshire meeting. If you Google Wentworth by the Sea, Newcastle, New Hampshire, that is where we'll be. It's a grand hotel from the old days, which has been refurbished by Marriott. It's right on the, not call it in a harbor, back channel. A very nice location, a very nice hotel, and I am sure your spouses will sure enjoy being there. They did 15 years ago.

CHAIRMAN GILMORE: Yes, Ray.

MR. KANE: A question to the New Hampshire contingency. Are you going to make sure that the hotel keeps the heat on, because I can remember Doctor Duval having to wear wool gloves at the round table at the Maine annual meeting?

MR. ABBOTT: It's not our problem that the folks from the southern states have such thin blood.

CHAIRMAN GILMORE: That was actually Maine, Ray. It's much warmer in New Hampshire than it is in Maine. The next item we actually got a discussion which was an add-on, on the annual report. I forgot my prop, but Tina has done an outstanding job. That annual report is just gorgeous this year, and not because New York City is on the cover, it just is a beautiful report that was done.

However, there was a discussion about it is pretty long, and there was a combination of the time to prepare it, and how many pages it is, the length of it. Was it useful to the Commissioners, in terms of their business, and would it be better to keep producing that report as it is, would it be a paper copy and printing it?

Would it be better to, or use just the electronic version? It is on the website, completely available on that. We had quite a bit of discussion about this, and I don't think we got to any conclusion other than there was a bunch of folks that were yes, they use that report.

They bring it when they're meeting with legislators, or different fishing groups or whatever that are interested in seeing the report.

Others prefer the electronic version. What we have concluded at the end of, I think a healthy discussion that was pretty much split down the middle. Some folks really would like the report to stay as it is, others would like an electronic version. Then Jay McNamee came up with a suggestion that maybe there was a hybrid version of this is that maybe we could have a scaled down version of it, and so we would have a paper copy to bring, but maybe not as lengthy.

Then also have an electronic version of that. What staff is going to do is work up maybe a mock up that we can look at and review for maybe the upcoming meeting or whatever, and see. Then we'll discuss it again, and see where everybody wants to go on it. Keep your eyes out for that and again, we'll see what everybody's opinion is. I've been going more electronic these days, because my experience has been as I bring that a legislator will flip through it and throw it on the table, and never look at it again.

But evidently there are other states that have representatives that actually use that document quite extensively. We'll have further discussion on that. But at this point are there any questions or comments on that? Okay, stay tuned on the annual report and what we do with that. The last official item we had on was the Executive Director's Review. We sent Bob out of the room for three or four hours, it was a rather good discussion. I'll be happy to note that it was completely unanimous and a lot of accolades about the job that Bob is doing. We all believe he's doing a terrific job, and we want to keep him on. There was actually a long list of accomplishments he's done for the last year, which is including, and the one I think we should highlight again, remember that some of the additional money Bob stuck to and did a lot of work on that and kept our 12 percent increase.

Anyway, Bob has passed his performance evaluation with flying colors, as voted by the Executive Committee. Keep up the good work, Bob! That is the Executive Committee, and that's everything, any other questions on the Executive Committee from yesterday?

UPDATE ON THE RISK POLICY WORK GROUP

CHAIRMAN GILMORE: Okay, next item on the agenda is an Update on the Risk Policy Work Group, and Jay McNamee is going to lead us on that. Jay.

MR. JASON McNAMEE: I'll be really brief. We just wanted to remind people that we were out there still. Last time we chatted, we had developed a couple of things to kind of support the Risk and Uncertainty Policy. Sara Murray and I have been continuing to develop that specifically with an eye towards developing guidance for the technical folks that will take a look at this.

The current plan is to bring that now developed guidance to the Striped Bass Technical Committee. We'll introduce it to them on an upcoming call. They are going to be busy. We don't think this is going to take up a lot of their time, but it is really important that we get this in front of them, so that they can review it, because this is exactly the type of process that it's meant for, and that's what we all agreed to as a Board.

Then the other group that we will be bringing this to is the SAS Committee, and we'll get on a call with them as well. We've got a couple more groups we're going to get this in front of, and work through, and then once we get that pilot run done, we will bring it back before this Board, and that's it.

CHAIRMAN GILMORE: Are there any questions for Jay? John Clark.

MR. JOHN CLARK: Jay, the Technical Committee report for the striped bass. I noticed they had in there the 50 percent chance of reaching F in one year. Is this sort of what you're talking about doing?

MR. McNAMEE: Yes, thanks John, exactly. This would better inform the process of arriving to that probability. As it happened, I thought the other day was a perfect example of why this is needed. I just kind of lobbed that out on the table, just to give them some guidance, because they had none otherwise. This process is meant to get them through a series of questions that arrived at the appropriate probability based on all of the parameters in the decision process.

CHAIRMAN GILMORE: Go ahead, John.

MR. CLARK: It is follow up. I hope when we get this ready to take out to the public that it's explained very clearly what it actually means, when you say 50 percent probability of getting F back down to the target.

MR. McNAMEE: Yes, good point. I think it is a difficult concept. I brought that up at the meeting too. People often, oh it's a coin toss. That's not right. It drives me crazy. Hopefully this will help both explain that better and also let people know in a very clear way how we get to these decisions.

CHAIRMAN GILMORE: Other questions for Jay. Okay seeing none, keep up the good work, Jay, and we'll look forward to the new progress.

UPDATE ON THE MRIP TRANSITION TO NEW SURVEYS

CHAIRMAN GILMORE: Next we have an update from the MRIP transition to new surveys. Dave Van Voorhees was originally on the schedule, but Rich Cody is going to give the presentation for that so would Rich, come on up.

MR. RICHARD CODY: I'll just introduce myself. I'm Richard Cody with the Marine Recreational Information Program. I just wanted to give you some updates, short updates on some ongoing activities with MRIP, but also basically to ask for your help in that we're trying to better establish a communications at all levels between states and MRIP, and between all the stakeholders.

If you have any concerns, I'm planning to make myself available at the ASMFC meetings regularly, so if there are any concerns I'll be here to help address those. I want to just make a point that we welcome any kind of questioning or concerns that you may have, and try to address them as best I can.

The other item that I wanted to mention is related to that and that we have been invited to participate in a South Atlantic Council Workshop on looking at potential differences in the FES based estimates relative to the older CHTS estimates. The workshop is hopefully planned for some time in August, and we'll keep you updated on the developments there.

But we're seeing it as an opportunity for us to address some of the concerns that were out there that we don't necessarily hear on a regular basis. Hopefully, by trying to establish this relationship here, we can do a better job of addressing them more proactively. That's basically what I wanted to mention, Jim.

CHAIRMAN GILMORE: Thanks, Richard. Are there any questions for Richard? Tom Fote.

MR. THOMAS P. FOTE: Richard, with the shutdown there was a lot of problems, because we rushed things through, and it wasn't a lot of communication going on during the shutdown. I found it very upsetting to find out at the joint meeting what was going on and all of a sudden this huge increase in the quota.

It didn't give us time, and I think it was a missed opportunity, how we could have figured out to do something on the quota. I think I'm going to later on in the meeting ask for a working group. If it happens in black sea bass, let's get out in front of it, so we decide what we're going to do with that increase.

But also, nobody looked at the impact. I mean I got a strange call from a commercial fisherman that was a former Council member saying, Tom, will you take half of our quota on the recreational side, and I said you've got to be kidding me? We can't do it, but why? He said, because we're going to flood the markets, and basically because you're giving that quota all in the last half of the year. Now it's a combination, I know it's not all yours, but it's a combination of things, so it needs better coordination. I'll leave it at that. Because they're worried that it will not only hurt this year, but hurt future years on that. We need to know ahead of time, and we need to work through that.

CHAIRMAN GILMORE: Toni has got a comment on that, Tom.

MS. KERNS: Hey Tom, I actually don't think that is, the quota difference is how the numbers went into the assessment. We all knew that these assessments would be having higher numbers. Then the results of the assessment were that we had a much higher stock number, and then thus got higher quotas.

Something that the Council and the Commission Summer Flounder, Scup, and Black Sea Bass Board will have to look at is do the states want to look at the quotas, the allocations between the commercial and the recreational sector? Do we want to make any shifts to those numbers, because that's how the commercial quota ended up getting a lot more fish, because we haven't looked at that allocation yet?

MR. FOTE: I think Toni, you misunderstood what I said. I'm not saying about the allocation. What I'm saying is between the commercial communities, how do we deal with that huge increase at one shot, because it affects their markets? That's what I'm saying, how do we do that? Plus, we could have done some of that where we're trying to smooth out states, do something like that. That's why I'm saying we need to get out in front of this, in case it happens with one of the other species that we come back with a huge quota.

MR. CODY: Tom, I agree with you that probably the commercial sector should have been a little bit more engaged in the process all along. I mean that said though, I think that we have made some steps towards improving that level of communication.

CHAIRMAN GILMORE: Lynn Fegley.

MS. LYNN FEGLEY: To that point, all I wanted to say was thank you for making yourself available. We do field some pretty tough questions, and some of them are good from our stakeholders, so really appreciate your presence and willing to help us answer some questions, so thank you for that.

CHAIRMAN GILMORE: Other questions? Erika.

MS. ERIKA BURGESS: Hi Richard, Erika Burgess with Florida FWC. The state of Florida, as I know you're aware, is extremely disturbed by the results of the new FES survey estimates, not the survey itself, but the estimates that are actually produced. Let me give you an example. FES generated an estimate of an average of 4,000 trips per day for each of Florida's 35 coastal counties, which is an average of 65 trips per day for each mile of tidal shoreline in Florida, and that is unrealistic. What is MRIP going to do to address and identify the biases in the FES estimates?

MR. CODY: Well to that affect, we are meeting with FWC this coming week, actually May 22, Beverly Sauls and Luiz Barbieri are coming up to Silver Springs to plan a workshop, to look at differences between the FES and the Gulf Reef Fish Survey, and other Gulf surveys, and to evaluate those concerns that the state has said to us.

MS. BURGESS: To that point, the Gulf Reef Fish Survey estimates refer to offshore fishing effort for reef fish, and I specifically brought up the shoreline estimates that are state wide.

MR. CODY: The question is, or you had a question?

MS. BURGESS: What are the plans to address the shoreline estimates? Do you plan to move beyond the Gulf Reef Fish Survey estimates, and address larger biases?

MR. CODY: The main concern with the FES right now is the discrepancy between the CHTS and the FES. We all know the CHTS was wrong. It was biased and it was biased low. I don't want to get into a back and forth here, but I think we will present information in the SSC workshop in August that will show that the FES is a better fit overall for estimating effort, than the CHTS was.

I would caution against surveys, or states that want to align their survey estimates with the previous estimates, because we know they were low. We know they were biased; they weren't representative of the general population. We have specific information that we'll present in that workshop, and also at the FWC workshop.

The plan is to plan the workshop on May 22 with Beverly and Luiz, probably in the St. Pete FWRI Lab, and involve the necessary folks. We're hoping that we can get some engagement from Division of Marine Fisheries Management, as well as the FWRI crew, the research end of things.

CHAIRMAN GILMORE: Other questions? Justin. I have to say everybody's last name. They actually said say your last names, I said Davis.

DR. JUSTIN DAVIS: I'm wondering, would it be helpful ahead of this August workshop for states, if they have certain estimates that have come out of the new MRIP model with the FES survey that seem aberrant, that seem to not make sense. Would it be helpful to forward those to the program as examples to potentially look at when you're trying to reconcile, perhaps differences between FES and CHTS?

I'll echo some of the comments that were made from Florida that we've seen some estimates from our shore modes that just seem astronomical, and don't seem to make sense. Now I understand the overarching that the survey FES may very well be a much better survey than CHTS, but that there may be certain instances for certain fisheries, and perhaps there is patterns across states that might emerge if states send in examples of certain fisheries that seem to be producing unusual estimates. Would that be helpful to send in that sort of thing ahead of August?

MR. CODY: It probably would. There are a suite of species that the South Atlantic Council wants to look at in their workshop, and they've listed three or four that they would specifically like to look at, and they might be good examples for other states as well, because I think what you were referring to is the calibrations that are being used, and how they may have impacted the previous trends, so you know resulting in spikes or troughs in the data.

Those are the things. I mean I would be happy to look at other species, but I think that for the workshop we would like to keep it to a limited few, so we can get through them and give them a good thorough deep dive, so to speak.

CHAIRMAN GILMORE: Go ahead, Justin.

DR. DAVIS: Just to clarify, I'm talking about some estimates that have come out of recent years, the new years, not necessarily the back calibrations of the old surveys. But from what I'm hearing you say is that it might be helpful to forward that information. It might not get addressed in the August workshop, but that it might generally be helpful for the program to forward that?

MR. CODY: It certainly would be helpful.

DR. DAVIS: Thank you.

CHAIRMAN GILMORE: Any other questions for Richard? Seeing none, thanks Richard for being here and giving us an update. I think it's going to be a definite benefit having better communication on this. Just so you know, Richard actually has come to; he recently did a meeting in New York at our Council meeting.

It was great having him there, because the fishermen were more angry at him than me, and he's got a very thick skin. He thought that was an easy meeting, so I thought that was very good. Thanks a lot.

COMMITTEE REPORTS

LAW ENFORCEMENT COMMITTEE

CHAIRMAN GILMORE: Okay, next we're going to get into committee reports. The first one up is the Law Enforcement Committee. Law Enforcement met this week for two days, and Mark Robson is going to give us an update on that. Mark.

MR. MARK ROBSON: As Jim indicated, we met Tuesday and Wednesday of this week, and had a very productive meeting. I would also like to thank several members of the Commission who attended the meeting, and helped participate in some of the discussion. We provided some initial input.

Mike Schmidtke from staff came in and briefed the Law Enforcement Committee on some of the preliminary options that are being considered for management of the cobia fishery in federal waters. We took a look at some of those. I don't want to go into great detail, because some of that information will be presented to the South Atlantic Board today.

But of course, as usual, the Law Enforcement Committee is certainly always striving for some level of consistency. To the extent that that can happen between state and federal waters, and between state boundaries adjacent to federal waters that's going to be very important. But there were some concerns expressed about some of the options, in terms of their complexity.

We recognize there is a lot of moving parts to this, in terms of either having coastwide regulations in federal waters or not. But we'll allow that process to go forward. These are just initial comments that we're going to be making on the cobia draft amendment. We also had some discussions, again with some of the Commissioners who came in, and helped in that review of the ongoing efforts to work with improving enforcement in the offshore American lobster fishery.

As you've probably heard, we have a group who is working on a way to purchase and operate a large offshore enforcement vessel, particularly for extending out beyond 12 miles, in some of these deeper waters. We also related to that had some review of the discussions going on with another work group, to develop an offshore tracking system for these vessels that are operating far from shore, and also tracking systems that might be useful in determining when traps are actually being hauled, when hydraulic gear is actually being activated.

We reiterated the importance of having that kind of a tracking system available to better target the use of this eventual offshore vessel to make it more effectively operating, and going where the fishermen are working, and being able to maximize the efficiency of that equipment. There are a lot of details that will continue to be worked out.

The state of Maine is taking kind of a lead role in looking at operating that vessel, but it would also be a shared platform, perhaps with other states. Of course there were questions from the Law Enforcement Committee about funding, and getting the money for the vessel, not only to purchase it, but also for its continued maintenance and operation.

It's important to the Law Enforcement Committee members that that money doesn't somehow get taken away from existing joint enforcement agreement funds, or other funds that are needed to do the operations that they're doing now. We also had some pretty good discussions about some enforcement tools and technology.

Pat Moran from Massachusetts, our Committee member from Massachusetts, their state has been working closely with an organization called PAARI which is the Police Assisted; get this right, the Police Assisted Addiction and Recovery Initiative. This is an organization or an agency that is set up to assist law enforcement agencies around the country in dealing with response to opioid overdoses, and problems that are encountered by officers in those situations.

Just like everywhere else in our society, this is something that we think is obviously, potentially a problem in the fishing industry in certain areas, just as it is in the community at large. Several of the states have indicated that in terms of enforcement, they are already carrying some of the antidote equipment with kits, to deal with opioid or fentanyl, and some of the other kinds of drugs, overdoses when they're encountered.

This potentially is a lifesaving action. But in addition to that PAARI, this organization is focusing also on outreach and education and follow up, sort of a community policing approach. This is something that I think is very helpful for our Natural Resource Officers to engage with the community at large, and to work with them, not just to react to an overdose situation, but to actually help in dealing with this problem, which is a serious one obviously throughout the country. We also discussed a little bit about the development of continuing use of drones in enforcement work, and particularly in natural resources. It's interesting, a number of the states, now we talked about this a little bit last year, and it sounded like there are two or three more states now that have acquired drones, and have got officers trained up to be pilots of those drones.

It's still at an early stage of technology use in law enforcement, where it's definitely being used as a tool in search and rescue, general surveillance, security, making sure that an area is secure, if groundwork is being done. But most of the states are still not using it directly as an enforcement tool to make cases, or to detect violations, or to use that surveillance information in making a case.

It's working its way in that direction. There are obviously concerns and issues from a privacy standpoint, and an admissibility of evidence issue. But it is something I think you're going to see more of our resource agencies using in the future for enforcement work. We also had a request through George Lapointe from the NOAA Southeastern Region Office down in St. Petersburg, to get some input from the Law Enforcement Committee regarding the development of electronic reporting systems, and implementation of those systems for the for-hire sector.

These are things that are being implemented, particularly in the Gulf of Mexico and up the east coast. The NOAA Southeast Region was very interested in getting some input from this Law Enforcement Committee, the Commission's Law Enforcement Committee. We heard that report from George; it was a very good one.

We're going to continue to follow up with him, and try to address some of the questions that he has for law enforcement, as far as how such a system would work, and whether there are any pitfalls or problems that we need to address from an enforcement perspective. Also, I think there were some comments made at a Commission meeting regarding, are there ways that we can take a look at measuring the effectiveness of our enforcement activities.

This is a very good question that is something that our Law Enforcement Committee generally wrestles with all the time, I think. We started an initial discussion at our meeting this week to think about ways that we can take a look at, or measure, or evaluate the effectiveness of our enforcement. We'll be continuing to develop those kinds of ideas. But it was interesting to me, because in the discussions it came out that one of the key areas is in terms of how do we determine how effective we are being?

We have issues with basic staffing and equipment levels. If there are some standards that could be applied that would indicate how much staffing you need, how much equipment you need, to adequately address enforcement needs in our marine areas based on population size or coastal area, or criteria like that.

But these are standards that might be good to try to work up. I think as a Committee we're going to put our heads together and try to take a look at some of those evaluation techniques, for how we determine how to best be effective as an enforcement agency. Then finally, at the last meeting in October, we received a presentation from the Mid-Atlantic Fishery Management Council, looking for some input from our Committee on a For-Hire Enforcement Workshop that was being planned for November. We provided that input, and then we also followed up with some materials provided to Andy Loftus from the Mid-Atlantic Council, and Doug Mesick from our Committee, Delaware representative from our Committee attended the workshop.

We kind of did a circle back around on that to let the members of the LEC know how that workshop went. We kind of reiterated some of the basic concerns with the questions that were being asked, about the responsibility of for-hire captains for any activities or violations that occur on their vessels.

Of course, the Law Enforcement Committee members did feel pretty strongly that the captains do need to be held accountable, that they are accountable for potential violations. This particularly is important when you start thinking about comingling of catch, sharing of fish and other issues where it may be difficult otherwise to find a violator on that vessel, if you're making a dockside or a boarding check.

But it becomes even more important to hold those captains accountable for the activities on their vessels. I think we've had a request for more input on enforcement issues from the Mid-Atlantic Council. We will pursue that and work through Toni and you as a Policy Board, in developing any further recommendations on those issues, and Mr. Chairman that's my report.

CHAIRMAN GILMORE: Toni's got an addition to that. Toni.

MS. KERNS: What Mark was alluding to at the end there was a specific request from the Council regarding tilefish, and making a recommendation to have consistent regulations between federal and state waters. We're going to circle back with the Council to get a better understanding of what they're actually looking for us to do, since the Commission does not manage tilefish. We're just trying to have a better understanding of what they're looking for from us, and the Law Enforcement Committee.

CHAIRMAN GILMORE: Okay, questions for Mark. John Clark.

MR. CLARK: Thank you for the report, Mark. Hey, on the effectiveness of enforcement. I was just wondering if the topic of actual prosecution for violations came up. I know one of the frustrations that our officers have is that they'll write up a bunch of violations, and a lot of times the Attorney General's Office will plea it down to practically nothing.

I know it's also a frustration for the vast majority of our commercial fishermen that are playing by the rules, that we have developed a small group of guys that feel it's more profitable to break the rules than follow the rules. I'm just curious as whether it's a problem in other states also.

MR. ROBSON: Yes that's a good question, and it did come up. Those are sort of the basic metrics that we initially were thinking about. A year or two ago this came up, and there was some concern or problems expressed that it was hard to get that information as to the actual disposition of cases, because in some cases they are handled through county courts, and so you have a lot of judicial jurisdictions that you have to work through to get that data. But apparently more of that information is now readily available to the enforcement officers, or the administrators. It is something that I think we would look at to get a better handle on how well cases are working through the system, and whether actual convictions and penalties are being applied adequately, because that certainly has a lot to do with their effectiveness.

CHAIRMAN GILMORE: Mel Bell.

MR. MEL BELL: Hi Mark. I know you guys talked about cobia the first day, and I didn't get to hear that. As we move forward with Amendment 1, obviously with cobia there are going to be a lot of different boundaries and things, where perhaps you have dissimilar regulations on either side of a boundary.

Did you all discuss, or have kind of a preference for what would work most effectively for enforcement in that situation? In other words, would it be preferred or better if in the waters in which you intercept the fishermen while they're fishing, if everything was consistent there, or if it's easier to deal with it from a standpoint of back in the waters in which they're landed, or at the dock or that type of thing? Was there a preference? Did you all discuss that some?

MR. ROBSON: We did, Mel. Basically, Mike presented us with three different options that are being looked at in the Amendment, and frankly the Committee had some issues with pretty much all three of the options as being somewhat problematic to actually enforce out there on the water, or to have situations where you might have an area closure in federal waters on one side, but not on the other, depending on which state regulations are being applied.

I think in general, first of all there was an Option C, I believe, and Mike can get into this in more detail. It was going to provide for the regulations for the state to apply, depending on where you're landing. But with the additional complication of special areas, special area regulations and how those would fit in, and that seemed very complicated, and I don't think the LEC was too much in favor of that one.

I think the issue of having the state regulations apply to where the fish are landed made the most sense, as far as the available options. But the Law Enforcement Committee suggested that that be tied specifically to the state where they're permitted as well. You nail it down a little bit better, and that furthermore if it's somebody who has multiple permits from different jurisdictions that the regulations would apply that are the strictest. That is kind of where they left that issue.

CHAIRMAN GILMORE: Other questions, Roy Miller.

MR. ROY W. MILLER: Thank you, Mark. At the Coastal Shark Board meeting the other day, the issue came up of potential circle hook compliance for fishing for Mako sharks, and or other regulated species of sharks. It was noted that as the Commission wrestles with this particular concept, Law Enforcement personnel input would be highly valued and appreciated. I'm just kind of giving you a heads up that that is on our radar, probably between now and the annual meeting we'll be looking for Law

Enforcement's input to help us wrestle with this concept of mandatory use of circle hooks for shark fishing.

ARTIFICIAL REEFS COMMITTEE

CHAIRMAN GILMORE: Are there any other questions for Mark? Okay thanks, Mark, great report. Next up we have another Committee report, Artificial Reefs, my favorite topic in New York these days, so Lisa Havel is going to give us an update from the Committee. Lisa.

MS. LISA HAVEL: As usual I'll be very brief. I only have a couple slides. Atlantic Coastal Fish Habitat Partnership and Habitat Committee are meeting in three weeks, so I'll have an update at the summer meeting on those two committees. The Artificial Reef Committee met February 26 and 27 in Savannah, with the Gulf States Marine Fisheries Commission Artificial Reef Committee.

There were discussions on the artificial reef materials guidelines update, which should be coming out soon. The deadline to submit all of the updates, was April 1, so hopefully that is getting released soon. We had a discussion on the impacts by Hurricane Michael to artificial reefs in the Gulf of Mexico, off of Florida.

We discussed monitoring protocols across the states, and how to better integrate artificial reefs into the Commission process. I welcome any feedback from all of you on that. We had guest presentations from Geoff White on the APAIS Artificial Reef Survey Question, and a presentation on ocean brick system in the Red Sea.

Everyone presented state updates, and then our next meeting will be held in 2020 by the Gulf States. We had a couple of committee changes. After the meeting Jordon Byrum replaced Jason Peters as the North Carolina representative, and the new Chair. Paul Medders replaced January Murray as the Georgia representative; Patrick Barrett replaced Eric Schneider as the Rhode Island representative.

Jeff Renchen replaced Christine Kittle as the Florida representative, David Molnar is representing Connecticut now on the Committee, and Chris LaPorta is the new Vice Chair, and he is from New York. As always, we welcome any suggestions for action items that you would like the Committee to work on, and with that I'll take any questions.

CHAIRMAN GILMORE: Any questions, John Clark.

MR. CLARK: Just curious about the materials update you were doing. Is this related to just overall, the durability of some of the materials that have been used in the past, or is this more based on contaminant guidelines?

MS. HAVEL: It covers all different reefing materials. What's been done in the past, what we're no longer doing, anything from train cars to descriptions on tires, to the different types of reef modules that we're putting out there, how to reef ships, all of that is going to be covered and updated.

CHAIRMAN GILMORE: Yes, John. Actually that is a good question, because with the resurgence of the New York program, I have been getting some interesting requests on materials, anything from voting machines, all the way up to entire buildings. That is going to be very helpful as we move forward. Are there any other questions for Lisa?

CHAIRMAN GILMORE: Okay Lisa, thanks very much for that.

OTHER BUSINESS

CHAIRMAN GILMORE: We're up to Item 8, which is a Review of Noncompliance Findings, which we don't have any here, so we can jump right past that one. We're into Other Business, so let's take these in order. We'll start with the issue on spiny dogfish. Dan, do you want to start that discussion?

TASKS FOR THE SPINY DOGFISH BOARD

MR. McKIERNAN: As you know, the Spiny Dogfish Plan is a little complicated, a little unique, in that the northern part of the range, the northern states have a quota that is shared, and they have a seasonal fishery, which typically ends by Thanksgiving, or around Christmas. Then all the states to the Mid-Atlantic and South have state-by-state quotas.

With the reduction in the quota that's occurring this year or next year, much lower than what has been historically. **It has been brought to our attention, among some of the processors that they fear that if there is an underage in the first part of the year that that fish cannot be transferred, as the second half of the year's fish can be. The southern states are allowed, under the plan, to move fish between them to cover overages, and unexpected occurrences.**

I'm suggesting, and I'll say it right up front, I don't think this is a complicated proposal, and the Division of Marine Fisheries will pledge to carry a lot of the work burden on developing this document, because I know it's not in the ASMFCs work plan. **But I propose that we develop an addendum to be reviewed at the next meeting, at the August meeting, to allow such transfers, and I have a motion if staff could put it up.**

CHAIRMAN GILMORE: Let's see if we've got a second to that first. All right, second by Justin Davis.

MR. McKIERNAN: A little bit more detail.

CHAIRMAN GILMORE: Go ahead, Dan. Why don't you speak to your motion?

MR. McKIERNAN: My vision here is that around Thanksgiving, is it four or five states? I can't recall what the northern group is, I think it's four states, would get together and decide either to, if not send all the fish, a majority of the unused fish, maybe 75, 80, 90 percent that they don't feel is going to be coming in, in the last four or five months of the year, to the overall quota of the south, and all those other states could get them in equal shares, equal shares meaning consistent with the shares that they have now proportional.

Then the second part you can see here after the word also. **I'm suggesting that we adopt for spiny dogfish, a very favored approach that we like in the black sea bass and scup plans, where if an individual state has a minor overage, and the overall quota is not exceeded, then no harm, no foul, and that state doesn't have to pay back the overage.** I think it works well, it's consistent with the overall conservation rules, and it minimizes the administrative burden of people having to move fish around.

CHAIRMAN GILMORE: I'm going to have a new rule, no Pierce-sized motions before 9:00 a.m., but anyway, Toni, do you have some comments on it?

MS. KERNS: I just want to give the Board some information, and just as Dan said, spiny dogfish is a low priority in the action plan this year. As you recall we worked on the action plan a little bit differently, and you all set high priority and low priority species. The only thing that is in the action plan would be to respond to changes in the data update for spiny dogfish for this year.

But because it's only a data update, I do not anticipate the quotas changing much, unless there is some dramatic change that we see in the data information. There is no money in the budget for spiny dogfish this year. You will see here the southern states total catch this year was roughly 8.3 million pounds, and if Jess slides over, obviously they had a higher quota this year at 16 million pounds.

Next year's quota they'll be at 8.6 million pounds. If the southern states were to catch equal amount this year, next year they'll still be under their quota. There would have to be a pledge for transferring of fish amongst those southern states, but they would be able to take care of it without that transfer from the northern states.

Then next year after that the quota does go up in total by 7 million pounds. The southern states will have roughly 3 million more pounds, so that quota would be increasing. I'm not sure if this is a resolution to a short term problem, or if it does need to be a long term fix of not. There are some other issues that we are trying to work through with the Mid-Atlantic Council and the New England Council, in terms of the trip limit.

The Spiny Dogfish Board has requested, as well as members of the Mid-Atlantic Council, to lift the federal trip limit to allow states and regions to set trip limits, in order to utilize their full quota, and so if that ever does change, which we're hoping that we can move forward action on that as early as next year, through the Council process.

Then I don't know how that would impact these types of transfers, et cetera, or if there would need to be any additional changes to the Commission's management plan, which would require action at that time. Just putting this out there, certainly if the Board prioritizes to make changes, then we would need to adjust the budget accordingly, to pay for public hearings, which I assume the states would want to have, to do this change. That would be up to this Board.

CHAIRMAN GILMORE: Dan.

MR. McKIERNAN: I would counter that this is such a simple proposal that I don't expect a need for a road show and public hearings. The total addenda may be two pages in length. I would urge this Board to approve this going forward.

CHAIRMAN GILMORE: Okay Dan, Rob O'Reilly.

MR. ROB O'REILLY: I support what Dan is indicating, and the concern I think is, and Toni will have the information, but I think it was 2016-17 season the landings were closer to 26 million. There is concern that with the just over 20 million pound quota that the market will stop early. You know that type of approach doesn't bode well for the following season even. I know that the quotas were much higher. I think they were approaching 50 million pounds, maybe five years ago. There is a data issue definitely. You know without going into a lot of that I think that's still being worked on, as far as strictly taking the average of three years of the spring trawl survey, when there is imperfect coverage of all the stations that need to be covered, and using that and making that decision.

That decision stands right now. I hope there is more work on that. One of the things that were talked about is the situation of a mismatch between the survey and the abundance of spiny dogfish, so we can look forward to that too. But I think the main problem is you are allowed to carry over 5 percent, and that's not a whole lot. Virginia this year was fortunate to receive a transfer from North Carolina, but can't guarantee that those transfers that Toni is talking about among the southern states will be available this coming season, which started yesterday.

CHAIRMAN GILMORE: Other discussion on the motion, I've got Jay McNamee. Actually, Jess, can you put the motion back up? Go ahead, Jay.

MR. McNAMEE: Rhode Island can support this as well, however maybe I'll start here. I talked with Toni. One of the things that we're interested in, is readdressing possession limits in Rhode Island. It's my understanding, based on my discussion with Toni that that can happen external to an addendum. I just wanted to get it on the record that we're okay with this, but we have some other items that we would like to discuss with regard to spiny dogfish, namely possession limits.

CHAIRMAN GILMORE: Okay Jay, thanks, Eric.

MR. ERIC REID: I certainly support anything that would max out the fishery. It is a relatively market driven situation. Certainly addressing Mr. McNamee's comments are correct. You need to be able to take advantage of economies of scale, to keep the cost down, in order to just make it work period.

But as far as this motion goes, it's also critical for the U.S. as a whole, the fishermen, the dealers, the processor and everybody, to maintain a constant supply of raw material into the market, so we can maintain our market share on an international basis. If this motion helps us do that I think in the long run, for the success of the fishery. I think that's a very good outcome.

CHAIRMAN GILMORE: Other discussion. Steve Murphy.

MR. STEVE MURPHY: I would support this motion. As Rob indicated, North Carolina was able to transfer a little quota. We don't anticipate necessarily being able to do that with the reduced overall quota. But this processing of these fish is fairly specialized, and as indicated, you kind of have to have supply in order for this to work. We would support this.

CHAIRMAN GILMORE: Other comments? I'll go to the audience in a second, but anybody else at the table want to have a comment or a question? Well, I have one comment and Dan, I understand. You know we can try to simplify this. You know the workload issue is probably from the Chair seat, is the concern for staff. I think it can be maybe quick, but we know how these things go sometimes, and maybe the question for Toni. Are there other alternatives for addressing this that doesn't get us into an addendum right away? I'm just thinking off the top of my head. I mean if it did come. We're going to do an addendum for essentially the one year. Then it's going to kind of get fixed again, and then is there maybe if we are going to hit the problem this year, a fast track later in the year, or something along those lines. But I'll turn it over to Toni, and see if there are other options for this. Go ahead, Dan.

MR. McKIERNAN: Could we ask the states if this were to go forward if they would want a public hearing, so that Toni can be comfortable about workload, because Massachusetts will not be requesting a public hearing, we'll take the public comment.

CHAIRMAN GILMORE: All right, well that's a good question. Go ahead, Doug.

MR. GROUT: Well, I would request the public hearing for it, yes. You know I'm certainly willing to move forward with this, to consider this concept, if Mass DMF is doing the lion share of the administrative workload. I ask that we have some landings data in there, showing it by month to see how late in the year spiny dogfish landings are occurring up in the north.

Because I believe our landings have been going later and later in the year. I may be incorrect, and obviously I can check that myself, but I would ask that that be in it. But I'm certainly willing to consider this, because I certainly believe in trying to be able to achieve optimal yield here.

CHAIRMAN GILMORE: Before I go to Rob, just a show of hands. How many states think they would want a public hearing if we go with this addendum? Five, okay go ahead.

MR. O'REILLY: From time to time ASMFC staff enlists the state representatives to conduct the public hearings. I agree, if there is a public hearing there is no reason why the state representatives can't hold those public hearings. That may help out as well. You know granted, usually when we do that there is a ton of public hearings.

But in this case if there are just four public hearings, I don't see why the states couldn't conduct those public hearings with the materials provided by staff, which doesn't seem to be insurmountable. Am I not in the microphone again, Kirby?

CHAIRMAN GILMORE: Toni's got a question.

MS. KERNS: Let me know if you want a hearing with Commission staff at the hearing.

CHAIRMAN GILMORE: Okay, let's have a show of hands, so who wants a hearing with Commission staff. Okay that looks better, nobody. I had a couple of hands up again. Steve Murphy, are you good or do you need another comment? Okay, anybody else have a question or a comment? Okay, I do have a comment from the audience, if you want to come up to the microphone and identify yourself, your name and affiliation.

JOHN F. WHITESIDE, JR.: Good morning, Mr. Chairman, Attorney John Whiteside, representing the Sustainable Fisheries Association, the Dogfish Processors, and my first comment would be a follow up to Mr. Grout's question. There is no appreciable landings in the north after December 1st, just a very minimal when you're considering the overall 8.5 million pounds that were landed.

By my calculations we're talking about roughly 3.5 million pounds that we were using this year's landings figures that around December 1st we were looking at having just over 3.5 million pounds left in the north quota that could not be transferred to the south. At that point there was just over a million in the south.

As of now there is just over a million in the south, and we're just under 3.5 in the north that can't be transferred down. With this really dramatic, roughly 50 percent cut in the quota, it really would help with just being able to sustain our market share throughout the world, and be able to alleviate any issues of transfers within the southern states, by sending the rest of some appreciable amount of that quota down to the south where it's needed, so we can maximize landings for the year.

CHAIRMAN GILMORE: Okay, back to the table, are there any other comments, questions? Dan, are you going to run the hearing in my state? Only kidding, seeing no additional comments, ready to call the question. Do we need any time to caucus? All right, I'm seeing everyone shaking their head no. **Why don't we start with, is there any objection to the motion? Seeing none, we will adopt the motion by unanimous consent.** Okay Dan, thanks.

LETTER TO NOAA FISHERIES FROM THE AMERICAN LOBSTER BOARD REQUESTING A CONTROL RULE FOR AREA 1

CHAIRMAN GILMORE: Our next item is the lobster letter. Toni is going to talk to us about that. Toni.

MS. KERNS: The Chairmen have left the building for Lobster, so on behalf of the Lobster Board; I will give you some background. The Lobster Board heard an update from the Atlantic Large Whale Take Reduction Team. That meeting had happened a week ago. That Team made a recommendation to NOAA Fisheries to collectively make a 60 percent reduction in risk to Atlantic Large Whales, through reductions in vertical lines, as well as changes in rope, which would be 1,700 pound rope, or a configuration of that.

The Board made a motion to do a Control Rule for Area 1, which is the New England portion, Gulf of Maine portion of the lobster fishery. In that we are going to be asking NOAA Fisheries to implement that control rule as well for the federal waters portion of that fishery. The

Lobster Board would be requesting that the Policy Board send a letter to NOAA Fisheries making that request for a Control Rule.

CHAIRMAN GILMORE: This is on behalf of the Board, so we don't need a second.

MS. KERNS: It's not to actually establish the Control Rule, but it's just for the NOAA Fisheries portion of it, so it's not the Control Rule in state waters that this Board is taking care of, it's just making the recommendation to NOAA Fisheries, so we'll need to clean this up a little bit. We don't actually need a motion if we can just have consensus. But I wanted to put the motion up there for reference, for folks to see what the Lobster Board actually did.

CHAIRMAN GILMORE: Okay Toni, thanks for the clarification, any comments, questions? Eric Reid.

MR. REID: I wanted clarification at that meeting about what we're asking the Feds to do, which is to set a control date for the offshore portion of Area 1 only, not for all federal waters. That was clarified that that was the intent, just so we're clear on that.

CHAIRMAN GILMORE: Any other comments? We don't need a vote on this, we just need a consensus, so if there is anybody that has an issue with this. Okay, seeing none I think we're good to go on it.

LETTER TO NOAA FISHERIES FROM THE STRIPED BASS BOARD REGARDING THE BLOCK ISLAND TRANSIT ZONE

CHAIRMAN GILMORE: The next letter from the Striped Bass Board, we have to do some action on that so Toni.

MS. KERNS: This one I do have a motion for, and I lost both of my Chairs for the Striped Bass Board. The Striped Bass Board took up the discussion of the Block Island Transit Zone, and the motion is, **On behalf of the Atlantic Striped Bass Board, move to forward the Block Island Transit Zone letter to NOAA Fisheries. This letter is a comment to NOAA Fisheries to not open that transit zone.**

CHAIRMAN GILMORE: **Discussion on this motion? Okay seeing none, is there objection to this motion? Actually, I guess I should have seen, does anybody need to caucus? No, is there any objection to the motion? Seeing none, we will adopt that by unanimous consent.** Thanks, Toni.

STATE ALLOCATIONS

CHAIRMAN GILMORE: Our last item that we had for additional business, Ray Kane wanted to talk about allocations. Ray.

MR. KANE: First and foremost, I want to congratulate the Commission, we just had a Kumbaya moment with the dogfish motion. Now I'm going to regress to yesterday's conversation on summer flounder. Presently, one of the states that belong to the Mid-Atlantic Fishery Management Council is going through a judicial and a legislative process for fairness within the Plan.

I've heard from another state about the socioeconomic impacts, and I'm speaking specifically to the state of Massachusetts. We have endured this failed plan for years. For years when I sat in the public audience and this is my third year at the table. I have to respond to fishermen, recreational, commercial, fishermen harvesters in the state of Massachusetts.

Fortunately, being the Governor's Appointee, I can tell the fishermen, if you can't speak to me in a civil tone then I'm not going to continue the conversation. Unfortunately, the employees on the DMF staff in Massachusetts, being how they're state employees, they have to deal with civil unrest on this entire management plan.

We've been told for years, and this is the message I brought back to our fishermen and our state that there is a process in place, we come through with management plans starting at the Mid-Atlantic Council, moving through the Commission. My charge now is that the Mid-Atlantic Fishery Management Council has failed this Commission, in moving forward on that Summer, Scup, and Black Sea Bass Plan.

I'm going to recommend to the Commission, and I've thought about this for years, and I've heard it spoken about for years that the Commission reach out to a third independent party, a well-respected party, and have them review the entire FMP plan coming out of the Mid-Atlantic, because I don't feel that the northern region is being treated fairly, and I've been telling constituents for years that we will get this changed. I heard yesterday, one state sends vessels; they steam for 24 hours, fish for 12, and steam for another 24 hours to take out. In Massachusetts, the fishermen steam 10 minutes and they're catching black sea bass.

I saw what happened with summer flounder, and my fear is that the Mid-Atlantic Council is going to say well, we pushed it through for summer flounder, let's use the same method to push black sea bass through. I'm really looking to this Commission, because I believe in this Commission more so than the Councils, that we bring in a third party, independent party that's well respected, to review the entire FMP.

CHAIRMAN GILMORE: Well let me just make some comments on that first, and I'll try to stay neutral. It's a great idea. I think part of what we're seeing; I was sort of in a quandary myself, because I'm looking at two issues that happened yesterday. As Commission Chair, I really want to protect our process, but as a State Commissioner, I want to make sure that we're moving forward, so it was a difficult time for me.

So you know, along those ideas, Bob and I and Mike Luisi, and Chris Moore, Pat Keliher, and Warren Elliot, have had a couple of meetings now, and we're looking at the bigger picture of that. Along the same lines, but not only just for that species, but for the other ones, black sea bass, summer flounder.

It came up from Delaware this week about maybe reallocating striped bass. We need a different approach, and I think you're 100 percent right. One of the problems we have is our territories. We have to protect our state's interest, in addition to the conflict that we have to look at the best data. Right now we're running into brick walls over that.

We need to look at the approach, and maybe in our toolbox right now we don't have it, and maybe your suggestion is what we've already talked about. We need some independents of this, and maybe a process that we're going to agree to, so that when we get to the table, it maybe neutralizes some of that.

I don't know what the solution is. But your suggestion of a third party, I mean we even hit it around as maybe we should have the Gulf States manage our fisheries and we'll do theirs, because we all know the science. But when you have a dog in the fight it gets to be more difficult to try and say yes, the science is saying this is different than it was a time ago, but I don't want to lose something for my state.

Anyway, we're going to pursue that through the leadership, and try to come up with some better ideas on who the third party would be, or different ideas on the third party. But anyway, we are already going ahead with that and I think we're going to have a lot of discussion on that. That is my opinion; I'll open it up to the table for discussion. John Clark.

MR. CLARK: I just wanted to check to see if you're talking about this for all species, not just for – because as Craig brought up the other day – striped bass of course is a special concern to us, and I'm sure every state has allocation issues that they would like to see discussed.

Are you talking like an arbitrator or a marriage counselor?

CHAIRMAN GILMORE: First off, to answer your question yes, it's for all species, because again it's a process issue or whatever that we really need to look at. Again, we've talked to NOAA Fisheries about this. Everybody seems to be coming to the same conclusion at that point. What it is right now, I don't know, and working group sounds too light for me. Whatever we put together is going to have to have more clout to it than a typical working group. Robert Boyles.

MR. ROBERT H. BOYLES, JR.: I agree with the comments that have been made. It is regretful that we find ourselves in these tough spots. I would just challenge us and encourage us, as we move forward with these difficult issues. To your point, Mr. Chairman, your struggle with being the Chairman, and also representing state interests, we all have people we answer to back home.

I would just challenge us and encourage us that as we move forward that we recognize our obligations to those folks back home. But also, recognize our obligations to each other, as a body, as a process. We've all been banged on when we go back home, and for instance, a number of times I have been yelled at for not fighting for South Carolina, necessarily.

I recognize I'm guilty of that from time to time. But the way I look at this is I view my role here is to bring a South Carolina perspective to the problems and the challenges that we are facing, and perhaps not necessarily all the time fighting for South Carolina. A little bit of a nuance, but I would just encourage us and challenge us as we move forward, to keep that longer term and broader perspective in view.

CHAIRMAN GILMORE: Other comments from the Board? Dennis.

MR. ABBOTT: Could we expect some sort of feedback in August, or solution in August? No, not really.

CHAIRMAN GILMORE: Feedback absolutely, and yes we don't want to let this thing sit. We really need to start addressing this. I think our meeting with the Council, they agree 100 percent. We're probably late to the table at this, and we really need to start working on it, so yes we will definitely have feedback at the August meeting. I seriously doubt we'll have a solution. Emerson Hasbrouck.

MR. EMERSON C. HASBROUCK: I agree with what Raymond was saying, and I certainly support going forward to explore an option here, to help us make some strides, and real effort towards allocation and reallocation. I can certainly understand why Commissioner's from states that have a relatively high allocation of whatever species, are going to be resistant to voting to reduce their state's allocation for the benefit of another state.

But if we can develop a system, whereby we don't put those Commissioners really on the spot, to vote to reduce their own state's allocation, maybe the process would work a little bit better. How we do that I don't know, but that's something to explore going forward.

CHAIRMAN GILMORE: Other comments from the Board, Tom Fote.

MR. FOTE: As I said when we were talking about this yesterday. We had a system in place we had worked on at working group that actually came up with a solution many years ago. The problem was that we went from where we thought our quota was going to go up to about 32 million pounds, and we were going to do this over a certain point. It went just the opposite direction.

I never brought up the fact about looking at reallocation between commercial and recreational, because what are we fighting over, scraps? It wouldn't make that much difference when you're looking at these low numbers. As the numbers increase, and again I think we missed an opportunity where we could have done something with this great increase. That's why I said; we should get out in front and see what happens in the future on those types of issues.

CHAIRMAN GILMORE: Okay, I have a comment from the audience. Arnold Leo, do you want to come up to the public microphone?

MR. ARNOLD LEO: I am Arnold Leo, representing the Fishing Industry of the Town of East Hampton. With mention of that idea of using an independent body, you know to address some of our issues. I thought it worthwhile to bring up, because I was once involved, in an arbitration procedure between a labor union and an employer. There you have that situation, where the Union and the employer simply are never going to agree.

Wisely, somewhere along the line they created the arbitration system, and it works. I think it would be very wise now for the Commission to consider beginning to use that technique of arbitration, with some of these issues such as allocation, where we simply cannot expect, at least not readily, to come to any kind of sane compromise. I just wanted to introduce that idea, thanks.

CHAIRMAN GILMORE: Thanks, Arnold, back to the table, Eric Reid.

MR. REID: I would have no problem with an independent body of some sort. Yesterday I suggested we needed an unbiased something. But it would not surprise me if an independent body would come back to us and say, well if you had a mathematical model that it would help you in an unbiased way, which in my opinion we may have. It may need further work, but I think we have that tool in the toolbox, you know. But if it takes an independent body to tell us that's what it is going to take, I think that's a good step.

CHAIRMAN GILMORE: Dennis.

MR. ABBOTT: It's a very good idea to have a third party. But I think that we have to consider having the agreement of the Commission, to abide by the results of the arbitrator, prior to even any decisions being made. I mean if a third party comes back and says this is the results, and there are plusses and there are minuses, and we sit down at the table, and it's time for a vote. We're back at Ground Zero, are we not? I think that the Commission really has to come to an agreement that we would abide by the results of whatever we decide to move forward with. Is that not true?

CHAIRMAN GILMORE: Excellent point, Dennis. That's exactly, you said it much better than I did, but yes we would have to have a process we would agree to, before we could go down a road of an arbitrator, or whatever we're going to do. But it's a great point. I've got, oh now everybody has lightened up. I've got Bill, go ahead, Bill.

MR. WILLIAM HYATT: Maybe just stating the obvious, but just to point out that setting up an arbitration process or a third party review actually removes or disincentives the initiative to compromise at this level. It's just something to keep in mind that going this route might actually reduce some of the compromise that takes place around this table.

CHAIRMA GILMORE: Next I have Adam. Dan's up. Let me go to Adam first.

MR. NOWALSKY: I just wanted to offer that with our jointly managed species, we essentially have a third party that's been telling us what to do with things that being the Mid-Atlantic SSC. I think many of us would agree that that has given us a lot of angst over the years. I would caution us all who say we can't do this on our own, let's let somebody else take a crack at it, because I'm not sure that it gets us to a better place.

It's a lot of work. The work that the Board is going through on the black sea bass side, I give a lot of credit to Chairman Ballou, for helping spearhead this effort. But there have been a lot of people who have gotten onboard with it, including the Service. It may not be moving as quickly as we would like it to, but at least we're making progress. I have every confidence that we can continue to make that progress on all of these issues, if we just make that commitment to work on them, and do the very best we can for everyone.

CHAIRMAN GILMORE: I would have absolutely no desire to abdicate our responsibility, maybe something of a hybrid, but again, don't know what it's going to look like, but it's a good point. Dan.

MR. McKIERNAN: One thing I've noticed that we're facing is sort of the Magnuson conundrum, where we've got these dual objectives, or those competing, counteracting objectives. I noticed in the discussion yesterday, we talked about reallocating based on redistribution, but then there is this caveat that talks about preserving communities. They are really counteracting. I think at some point the Commission should not be giving that kind of a task to a third party.

The Commission could give the first one or the second one, but you can't be everything to everyone. If we're going to redistribute quota, based on shifting stocks that's got to be what it is, or if we want to give this group or an arbitration group a mandate, preserve 25 percent of the change, keep it for the community, do that. But everything is just too fluid with these counteracting objectives.

CHAIRMAN GILMORE: Tom Fote.

MR. FOTE: I've been through arbitration and seen it work with unions, and there is always a bias when you get to the arbitrator. He has his own bias, or she has her own biases when they start arbitrating. We're a compact of 15 states. That is what we basically signed on when we passed the Atlantic Coast Conservation Act. We're supposed to work together to come up with solutions.

I think the biggest problem here is we have to deal with the Council and the Magnuson-Stevens Act, because I think if it were just us sitting around the table, we could come up with a solution fast. We could have implemented this thing we did yesterday, we voted on the other day, which actually would have started solving some of the problems.

I don't think it's the Compact that is failing us, I think it's the ability that we can work within ourselves to basically come up with solutions, without going through the other parties involved. I don't trust outside arbitrators, I really don't. I learned over the period of time dealing with it. Nobody is purely unbiased; they are all bringing what they basically have gone through over the years and where you're from.

CHAIRMAN GILMORE: Maybe we just need a special council doing an investigation that worked so well lately. John Clark.

MR. CLARK: I know the idea went over like a led balloon about auctions, but quota is money, and that is the reason this is such a contentious issue between states. Psychology shows that people feel the pain of loss much more than they savor the feeling of gain. I can guarantee that states that lose quota in the process will be hearing about it in the states that gain it. They'll be hearing, why is that all you got for us, when you come back with an extra 1 or 2 percent. I think again that it is an economic issue, and we should start looking at some sort of market-based solution to this.

CHAIRMAN GILMORE: Rob O'Reilly.

MR. O'REILLY: That was my sentiment as well, in that we often don't talk about the economic aspects. We hear time and again how quickly market forces change. We heard a little bit about that with dogfish today. Yes, there can be more quota spread around, but what does it do to the economics? I think the social and economic part is something that I know is difficult to really get information that's current.

But you know we talked about the summer flounder yesterday, and North Carolina and Virginia and New Jersey, they do try to at least increase their market share by virtue of when these commercial fisheries open and close. We have interjurisdictional fisheries, and yet we don't have interjurisdictional considerations of the market, and how that all takes place.

I mean this has been talked about for years at the ASMFC, and yet we're just talking about wanting differences, you know allocations give differences the way they stand now. But it would be really great if we had some economic profiles, and even some social profiles. You know we've heard a lot before about with New York, some of the infrastructure has been lost.

I mean I've heard that from Emerson a couple of times, and now we have to consider how we bring infrastructure back, if there is reallocation. I think along the coast that is the case. I don't know how we do that in particular. I know with menhaden there was at least a social and economic profile of that fishery.

Short of that I can't really remember anything in depth from the ASMFC. When you talk about the federal side, and doing an EIS or an EA, I mean that's incumbent on those plans there. But I'm not even sure there that it translates into the decision making. I agree wholeheartedly with John Clark that that is something that we really should consider, and when the day is done, and reallocation happens. What have we done for the economics for the market and everything else?

CHAIRMAN GILMORE: Steve Murphy.

MR. MURPHY: I totally agree with the market analysis. Really if you look at this, if you kind of did root cause analysis, it leads you to limited entry discussion, to me. It's important to note that even though these are interstate fisheries, commercial fisheries at least in North Carolina, and I would suspect in other states as well, are certainly coastwide. North Carolina trawlers travel to Florida for shrimp, and work up and down the coast, just as those trawlers travel up here.

We fish for scallops off New England. All of those have been sort of integrated into business models, markets, and largely into coastal counties, where that's all there is. You either commercial fish or you farm. If you're in the Wanchese or Dare/Hyde County areas, there is not a whole lot unless you're into tourism. It's important to keep that market in the equation, because that's really what's so important for the states with this allocation.

CHAIRMAN GILMORE: Lynn Fegley.

MS. FEGLEY: Just jumping off of what Steve just said. I sat on a webinar with some social scientists who were starting to look at the dynamics, and the socioeconomics of shifting stocks. What they were seeing was, you know the fleets will follow, the fleets will travel, because that's all they can do is move where the stocks are going.

But they would obviously prefer to fish close. But the problem is that they can't, because there is nothing to fish on close, because they don't have the allocation, or the quota, or the species. What that kind of leads to, is that this is the sort of thing that can't be considered in a species-specific vacuum. It really almost becomes a multispecies problem, whereas the stocks are shifting, if we're trying to keep fleets close to home, what's going to fill the void as allocation shifts?

CHAIRMAN GILMORE: Okay, I think we've had a good discussion on this. Again, this is the beginning of this right now. Obviously, we're going to be discussing it quite a bit. I thank Ray for raising it. It's a great point, and obviously just about every state weighed in on this, so it's something we are going to have to address. I guess Bob and I work with the Council, and we'll come back, and hopefully start getting something on paper that maybe gets us in the right direction. Tom Fote. Is there any other business to come before the Board? Go ahead, Tom.

MR. FOTE: As we saw with striped bass, and as we're seeing with summer flounder and black sea bass and red snapper, we have a big problem with catch and release. When the numbers in the recreational sector start basically rising above what we're taken home, we're killing by catch and release, it starts being an extreme problem, especially when it starts affecting the stocks.;

Years ago the ASMFC formed a committee, I sat as Chair of that actually a working group to look at circle hooks and what circle hooks we should be doing if we were going to do it with law enforcement. Since I was on the Board of ASA at the time, I asked them if they would get the hook manufacturers.

Well after two years of trying to deal with Mustad, Gamakatsu, Eagle Claw, trying to find out what they thought was a circle hook. There were 14 different hooks they said were circle hooks. It winds up being a problem, but we need to move in that direction. I would be willing to basically talk to ASA again, try to get the hook manufacturers and do that.

The other thing I looked at years ago on summer flounder. We shouldn't be selling rigs in the tackle stores that have 1-0 and 2-0 hooks for summer flounder. It's a gut hooking experience when I see them up there. Again, we looked at a phase-in period that way you get off those hooks, because we now know they should be at least 5, 6, or 7-0 hooks.

I think we really should start looking at that. Of course, I sit as Governor of Affairs at ASA, so I hear all the red snapper stories going on and on forever in the Gulf and the West Coast. I think we need to do that. We need to start looking at how we do that. I would volunteer to be on any of those working groups you want, and if you want me to reach out to ASA about the hook thing, I could put a little group together, to sit and look at it.

But we're not discussing how the hook is. We go to Law Enforcement and tell them we want circle hooks, then they're going to ask us, well what is a circle hook, can it be offset, can it not be offset, and all those questions. I'm just trying to get the ball rolling. I know it's late, and I've got to catch a flight, but anyway. I'm just bringing that to your attention, and I'm willing to work on it.

CHAIRMAN GILMORE: Okay Tom, thanks and I'll follow up with you on that after, Marty.

MR. MARTIN GARY: Just hopefully a simple inquiry into the status of the funding for the Cooperative Winter Striped Bag Tagging Efforts, if we know any. I know we had that bridge for this past year. That dataset is now past 30 years, and I'm just curious where we are with that if we know.

MS. KERNS: Marty, I'm going to have to e-mail the Board out that information. I don't think we've really brought up questions about next year's tagging study yet, and we'll have to do that and go there.

CHAIRMAN GILMORE: You win the award, Marty. You stumped Toni. Roy Miller.

MR. MILLER: Just a quick follow up to Tom Fote's comments. I think as a Commission we would be wise to be thinking in the future about ways to reduce hook and release mortality. It isn't just circle hooks. There are other methods in the toolbox for reducing hook and release mortality. Maryland made some strides with that with their striped bass proposal in the Bay. There may be other possibilities that would help us down that road, thank you.

ADJOURNMENT

CHAIRMAN GILMORE: Agreed, Roy, good point. Okay, anything else to bring up before the Policy Board. Seeing none; a motion to adjourn by Doug Grout, and seconded by everyone. Thanks, everyone.

(Whereupon the meeting adjourned at 9:45 o'clock a.m. on May 2, 2019)

Atlantic States Marine Fisheries Commission

Annual Performance of the Stocks: 2019 Review

July 2019

Objective: – Support the ISFMP Policy Board's review of stock rebuilding performance and management board actions and provide direction to management boards for 2020 Action Plan.

A. Validate status/rate of progress (acceptable/not acceptable)
B. If not acceptable, identify appropriate corrective action

Species Groups: – Species are grouped under five major categories (1) rebuilt/sustainable; (2) recovering/rebuilding; (3) concern; (4) depleted; and (5) unknown, as defined below.

Rebuilt/Sustainable – Stock biomass is equal to or above the biomass level established by the FMP to ensure population sustainability. When between benchmark assessments a stock can still be considered rebuilt/sustainable if it drops below the target but remains above the threshold.

Recovering/Rebuilding – Stocks exhibit stable or increasing trends. Stock biomass is between the threshold and the target level established by the FMP.

Concern – Those stocks developing emerging issues, e.g., increased effort, declining landings, or impacts due to environmental conditions.

Depleted – Reflects low levels of abundance though it is unclear whether fishing mortality is the primary cause for reduced stock size

Unknown – There is no accepted stock assessment to estimate stock status.

Status as of 2019

Rebuilt/Sustainable:
American Lobster (GOM/GBK)
Atlantic Menhaden
Black Drum
Black Sea Bass
Bluefish
Horseshoe Crab (Southeast)
Cobia
Scup
Spanish Mackerel
Spiny Dogfish

Recovering/Rebuilding:
Horseshoe Crab (Delaware Bay)
Red Drum
Summer Flounder
Tautog (MA/RI)

Concern:
Coastal Sharks
Winter Flounder (GOM)

Depleted:
American Eel
American Lobster (SNE)
American Shad
Atlantic Herring
Atlantic Striped Bass
Atlantic Sturgeon
Horseshoe Crab (New York)
Northern Shrimp
River Herring
Tautog (LIS, NJ/NY Bight, DelMarVa)
Weakfish
Winter flounder (SNE/MA)

Unknown:
Atlantic Croaker
Horseshoe Crab (New England)
Jonah Crab
Spot
Spotted Seatrout

Status as of 1998

Rebuilt/Rebuilding
Atlantic Herring
Atlantic Striped Bass
Bluefish
Black Sea Bass
Spanish Mackerel
Summer Flounder

Concern/Depleted
American Lobster (SNE)
Atlantic Menhaden
Northern Shrimp
Red Drum
Scup
Spiny Dogfish
Tautog
Weakfish
Winter Flounder (SNE/MA and GOM)

Unknown
American Eel
American Shad
Atlantic Croaker
Atlantic Sturgeon
Horseshoe Crab
River Herring
Spot
Spotted Seatrout

Summary Table of Rebuilt/Sustainable Species

Species	Biomass % of Target	Assessment Schedule	Caveats/Notes (what actions need to be taken to maintain rebuilt status)
American Lobster (Gulf of Maine/ Georges Bank)	375% of abundance threshold (2015 benchmark assessment)	Benchmark Assessment – 2020	The stock is not overfished nor experiencing overfishing. Dramatic increase in stock abundance since the late 1980s, and at an increasing rate since 2005. Average spawning stock and recruit abundance are above the 75th percentile, while young-of-the-year indicators are generally below the median. Management action is being considered regarding the stock's resiliency, but is currently on hold pending resolution of the immediate issues concerning the fishery's interactions with right whales.
Atlantic Menhaden	84% of fecundity target (2017 stock assessment update)	Benchmark Assessment – 2019	The stock is not overfished nor experiencing overfishing. High abundance of older fecund fish in the population. Fecundity has been increasing since the mid-2000s after a period of low fecundity in the 1990s. Menhaden-specific ecological reference points are being pursued to assess the status of the species in an ecosystem context.
Black Drum	192% of B_{MSY} (2015 benchmark assessment)		The stock is not overfished nor experiencing overfishing. Future assessments can be improved by applying a more complex, data-rich assessment method such as a statistical catch-at-age model. This would require fishery-dependent biological sampling of lengths and ages and a fishery-independent survey to track abundance and age structure of the mature stock, which not all states are collecting.
Black Sea Bass	229% of the SSB target (2016 benchmark stock assessment)	Assessment Update – 2019 (SAW/SARC Operational Assessment)	The stock is not overfished nor experiencing overfishing. Recent strong recruitment has led to the highest biomass estimate in the time series. It is unknown whether strong year classes/recruitment will continue to maintain high abundance in future years.
Bluefish	85% of SSB target (2015 benchmark assessment)	Assessment Update – 2019 (SAW/SARC Operational Assessment)	The stock is not overfished nor experiencing overfishing. Considered less vulnerable to becoming overfished relative to the biological reference points due to their life history characteristics (e.g., pelagic species, opportunistic feeder, multiple spawning events per year).

Summary Table of Rebuilt/Sustainable Species

Cobia	175% of minimum stock size threshold (MSST) (2013 benchmark stock assessment)	SEDAR Benchmark Assessment – 2019	The stock is not overfished nor experiencing overfishing, according to the 2013 assessment. However, the commercial fishery has exceeded its federal annual catch limit (ACL) in each of the last four years. The recreational fishery, as of 2018, is subject to a recreational harvest limit (RHL) that is allocated among the states and evaluated as a 3-year average. Coastwide recreational harvest exceeded the RHL in 2018. While the last assessment did not determine an overfished status, there was a notable declining trend in spawning stock biomass from 2002 through the terminal year of 2011.
Horseshoe Crab (Southeast Region)	Unknown (2019 benchmark assessment)		No overfishing or overfished definitions have been adopted for management use. Stock status is based on the percentage of surveys within a region having a >50% probability of the final year being below the ARIMA reference point. "Good" status indicates <33% of surveys had a >50% probability. 0 of the 2 surveys in the Southeast region had a probability >50%. The Southeast region's status has remained "good" through the last three assessments.
Scup	206% of SSB target (2017 stock assessment update)	Assessment Update – 2019 (SAW/SARC Operational Assessment)	The stock is not overfished nor experiencing overfishing. There is no consistent internal retrospective pattern in fishing mortality, spawning stock biomass, or recruitment evident in the scup assessment model.
Spanish Mackerel	SSB_{2011}/SSB_{MSY}=1.49; SSB_{2011}/MSST=2.29 (2012 benchmark stock assessment)	SEDAR Benchmark Assessment – 2020	The stock is not overfished nor experiencing overfishing.
Spiny Dogfish	67% of SSB target in 2018 (based on the 3 year averaging approach)	Benchmark Assessment 2022 (SAW/SARC Research Track Assessment)	The stock is not overfished nor experiencing overfishing. Spawning stock biomass (SSB) was 67% of the SSB target in 2018. Despite remaining over the threshold, biomass has declined in recent years, requiring a significant reduction in 2019-2020 to ensure overfishing does not occur.

Summary Table of Species Undergoing Recovery/Rebuilding

Species	Biomass % of Target	Assessment Schedule	Caveats/Notes (what actions need to be taken to continue rebuilding)
Horseshoe Crab (Delaware Bay)	Unknown (2019 benchmark assessment)		No overfishing or overfished definitions have been adopted for management use. Stock status is based on the percentage of surveys within a region having a >50% probability of the final year being below the ARIMA reference point. “Neutral” status indicates 34-65% of surveys had a >50% probability. 2 of the 5 (40%) surveys in the Delaware Bay region had a probability >50%. The Delaware Bay region’s status has remained “neutral” since the 2009 benchmark assessment.
Red Drum	Unknown	5-year Trigger – 2021	Red drum does not fit into any of the Commission categories perfectly. The stock is not experiencing overfishing. The estimates of biomass from the assessment are highly uncertain and were not recommended for management use. While indices used in the assessment are variable, the long term trends are stable.
Summer Flounder	78% of SSB Target (2018 benchmark stock assessment)	Assessment Update – 2021 (SAW/SARC Management Track)	The stock is not overfished nor experiencing overfishing. The 2018 stock assessment data indicated an expanding age structure, but also showed a decrease in relative total abundance since the late 2000s, as well as decreasing trends in average lengths and weights at age for both sexes, suggesting slower growth and delayed maturity. The assessment shows current mortality from all sources is greater than recent recruitment inputs to the stock, which has resulted in a declining stock trend.
Tautog (Massachusetts/Rhode Island)	82% of SSB Target (2016 assessment update)		The stock is not overfished nor experiencing overfishing (spawning potential ratio was used to determine stock status). Total abundance and SSB declined rapidly from 1982 until 2000. SSB decreased from 8,994 mt in 1985 to the current estimate of 2,196 mt in 2015.

Overview of Species of Concern

Coastal Sharks: Concern

Assessment Findings

Species or Complex Name	Stock Status		References/Comments
	Overfished	Overfishing	
Pelagic			
Porbeagle	Yes	No	Porbeagle Stock Assessment, ICCAT Standing Committee on Research and Statistics Report (2009); Rebuilding ends in 2108 (HMS Am. 2)
Blue	No	No	ICCAT Standing Committee on Research and Statistics Report (2015)
Shortfin Mako	Yes	Yes	ICCAT Standing Committee on Research and Statistics Report (2017)
All other	Unknown	Unknown	
Aggregated Large Coastal Sharks (LCS)			
Atlantic Blacktip	Unknown	Unknown	SEDAR 11 (2006)
Aggregated Large Coastal Sharks Atlantic Region	Unknown	Unknown	SEDAR 11 (2006); difficult to assess as a species complex due to various life history characteristics/ lack of available data
Non-Blacknose Small Coastal Sharks (SCS)			
Atlantic Sharpnose	No	No	SEDAR 34 (2013)
Bonnethead	Unknown	Unknown	SEDAR 34 (2013)
Finetooth	No	No	SEDAR 13 (2007)
Hammerhead			
Scalloped	Yes	Yes	SEFSC Scientific Review by Hayes et al. (2009) Hayes, et al. (2009): Rebuilding ends in 2023 (HMS Am. 5a)
Blacknose			
Blacknose	Yes	Yes	SEDAR 21 (2010); Rebuilding ends in 2043 (HMS Am. 5a)
Smoothhound			
Atlantic Smooth	No	No	SEDAR 39 (2015)
Research			
Sandbar	Yes	No	SEDAR 54 (2018)

Overview of Species of Concern

Prohibited			
Dusky	Yes	Yes	SEDAR 21 (2016); Rebuilding ends in 2107 (HMS Am. 5b)
Basking		No	Campana (2008)
Night		No	Carlson et al (2008)
Sand Tiger		No	Carlson et al (2008)
White		No	Curtis et al (2014)
Bigeye Thresher		No	Young et al (2016)
All other	Unknown	Unknown	

Board Adherence to Scientific Advice

- In April 2019, the Board increased the recreational minimum size limit for Atlantic shortfin mako sharks in state waters. These measures specify a 71-inch straight line fork length (FL) for males and an 83-inch straight line FL for females. The measures are consistent with those required for federal highly migratory species (HMS) permit holders under HMS Amendment 11, which was implemented in response to the 2017 Atlantic shortfin mako stock assessment that found the resource is overfished and experiencing overfishing.
- May 15 – July 15 closed season from New Jersey – Virginia to protect pupping females for the following species: sandbar, silky, tiger, blacktip, spinner, bull, lemon, nurse, scalloped hammerhead, great hammerhead, and smooth hammerhead.

Monitoring and Management Measures

- Fins must remain attached to the carcass through landing for all species except smooth dogfish (25% catch composition applies), which complements the Shark Conservation Act.
- The 2019 commercial fishery is year-round, starting January 1 and remaining open through December 31 unless NMFS determines landings for a shark management group have reached, or are projected to reach, 80 percent of the available quota.
- For 2019, adjustable commercial retention limits for the aggregated large coastal shark (LCS) and hammerhead shark management groups were implemented in both state and federal waters. The fishery opened with a commercial retention limit of 25 sharks per trip per vessel and was increased to 36 LCS per trip on June 25th. The revised retention limit will remain in effect for the rest of the 2019 fishing season or until NMFS announces another adjustment to the retention limit. Additionally, a commercial possession limit of 8 blacknose sharks per trip was implemented in both state and federal waters.
- Recreational fishing is controlled through possession limits except for the following species: Atlantic sharpnose, finetooth, blacknose, and bonnethead.
- Recreational anglers can only harvest sharks caught with a handline or rod & reel.
- In August 2018, the Board approved Addendum V, which provides the Board the ability to respond to changes in the stock status of coastal shark populations and adjust regulations through Board action rather than an addendum, ensuring greater consistency between state and federal measures for coastal sharks.

Next Assessment: Variable by species/complex **Rebuilding Trajectory:** Variable by species/complex

Overview of Species of Concern

Winter Flounder - GOM: Concern

2017 Groundfish Operational Stock Assessment

Overfished Unknown

- Assessment is based on 30+ cm area-swept biomass estimated directly from the surveys.
- B_{MSY} and F_{MSY} are unknown, and consequently the fishing mortality (F) and SSB targets could not be generated.
- The primary source of uncertainty for the estimate of biomass is the survey gear catchability (q).

Overfishing Not Occurring

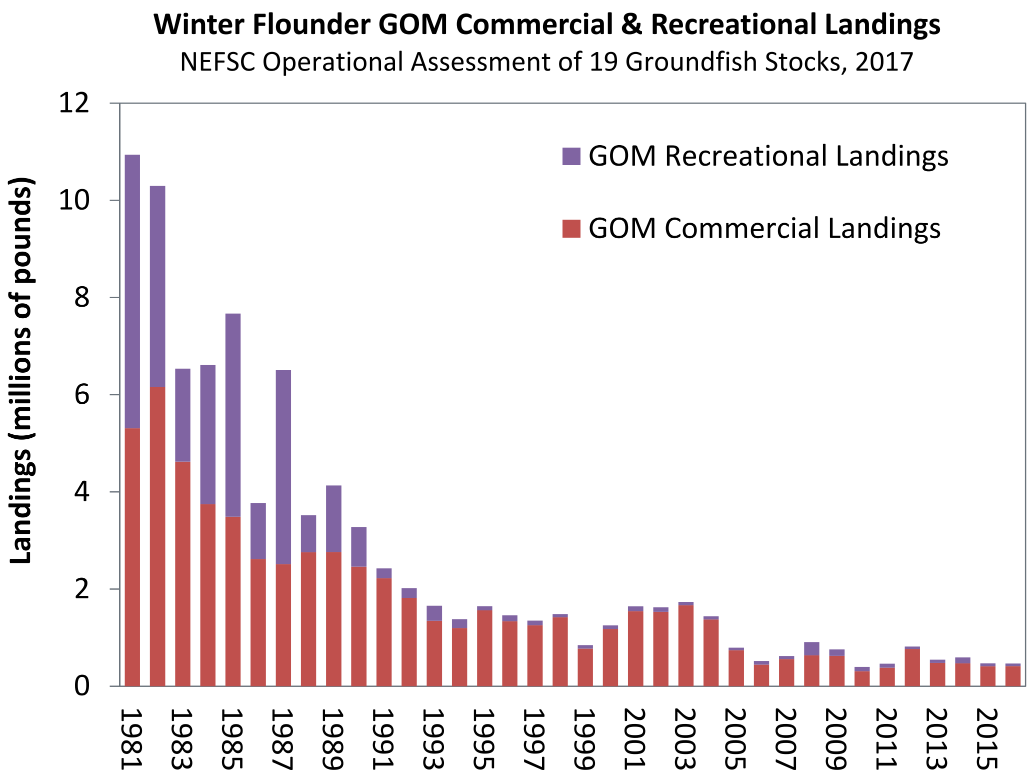
- The 2016 30+ cm exploitation rate is estimated to be 0.086, which is 37% of the overfishing exploitation threshold proxy.
- It is unknown why large declines in recreational and commercial catch have had little impact on the GOM winter flounder survey indices, which are relatively flat and show minimal change in size structure.

Board Adherence to Scientific Advice

- Addendum I measures, implemented in 2009, reduced recreational and commercial harvest by an estimated 11% and 31%, respectively
- In response to the 2011 stock status, NOAA Fisheries increased the 2012 state water sub-component to 272 mt (a 450% increase from 2010 levels) based on the overfishing status.
- Following this federal action, the Commission's Winter Flounder Board approved Addendum II in October 2012 to increase the maximum possession limit for non-federally permitted commercial vessels from 250 pounds to 500 pounds.
- In 2017, NOAA Fisheries reduced the state waters sub-component to 67 mt (from 122 mt in 2016) and reduced the total stock-wide annual catch limit to 428 mt (from 776 mt in 2016).
- The Commission's Board has maintained the trip limits and size limits in GOM winter flounder fishery since 2012.

Next Assessment: Unknown

Rebuilding Trajectory: Flat at low levels



Timeline of Management Actions: FMP & Addendum I ('92); Addendum II ('98); Amendment 1 ('05); Addendum I ('09); Addendum II '12); Addendum III ('13)

Overview of Depleted Species

American Eel: Depleted

2017 Stock Assessment Update

Depleted: Trend analyses and model results indicate American eel has declined in recent decades and the prevalence of significant downward trends in multiple surveys across the coast is cause for concern.

Overfishing Determination: No overfishing determination can be made at this time.

Assessment Findings

- In recent decades, there has been neutral or declining coastwide abundance.
- Decreasing trends in yellow eels were seen in the Hudson River and South Atlantic regions.
- Although commercial fishery landings and effort in recent times have declined in most regions from historical levels, current fishing effort may still be too high given the additional stressors affecting the stock, such as habitat loss, passage mortality, and disease, as well as potentially shifting oceanographic conditions.
- Management efforts to reduce mortality on American eels in the U.S. are warranted.

Board Adherence to Scientific Advice

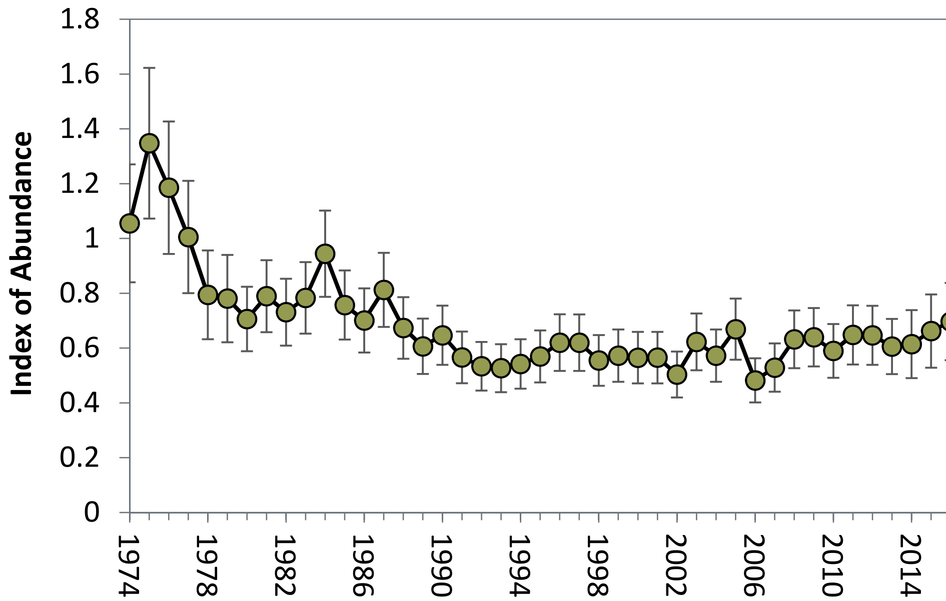
- Based on results of the 2012 benchmark assessment, the Board implemented two Addenda (III and IV) to reduce fishing mortality on American eels through size and possession limits for yellow eel, prohibiting most silver eel fisheries, establishing a 907,671 pound coastwide quota for yellow eel fisheries, and reducing Maine's glass eel quota to 9,688 pounds.
- The Board approved Addendum V in August 2018, which slightly increases the yellow eel cap, inconsistent with the advice of both the Technical and Stock Assessment Committee. The Addendum also adjusts the management trigger and response should the cap be exceeded.

Next Assessment: Unknown

Rebuilding Trajectory: Unknown

40+ Year Index of Abundance of Yellow American Eel along the Atlantic Coast, 1974 - 2016

Source: ASMFC American Eel Stock Assessment Update, 2017



The error bars represent the standard errors about the estimates.

Timeline of Management Actions: FMP ('99); Addendum I ('06); Addendum II ('08), Addendum III ('13); Addendum IV ('14); Addendum V ('18)

Overview of Depleted Species

Trend Analysis of Regional and Coastwide Indices of American Eel Abundance by Young-of-the-year (YOY) and Yellow Eel Life Stages

Region	Life Stage	Time Period	2012 Trend	2017 Trend
Gulf of Maine	YOY	2001–2016	NS	NS
Southern New England	YOY	2000–2016	NS	NS
	Yellow	2001–2010	NS	-
Hudson River	YOY	1974–2009	↓	-
	Yellow	1980–2016	↓	↓
Delaware Bay/ Mid-Atlantic Coastal Bays	YOY	2000–2016	NS	NS
	Yellow	1999–2016	NS	NS
Chesapeake Bay	YOY	2000–2016	NS	NS
	Yellow	1990–2009	↑	↑
South Atlantic	YOY	2001–2015	NS	↓
	Yellow	2001–2016	↓	↓
Atlantic Coast	YOY (short-term)	2000–2016	NS	NS
	YOY (long-term)	1987–2013	NS	NS
	Yellow (40+ year)	1974–2016	NS	↓
	Yellow (30-year)	1987–2016	↓	↓
	Yellow (20-year)	1997–2016	NS	NS

Overview of Depleted Species

American Lobster – Southern New England: Depleted

Assessment Findings (2015 Benchmark Stock Assessment)

- Depleted and overfishing not occurring
- Abundance at 42% of threshold
- Current exploitation (0.27) below threshold (0.41)
- Model estimates for recruitment are near zero and the lowest on record
- The inshore portion of the stock shows a dramatic decline in spawning stock abundance
- The stock has not rebuilt and is in recruitment failure
- Little possibility of recovery unless fishing effort is significantly curtailed

Board Adherence to Scientific Advice

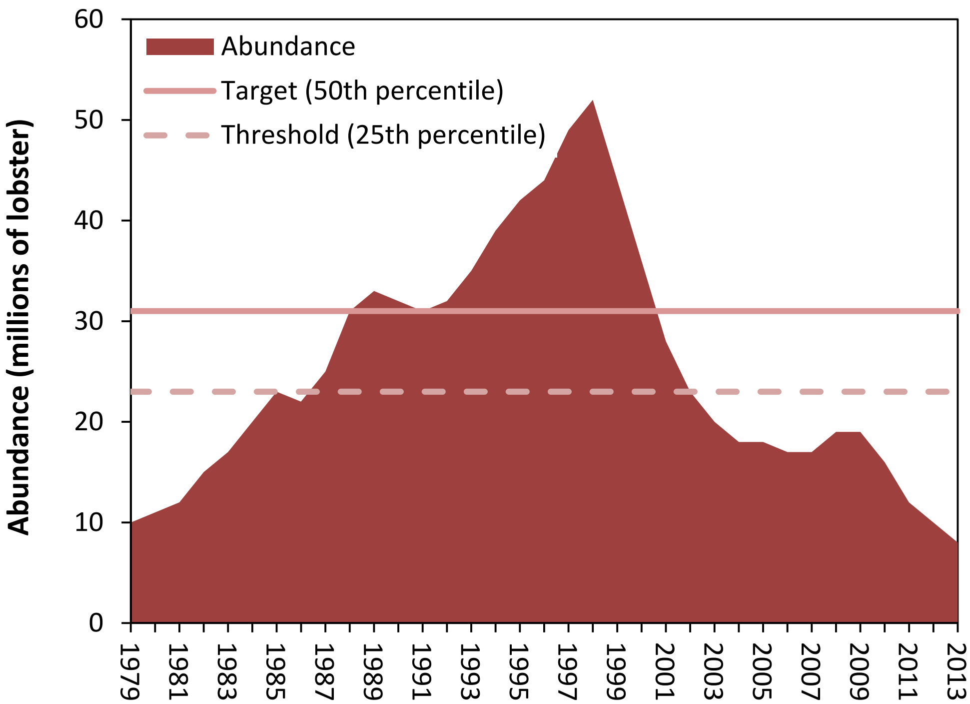
- Technical Committee has advised use of output controls; Board continues to use input measures
- Technical Committee has advised prohibiting conservation equivalency (CE) in LCMA 6; Board approved CE program
- Technical Committee has advised 50-75% reductions in SNE LCMAs; Board approved 10% reduction
- Technical Committee has advised 100% trip level harvester reporting; via Addendum XXVI, the Board established a deadline that, within five years, states are required to implement 100% harvester reporting

Rebuilding Trajectory: Population continues to decline; Addendum XI (2007) established a 15-year rebuilding timeline (ending in 2022) with a provision to end overfishing immediately.

Next Assessment: Benchmark assessment in 2020

Southern New England Lobster Abundance

Source: American Lobster Benchmark Stock Assessment, 2015



Timeline of Management Actions: Amendment 3 (‘97); Addendum I (‘99); Addendum II (‘01); Addendum III (‘02); Addenda IV & V (‘04); Addenda VI & VII (‘05); Addenda VIII & IX (’06); Addenda X & XI (‘07); Addendum XIII (‘08); Addenda XII & XIV (‘09); Addendum XV (‘09); Addendum XVI (‘10); Addendum XVII (‘11); Addendum XVIII (’12); Addenda XIX – XXII (’13); Addendum XXIII (’14); Addendum XXIV (’15); Addendum XXVI (’18)

Overview of Depleted Species

American Shad: Depleted

2007 Assessment Findings

- 86 river systems assessed; 64% of which have unknown stock status
- Collectively, stocks are at all-time lows and do not appear to be recovering

Scientific Advice Based on Assessment Findings

- Improved monitoring (fishery-independent and -dependent) and fish passage
- Management measures based on total mortality (Z), which combines fishing and natural mortality
- Lower JAI threshold needed to trigger management action

Board Adherence to Scientific Advice

- Management Board approved Amendment 3 in February 2010.
- Management actions contained in the Amendment are based on recommendations from the stock assessment.
- Member states/jurisdictions were required to submit sustainable fishery management plans (SFMPs) by August 1, 2012 (for Technical Committee review and Board approval). As of January 1, 2013, the Shad and River Herring Management Board approved SFMPs for Massachusetts, Connecticut, the Delaware River, the Potomac River, North Carolina, South Carolina, Georgia, and Florida. States/jurisdictions without approved SFMPs by January 1, 2013 were required to close their American shad fisheries, with the exception of catch and release recreational fisheries. All SFMPs were updated as of February 2019.

Trends in Stock Status of American Shad Populations from the 2007 and 1998 Benchmark Assessments. A "?" indicates either insufficient data or various data analyses gave conflicting indications of trend. Source: ASMFC American Shad Stock Assessment Report, 2007

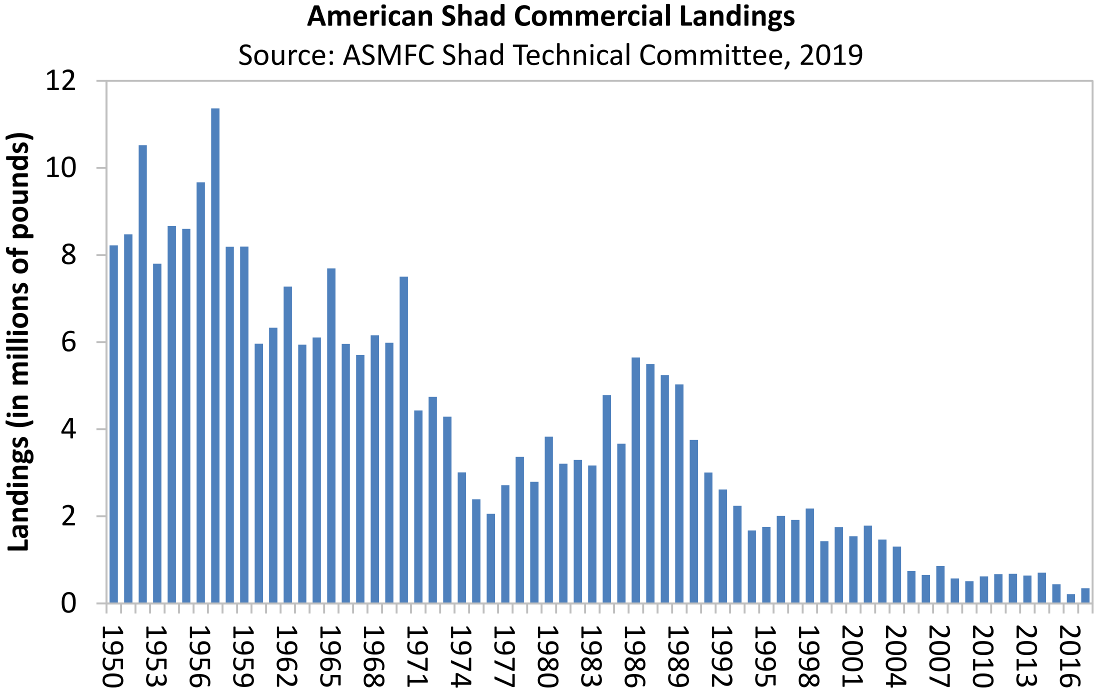
State	River	2007 Status Trend	1998 Status Trend
ME	Merrymeeting Bay	Declining	
	Kennebec		
	Androscoggin		
	Saco		
NH	Exeter	Declining	
MA	Merrimack	Stable	Stable
RI	Pawcatuck	Declining	Stable
CT & MA	Connecticut	Stable	Stable
NY	Hudson	Declining	Declining
NY, PA, NJ, DE	Delaware River & Bay	Stable	Stable
MD	Nanticoke	Stable	Increasing
PA & MD	Susquehanna River & Flats	Declining	
MD, DC, VA	Potomac	Increasing	
VA	York	Increasing	Declining
	James	Declining	Stable
	Rappahannock	Stable	Stable
NC	Albemarle Sound	Stable	
	Roanoke	Stable	
	Tar-Pamlico	?	
	Neuse	?	
	Cape Fear	?	
SC	Winyah Bay	Stable	
	Waccamaw	?	
	Great Pee Dee	?	
	Santee	?	Increasing
	Cooper	Stable	
	Combahee	?	
	Edisto	Declining	Stable
SC & GA	Savannah	Stable	
GA	Altamaha (+ Ocmulgee)	Declining	Increasing
	Ogeechee		
FL	St. Johns	Stable	

Overview of Depleted Species

- By August 1, 2013, states/jurisdictions were required to submit a Habitat Plan, which contains a summary of current and historical spawning and nursery habitat; the most significant threats to those habitats; and a habitat restoration program to improve, enhance and/or restore habitat quality and quantity. In February 2014, the Board approved habitat plans for the majority of states and jurisdictions.

Next Assessment: Benchmark assessment in 2020

Rebuilding Trajectory: Variable by River System (see accompanying table)



Timeline of Management Actions: FMP ('85); Amendment 1 ('99); Amendment 3 ('10)

Overview of Depleted Species

Atlantic Herring: Depleted

2018 Benchmark Stock Assessment Findings

- Not overfished nor experiencing overfishing
- Recruitment has been below the time series average for the past five years; 2016 has the lowest on record at 1.7 million fish
- SSB has been lower in recent years and was below the SSB threshold in 2017
- Based on projections, and assuming recruitment and landing trends continue at similar levels, the stock was expected to become overfished with overfishing occurring starting in 2018
- Fishing mortality has also decreased in recent years and was below the F threshold in 2017

Scientific Advice Based on Assessment Findings

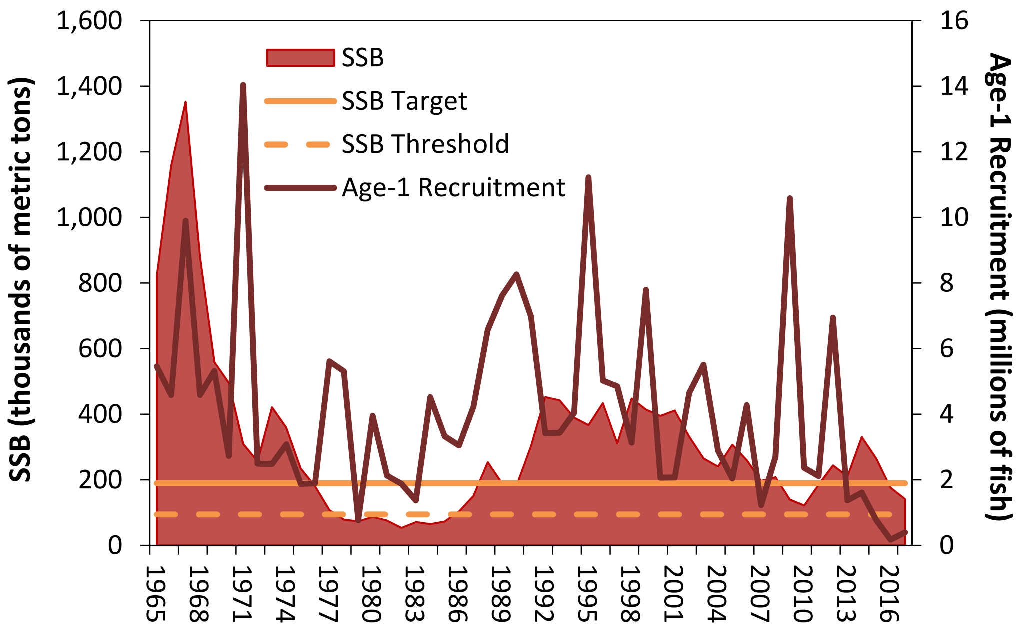
- Technical Committee analysis suggests that reducing the GSI_{30} trigger value to 23 or 24 would reduce the probability of greater than 25% spawning fish in the catch, especially for years with fewer GSI_{30} samples.
- Technical Committee concluded that the use of a 4-week spawning closure would likely result in frequent use of the re-closure protocol; Board could consider implementing a 5- or 6-week spawning closure.

Board Adherence to Scientific Advice

- Board approved Addendum II in April 2019. The addendum strengthens the protections provided to spawning herring in Area 1A by: 1) lowering the threshold that triggers initial spawning closure (From 25 to 23); 2) increasing the length of the initial spawning closure (from 4 to 6 weeks); and 3) lowering the threshold that triggers a re-closure due to spawning activity, in order to provide greater protection to the stock (from 25% to 20% or more mature herring).
- The Board is working on Draft Addendum III, which considers the establishment of a spawning protection program in Area 3 (off of Cape Cod and Georges Bank) to promote stock rebuilding.

Atlantic Herring Spawning Stock Biomass & Recruitment

Source: 65th Northeast Regional Stock Assessment Workshop, 2018



Timeline of Management Actions: FMP ('93); Amendment 1 ('99); Amendment 2 ('06); Technical Addendum I ('06); Addendum I ('09); Addendum II ('10); Addendum V ('12); Addendum VI ('13); Amendment 3 ('16); Addendum I ('17); Addendum II ('19)

Next Assessment: Benchmark Assessment Update in 2020 (SAW/SARC Management Track)

Rebuilding Trajectory: Declining

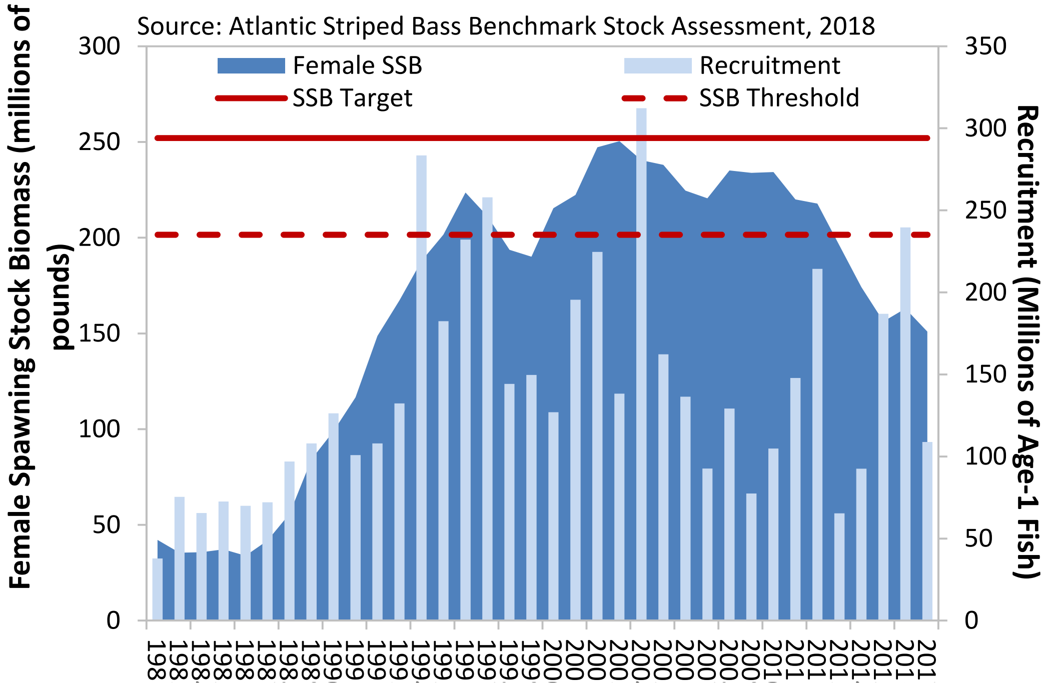
Overview of Depleted Species

<u>Atlantic Striped Bass: Depleted</u>

2018 Benchmark Assessment Findings

- The assessment used fisheries-dependent and -independent data, as well as tagging data, to determine the status of the stock.
- The stock is overfished and experiencing overfishing.
- Female SSB was estimated at about 75% of the SSB threshold in 2017.
- F was estimated at about 128% of the F threshold in 2017.
- The stock experienced a period of low recruitment (age-1 fish entering the population) from 2005-2011 (although not as low as the early 1980s), which contributed to the decline in SSB in recent years.
- Recruitment has been variable since 2011, and was estimated at 109 million fish in 2017 which is 23% below the time series average.

Atlantic Striped Bass Female Spawning Stock Biomass and Recruitment



Timeline of Management Actions: FMP ('81); Amendment 3 ('85); Amendment 5 ('95); Addenda I & II ('97); Addendum II ('98); Addendum IV ('01); Addendum V ('01); Amendment 6 ('03); Addendum I ('07); Addendum II ('10); Addendum III ('12); Addendum IV ('14)

Scientific Advice Based on Assessment Findings

- The Technical Committee estimated an an approximate 17% reduction in total removals (commercial and recreational harvest, including dead releases) to reduce F to the target in 2020 relative to 2017 levels.

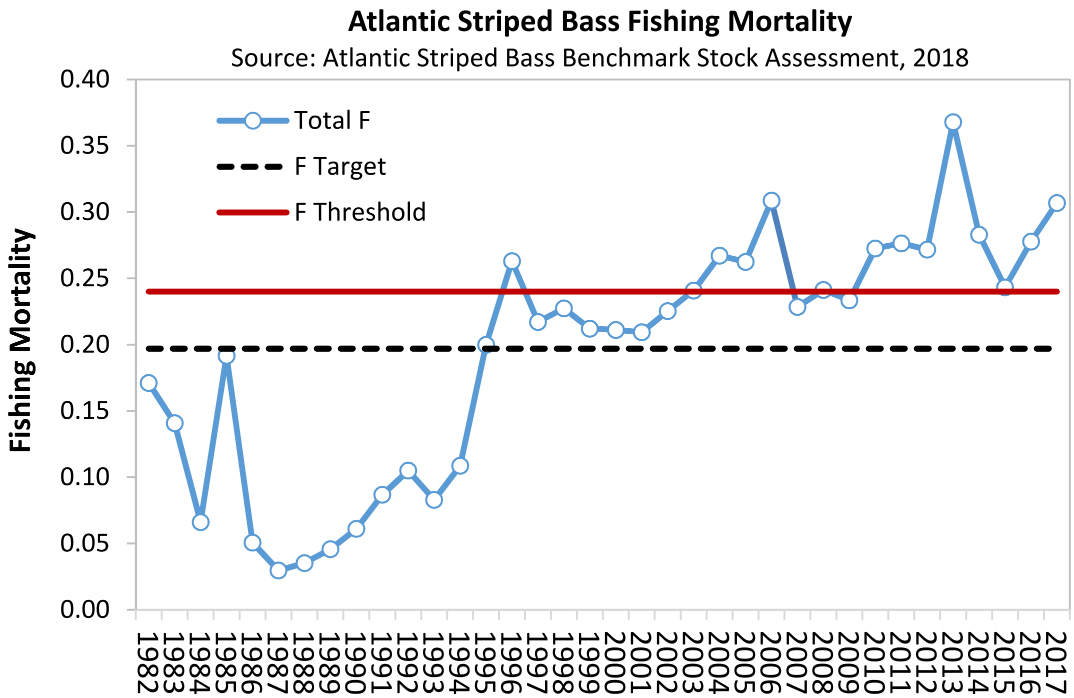
Board Adherence to Scientific Advice

- The Board initiated the development of a Draft Addendum to consider measures aimed to reduce F to the target level for implementation in 2020.
- The Draft Addendum will explore combinations of commercial quotas and recreational measures (including minimum size and slot limits) for the ocean and Chesapeake Bay fisheries to achieve the desired reduction removals, as well as a coastwide circle hook requirements.
- In August, the Board will consider a motion to initiate the development of an Amendment which will address other issues including reference points, management triggers, regional management, and rebuilding the biomass.

Next Assessment: Recommended for 2024

Rebuilding Trajectory: Declining

Overview of Depleted Species



Overview of Depleted Species

Atlantic Sturgeon: Depleted

Available Information

- Commercial landings of Atlantic sturgeon peaked in 1890 at an estimated 7.5 million pounds.
- A 2007 status review identified five distinct population segments (DPS) – discrete population units with distinct physical, genetic, and physiological characteristics – along the Atlantic coast; the Gulf of Maine DPS, New York Bight DPS, Chesapeake Bay DPS, Carolina DPS and South Atlantic DPS.
- In April 2012, NOAA Fisheries listed the Gulf of Maine DPS as threatened and the New York Bight, Chesapeake Bay, Carolina and South Atlantic DPSs as endangered under the Endangered Species Act (ESA).
- In 2017, areas of habitat considered essential to the species' conservation were designated for each DPS.
- A 2017 benchmark stock assessment indicated the coastwide population appears to be recovering slowly since 1998 – the year ASMFC implemented a complete moratorium – although populations remain depleted at the coastwide and DPS-levels relative to historical abundance.
- Despite the moratorium, the population still experiences mortality from several sources, but the assessment indicates total mortality is sustainable.
- The assessment listed bycatch, habitat loss, ship strikes, and climate change as the primary threats to recovery.
- NOAA Fisheries is currently conducting a 5-year Status Review of the ESA listing and developing a Recovery Plan for the species.

Needed Information/Data

- Efforts to assess the status of Atlantic sturgeon are hampered by a lack of data
- Better DPS-specific life history information including age, growth, fecundity and maturity
- Better information on population trends, especially at the DPS-level, is a high priority
- Increased fishery-independent monitoring efforts directed at Atlantic sturgeon
- Improve fishery-dependent monitoring of sturgeon bycatch and bycatch mortality
- Collect information on regional ship strike occurrences, including mortality estimates
- Maintain and expand current networks of acoustic receivers and acoustic tagging programs

Monitoring and Management Measures

- Monitoring: States must report annually on Atlantic sturgeon bycatch, fisheries-independent monitoring, habitat status and authorized aquaculture operations.
- Management: In 1998, the ASMFC implemented a coastwide moratorium until a minimum of 20 year classes of spawning females have been protected.
- States have been working with NOAA Fisheries to obtain Section 10 incidental take permits for various fisheries and gear types regulated in its jurisdictions.

Next Assessment: Unknown

Timeline of Management Actions: FMP ('90); Amendment 1 ('98); Addendum I ('01); Addendum II ('05); Addendum III ('06); Addendum IV ('12)

Overview of Depleted Species

Atlantic Sturgeon Coastwide and DPS-level Stock Status Based on Mortality Estimates (Z) and Biomass/Abundance Status Relative to Historic Levels and the Last Year of Available Indices Data Relative to the Start of the Coastwide Moratorium

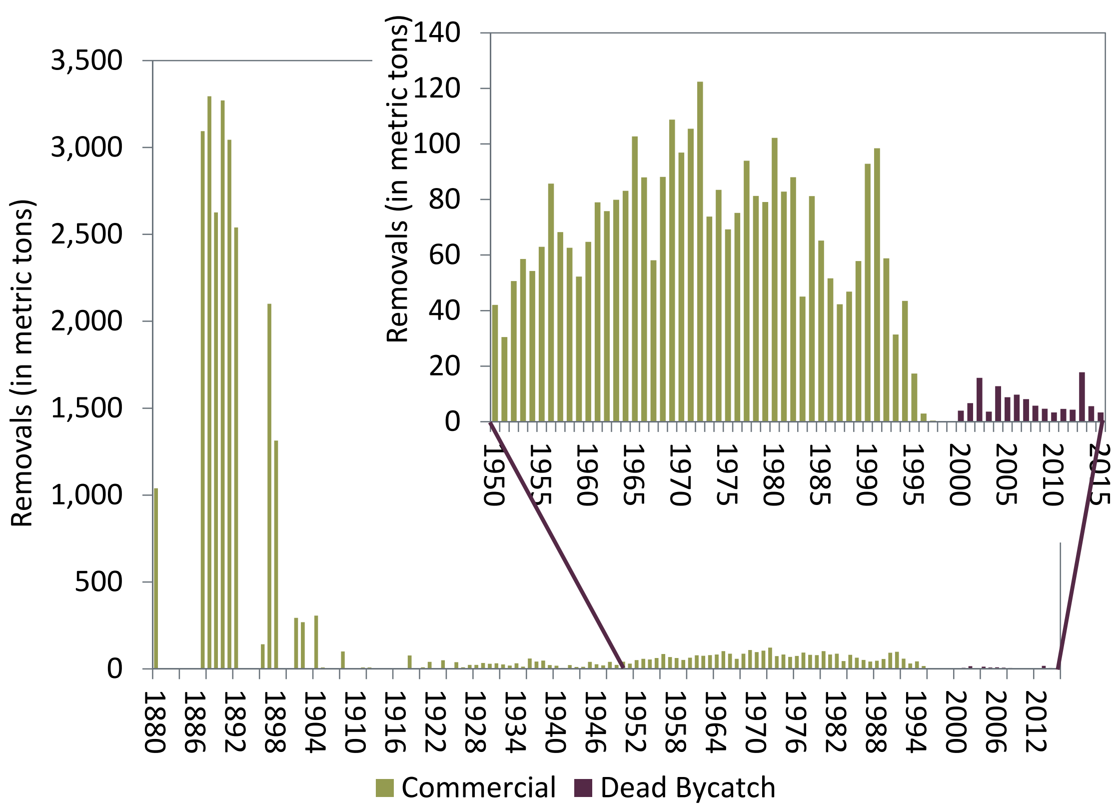
Source: ASMFC Atlantic Sturgeon Benchmark Stock Assessment, 2017

Stock status was determined via the probability that the terminal year of the indices for a given DPS was greater than the 1998 index value (or first year of the time series if after 1998) as evaluated by the ARIMA analysis, and by comparing estimates of total mortality (Z) from the tagging model to estimates of $Z_{50\%EPR}$ (that level of mortality that would result in 50% of the egg production of an unexploited population), with 80% confidence.

	Mortality Status	Biomass/Abundance Status	
Population	Probability that $Z > Z_{50\%EPR}$ 80%	Relative to Historical Levels	Average probability of terminal year of indices > 1998* value
Coastwide	7%	Depleted	95%
Gulf of Maine	74%	Depleted	51%
New York Bight	31%	Depleted	75%
Chesapeake Bay	30%	Depleted	36%
Carolina	75%	Depleted	67%
South Atlantic	40%	Depleted	Unknown (no suitable indices)

Coastwide Atlantic Sturgeon Commercial Landings and Dead Bycatch, 1880–2014. Inserted graph provides same information but for a more recent timeframe, 1950–2014.

Source: ASMFC Atlantic Sturgeon Benchmark Stock Assessment, 2017



Overview of Depleted Species

Horseshoe Crab (New York): Depleted

2019 Benchmark Stock Assessment Findings

- Stock status was based on the percentage of surveys within a region (or coastwide) having a >50% probability of the ARIMA-fitted index for the final year (i_f) being below the 1998 reference index value (i_{1998}). "Poor" status was >66% of surveys meeting this criterion, "Good" status was <33% of surveys, and "Neutral" status was 34-65% of surveys.
- With 4 of 4 surveys (100%) having a >50% probability in the New York Region, the region is considered "poor."
- The New York region's status has declined from "Good" (2009 Benchmark Assessment), to "Neutral" (2013 Assessment Update), and now to "Poor."

Survey	i_f	i_{1998}	$P(i_f<i_{1998})$
New York Region			
CT Long Island Sound Trawl - Fall	0.06	0.86	1.00
NEAMAP - Fall	1.19		
NY Jamaica Bay Seine	-0.69	0.10	0.96
NY Little Neck and Manhasset Bay Seine	0.33	1.47	1
NY Peconic Trawl	-1.65	0.38	1.00

Needed Information/Data

- Development of a population model and reference points
- Better characterization of commercial discards and resulting mortalities, as well as fishery-independent surveys and landings by fishery, sex, and life stage
- Expanded data collection and analysis of current fishery-independent surveys and implementation of new surveys that target horseshoe crabs throughout their full range
- Dedicated funding for a coastwide survey or surveys by broader geographical region

Scientific Advice Based on Assessment Findings

- The New York region shows a concerning trend of population decline, despite no biomedical use and bait harvest lower than the quota allowed by the Fishery Management Plan (quota shown in the figure is the sum of CT and NY state quotas).

Board Adherence to Scientific Advice

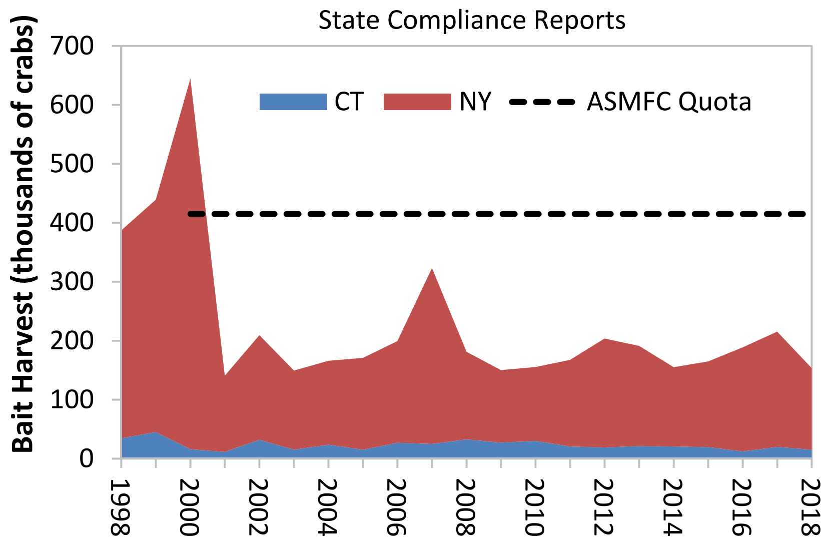
- The Board will consider a possible management response to the assessment in August.

Next Assessment: Unknown

Rebuilding Trajectory: Declining

New York Region Horseshoe Crab Bait Harvest

Source: ASMFC 2019 Benchmark Stock Assessment and State Compliance Reports



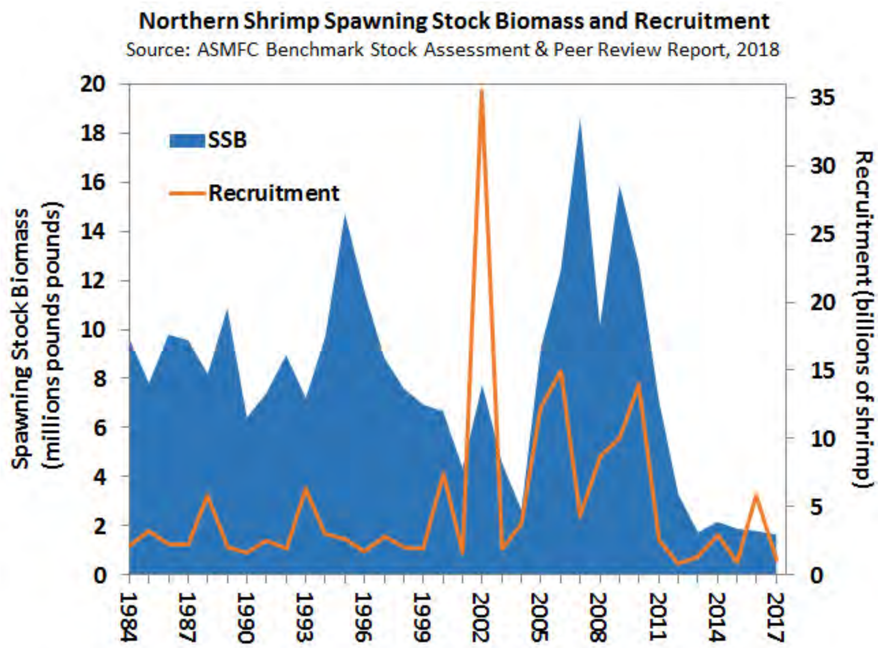
Timeline of Management Actions: FMP ('99); Addendum I ('00); Addendum II ('01); Addendum III ('04); Addendum IV ('06); Addendum V ('08); Addendum VI ('10); Addendum VII ('12)

Overview of Depleted Species

Northern Shrimp: Depleted

Assessment Findings (2018 Stock Assessment Update)

- The Technical Committee used a length-structured stock assessment model to analyze catch and landings data, survey indices of abundance and biomass, and environmental conditions, to determine the status of the stock.
- Based on the results of the 2018 Stock Assessment Update, the northern shrimp stock in the Gulf of Maine remains depleted, with spawning stock biomass at extremely low levels since 2013.
- Fishing mortality has been very low in recent years due to the moratorium.
- Recruitment failure has been observed in five of the past eight years (the 2010, 2011, 2012, 2014, and 2016 year classes), and recruitment of the 2013, 2015, and 2017 year classes was below average. Long-term trends in environmental conditions are not favorable for northern shrimp, suggesting a need to conserve spawning stock biomass to help compensate for what may continue to be an unfavorable environment.
- Low recruitment and high natural mortality hinder stock recovery.



Timeline of Management Actions: FMP ('86); Amendment 1 ('04); Amendment 2 ('11); Addendum I ('12); Amendment 3 ('17)

Scientific Advice Based on Assessment Findings

Given the continued poor condition of the resource, the poor prospects for a 2019 commercial season, and the value of maximizing spawning potential to rebuild the stock, the Technical Committee recommended extending the moratorium on fishing through 2019.

Board Adherence to Scientific Advice

- The Section has implemented a fishery moratorium since 2014. In 2018, the Section extended the moratorium until 2021.

Next Assessment: Stock Assessment Data Update in 2019

Rebuilding Trajectory: Declining

Overview of Depleted Species

River Herring: Depleted

Depleted: The coastwide meta-complex of river herring stocks on the US Atlantic coast remains depleted to near historic lows (2017 Assessment Update).

Overfishing Determination: No overfishing determination can be made at this time.

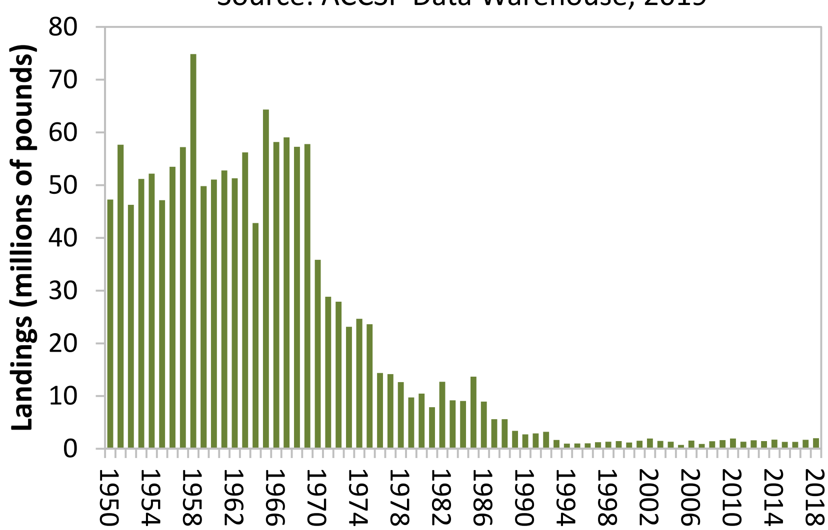
Assessment Findings (2017 Assessment Update)

- Of the 54 in-river stocks of river herring for which data were available, 16 experienced increasing trends over the ten most recent years of the Assessment Update data time series, 2 experienced decreasing trends, 8 were stable, 10 experienced no discernible trend/high variability, and 18 did not have enough data to assess recent trends, including 1 that had no returning fish.
- One of sixteen young-of-the-year seine surveys indicated a declining trend over the last ten years, two indicated increasing trends, and thirteen indicated no trend.
- For both species, mean length continues to decline; there is no significant change in trends in maximum age and mean length-at-age since the 2012 Benchmark Assessment.
- Recent domestic landings totaled <2.3 million pounds in any given year.
- Commercial landings by domestic and foreign fleets peaked at 140 million pounds in 1969.
- The "depleted" determination was used instead of "overfished" and "overfishing" because of the many factors that have contributed to the declining abundance of river herring, including habitat loss, predation, and climate changes.

Board Adherence to Scientific Advice

- In 2009, the Board approved Amendment 2, in response to concern for river herring stocks.
- The Amendment prohibits state waters commercial and recreational fisheries beginning January 1, 2012, unless a state or jurisdiction has a SFMPplan reviewed by the Technical Committee and approved by the Management Board.
- Amendment 2 required states to implement fisheries-dependent and -independent monitoring programs, and contains recommendations to conserve, restore, and protect critical river herring habitat.
- As of January 1, 2012, the Shad and River Herring Management Board approved SFMPs for Maine, New Hampshire, New York, North Carolina and South Carolina. As of March 2017, the Board approved updates to all SFMPs.

River Herring Commercial Landings
Source: ACCSP Data Warehouse, 2019



Timeline of Management Actions: FMP ('85); Amendment 1 ('95); Amendment 2 – River Herring ('09)

Next Assessment: Unknown

Rebuilding Trajectory: Unknown

Overview of Depleted Species

Abundance Trends of Select Alewife and Blueback Herring Stocks along the Atlantic Coast from the 2012 Benchmark Assessment and the 2017 Assessment Update

State	River	Benchmark Trends (2001-2010)	Updated Recent Trends (2006-2015)
NE U.S. Continental Shelf (NMFS Bottom Trawl)^		NA	Increasing[A,B]
ME	Androscoggin	Unknown[A]	Increasing[A]
	Kennebeck	Unknown[RH]	Increasing[RH]
	Sebasticook	Unknown[A]	Increasing[RH]
	Damariscotta	Stable[A]	Increasing[A]
	Union	Stable[A]	No Trend[A]
NH	Cocheco	Stable[A,B]	Increasing[A,B]
	Exeter	Unknown[A,B]	Stable[RH]
	Lamprey	Increasing[A]	Increasing[RH]
	Oyster	Stable[B]	Decreasing[RH]
	Taylor	Decreasing[B]	No Returns[RH]
	Winnicut	Unknown[A,B]	Unknown[A,B]
MA	Mattapoisett	Unknown[A]	Increasing[A]
	Monument	Unknown[A]	Increasing[A,B]
	Nemasket	Unknown[A]	Increasing[A]
	Parker	Unknown[A]	Stable[A]
	Stony Brook	Unknown[A]	Unknown[A]
RI	Buckeye	Unknown[A]	Increasing[A]
	Gilbert	Decreasing[A]	Stable[A]
	Nonquit	Decreasing[A]	Decrease[A]
CT	Bride Brook	Unknown[A]	Increasing[A]
	Connecticut	Decreasing[B]	Stable[B]
	Farmington	Unknown[A,B]	Unknown[A,B]
	Mianus	Unknown[A,B]	No Trend[A], Increasing[B]
	Mill Brook	Unknown[A]	No Trend[A]
	Naugatuck	Unknown[A,B]	Unknown[A,B]
	Shetucket	Unknown[A,B]	No Trend[A], Stable[B]
NY	Hudson	Stable[A.B]	Increasing[RH]
NJ, DE,PA	Delaware	Unknown[A,B]	No Trend[A,B]
MD, DE	Nanticoke	Decreasing[A,B]	Stable[A], No Trend[B]
VA, MD, DC	Potomac	Unknown[A,B]	Stable[A], Unknown[B]
VA	James	Unknown[A,B]	Unknown[A,B]
	Rappahannock	Unknown[A,B]	No Trend[A], Increasing[B]
	York	Unknown[A,B]	Unknown[A,B]
NC	Alligator	Unknown[A,B]	Unknown[A,B]
	Chowan	Stable[A.B]	No Trend[A], Stable[B]
	Scuppernog	Unknown[A,B]	Unknown[A,B]
SC	Santee-Cooper	Increasing[B]	No Trend[B]
FL	St. Johns River	NA	Unknown[B]

^NE shelf trends are from the spring, coastwide survey data which encounters river herring more frequently than the fall survey. A = Alewife only; B= Blueback herring only; A,B = Alewife and blueback herring by species; RH = alewife and blueback herring combined.

Overview of Depleted Species

Tautog: Depleted

Assessment Findings

2016 Stock Assessment Update

- The assessment includes data through 2015
- The LIS and NJ/NY Bight regions indicate overfishing
- LIS, NJ/NY Bight and DelMarVa regions are overfished

Scientific Advice Based on Assessment Findings

- The assessment proposed new reference points for each region (see table for stock condition and regional stock definition)

Board Adherence to Scientific Advice

- Board approved Amendment 1 in October 2017, which includes new management goals and objectives, biological reference points, fishing mortality targets, and stock rebuilding schedules. The Amendment institutes regional management and delineates the stock into four regions based on stock definition.
- The Board approved a lower harvest reduction for Long Island Sound (20.3%) than that recommended by scientific advice (the assessment recommended a 47% reduction) based on economic and data concerns.

Rebuilding Trajectory: Flat at low levels

Tautog Biological Reference Points and Stock Status by Region
Source: ASMFC Tautog Stock Assessment Update, 2016

Region	Fishing Mortality			Spawning Stock Biomass (mt)			MSY or SPR	Status
	Target	Threshold	3-Year Average	Target	Threshold	SSB_{2015}		
Massachusetts – Rhode Island	0.28	0.49	0.23	2,684	2,004	2,196	SPR	Not overfished, overfishing not occurring
Long Island Sound	0.28	0.49	0.51	2,865	2,148	1,603	MSY	Overfished, overfishing occurring
New Jersey – New York Bight	0.20	0.34	0.54	3,154	2,351	1,809	SPR	Overfished, overfishing occurring
Delaware – Maryland – Virginia	0.16	0.24	0.16	1,919	1,447	621	SPR	Overfished, overfishing not occurring

Timeline of Management Actions: FMP ('96); Addendum I ('97); Addendum II ('99); Addendum II ('02); Addenda IV & V ('07); Addendum VI ('11); Amendment 1 (’17)

Overview of Depleted Species

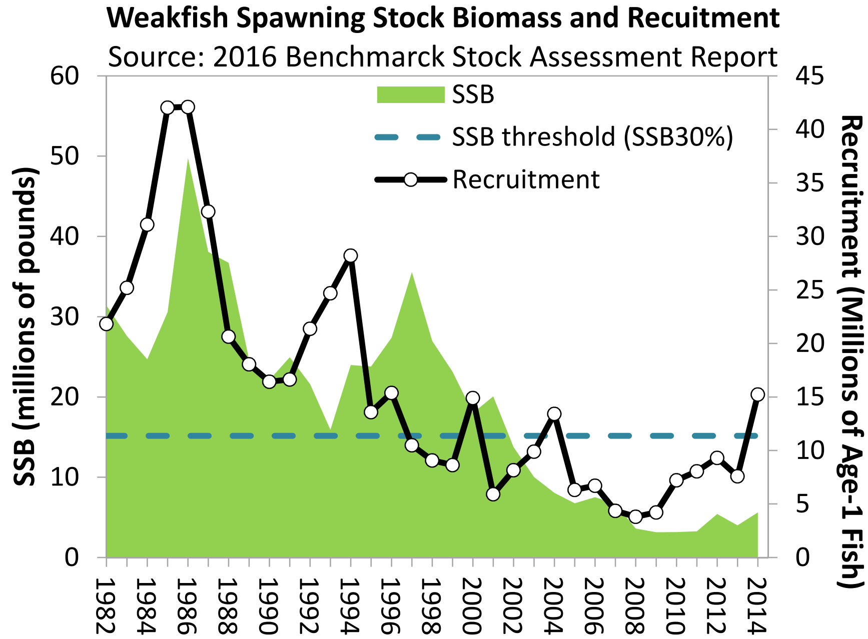
Weakfish: Depleted

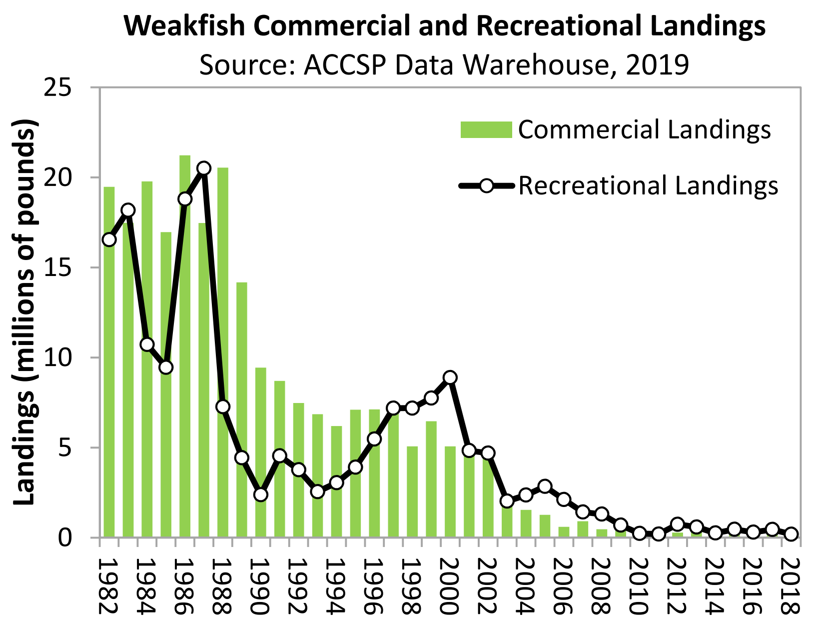
2016 Benchmark Assessment - Depleted: SSB at 37% of threshold in 2014

Overfishing Not Occurring: Total mortality (Z) in 2014 was above the threshold but below the target, indicating that Z is still high but within acceptable limits.

Assessment Findings (2016 Benchmark Assessment)

- Natural mortality (M) has increased since the mid-1990s, from approximately 0.16 in the early 1980s to an average of 0.93 from 2007-2014. Potential factors causing high M include predation, competition, and changes in the environment.
- While the assessment indicates some positive signs in the weakfish stock in the most recent years, including a slight increase in SSB and total abundance, the stock is still well below the SSB threshold.
- Weakfish landings have dramatically declined since the early 1980s, dropping from over 19 million pounds in 1982 to roughly 299,522 pounds in 2018.





Timeline of Management Actions: FMP ('85); Amendment 1 ('91); Amendment 2 (1995); Amendment 3 ('96); Amendment 4 ('02); Addendum I ('05); Addenda II & III ('07); Addendum IV ('09)

Board Adherence to Scientific Advice

- Based on results of the 2009 stock assessment and peer review, the Board approved Addendum IV, which 1) revised the biological reference points; 2) implemented a commercial trip limit, and 3) reduced the recreational bag limit, the commercial bycatch limit, and the finfish trawl fishery's allowance for undersized fish.
- Following the 2016 stock assessment, the Board maintained strict regulations on the harvest of weakfish in the commercial and recreational fishery. The Board also adopted new reference points based on SSB and Z, per the recommendation of the Technical Committee.

Next Assessment: Assessment Update in 2019

Rebuilding Trajectory: Slight increase in SSB and abundance

Overview of Depleted Species

Winter Flounder - SNE/MA: Depleted

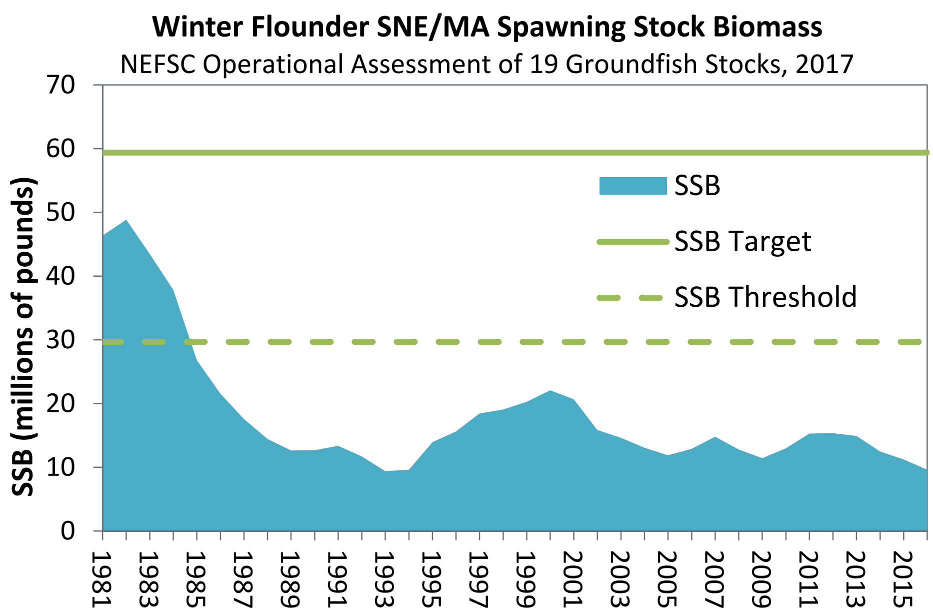
2017 Groundfish Operational Stock Assessment
Overfished:

- 2016 SSB was estimated to be 4,360 mt, which is 18% of the SSB target and 36% of the SSB threshold.
- Overall, there is a declining trend for SSB throughout the time series, with current estimates near the time series low; however, recruitment has increased since an all-time low in 2013.

Overfishing is Not Occurring:

- F in 2016 was estimated to be 0.21, which is 52% of the overfishing threshold.
- Estimates of fishing mortality have remained steady since 2012.

Board Adherence to Scientific Advice



Timeline of Management Actions: FMP & Addendum I ('92); Addendum II ('98); Amendment 1 ('05); Addendum I ('09); Addendum II ('12); Addendum III ('13)

- Stock status remains unchanged since the 2011 benchmark assessment.
- After reviewing the 2015 assessment update, the Board sent a letter to the New England Council and NOAA Fisheries expressing its concern regarding winter flounder stocks, specifically highlighting the SNE/MA stock. The Board requested the Technical Committee further investigate the impacts of the zero possession limit on the SNE/MA stock.
- In 2016, the Technical Committee presented the following report to the Board, *A Review of the SNE/MA Winter Flounder Fishery and Management Program Under Zero Possession Limits.* The Technical Committee believes the length of the moratorium (May 1, 2009-April 30, 2013) may not have been long enough to positively impact the stock. Most surveys indicate a declining trend in abundance, suggesting the moratorium did not result in increased stock size. While the Technical Committee did not recommend a reduction in the trip limits, currently set at a bycatch limit of 50 pounds, it encouraged the Board to choose management actions that continue to reduce fishing mortality and maintain a bycatch fishery in state waters.
- Following Technical Committee advice, the Board maintained a 50-pound trip limit for non-federally permitted commercial vessels for the 2017 and 2018 fishing seasons.
- For 2018, NOAA Fisheries set the state waters sub-component to 73 mt, a slight increase from the 70 mt in 2017. The total stock-wide annual catch limit was reduced to 700 mt in 2018 (from 749 mt in 2017).

Next Assessment: Unknown

Rebuilding Trajectory: Flat at low levels

Overview of Species of Unknown Stock Status

Atlantic Croaker: Unknown

2010 Stock Assessment Findings

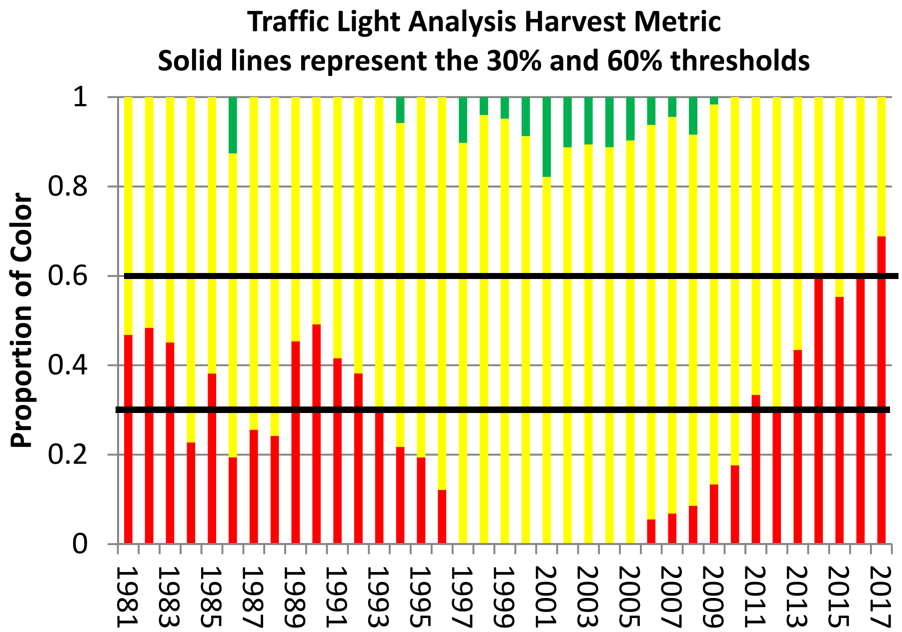
- Atlantic croaker were not experiencing overfishing. The assessment showed increasing biomass and an expanding age structure in the population since the 1980s. Atlantic croaker are considered to be a single stock on the Atlantic coast.
- Due to a high degree of uncertainty in the amount of shrimp trawl discards, the overfished status could not be determined. Similarly, values of SSB and F were not considered reliable; however, estimated trends show increasing biomass and decreasing fishing mortality.

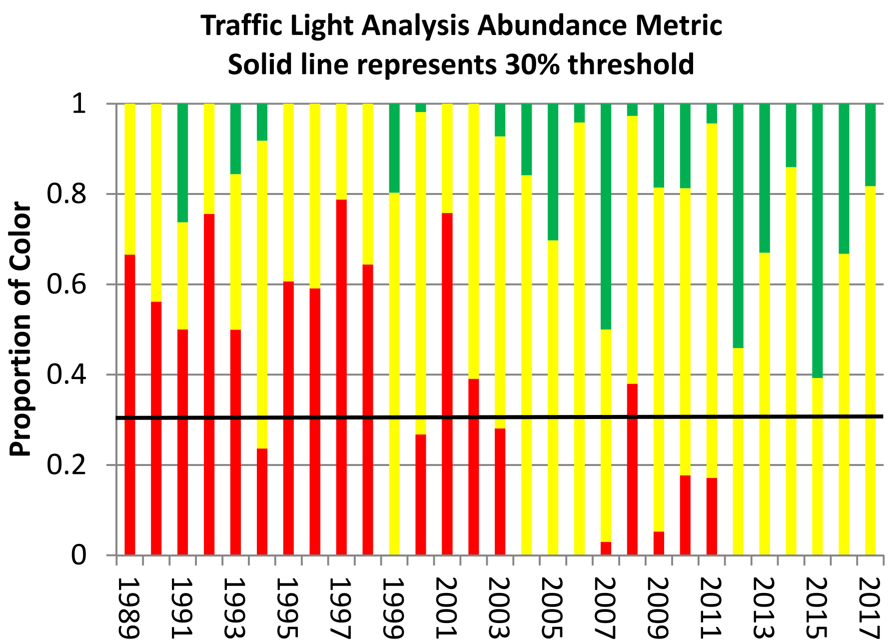
2017 Stock Assessment

- The 2017 benchmark stock assessment used a stock synthesis model to address a major source of uncertainty from previous assessments – the magnitude of croaker bycatch in South Atlantic shrimp trawls. However, due to conflicting trends in abundance and harvest, as well as other uncertainties, this assessment was not recommended for management use.

Board Adherence to Scientific Advice

- In August 2018, the PRT completed a traffic light analysis (TLA) for the 2017 fishing year. The results showed increasing trends in the fishery-independent indices, but a drop in both commercial and recreational landings. While the harvest index was above the 30% and 60% thresholds with a red proportion of 69%, management measures were not tripped since the abundance index was below the threshold at 0% red.





Management response is triggered when proportion of red exceeds the 30% threshold level (black line) for three consecutive years in both fishery characteristics (landings and fishery-independent survey indices).

Timeline of Management Actions: FMP ('87); Amendment 1 ('05); Addendum I ('11); Addendum II ('14)

Overview of Species of Unknown Stock Status

- The 2017 stock assessment was not approved for management advice, in part, due to conflicting trends in abundance and harvest, which are also seen in the TLA. The Technical Committee determined this conflict was impacted by juvenile fish being captured by purportedly adult surveys. The Technical Committee recommended several adjustments to the TLA that would allow adult abundance trends to be more apparent and agreeable with harvest trends. The South Atlantic Board initiated an addendum to incorporate these adjustments and redefine the management response at the 2019 Spring Meeting.

Scientific Advice Based on Assessment Findings

- The 2017 Peer Review Panel stressed the importance of developing valid estimates of shrimp trawl discards to improve the certainty of future assessment results. The following were also highlighted as needs for data and analysis:
    - More information on the coastwide distribution, behavior, and movement of croaker by age, length, and season, with an emphasis on collecting larger, older fish
    - Continuation of fishery independent surveys throughout the species range with subsamples for individual lengths and ages
    - Continued development of estimates of length-at-maturity and year-round reproductive dynamics throughout the species range to determine whether temporal and/or density-dependent shifts in reproductive dynamics have occurred

Monitoring and Management

- Under the TLA, if thresholds for both population characteristics (adult abundance and harvest) achieve or exceed the management threshold of 30% for the specified three year period, management action will be taken.

Rebuilding Trajectory: Unknown

Next Assessment: Unknown

Overview of Species of Unknown Stock Status

Horseshoe Crab (Northeast): Unknown

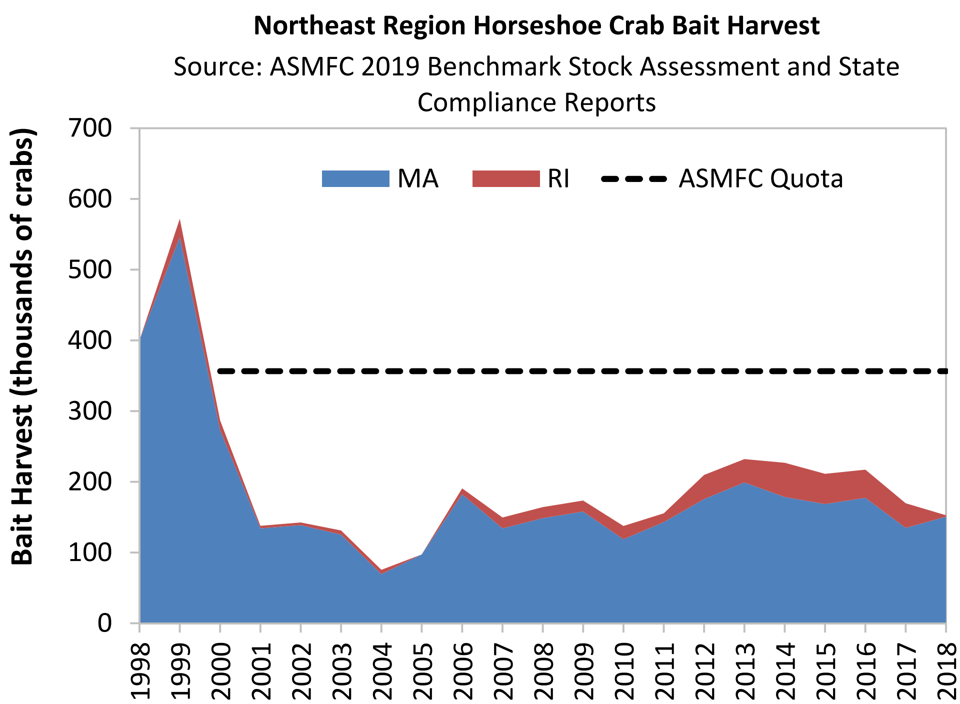
2019 Benchmark Stock Assessment Findings

- Stock status was based on the percentage of surveys within a region (or coastwide) having a >50% probability of the final year being below the ARIMA reference point. "Poor" status was >66% of surveys meeting this criterion, "Good" status was <33% of surveys, and "Neutral" status was 34-65% of surveys.
- With 1 of 2 surveys (50%) having a >50% probability in the Northeast Region, the region is considered "neutral." This may be an improvement from the previous two stock assessments, which categorized the region as "poor;" however, there is considerable uncertainty to this designation due to the conflicting signals and the limited amount of spatial coverage by the surveys modeled.
- One of the two surveys used in analysis showed an increasing trend, while the other showed a decreasing trend, so the region's stock status is unknown.

Survey	i_f	i_{1998}	$P(i_f<i_{1998})$
Northeast Region			
MA DMF Trawl – South of Cape Cod	-0.11	-1.13	0.08
RI Monthly Trawl - Fall	-1.16	-0.88	0.62

Needed Information/Data

- Development of a population model and reference points
- Better characterization of commercial discards and resulting mortalities, as well as fishery-independent surveys and landings by fishery, sex, and life stage
- Expanded data collection and analysis of current fishery-independent surveys and implementation of new surveys that target horseshoe crabs throughout their full range
- Dedicated funding for a coastwide survey or surveys by broader geographical region



Scientific Advice Based on Assessment Findings

- The Northeast population of horseshoe crab should continue to be monitored due to uncertainty of the population's status. The regional quota shown in the figure is the sum of the Massachusetts and Rhode Island state quotas.

Board Adherence to Scientific Advice

- The Board will consider a possible management response to the assessment at its next meeting in August.

Next Assessment: Unknown

Rebuilding Trajectory: Unknown

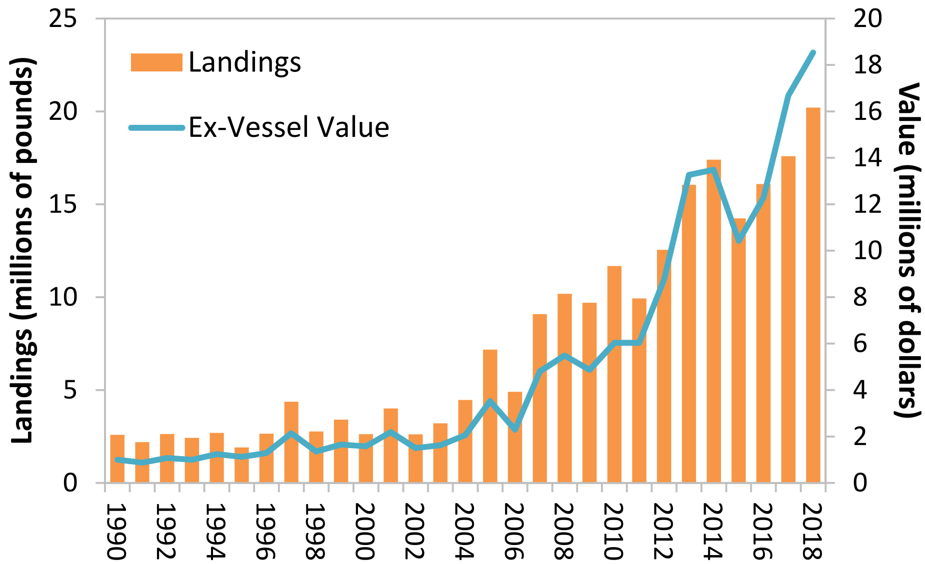
Overview of Species of Unknown Stock Status

Jonah Crab: Unknown

Available Information

- Landings have increased 6.48 fold since the early 2000s, with over 17 million pounds of crab landed in 2014. These high landings have continued with 20.2 million pounds of Jonah crab landed in 2018.
- The status of the Jonah crab resource is relatively unknown and there is currently no data on juvenile recruitment.
- Bottom trawl surveys conducted by the Massachusetts Division of Marine Fisheries found an exponential increase in Jonah crab abundance since 2010, particularly in the spring.
- The Northeast Fisheries Science Center 2014 surveys showed record high abundance in the Georges Bank and Gulf of Maine regions. The spring survey in Southern New England has been fairly stable.

Commercial Landings and Ex-Vessel Value
Source: ACCSP Data Warehouse, 2019



Timeline of Management Actions: FMP ('15); Addendum I ('16); Addendum II ('17); Addendum III ('18)

Needed Information/Data

- Conduct age-at-maturity studies in U.S. waters.
- Investigate the extent and motivation of annual migration patterns.
- Research the timing and rates of maturity at different regions along the coast.
- Determine Jonah crab growth rates, including the frequency of molting and molt increments.

Management and Monitoring Measures

- Following the recommendations of the Jonah Crab Fishery Improvement Project, the Board approved an Interstate Fishery Management Plan in August 2015 which included a 4.75" minimum size and a prohibition on the retention of egg-bearing females.
- To address concerns about bycatch in the fishery, the Board approved Addendum I in May 2016, setting a 1,000 crab limit for non-trap gear and non-lobster traps. Addendum II built upon this management measure by defining bycatch based on the composition of catch, by weight. Addendum II also established a coastwide standard for claw landings in the fishery.
- In 2018, the Board approved Addendum III, which expanded the required harvester reporting data elements, established a timeline for increased harvester reporting, and improved the spatial resolution of harvester data.

Next Assessment

No assessment is currently scheduled due to a lack of data.

Overview of Species of Unknown Stock Status

Spot: Unknown

Available Information

- Coastwide commercial landings have declined since 1950, with a high of 14.52 million pounds landed in 1952 and a low of 675,515 pounds landed in 2016.
- Recreational catches between 1981 and 2018 show a general decline, with the lowest recreational harvest (3.29 million pounds) occurring in 2018.
- Traffic Light Analysis of the 2017 fishing year showed a red proportion above the 30% threshold (37%) for the third consecutive year. 2017 adult abundance decreased significantly from 2016, but was still just below the 30% threshold at 29% red. Management measures were not tripped since the abundance index was below the threshold and has been for the last three years.
- Recruitment indices are highly variable but have shown low abundances since 2013.
- A stock assessment was completed in 2017, but no assessment has been recommended for management advice; ability to conduct a defensible assessment has been hindered by inadequate discard data, particularly in the South Atlantic shrimp trawl fishery, and difficulties caused by misclassification of juveniles in adult abundance surveys.

Board Adherence to Scientific Advice

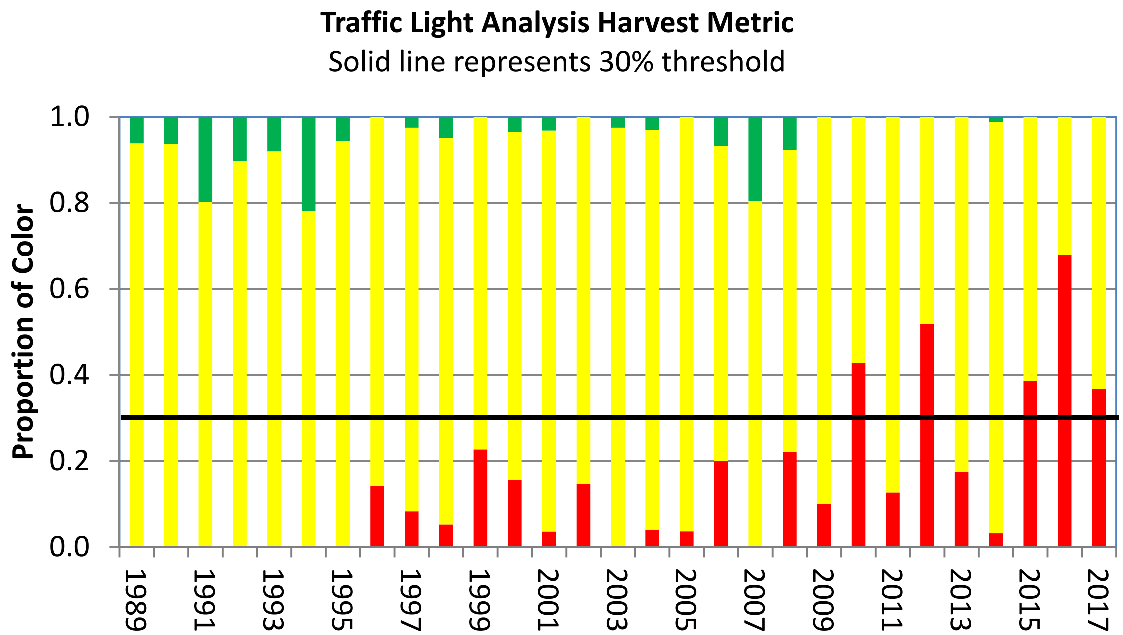
- In August 2018, the PRT completed a traffic light analysis for the 2017 fishing year. The results showed increasing trends in the fishery independent indices and an increase in both commercial and recreational landings. While the harvest index was above the 30% threshold with a red proportion of 37%, management measures were not tripped since the abundance index was below the threshold at 29%.
- The 2017 stock assessment was not approved for management advice, in part, due to conflicting trends in abundance and harvest, which are also seen in the TLA. The Spot PRT determined that this conflict was impacted by juvenile fish being captured by purportedly adult surveys. The PRT recommended several adjustments to the TLA that would allow adult abundance trends to be more apparent and agreeable with harvest trends. The South Atlantic State/Federal Fisheries Board initiated an addendum to incorporate these adjustments and redefine the management response at the 2019 Spring Meeting.

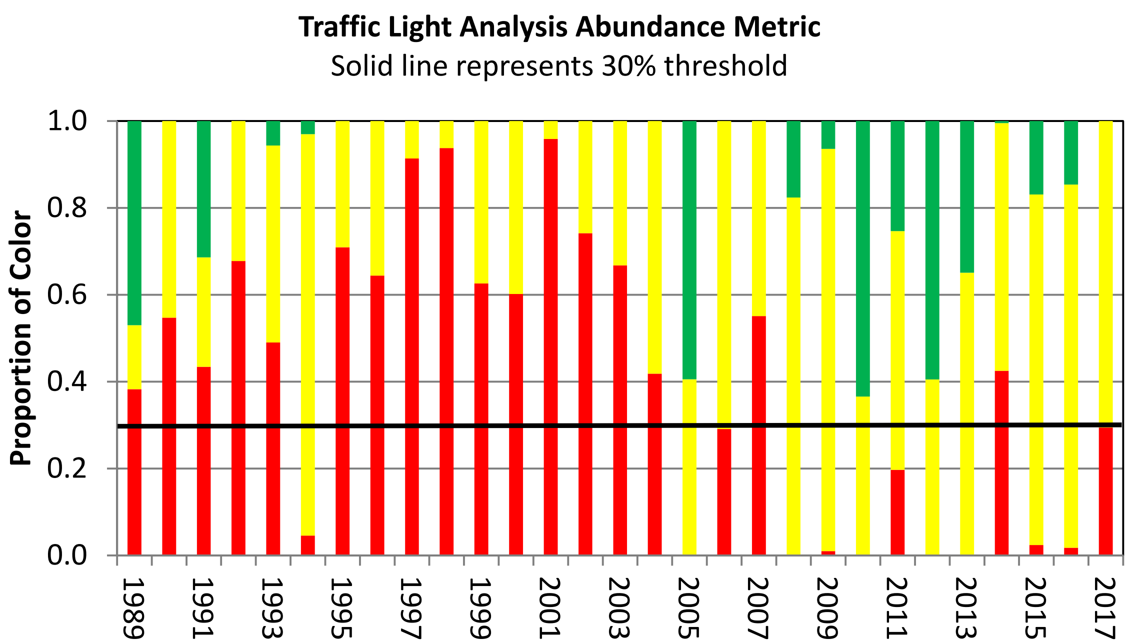
Monitoring and Management Measures

- Addendum I (2014) established the Traffic Light Analysis as the new management framework to evaluate trends in the fishery. When harvest and abundance thresholds are exceeded for two years, management actions are developed. The Traffic Light Analysis is not updated during years in which a stock assessment is being conducted.

Next Assessment: Unknown

Overview of Species of Unknown Stock Status





Management response is triggered when proportion of red exceeds the 30% threshold level (black line) for two consecutive years in both fishery characteristics (landings and fishery-independent survey indices).

Timeline of Management Actions: FMP ('87); Omnibus Amendment ('11); Addendum I ('14)

Overview of Species of Unknown Stock Status

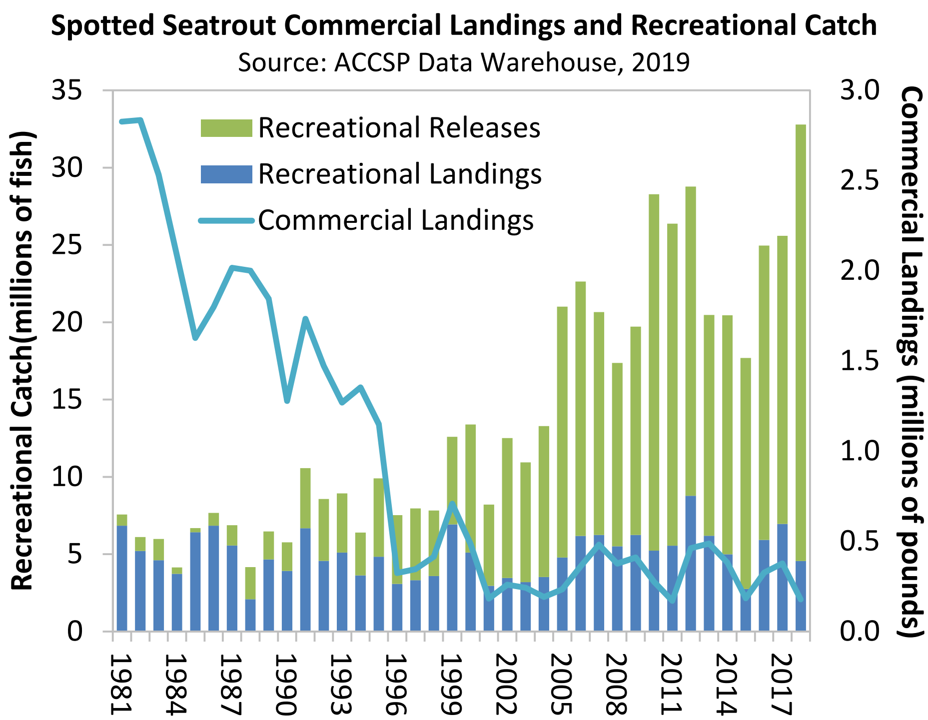
Spotted Seatrout: Unknown

Available Information

- Commercial landings have generally decreased from the 1970s through 2018, but have varied without much directional trend since 1996.
- Recreational catches have increased since 1981. However, this is due to an increase in the number of releases; harvest has remained stable.
- State stock assessments
  - NC and VA: stock assessment covering 1991-2013 indicated SPR above 20% goal; shows an expanded age structure, but a decline in recruitment after 2010
  - SC: SPR just above 20% goal in 1992; non-peer reviewed assessment through 2004 indicated SPR below 20% goal
  - GA: SPR below 20% goal in 1995
  - FL: SPR = 29% northeast region, 45% southeast regions during 2013-2015; goal of 35% SPR; overfishing not likely in either region

Needed Information/Data

- Conduct state-specific stock assessments to determine stock status relative to the plan objective of maintaining a spawning potential of at least 20%
- Collect data on the size or age of spotted seatrout released alive by anglers and the size and age of commercial discards
- Research release mortality and how this changes with factors such as season, habitat (e.g., depth, temperature, salinity), fish life history (e.g., size, age) and fishing methods (e.g., gear types)



Timeline of Management Actions: FMP (1985); Amendment 1 (1991); Omnibus Amendment (2011)

Monitoring and Management

- Amendment I sets the objective of the FMP to achieve 20% spawning potential to minimize the possibility of recruitment failure. Florida has established a 35% SPR.
- The Omnibus Amendment, approved in 2011, updated the Spotted Seatrout FMP to include at 12" TL minimum size and recommended measures to protect the spawning stock.

Next Assessment: No coastwide assessment planned or recommended by PRT due to the non-migratory nature of the species and the lack of available data.

Draft ISFMP Charter for ISFMP Policy Board Review

Atlantic States Marine Fisheries Commission

Interstate Fisheries Management Program Charter

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

August 2019

Draft ISFMP Charter for ISFMP Policy Board Review

Preface

This document outlines the standard operating procedures and policies of the Atlantic States Marine Fisheries Commission's Interstate Fisheries Management Program. It was first developed in response to passage of the Atlantic Coastal Fisheries Cooperative Management Act of 1993, which provided the Commission with responsibilities to ensure member state compliance with interstate fishery management plans. The Act authorizes the Secretary of Commerce to pre-empt any state fishery not in compliance with a Commission fishery management plan.

The Charter was first printed in April 1995 and subsequently revised in May 1996, October 2000, and November 2002. It was further edited in April 2001 (to reflect changes in the membership of the Atlantic Menhaden Management Board); July 2003 (to correct for incorrect references); January 2006 (to reflect a policy decision on voting by specific proxies); November 2008 (to reflect the addition of a habitat addendum provision); August 2009 (minor editorial changes); May 2013 (to reflect the Technical Support Group Guidance and Benchmark Stock Assessment Process Document). The revisions were adopted in February 2016 to reflect current Commission practices regarding appealing noncompliance findings; defining final actions and two-thirds majority; public hearing requirements for public information documents, FMPs, amendments and addenda; the timing of advisory panel input on proposed management actions; and clarifying regional management council participation on species management boards that manage multiple species. The last revisions were adopted in November 2017 to reflect changes in the membership on the Committee on Economics and Social Sciences.

Draft ISFMP Charter for ISFMP Policy Board Review

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Draft ISFMP Charter for ISFMP Policy Board Review

Section One. Introduction and Policy

(a) **General.** The Atlantic States Marine Fisheries Commission (Commission) was formed in 1942. The purpose of the Commission is:

....to promote the better utilization of the fisheries, marine, shell and anadromous, of the Atlantic seaboard by the development of a joint program for the promotion and protection of such fisheries, and by the prevention of the physical waste of the fisheries from any cause. It is not the purpose....to authorize the states joining herein to limit the production of fish or fish products for the purpose of establishing or fixing the price thereof or creating and perpetuating monopoly.

(b) **Interstate Fisheries Management Program.** The Commission carries out an Interstate Fisheries Management Program (ISFMP), authorized by Article IV of the Commission's Rules and Regulations.

(c) It is the policy of the Commission that its ISFMP promote the conservation of Atlantic coastal fishery resources, be based on the best scientific information available, and provide adequate opportunity for public participation.

Section Two. Role of the Commission

(a) **General**. The Commission is responsible generally for the Commission's fishery management activities. These activities will be carried out through the ISFMP established under this charter.

(b) **Final Approval Authority**. The Commission will be the final approval authority for:

(1) Any fishery management plan (FMP) and FMP amendment; and

(2) Any final determination of a state's non-compliance with the provisions of a Commission approved FMP.

Section Three. ISFMP Policy Board

(a) **Membership.** The membership on the ISFMP Policy Board shall be comprised as follows:

(1) All member states of the Commission shall be voting members, and shall be represented by all of its Commissioners (or duly appointed proxies) in attendance. The position of a state on any matter before the Policy Board shall be determined by caucus of its Commissioners in attendance;

(2) One representative from the NOAA Fisheries and one representative from the U.S. Fish and Wildlife Service shall each be a voting member;

(3) One representative from the Potomac River Fisheries Commission and one representative from the government of the District of Columbia shall each be a member, eligible to vote, on any matter which may impose a regulatory requirement upon their respective jurisdictions; and

(4) One representative of the Commission's Law Enforcement Committee shall be a non-voting member.

(b) **Proxies**. Any Commissioner from a state, or duly authorized representative of a jurisdiction or agency, that is a member of the Policy Board may designate a permanent, ongoing, board or meeting specific proxy. A change in the designation of a permanent or ongoing proxy may be made only once during the year. In the case of extenuating circumstances, a Commissioner may appoint specific proxies as needed to ensure representation. Proxies must be from the same state, jurisdiction, or agency as the individual making the designation. The Commission's code of conduct shall apply to all proxies. Only an individual who is serving as a permanent or ongoing proxy may further designate a specific proxy.

(c) The **Chair and Vice-Chair** of the Commission shall respectively be the Chair and Vice-Chair of the ISFMP Policy Board.

(d) **Role and Functions**. The ISFMP Policy Board will be responsible for the overall administration and management of the Commission's fishery management programs. In this regard it will:

(1) Interpret and give guidance concerning the standards and procedures contained in Sections Six and Seven, and generally provide Commission policy governing the preparation and implementation of cooperative inter-jurisdictional fishery management for coastal fisheries of the Atlantic coast;

(2) Establish the priority species to be addressed by the Commission's fishery management program, taking into account the following criteria:

(i) The species constitutes a "coastal fishery resource" as defined in Section 803(2) of the Act;

(ii) The degree to which the species is of importance along the Atlantic coast; and

(iii) The probability that the species and associated fisheries will benefit from cooperative inter-jurisdictional management.

(3) Establish management boards/sections described in Section Four;

(4) Review and approve declarations of interest in species management by states according to the standards contained in the Commission Rules and Regulations;

(5) Monitor and review the implementation of FMPs for which no management board or section is currently operational;

(6) Review and approve action plans, including priorities for activities, for the ISFMP;

(7) Establish, for any matter that does not come under the purview of an existing management board or section, a committee to provide it with any relevant analysis, reviews, and recommendations;

(8) Recommend to the Commission that it make a determination of a state's non-compliance with the provisions of a Commission approved FMP, according to the procedures contained in Section Seven;

(9) Consider and decide upon appeals of states to actions of any management board or section under Section Four(h); and

(10) Take any other action that is consistent with this Charter and that is necessary and appropriate to carry out the fishery management program of the Commission; except that a final determination of a state's non-compliance with the provisions of a Commission-approved plan must be made by the Commission.

Section Four. Management Boards

(a) **Fishery Management Board**. Upon determining that a need exists in a fishery for the development of an FMP or amendment, the ISFMP Policy Board shall establish a management board for that fishery. A management board may be disbanded by the Policy Board upon a determination that it is no longer needed for the preparation, review, or ongoing monitoring of the implementation of an FMP or amendment.

(b) **Management Board Membership**. The voting membership of each management board shall be comprised as follows:

(1) Each state with an interest in the fishery covered by the management board shall be a voting member, and shall be represented by all of its Commissioners (or duly appointed proxies) in attendance. The position of a state on any matter before the management board shall be determined by caucus of its Commissioners in attendance;

(2) A representative from the Potomac River Fisheries Commission and the District of Columbia may each elect to serve as a voting member on any management board in which they have an interest or which may result in the imposition of regulatory requirements on their jurisdictions;

(3) NOAA Fisheries and the U.S. Fish and Wildlife Service may each elect to serve as a voting member of any management board; and

(4) Any one of the Executive Directors/Chairs of the Regional Fishery Management Councils may be invited to be a voting member of an ISFMP species management board when the management board determines that such membership would advance the inter-jurisdictional management of the specific species. When the management area includes more than one Council, the applicable Councils will need to identify one Executive Director/Chair to receive the invitation to participate on that board as a voting member. If a Council has been invited as a voting member of a Board/Section that manages multiple species, the Board/Section will designate which species can be discussed and voted on by the Council representative. A council staff member or member of the council may be appointed as a proxy for the Executive Director or Council Chair.

(c) **Proxies**. Any Commissioner from a state, or duly authorized representative of a jurisdiction or agency, that is a member of a management board may designate a permanent, ongoing, board specific or meeting specific proxy. A change in the designation of a permanent or ongoing proxy may be made only once during the year. In addition, a Commissioner may appoint specific proxies as needed to ensure representation. Proxies must be from the same state or jurisdiction or agency as the individual making the designation. The Commission's code of conduct shall apply to all proxies. Only an individual who is serving as a permanent or ongoing proxy may further designate a specific proxy.

(d) **Conduct of Meetings**.

(1) Meetings will generally be run according to the current edition of "Robert's Rules of Order."

(2) Any Commissioner or proxy of a Commissioner or duly authorized representative of a jurisdiction or agency that is a member of a management board may make or second any motion; provided that the maker of the motion and second (when necessary) must each come from a different state, jurisdiction, or agency.

(3) Any meeting specific proxy appointed by a Legislative or Governor's Appointee Commissioner may not vote on a final action being considered by a board, section, or committee. For this section a final action will be defined as: setting fishery specifications (including but not limited to quotas, trip limits, possession limits, size limits, seasons, area closures, gear requirements), allocation, final approval of FMPs/amendments/ addenda, emergency actions, conservation equivalency plans, and non-compliance recommendations. A meeting specific proxy may participate in the deliberations of the meeting, including making and seconding motions. Meeting specific proxies may vote on preliminary decisions such as issues to be included in a public hearing draft or approval of public information documents. Questions of procedure will be determined by the chair of the meeting upon the advice of the Executive Director or the senior Commission employee in attendance.

(4) Advisory Panel Chairs will only be reimbursed to attend Commission meetings if the advisory panel met between board/section meetings to provide feedback on an issue.

(e) **Functions**.

(1) Each management board shall be responsible for the development of an FMP, amendment, or addendum with respect to the fisheries under its jurisdiction as established by the ISFMP Policy Board.

(2) Management boards/sections shall solicit public participation during the development of FMPs, amendments, or addenda.

(3) A management board may, after the necessary FMP, amendment, or addendum has been approved, continue to monitor the implementation, enforcement, and effectiveness of the FMP, amendment, or addendum or take other actions specified in the applicable document that are necessary to ensure its full and effective implementation.

(4) Each management board shall select its own chair and vice-chair. The chair of management boards/sections will rotate among the voting members every two years, with the vice-chair acceding to the chair.

(f) **Sections under Amendment One**. Under Amendment One to the Compact creating the Commission, one or more states may agree to designate the Commission as a joint regulatory agency; Commissioners of these states shall constitute a separate section for these purposes. In any such instance the following procedures apply:

(1) Agreements among states under Amendment One shall be in writing, and open to participation by all states with an interest in any fishery to which the agreement applies;

(2) All Commissioners from states forming a section under Amendment One shall be members of the section; and

(3) Regulatory authority exercised by the Commission under Amendment One shall be carried out pursuant to an FMP prepared according to this Charter. For these purposes, including determinations of non-compliance under Section Seven, a section shall have the same authority and responsibility as set forth in this Charter for a management board.

(g) **Coordination with Regional Fishery Management Councils**. Each management board shall work with appropriate committees of the Regional Fishery Management Councils and appropriate federal officials to insure that state and federal fishery management programs are coordinated, consistent, and complementary. It will be the policy of the Commission to develop FMPs jointly with Regional Fishery Management Councils wherever applicable

(h) **Appeal Opportunity**. Any state that is aggrieved by an action of the management board may appeal that action to the Policy Board, with the exception of a non-compliance finding in accordance with Section Three (d)(9).

Draft ISFMP Charter for ISFMP Policy Board Review

Section Five. Staff, Management, Technical, and Advisory Support

(a) **Staff Support**. The Commission's Executive Director or the ISFMP Director shall serve ex-officio as non-voting members of all management boards and sections. Commission staff shall serve as ex-officio members of all technical committees and will chair the plan development teams (PDTs) and plan review teams (PRTs). Staff will provide liaison among the PDTs, PRTs, species stock assessment subcommittees, technical committees, and advisory panels and the management boards/sections. Commission staff will also provide liaison among the Committee on Economics and Social Sciences, the Assessment Science, Habitat, Artificial Reef, Law Enforcement, and Management and Science Committees and the management boards/sections, and the Policy Board.

ISFMP and Science Program staffs have specific responsibilities with respect to supporting the activities of the technical support groups. These responsibilities are detailed in the *Technical Support Group Guidance and Benchmark Stock Assessment Process* (approved February 2016).

(b) **Committee Organization**. Unless otherwise specified, each group included in this section shall elect its own chair and chair-elect (or vice-chair), which shall rotate every other year among the Committee members, with the chair-elect acceding to the chair. Committees shall maintain a record of their meetings compiled by the chair-elect (vice-chair) in consultation with the chair and Commission staff.

(c) **PDTs** shall be appointed by the management boards/sections to draft FMPs, amendments and addenda.

> (1) PDTs shall be comprised of personnel from state and federal agencies who have scientific and management ability, knowledge of a species and its habitat, and an interest in the management of a species under the jurisdiction of the relevant management board. Personnel from Regional Fishery Management Councils, academicians, and others as appropriate may be included on a PDT. The size of the PDT shall be based on specific need for expertise but shall generally be kept to a maximum of six persons.
>
> (2) It shall be the responsibility of a PDT to prepare all documentation necessary for the development of an FMP, amendment, or addendum using the best scientific information available and the most current stock assessment information. Each FMP, amendment, or addendum shall be developed by the PDT in conformance with Section Six of the ISFMP Charter.
>
> (3) PDTs shall be tasked directly by the management boards/sections. In carrying out its activities, the PDT shall seek advisement from the appropriate technical committee, stock assessment subcommittee, advisory panel, Committee on Economics and Social Sciences, and the Assessment Science, Habitat, Artificial Reef and Law Enforcement Committees, where appropriate.
>
> (4) Following completion of its charge, the PDT will be disbanded unless otherwise

determined by the board/section.

(d) **PRT** shall be appointed by the management boards/sections to review regulations and compliance. Members should be knowledgeable concerning the scientific data, stock and fishery condition, and fishery management issues. The PRT shall generally be kept to a maximum of six persons.

(1) PRTs will be responsible for providing advice concerning the implementation, review, monitoring, and enforcement of FMPs that have been adopted by the Commission, and as needed be charged by the management board/sections.

(2) Each PRT shall at least annually or as provided in a given FMP, conduct a review of the stock status and Commission member states' compliance for which implementation requirements are defined in the FMP. The PRT shall develop an annual plan review in order to evaluate the adequacy of the FMP. This report will address, at a minimum, the following topics: adequacy and achievement of the FMP goals and objectives (including targets and schedules), status of the stocks, status of the fisheries, status of state implementation and enforcement, status of the habitat, research activities, and other information relevant to the FMP. The PRT shall report all findings in writing to the management board/section for appropriate action. Compliance review shall be consistent with the requirements of Sections Six and Seven of the ISFMP Charter and the respective FMP requirements. In addition to the scheduled compliance reviews, the PRT may conduct a review of the implementation and compliance of the FMP at any time at the request of the management board/section, Policy Board, or the Commission. When a plan amendment process is initiated by the management boards/sections, the PRT will continue its annual review function applicable to the existing plan.

(3) In carrying out its activities, the PRT shall seek advisement from the appropriate technical committee, stock assessment subcommittee, advisory panel, Committee on Economics and Social Sciences, and the Assessment Science, Habitat, Artificial Reef Law Enforcement, and Management and Science Committees.

(e) **Assessment Science Committee**. The Assessment Science Committee (ASC) shall be appointed by the ISFMP Policy Board. All agencies should nominate individuals for appointment to the ASC based on stock assessment and population dynamics expertise. Agencies may nominate personnel that require some training prior to official appointment as a committee member. The ISFMP Policy Board should review all nominations and appoint members to the ASC based on expertise, as opposed to agency representation. The ISFMP Policy Board may appoint a limited number of ASC members that are currently being trained in stock assessment methods, with the intent of formalizing the appointment upon completion of training. ASC membership should be kept to a maximum of 25 members and periodic rotation of membership should be considered.

(1) ASC will assist the ISFMP Policy Board in setting overall priorities and timelines for conducting all Commission stock assessments in relation to current workloads.

(2) ASC will provide guidance to species stock assessment subcommittees, technical

committees, and management boards on broad technical issues (e.g., stock assessment methods, biological reference points, sampling targets, and other assessment issues common to multiple Commission-managed species).

(3) ASC may provide input and advice to the species stock assessment subcommittees mainly during a benchmark assessment, when a model change and/or a major revision of the data are conducted. The species stock assessment subcommittee will be responsible for conducting the species assessment and will report directly to the species technical committee. ASC may provide overall guidance to the development of the species assessment, but will not be involved in peer review of the assessment. Assessment updates will be conducted by the species stock assessment subcommittee, with input from the ASC upon written request.

(f) **Technical Committees**. A management board/section may appoint a technical committee to address specific technical or scientific needs requested periodically by the respective management board/section, PDT, PRT, or the Management and Science Committee.

(1) A technical committee shall be comprised of state, federal, Regional Fishery Management Council, Commission, university or other specialized personnel with scientific and technical expertise and knowledge of the fishery or issues pertaining to the fishery being managed, and should consist of only one representative from each state or agency with a declared interest in the fishery, unless otherwise required or directed by the management board.

(2) Technical committees are responsible for addressing specific technical or scientific needs requested periodically by the respective management board/section, PDT, PRT, or the Management and Science Committee. At times the board/section may task the technical committee to provide a technical analysis of species advisory panel recommendations. All requests to the technical committee should be in writing from the board/section chair and should include all specific tasks, the deliverable expected, and a timeline for presentation of recommendations to the board/section. Even though the technical committee may respond to requests from multiple committees, the management board/section provides the oversight to technical committee tasks and priorities. When tasked by multiple committees, it is the responsibility of the ISFMP staff in consultation with the technical committee and management board/section chairs to prioritize these tasks.

(3) It shall be the responsibility of a technical committee for addressing specific technical or scientific needs requested by the respective management board/section, PDT, and PRT in the development and monitoring of an FMP or amendment as requested, including evaluating fishery-dependent and fishery-independent data, evaluating state monitoring programs, and providing information on the status of the stock and the fishery to the PDT and PRT. At times the board/section may task the technical committee to provide a technical analysis of an advisory panel recommendation.

(4) Among its duties, the technical committee shall provide a range of management options, risk assessments, justifications, and probable outcomes of various management options.

(5) The technical committee will coordinate the process of developing stock assessments for Commission-managed species.

(6) It is not the responsibility of the technical committee to conduct a review of the Commission member states' compliance for which implementation requirements are defined in the FMP. This is a responsibility of the PRTs.

(g) **Species Stock Assessment Subcommittees**. Upon the request of a management board/section, the technical committee shall appoint individuals with appropriate expertise in stock assessment and fish population dynamics to a species stock assessment subcommittee, which will report to the technical committee and shall continue in existence so long as the management board/section requires.

(1) Membership to a species stock assessment subcommittee will be comprised of technical committee members with appropriate knowledge and experience in stock assessment and biology of the species being assessed. Individuals from outside the technical committee with expertise in stock assessment or biology of the species may also be nominated and appointed, if necessary. The technical committee chair will serve as an ex-officio member of the species stock assessment subcommittee. Overall membership should be kept to a maximum of six persons, unless otherwise required and directed by the management board/section.

(2) The species stock assessment subcommittee is responsible for conducting a stock assessment for use by the PDT in formulation of an FMP, amendment, or addendum; and conducting periodic stock assessments as requested for use by the technical committee in reporting status of the stock to the respective management board. A stock assessment update consists of adding the most recent years of data to an existing, peer-reviewed, and board-accepted stock assessment model without changing the model type or structure.

(3) The species stock assessment subcommittee is responsible for data analysis and preparation of a stock assessment report. Initial input on available data and stock assessment methods may be provided by ASC and technical committee. Additional input may be requested of the ASC upon written request of the species stock assessment subcommittee. The species stock assessment subcommittee shall use the best scientific information available and established stock assessment techniques. Stock assessment techniques should be consistent with the current state of scientific knowledge.

(4) The species stock assessment subcommittee will be tasked directly by the technical committee and will report to the technical committee for review and approval of work. All subcommittee recommendations and documents must be approved by the technical committee and forwarded by the technical committee to the management board/section. Any substantive issues and concerns raised by the technical committee during the

approval process should be referred back to the species stock assessment subcommittee to be addressed.

(h) **Other Technical Support Subcommittees** (e.g., tagging, stocking – with the exception of ISFMP socioeconomic subcommittees). Upon the approval of a management board/section, the technical committee shall appoint individuals with special expertise, as appropriate, to other technical support subcommittees in order to support technical committee deliberations on specific issues. All technical support subcommittees shall report to the technical committee and shall continue in existence so long as the management board/section requires. All technical support subcommittees should elect their own chair and vice-chair, who will be responsible for reporting to the technical committee. Overall membership should be kept to a maximum of six persons.

(1) Special subcommittees may be required to address specific scientific issues important to the assessment and management of the species. These subcommittees will be tasked directly by the technical committee and will report to the technical committee for review and approval of work. All subcommittee recommendations and documents must be approved by the technical committee before being forwarded to the management board/section. Any substantive issues and concerns raised by the technical committee during the approval process should be referred back to the technical support subcommittee to be addressed.

(i) **Advisory Panels**. A management board/section may at any time establish an advisory panel in conformance with the Commission's Advisory Committee Charter, to assist in carrying out the board's/section's responsibilities. Advisory panels shall also work with PDTs and PRTs, as requested. Advisory panel chairs should present reports to Boards/Sections and answer any specific questions relevant to their report. Chairs may not ask questions or present their own viewpoints during Board/Section deliberations. If the chair would like to present their own viewpoints, they must go to the public microphone during the public comment portion of the meeting.

(j) **Habitat Committee**. The Habitat Committee is a standing Commission committee appointed at the discretion of the Chair of the Commission. The purpose of the Habitat Committee is to review, research, and develop appropriate response to concerns of inadequate, damaged or insufficient habitat for Atlantic coastal species of concern to the Commission. Among its duties for the Commission, the Habitat Committee shall:

(1) Serve as a consultant to the ISFMP regarding habitat on which the species of concern to the Commission are dependent, whether salt, brackish or freshwater;

(2) Provide comment on the habitat sections of FMPs, and provide suggested text for these sections;

(3) Propose habitat mitigation measures, comment on proposed habitat mitigation measures, and proposed alternate measures if necessary to ensure appropriate habitat conservation;

(4) Establish subcommittees or other work groups as are necessary to research various habitat related issues; and

(5) Formulate habitat specific goals for consideration of and adoption by the Commission.

(k) Artificial Reef Committee. The Artificial Reef Committee is a standing Commission committee appointed at the discretion of the Commission Chair. The Committee advises the ISFMP Policy Board with the goal of enhancing marine habitat for fish and invertebrate species through the appropriate use of man-made materials. The Committee is comprised of the state artificial reef coordinators, representatives from NOAA Fisheries, and the U.S. Fish and Wildlife Service. The Artificial Reef Committee works in close coordination with Habitat Committee, and reports to the ISFMP Policy Board.

(l) Law Enforcement Committee. The Law Enforcement Committee (LEC) is a standing committee appointed by the Commission. LEC carries out assignments at the specific request of the Commission, the ISFMP Policy Board, the management boards/sections, the PDTs, and the PRTs. In general, the Committee provides information on law enforcement issues, brings resolutions addressing enforcement concerns before the Commission, coordinates enforcement efforts among states, exchanges data, identifies potential enforcement problems, and monitors enforcement of measures incorporated into the various interstate fishery management plans. LEC is comprised of law enforcement representatives from each member state, the U. S. Fish and Wildlife Service, NOAA Fisheries, the U. S. Coast Guard, and US Department of Justice. LEC convenes a working meeting in the spring, meets in conjunction with the Commission's Annual Meeting, and convenes other meetings as needed. Among its ISFMP duties, the LEC shall:

(1) Provide advice to PDTs regarding the enforceability of measures contemplated for inclusion in FMPs, including enforcement information needed for the Source Document and Background Summary pursuant to Section Six (b)(1)(v)(E); analysis of the enforceability of the proposed measures; and if the FMP provides for conservation equivalency, enforcement procedures for alternative management measures;

(2) Provide advice to each PRT at least annually or as provided in a given FMP regarding the adequacy and effectiveness of states' enforcement of the measures implemented pursuant to the FMP;

(3) Coordinate, among law enforcement personnel, the preparation of reports concerning state law enforcement and compliance in order to ensure these analyses are comparable; and

(4) Upon request or on its own initiative, provide enforcement advice and information regarding any FMP to any committee, team, board/section, or advisory panel in order to carry out activities under this Section.

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(m) **Management and Science Committee**. The Management and Science Committee (MSC) is a standing committee appointed by the Commission. MSC carries out assignments at the specific request of the Commission, Executive Committee, or the ISFMP Policy Board, and generally provides advice to these bodies concerning fisheries management and the science of coastal marine fisheries. MSC is comprised of one representative from each member state, the NOAA Fisheries Greater Atlantic and Southeast Regional Offices, and the U.S. Fish and Wildlife Service's Regions 4 and 5 who possess scientific as well as management and administrative expertise. Among its duties for the Commission, MSC shall:

(1) Serve as the senior review body of the Commission, Executive Committee, and ISFMP Policy Board;

(2) Provide oversight to the Commission's Stock Assessment Peer Review Process;

(3) Upon request of the ISFMP Policy Board for any management board/section, review and provide advice on species specific issues;

(4) Evaluate the state of the science of species interactions and provide guidance to fisheries managers on multispecies and ecosystem issues. Evaluations and/or recommendations should focus on modifying the single-species approach in development of Commission FMPs and/or stock assessments;

(5) Evaluate and provide advice on cross-species issues and including, but not limited to tagging, invasive species and exotics, fish health and protected species issues; and

(6) Coordinate Commission technical and scientific workshops and seminars, when requested.

(n) **Committee on Economics and Social Sciences**. The Committee on Economics and Social Sciences (CESS) is a standing Commission committee appointed at the discretion of the Chair of the Commission. Committee membership should consist of a balance of economists and other social scientists knowledgeable about fisheries issues in their regions, preferably distributed geographically to provide coastwide representation. Members can be nominated in two ways: (1) by member states and (2) through a widespread solicitation issued by Commission staff. Membership can consist of up to twenty individuals.

The purpose of CESS is to provide socioeconomic technical oversight for both the ISFMP and the Atlantic Coastal Cooperative Statistics Program. Among its duties for the Commission, CESS shall:

(1) Develop and implement mechanisms to make economic and social science analysis a functioning part of the Commission's decision making process;

(2) Nominate economists and social scientists to serve on each species technical committee or socioeconomic subcommittee, and PDT, in order to provide technical support and development of socioeconomic sections of FMPs (including amendments and addenda);

(3) Upon request by species management boards or the Policy Board, provide social and economic advice, information, and policy recommendations to these respective boards;

(4) Upon request by the Policy Board, provide social and economic advice, information, and policy recommendations to the Policy Board;

(5) Provide technical recommendations to the social and economic data collection and data management programs of the Atlantic Coastal Cooperative Statistics Program;

(6) Function as the technical review panel for social and economic analyses conducted by the Commission and the Atlantic Coastal Cooperative Statistics Program; and

(7) Establish CESS subcommittees or other work groups as are necessary to research various social and economic issues;

(o) **Other ASMFC Committees**. Other Commission committees, as appointed, shall upon request or on their own initiative provide advice and information to any other committee, in order to carry out activities under this Section.

Section Six. Standards and Procedures for Interstate Fishery Management Plans

(a) **Standards**. These standards are adopted pursuant to Section 805 of the Atlantic Coastal Fisheries Cooperative Management Act (P.L. 103-206), and serve as the guiding principles for the conservation and management programs set forth in the Commission's FMPs. The Commission recognizes that an effective fishery management program must be carefully designed in order to fully reflect the varying values and other considerations that are important to the various interest groups involved in coastal fisheries. Social and economic impacts and benefits must be taken into account. Management measures should focus on conservation while allowing states to make allocation decisions. Fishery management programs must be practically enforceable, including as much as possible the support of those being regulated, in order to be effective. Above all, an FMP must include conservation and management measures that ensure the long-term biological health and productivity of fishery resources under management. To this end, the Commission has adopted the following standards:

(1) Conservation programs and management measures shall be designed to prevent overfishing and maintain over time, abundant, self-sustaining stocks of coastal fishery resources. In cases where stocks have become depleted as a result of overfishing and/or other causes, such programs shall be designed to rebuild, restore, and subsequently maintain such stocks so as to assure their sustained availability in fishable abundance on a long-term basis.

(2) Conservation programs and management measures shall be based on the best scientific information available.

(3) Conservation programs and management measures shall be designed to achieve equivalent management results throughout the range of a stock or subgroups of that stock.

(4) Management measures shall be designed to minimize waste of fishery resources.

(5) Conservation programs and management measures shall be designed to protect fish habitats.

(6) Development and implementation of FMPs shall provide for public participation and comment, including public hearings when requested by the states.

(7) Fairness & equity.

(i) An FMP should allow internal flexibility within states to achieve its objectives while implemented and administered by the states; and

(ii) Fishery resources shall be fairly and equitably allocated or assigned among the states.

(b) **Contents**. An FMP should be a readily available, concise, and understandable document. It is designed to inform the Commission and the public of the need for and nature of management action, to provide for conservation of coastal fisheries, to allow the public to have effective participation in the management planning process, and to help Commissioners to make decisions on fishery management plans. Additionally, the FMP should facilitate implementation and enforcement of the fishery management program in the individual states. With this in mind, all FMPs of the Commission shall contain the following items:

(1) Management Program Elements:

(i) A statement of the problem being addressed by the FMP, and the objectives to be achieved through implementation, including the social and economic impacts.

(ii) The goals and objectives of the FMP, including a specification of the management unit, a plan-specific definition of overfishing when available, and, if a stock is determined to be depleted/overfished as a result of overfishing and/or other causes, a specific rebuilding program and schedule for the resource.

(iii) A statement of management strategies, options, and alternatives.

(iv) A complete statement of the management measures needed to conserve the fishery, including:

(A) A detailed statement on a state-by-state basis of each specific regulatory, monitoring, and research requirement that each state must implement in order to be in compliance with the plan; provided that the relative burden of the plan's conservation program and management measures may vary from state to state relative to the importance of the fishery in that state as compared to its importance in other states throughout its range; and provided that each FMP shall address the extent to which states meeting *de minimis* criteria may be exempted from specific management requirements of the FMP to the extent that action by the particular states to implement and enforce the plan is not necessary for attainment of the FMP's objectives and the conservation of the fishery;

(B) If the FMP so provides, procedures under which the states may implement and enforce alternative management measures that achieve conservation equivalency;

(C) A complete schedule by which states must take particular actions in order to be in compliance with the plan;

(D) A specification of the requirements for states' reports on compliance to be submitted to the PRT at least annually or as provided in a given FMP, including the requirement for submission within a specified time line of copies of relevant laws and regulations for the record; and

(E) A detailed description of penalties and repayments that will result if a state/jurisdiction does not implement any management measure consistent with the compliance schedule established in an FMP, amendment, or addendum.

(F) A statement of the minimum notification time that the Commission must provide a state/jurisdiction prior to requiring an in-season management adjustment; and establishment of a reporting and tracking system for management changes

(G) A statement of those recommendations which states should implement in order to conserve fishery resources.

(v) Supporting Summary Information and Analyses:

(A) A review of the resource and its biological status;

(B) A review and status of fish habitat important to the stocks, and ecosystem considerations;

(C) A review of the fishery and its status, including commercial and recreational fisheries and non-consumptive considerations;

(D) A review of the social and economic characteristics of the fishery; and

(E) An analysis of the enforceability of the proposed measures.

(vi) Impacts: A summary evaluation of the biological, environmental, social, and economic impacts of the requirements and recommendations included in the FMP.

(vii) Source Document: In addition to the FMP, the PDT and the staff shall compile a Source Document that contains all of the scientific, management, and other analyses and references utilized in preparation of the FMP.

(2) A management board/section, by two-thirds vote, may extend, after giving the public one month's notice, the period of effectiveness for any FMP or provision that would otherwise expire for a period of up to six months, and may be extended for an additional six months, if the management board/section is actively working on an amendment or addendum to address the provisions that would otherwise expire. A two-thirds majority will be defined by the entire voting membership, however any abstentions from the federal services would not count when determining the total number of votes.

(3) Adaptive Management: Each FMP may provide for changes within the management program to adapt to changing circumstances. FMPs, which provide for adaptive management shall identify specifically the circumstances under which adaptive management changes may be made, the types of measures that may be changed, the schedule for state implementation of changes, and the procedural steps necessary to effect a change. Changes made under adaptive management shall be documented in writing through addenda to the FMP. Addenda to the FMP must provide for a minimum of 30 days for public comment in making adaptive management changes. The management board/section shall in coordination with each relevant state, utilizing that state's established public review process, ensure that the public has an opportunity to review and comment upon proposed adaptive management changes.

(4) Technical Addenda: The management board/section may make technical corrections to an approved FMP, amendment, or addendum without use of the public review process. This flexibility is for the correction of accidental omissions, erroneous inclusions, and/or to address non-substantive editorial issues.

(5) Habitat Addenda: The management board/section may utilize the Adaptive Management (Section Six (b)(3)) to modify/update a habitat section contained in an FMP or Amendment. The modifications to the habitat section will be documented in writing

through addenda to the FMP. The adaptive management procedures detailed in the FMP will be used when developing and approving a habitat addendum.

(c) **Procedures.** All FMPs and amendments of the Commission shall be prepared according to the following procedures:

(1) Need for an FMP - Identification of priority species by the Policy Board will initiate the process to create an FMP. A management board or section will be created pursuant to Section Four. The management board or section will appoint a PDT to develop the FMP for a particular species according to the process described in Section Five (c)(1) through (4).

(2) Need for FMP Amendment - Each PRT shall evaluate the adequacy of each respective FMP at least annually and will submit to the management board/section a written report of its findings. The report will address, at a minimum, the following topics: adequacy and achievement of the FMP goals and objectives (including targets and schedules); status of the stocks; status of the fisheries; status of state implementation and enforcement; status of the habitat; research activities; and other information relevant to the FMP. The PRT shall also solicit and consider the input of the relevant advisory panel, in preparation of its report. The PRT may recommend to the management board or section that a PDT be reinstated or convened. Using this information, the management board/section will determine whether the FMP needs amendment, including issues to be addressed, such as updating data, including results of new research or a new stock assessment, needed changes in state rules and/or enforcement, and recommended options and strategies to address the concerns. All Draft FMP Amendments shall be subject to the public comment process described under Section Six (c)(8), and shall be approved by the process described in Section Six (c)(4) through (7).

(3) Public Information Document (PID) - The species PDT shall prepare a PID containing a preliminary review of biological information, fishery issues, and potential management options for the subject FMP or amendment being prepared. The PDT shall also solicit and consider the advisement of the relevant advisory panel, if any, under the Commission's Advisory Committee Charter, in preparation of the PID. The PDT Chair (Commission staff) shall also prepare appropriate audio-visual material to accompany the PID for presentation to the public. The PID, after approval by the management board/section, shall be made available to each state with an interest in the fishery and where applicable, Regional Fishery Management Councils, for the purpose of soliciting public comment as described in Section Six (c)(8).

(4) Preparation of Source Document and Background Summaries - During review and consideration of the PID, the PDT will begin to collate and prepare the Source Document as provided in Section Six (b)(1) (vii). After consideration of the reviews of the PID, the PDT shall prepare background summaries as provided in Section Six (b)(1)(v).

(5) Preparation of Draft FMP or Amendment - After consideration of comments and views developed in response to the PID, the PDT, at the direction of the management

board/section, will prepare a Draft FMP or Amendment. Upon approval by the management board/section, the Draft FMP shall be referred to all relevant states and, where applicable, Regional Fishery Management Councils, for the purpose of conducting public hearings and soliciting other public comment as described in Section Six (c)(8).

(6) Preparation of the final FMP or Amendment - After consideration of the record developed in receiving comment on the Draft FMP or Amendment, the PDT shall, at the direction of the management board/section, prepare the final FMP or Amendment.

(7) Review and Approval - The management board/section shall approve the FMP or Amendment or refer it back to the PDT for revision. The management board/section will approve revisions to established FMPs (amendment or addendum). Final approval of FMPs and amendments shall be the decision of the Commission.

(8) Advisory Panel Participation – The advisory panel may provide feedback to the board/section on FMPs/Amendments as described below. The board/section may seek additional guidance outside of the below process if necessary.

- (i) **During the development of the PID**. Advisory panels provide guidance to the PDT before the Board reviews the document for public comment.
- (ii) **During the development of the Draft FMP.** After the Board gives the PDT guidance on issues to include in the draft, advisory panels provide feedback to the PDT on those issues.
- (iii) **During the public comment of the Draft FMP.** Advisory panels meet to give recommendations on the public comment draft of the FMP.

(9) Public Participation:

(i) The management board/section shall in coordination with each relevant state, utilizing that state's established public review process, ensure that the public has an opportunity to review and comment upon the problems and alternative solutions addressed by the PID (see Section Six [c][3]). Upon completion of a PID and its approval by the management board/section, the Commission shall again utilize the relevant states' established public review process to elicit public comment on the PID. The Commission shall ensure that a minimum of four public hearings are held, including at least one in each state that specifically requests a hearing. A hearing schedule will be published within 60 days following approval of the PID; hearings may be held in conjunction with state agencies. The hearing document will be made available to the public for review and comment at least 30 days prior to the date of the first public hearing; availability will be announced by a press release issued by the Commission. Written comments will be accepted for 14 days following the date of the last public hearing.

(ii) Upon completion of a draft FMP or amendment and its approval by the management board/section, the Commission shall again utilize the relevant states' established public review process to elicit public comment on the draft. The

Commission shall ensure that a minimum of four public hearings are held, including at least one in each state that specifically requests a hearing. A hearing schedule will be published within 60 days following approval of the draft FMP or amendment; hearings may be held in conjunction with state agencies. The hearing document will be made available to the public for review and comment at least 30 days prior to the date of the first public hearing; availability will be announced by a press release issued by the Commission. Written comments will be accepted for 14 days following the date of the last public hearing. The Commission will make the draft FMP or amendment and the accompanying PID widely available to the public, including fishermen, consumers, government agencies and officials, environmental groups, and other interested parties throughout the geographic range of the draft FMP or amendment. Records of the public hearings and summaries of the written comments will be made available at cost to anyone requesting them. Summaries of verbal and written comments will be prepared by Commission staff and provided to Commissioners, the management board/section, and advisory panel members. Copies of the summaries will be made available to other parties at cost.

(iii) Agendas for meetings of the management board/section, the ISFMP Policy Board, or the Commission, as appropriate, will include an opportunity for public comment prior to the board, section, or Commission taking action on a fishery management issue consistent with the public comment guidelines.

(iv) Public comments will be evaluated and considered prior to deciding what modifications will be made to the draft FMP or amendment, or draft final FMP or amendment, and prior to approval of the FMP or amendment consistent with the public comment guidelines. .

(10) Administrative Record - The Commission staff, with support from the PDT, shall be responsible for collating and maintaining the administrative record for all FMPs.

(11) Emergencies - A management board/section may, without regard to the other provisions of Section Six (c), authorize or require any emergency action that is not covered by an FMP or is an exception or change to any provision in an FMP. Such action shall, during the time it is in effect, be treated as an amendment to the FMP.

(i) Such action must be approved by two-thirds of all voting members (a two-thirds majority will be defined by the entire voting membership, however any abstentions from the federal services would not count when determining the total number of votes) of the management board/section prior to taking effect. The decision may be made by meeting, mail, or electronic ballot in the case of an emergency.

(ii) Within 30 days of taking emergency action, the states and the Commission shall hold at least four public hearings concerning the action, including at least one in each state that requests it.

(iii) Any such action, with the exception of public health emergencies, shall originally be effective for a period not to exceed 180 days from the date of the management board/section's declaration of an emergency, but may be renewed by the management board/section for two additional periods of up to one year each, provided the board/section has initiated action to prepare an FMP, or initiated action to amend the FMP in accordance with Section Six(c). Emergency actions taken to address a public health emergency shall remain in effect until the public health concern ceases to exist (this determination to be made by the management board/section). The management board/section may terminate an emergency action at any time with approval of two-thirds of all voting members (i.e., entire membership).

(iv) Definition of Emergencies. The provisions of this subsection shall only apply in those circumstances under which public health or the conservation of coastal fishery resources or attainment of fishery management objectives has been placed substantially at risk by unanticipated changes in the ecosystem, the stock, or the fishery.

(12) Joint FMPs with Regional Fishery Management Councils - The Commission recognizes that fish species and fisheries are transboundary across state and federal jurisdictions, and that proper and efficient fisheries conservation can only be achieved by close coordination between state and federal management systems. The Commission is committed to close cooperation with the Regional Fishery Management Councils in providing for coordinated and compatible fisheries management. To this end, each management board shall work closely with appropriate Council committees to develop coordinated approaches to management.

(i) A management board may decide with a Regional Fishery Management Council to prepare an FMP jointly with that Council, with the intent that the Council and the Commission will approve the same FMP document. In such instances the management board and the Council will establish the specific procedures and schedules to follow during FMP development, including assignments of staff responsibilities on PDTs, technical committees and other fishery management program staffing and support groups, including advisory panels.

(ii) A management board shall endeavor whether or not a joint FMP is being prepared, to coordinate its meetings, meetings of the relevant advisory panel, and public hearings with relevant Council meetings and hearings.

Section Seven. Compliance

(a) **Implementation and Enforcement** - All states are responsible for the full and effective implementation and enforcement of FMPs within areas subject to their jurisdiction. Each state shall submit a written report on compliance with required measures of a specific FMP in conformance with reporting requirements and schedules specified in the plan, which shall include submission of copies of relevant laws and regulations for the Commission's record. At any time, according to the procedures contained in this Section, the Commission may determine a state is not fully and effectively implementing and enforcing the required provisions of an FMP, and is therefore not in compliance with that plan. All evaluations, findings, and recommendations regarding compliance determinations shall be in writing.

(b) **Schedule for Reviews** - Implementation and compliance for FMPs will be reviewed according to the Commission's Action Plan. The schedule shall provide for review of each FMP at least annually, or more frequently as provided in a given FMP. In addition to the scheduled reviews, the PRT may conduct a review of the implementation and compliance of the FMP at any time at the request of the management board/section, Policy Board, or the Commission.

(c) **Role of the Management Board/Section** - Each management board/section shall, within 60 days of receipt of a state's compliance report, review the written findings of the PRT developed according to the previous subsection. Based upon that written review, as well as other information that it has or may receive, the management board/section may recommend to the Policy Board that a state be found out of compliance, including the rationale for the recommended finding of non-compliance. The recommendation shall specifically address the required measures of the FMP that the state has not implemented or enforced, a statement of how that failure to implement or enforce the required measures jeopardizes the conservation of the resource, and the actions a state must take in order to comply with requirements of the FMP.

(d) **Role of the Policy Board** - The Policy Board shall, within 30 days of receiving a recommendation of non-compliance from a management board/section, review that recommendation of non-compliance. If it concurs in the decision, it shall recommend at that time to the Commission that a state be found out of compliance. A recommendation regarding non-compliance from the Policy Board will be submitted to the Commission in writing provided there is sufficient time between meetings to develop such documentation.

(e) **Review and Determination by the Commission** - The Commission shall consider any recommendation forwarded under Subsection(d), as quickly as possible and within 30 days of receiving a recommendation of non-compliance from the Policy Board. Any state which is the subject of a recommendation for a finding of non-compliance shall be given an opportunity to present written and/or oral testimony concerning whether it should be found out of compliance. The state may request that the Commission's consideration be held at a formal meeting by roll call vote. With the consent of the Commissioners from the state subject to the recommendation, the Commission's decision may be made by electronic ballot. If the Commission agrees with the recommendation of the Policy Board, it may determine that a state is not in compliance with the relevant FMP, and specify the actions the state must take to come into compliance. Upon a non-compliance determination, the Executive Director shall within ten working days notify the state, the Secretary of Commerce, and the Secretary of the Interior of the Commission's determination.

(f) **Withdrawal of Determination** - Any state subject to a moratorium that has revised its conservation program in response to a determination of non-compliance may request that the

Commission rescind its findings of non-compliance.

(1) If the state provides written documentation to the Commission of implementation of every measure required of it, the withdrawal will be automatic upon issuance of a letter from the Commission Chair to the state, Secretary of Commerce, and the Secretary of the Interior.

(2) If the measures implemented deviate from those required of the state, the state shall provide a written statement on its actions that justify a determination of compliance. The management board/section shall promptly conduct such re-evaluation and make a recommendation to the Policy Board that the recommendation or determination of non-compliance be withdrawn. Upon the recommendation of the Policy Board, the Commission may withdraw its determination of non-compliance, whereupon the Executive Director shall promptly notify the state, the Secretary of Commerce, and the Secretary of the Interior. The re-evaluation by the Management board/section, review by the Policy Board, and action by the Commission shall be made within 45 days of the receipt by the Commission of the request for reconsideration by the State. It may be made by electronic ballot with the consent of the Commissioners from the subject state.

(g) **Procedure to Address Management Program Implementation Delays** - Each species management board shall evaluate the current FMP, amendment, and/or addendum to determine if delays in implementation have impacted, or may negatively impact, the achievement of the goals and objectives of the management program. Each of the species management boards, with the assistance of the respective technical committee if necessary, will conduct this evaluation and provide, in writing, a summary of its findings to the ISFMP Policy Board. Each species management board that determines that there is a negative impact due to delayed implementation will provide the ISFMP Policy Board a proposed timeline to develop an amendment or addendum to address delayed implementation.

If the ISFMP Policy Board determines that an amendment or addendum should be developed to address delayed implementation, the amendment or addendum should, at a minimum, include any penalties and repayments for delays in implementation, the minimum notification time that Commission staff must provide a state/jurisdiction prior to requiring an in-season management adjustment; and establishment of a reporting and tracking system for management changes.

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Section Eight. Definitions

(a) **Act** - The Atlantic Coastal Fisheries Cooperative Management Act, 1993. 16 U.S.C. Chapter 71, et seq.

(b) **Action plan** - A document prepared annually by Commission staff and approved by the Policy Board to provide priorities and schedules for the specific activities of the ISFMP during a given year.

(c) **Adaptive management** - An iterative process which includes evaluation of the response of the managed fishery and stock to specific management measures and adjusting such measures based on that evaluation.

(d) **Advisory Panel (AP)** - A group of interested and knowledgeable persons convened under the Commission's Advisory Committee Charter to assist in development of an FMP or amendment.

(e) **Assessment Science Committee (ASC)** - A group consisting of experts in fish population dynamics and appointed and convened by a Technical Committee, at the request of a Management Board, to prepare a stock assessment for a specified fish stock using the best scientific data available and established techniques.

(f) **Best scientific information available** - Includes but is not limited to that body of biological, environmental, ecological, economic, and social data concerning the fish stock and fisheries which are the subject of an FMP or amendment, provided that the methods of collecting such information are clearly described and are generally accepted as scientifically valid. Data may come from state, federal, or private databases and from published and unpublished sources. Information that becomes available during preparation of an FMP or amendment should be incorporated to the extent practicable.

(g) **Bycatch** - That portion of a catch taken in addition to the targeted species because of non-selectivity of gear to either species or size differences; may include non-directed, threatened, or endangered and protected species.

(h) **Compliance** - Condition in which a state has implemented and is enforcing all measures required by an FMP. States are presumed to be in compliance unless determined to be out of compliance pursuant to Section Seven.

(i) **Conservation** (from the Act, Section 803[4]) - The restoring, rebuilding, and maintaining of any coastal fishery resource and the marine environment, in order to assure the availability of coastal fishery resources on a long-term basis.

(j) **Conservation equivalency** - Actions taken by a state which differ from the specific requirements of the FMP, but which achieve the same quantified level of conservation for the resource under management. For example, various combinations of size limits, gear restrictions, and season length can be demonstrated to achieve the same targeted level of fishing mortality. The appropriate Management Board/Section will determine conservation equivalency.

(k) **Conservation program** - Enactment of rules or statutes, research, biological monitoring, collection of statistics, stock enhancement, and enforcement activities conducted by a state to maintain, restore, and/or rebuild a fish stock and its habitat.

(l) ***De minimis*** - A situation in which, under existing conditions of the stock and scope of the fishery, conservation, and enforcement actions taken by an individual state would be expected to contribute insignificantly to a coastwide conservation program required by an FMP or amendment.

(m) **Directed fishery** - Fishing for a stock using gear or strategies intended to catch a given target species, group of species, or size class.

(n) **Emergency** - Unanticipated changes in the ecosystem, the stock, or the fishery which place public health, the conservation of coastal fishery resources, or attainment of fishery management objectives substantially at risk.

(o) **Endangered, threatened, or protected species** – Species that are regulated under the jurisdiction of the federal or a state's endangered species act (threatened or endangered) or are provided other special protection.

(p) **Fish** (from the Act, Section 803[7]) - "Finfish, mollusks, crustaceans, and all other forms of marine animal life other than marine mammals and birds."

(q) **Fishable abundance** - Numbers of fish in a stock sufficient to provide continuing harvests in the range of historic average levels without overfishing the stock.

(r) **Fishery** (from the Act, Section 803[8])

> (1) "One or more stocks of fish that can be treated as a unit for purposes of conservation and management and that are identified on the basis of geographical, scientific, technical, commercial, recreational, or economic characteristics; or
>
> (2) Any fishing for such stocks."

(s) **Fish habitat** - The environment upon which a fish stock is dependent as it conducts its normal life history functions of spawning, feeding, and migration; including biological, physical, and chemical factors which influence the choices of such areas.

(t) **Fishery management** - All activities conducted by a government to improve, restore, rebuild, or maintain fish stocks and fisheries, including statutory action and rule-making, enforcement, research, monitoring, collection of statistics, enhancement, protection, development, and habitat conservation.

(u) **Habitat Committee (HC)** - The principal body, established by the Commission, which advises the Commission on issues of habitat, habitat management, habitat requirements by the

managed species, enforceability of proposed habitat management measures.
(v) **Implementation of an FMP** - Conducting a state conservation program that meets all requirements for that state as provided in an FMP or amendment.

(w) **Law Enforcement Committee (LEC)** - The principal body, established by the Commission, which advises the Commission on issues of law enforcement and enforceability of potential management measures, comprised of representatives of each member state, Washington, D.C., NOAA Fisheries, U.S. Fish and Wildlife Service, and the U.S. Coast Guard.

(x) **Management measure** - A statute or rule enacted by a state to conserve a fishery and/or protect its habitat.

(y) **Management and Science Committee (MSC)** - The principal scientific advisory body of the Commission, comprised of representatives from member states, NOAA Fisheries, and U. S. Fish and Wildlife Service.

(z) **Minimize waste** - Process of taking specific actions, which reduce the effects of fishing activities on non-target resources (habitat and bycatch) and promote full, efficient utilization of the catch.

(aa) **Non-compliance** - A condition under which the Commission has determined that a state has failed to implement and enforce a conservation program as required in an FMP or amendment.

(bb) **Non-indigenous species** - A species of fish, plant or other organism that is not native to a particular geographic area.

(cc) **Overfishing** - In the context of the ISFMP, harvesting from a stock at a rate greater than the stock's reproductive capacity to replace the fish removed through harvest. Each FMP contains a plan-specific definition of overfishing.

(dd) **Plan Development Team (PDT)** - A group of individuals who are knowledgeable concerning the scientific facts and fishery management issues concerning a designated fish stock and who are appointed and convened by a Management Board to prepare an FMP or amendment and its supporting Source Document.

(ee) **Plan review** - An evaluation of an FMP, considering adequacy and relevance of the goals and objectives, stock status, fishery status, implementation status, research activities, and recommendations.

(ff) **Plan Review Team (PRT)** - A group of individuals who are knowledgeable concerning the scientific facts, stock and fishery condition, and fishery management issues concerning a designated fish stock and who are appointed and convened by a Management Board for the purpose of conducting an annual plan review for an FMP.

(gg) **Public Information Document (PID)** - A document of the Commission which contains preliminary discussions of biological, environmental, social, and economic information, fishery

issues, and potential management options for a proposed FMP or amendment.
(hh) **Range (functional)** - The geographic area utilized by a fish stock and its dependent fishery as defined in an FMP.

(ii) **Recommendations** - Actions identified in an FMP which should be taken by the states, but are not required, such as enactment of rules, research, monitoring, collection of statistics, and enhancement, which collectively will promote restoration, rebuilding, or maintenance of a stock.

(jj) **Regulatory** - Of or pertaining to any administrative or legislative measure in a sense that requires compliance by individuals involved in the fishery.

(kk) **Requirements** - Actions set forth in an FMP which must be taken by the states specified in such FMP, such as enactment of rules, research, monitoring, collection of statistics, and enhancement, which collectively will promote attainment of the FMP's objectives for restoration, rebuilding, or maintenance of a stock, and are the measures against which compliance is judged. Failure of a specified state to implement a required action may result in a finding of non-compliance under the Act.

(ll) **Source document** - The comprehensive support document to an FMP which is compiled by the Plan Development Team and Commission staff and contains all the scientific, management, and other analyses and references utilized in preparation of the FMP; the Source Document is kept on file with the Commission.

(mm) **State** - (from the Act, Section 803[13]) For purposes of the Act, one of the following East Coast jurisdictional entities: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida; also includes the District of Columbia, or the Potomac River Fisheries Commission.

(nn) **Stock** - A group of fish of the same species which behave (spawn, migrate, feed) as a unit.

(oo) **Subgroup** - A group of fish from the same stock which consistently conducts itself as an identifiable unit.

(pp) **Target species** - A species or group of species of fish which certain fishing gear or strategies are designed to catch.

(qq) **Technical Committee (TC)** - A group of persons who are expert in the scientific and technical matters relating to a specific fish stock and who are appointed and convened by a Management Board to provide scientific and technical advice in the process of developing and monitoring FMPs and amendments.

(rr) **Trigger** - A measure of a specific attribute of a fish stock or fishery for which values above or below an established level initiates a pre-specified management action.

Atlantic States Marine Fisheries Commission

Technical Support Group Guidance and Benchmark Stock Assessment Process

February 2016
(May 2019 Draft Edits included in Yellow)

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

Atlantic States Marine Fisheries Commission

Technical Support Group Guidance and Benchmark Stock Assessment Process

Approved February 2016

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The Commission would like to acknowledge the efforts of the two committees that have overseen the revisions and additions to this document – the Management and Science Committee and the Assessment Science Committee.

This document was first approved in May 2015. February 2016 revisions include clarifying the role of ASMFC staff on species technical committees and stock assessment subcommittees; and modifying guidance on the participation of law enforcement representatives and technical committee Chairs at species management Board meetings.

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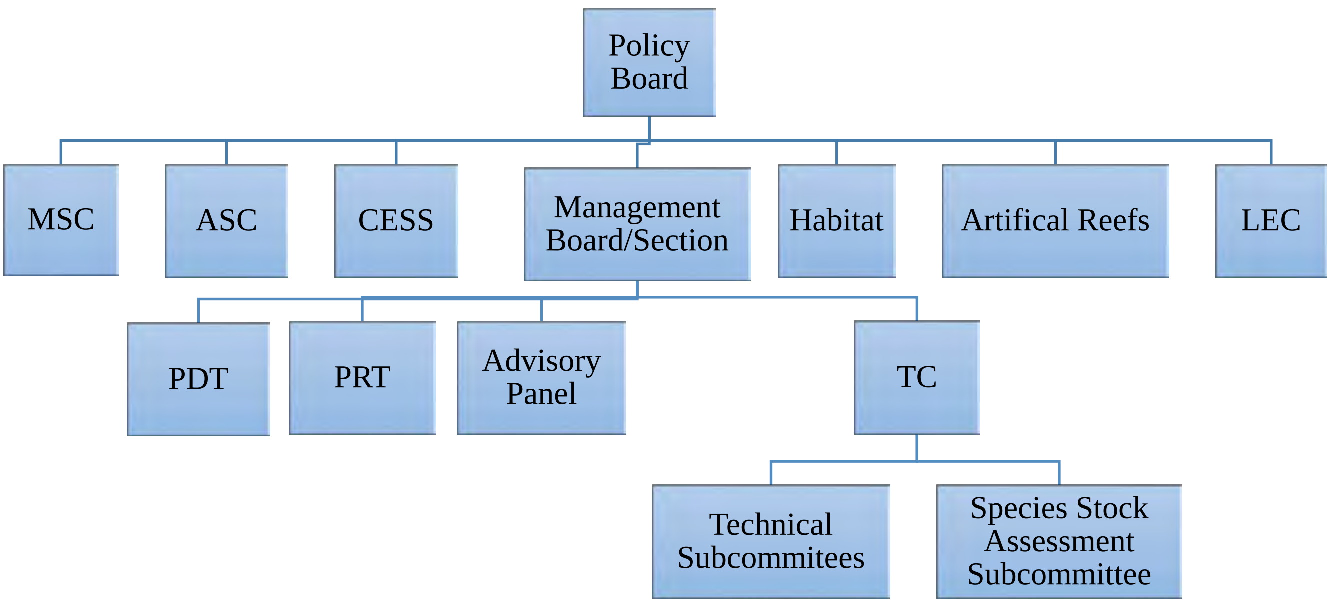
1.0 INTRODUCTION

The purpose of this document is to improve the functioning of the Atlantic States Marine Fisheries Commission (Commission) by providing guidance to all Commission technical support groups on the structure, function, roles, and responsibilities of Commission committees and their members. This document also provides guidance on the Commission stock assessment process.

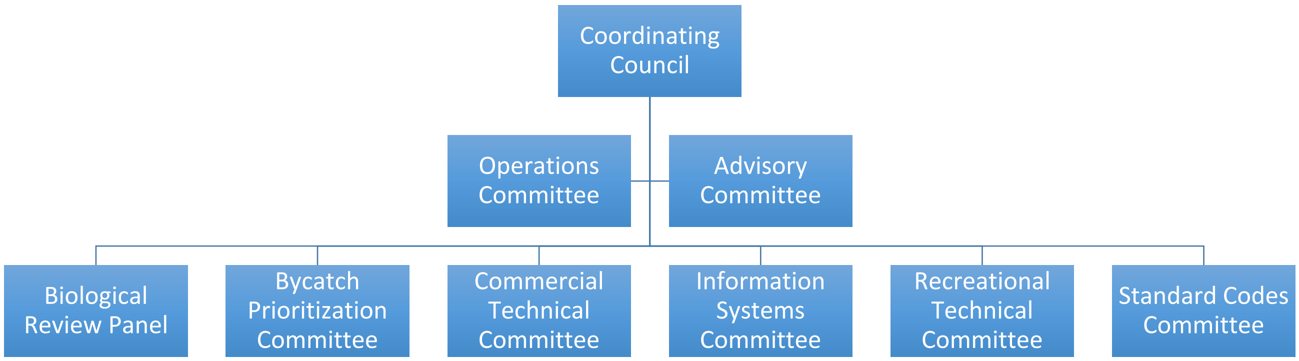
2.0 BOARDS AND COMMITTEES

This section contains a brief outline of the structure, composition, and function of Commission committees. For additional details, please consult the Interstate Fisheries Management Program Charter.

ISFMP Committee Organization



ACCSP Committee Organization



2.1 ISFMP Policy Board

The Interstate Fisheries Management Program (ISFMP) Policy Board is comprised of: all member states of the Commission, each state a voting members (The position of a state shall be determined by caucus of its Commissioners in attendance); one representative from NOAA Fisheries and one representative from U.S. Fish and Wildlife Service (USFWS) each a voting member; one representative from the Potomac River Fisheries Commission and one representative from the government of the District of Columbia shall each be a member, eligible to vote, on any matter which may impose a regulatory requirement upon their respective jurisdictions; and one representative of the Commission's Law Enforcement Committee (LEC) is a non-voting member.

The ISFMP Policy Board is responsible for the overall administration and management of the Commission's fishery management programs. The goal of the program is to promote the cooperative management of marine, estuarine, and anadromous fisheries in state waters of the East Coast through interstate fishery management plans (FMPs). The major objectives of the ISFMP are to:

- Determine the priorities for interjurisdictional fisheries management in coastal state waters;
- Develop, monitor, and review FMPs;
- Recommend to states, regional fishery management councils, and the federal government management measures to benefit these fisheries;
- Provide an efficient structure for the timely, cooperative administration of the ISFMP; and
- Monitor compliance with approved FMPs.

2.2 Management Boards and Sections

Management Boards are established by and advise the ISFMP Policy Board. Each Board/Section is comprised of the states/jurisdictions with a declared interest in the fishery covered by that Board/Section. The Boards/Sections consider and approve the development and implementation of FMPs, including the integration of scientific information and proposed management measures. In this process, the Boards/Sections primarily rely on input from two main sources – species technical committees and advisory panels. Boards/Sections are responsible for tasking plan development teams (PDTs), plan review teams (PRTs), technical committees (TCs), advisory panels (APs) and stock assessment subcommittees (SAS). Each Management Board/Section shall select its own Chair and Vice-chair. Chairmanship will rotate among the voting members every two years.

2.3 Plan Development Teams

PDTs are appointed by Boards/Sections to draft FMPs. They are comprised of personnel from state and federal agencies who have scientific and management ability, knowledge of a species and its habitat, and an interest in the management of species under the jurisdiction of the relevant Board. Personnel from regional fishery management councils, academicians, and others as appropriate may be included on a PDT. The size of the PDT shall be based on specific need for expertise but should generally be kept to a maximum of six persons.

PDTs will be responsible for preparing all documentation necessary for the development of a FMP, amendment, or addendum, using the best scientific information available and the most current stock assessment information. Each FMP, amendment, or addendum will be developed by the PDT in conformance with Section Six of the ISFMP Charter. PDTs will be tasked directly by the Board/ Section. In carrying out its activities, the PDT shall seek advisement from the appropriate TC, SAS, AP, LEC and the Habitat Committee. Following completion of its charge, the Board/Section will disband the PDT.

2.4 Plan Review Teams

PRTs are appointed by the Boards/Sections to review regulations and compliance. Members are knowledgeable concerning the scientific data, stock and fishery condition, and fishery management issues. PRTs are responsible for providing advice concerning the implementation, review, monitoring and enforcement of fishery management plans that have been adopted by the Commission, and as needed be charged by the Board/Sections. The PRT should generally be kept to a maximum of six persons.

PRTs will be responsible for providing advice concerning the implementation, review, monitoring, and enforcement of FMPs that have been adopted by the Commission, and as needed be charged by the Boards/Sections to draft plan addenda. PRTs will be tasked directly by the Board/Section. Each PRT shall at least annually or as provided in a given FMP, conduct a review of the stock status and Commission member states' compliance for which implementation requirements are defined in the

FMP. The PRT shall develop an annual plan review in order to evaluate the adequacy of the FMP. This report will address, at a minimum, the following topics: adequacy and achievement of the FMP goals and objectives (including targets and schedules), status of the stocks, status of the fisheries, status of state implementation and enforcement, status of the habitat, research activities, and other information relevant to the FMP. The PRT shall report all findings in writing to the Board/Section for appropriate action. Compliance review shall be consistent with the requirements of Sections Six and Seven of the ISFMP Charter and the respective FMP requirements. In addition to the scheduled compliance reviews, the PRT may conduct a review of the implementation and compliance of the FMP at any time at the request of the Board/Section, Policy Board, or the Commission. When a plan amendment process is initiated by the Management Board/Section, the PRT will continue its annual review function applicable to the existing plan. In carrying out its activities, the PRT shall seek advisement from the appropriate TC, SAS, AP, LEC, MSC and Habitat Committee.

2.5 Advisory Panels

AP members include stakeholders from a wide range of interests including the commercial, charter boat, and recreational fishing industries, conservation interests, as well as non-traditional stakeholders. Members are appointed by the three Commissioners from each state with a declared interest in a species because of their particular expertise within a given fishery. APs provide guidance about the fisheries that catch or land a particular species. The AP's role is to provide input throughout the entire fishery management process from plan initiation through development and into implementation.

2.6 Technical Committees

Management Boards/Sections appoint TCs to address specific technical or scientific needs requested periodically by the respective Board/Section, PDT, PRT, or the Management and Science Committee (MSC). A TC may be comprised of representatives from the states, federal fisheries agencies, Regional fishery management councils, Commission, academia, or other specialized personnel with scientific and technical expertise and knowledge of the fishery or issues pertaining to the fishery being managed. The TC should consist of only one representative from each state or agency with a declared interest in the fishery, unless otherwise directed by the Board/Section.

TCs are responsible for addressing specific technical or scientific needs of the Board/Section, PDT, PRT, or the MSC. Among its duties, the TC shall provide a range of management options, risk assessments, justifications, and probable outcomes of various management options. The TC will coordinate the process of developing stock assessments for Commission-managed species. TCs can be asked to provide a technical analysis of AP recommendations by the species Board or Policy Board. It is not the responsibility of the TC to conduct a review, or provide recommendations, of Commission member states' compliance with the specified requirements of a species FMP. This is a responsibility of the species PRT.

Although the TC may respond to requests from multiple committees, the Board/Section provides oversight of TC tasks and priorities. When tasked by multiple committees, it is the responsibility of the ISFMP staff, in consultation with the TC and Board/Section Chairs, to prioritize these tasks. Although members have been appointed to the TC by their specific agency, each member's responsibility is to use the best science available in an objective manner, not to represent the policies and/or politics of that agency.

2.7 Stock Assessment Subcommittees

Upon the request of a Board/Section, the TC shall nominate individuals with appropriate expertise in stock assessment and fish population dynamics to a species stock assessment subcommittee (SAS), which will report to the TC. SAS nominations are approved by the Board/Section and shall continue in existence as long as the Board/Section requires. Membership of a species SAS will be comprised of TC members with appropriate knowledge and experience in stock assessment and biology of the species being assessed. Individuals from outside the TC with expertise in stock assessment or biology of the species may also be nominated and appointed, if necessary. The TC Chair will serve as an ex-officio member of the species SAS. Overall membership should be kept to a maximum of six persons unless additional analytical expertise is requested by the Board, TC or SAS.

SASs are responsible for conducting stock assessments for use by the PDT in the formulation of a FMP, amendment, or addendum and for conducting periodic stock assessment updates as requested by the Board/Section for use by the TC in reporting status of the stock. The SAS is responsible for data analysis and preparation of a stock assessment report. Initial input on available data and stock assessment methods should be provided by the TC and ASC. The SAS shall use the best scientific information available and established stock assessment techniques. Stock assessment techniques should be consistent with the current state of scientific knowledge. See Appendix 1 for information on specific roles and responsibilities in the stock assessment process.

2.8 Management and Science Committee

The MSC provides advice concerning fisheries management and the science of coastal marine fisheries to the ISFMP Policy Board. MSC's major duties are to provide oversight to the Commission's Stock Assessment Peer Review Process, review and provide advice on species- specific issues upon request of the ISFMP Policy Board, evaluate and provide guidance to fisheries managers on multispecies and ecosystem issues, and evaluate and provide advice on cross-species issues (e.g., tagging, invasive species and exotics, fish health and protected species issues). The MSC also assists in advising the Policy Board regarding stock assessment priorities and timelines in relation to current workloads. The MSC is comprised of one representative from each member state/ jurisdiction, the NOAA Fisheries Northeast and Southeast Regions, and the USFWS Regions 4 and 5 who possess scientific as well as management and administrative expertise.

2.9 Assessment Science Committee

The Assessment Science Committee (ASC) is a stock assessment advisory committee that reports to the ISFMP Policy Board. ASC is comprised of one representative from each state/jurisdiction, the NOAA Fisheries Northeast and Southeast Regions, the 3 East Coast regional fishery management councils, and the USFWS. All agencies may nominate individuals for appointment to the ASC based on stock assessment and population dynamics expertise. The ISFMP Policy Board should review all nominations and appoint members to the ASC based on expertise, as opposed to agency representation. The ASC membership should be kept to a maximum of 25 members and periodic rotation of membership should be considered. The ASC is responsible for reviewing and recommending changes to the update and benchmark stock assessment schedule, advising the Policy Board regarding priorities and timelines in relation to current workloads, providing stock assessment advice and guidance documents for TCs and Boards on technical issues as requested, and providing oversight to the Commission's Stock Assessment Training Program.

2.10 Ecological Reference Point Working Group

The Ecological Reference Point Working Group (ERP WG) is appointed by and advises the Atlantic Menhaden Board on multispecies modeling efforts with the goal of moving towards the use of multispecies model results in management decisions. The ERP WG is comprised of state, federal, and academic scientists from the Atlantic Menhaden TC with the expertise necessary to complete multispecies tasks on the species of interest and modeling approaches being employed. Individuals from outside the TC with expertise in stock assessment or biology of the species may also be appointed, if necessary.

2.11 Habitat Committee

The Habitat Committee is a standing Commission committee appointed at the discretion of the Commission Chair on an annual basis. The Committee advises the ISFMP Policy Board with the goal of enhancing and cooperatively managing vital fish habitat for conservation, restoration, and protection, and supporting the cooperative management of Commission managed species. The Habitat Committee is primarily responsible for developing habitat sections of FMPs and creating habitat management series publications as needed. Membership includes state representatives, the - USFWS, NOAA Fisheries, National Ocean Service, Environmental Protection Agency, U.S. Geological Survey, and the Army Corps of Engineers. Two seats are available on the Habitat Committee for members from non-governmental organizations (NGOs).

2.12 Law Enforcement Committee

The LEC is a unique body of professionals in marine fisheries enforcement. It is comprised of representatives from each of the Commission's participating states and the District of Columbia. Members also represent NOAA Fisheries, the U. S. Coast Guard and USFWS. The LEC carries out assignments at the specific request of the Commission, the ISFMP Policy Board, the Boards/ Sections, the PDTs, and the PRTs. In general, the Committee provides information on law enforcement issues, brings resolutions addressing enforcement concerns before the Commission, coordinates enforcement efforts among states, exchanges data, identifies potential enforcement problems, and monitors enforcement of measures incorporated into the various FMPs.

2.13 Committee on Economics and Social Sciences

The purpose of the Committee on Economics and Social Sciences (CESS) is to provide socioeconomic technical oversight for both the ISFMP and the Atlantic Coastal Cooperative Statistics Program (ACCSP). CESS's major duties are to develop and implement mechanisms to make economic and social science analysis a functioning part of the Commission's decision-making process; function as the technical review panel for social and economic analyses conducted by the Commission and the ACCSP; and nominate economists and social scientists to serve on each species TC, Socioeconomic Subcommittee, or PDT, in order to provide technical support and development of socioeconomic sections of FMPs (including amendments and addenda). The CESS is comprised of one representative from each member state, two representatives from NOAA Fisheries Headquarters (one economist and one social scientist), the NOAA Fisheries Northeast and Southeast Regions, and one representative from the USFWS who possess social science expertise and familiarity with fisheries management.

2.14 Other Technical Support Subcommittees

Upon the approval of a Board/Section, the TC shall appoint individuals with special expertise, as appropriate, to other technical support subcommittees (not including SASs) in order to support TC deliberations on specific issues. These kinds of subcommittees include species tagging and stocking subcommittees, but do not include ISFMP socioeconomic subcommittees. All technical support subcommittees shall report to the TC and shall continue in existence so long as the Management Board/Section requires. All technical support subcommittees should elect their own Chair and Vice-chair, who will be responsible for reporting to the TC and the management Board/Section as necessary. Overall membership should be kept to a maximum of six persons unless additional expertise is requested by the TC or Board.

2.15 Special Issue Technical Committees

The ISFMP Policy Board may form new TCs to address special issues (e.g., Interstate Tagging Committee, Fish Ageing Committee, Fishing Gear Technology Work Group, Fish Passage Working Group). Nominations are approved by the Policy Board. Special TCs meet as often as necessary (resources permitting) to address specific Policy Board tasks.

2.16 Coordinating Council

The ACCSP Coordinating Council is the governing body of the Program and oversees program design and implementation. The policies set by the Council guide the Program and each partner's participation in it. Membership is composed of one voting member from each of the ACCSP's 23 state and federal partners. Coordinating Council members represent the policy-level of their respective agencies. The Executive Committee, a subset of the Coordinating Council, meets bimonthly to ensure timely decisions are made about the Program.

2.17 Operations Committee

The Operations Committee serves as the steering committee to direct development of program standards and assimilate information from the various committees into cohesive recommendations to the Coordinating Council. By providing recommendations to the Coordinating Council, the Operations Committee guides the development of program standards and serves as the review body for annual project funding priorities. The Committee, along with the Advisory Committee, reviews and prioritizes project proposals with funding recommendations forwarded to the Coordinating Council.

2.18 Advisory Committee

The Advisory Committee was established to ensure, to the greatest extent practicable, that the fishing industry perspective is considered in the development and implementation of the Program. The Advisory Committee includes representatives from the commercial, recreational, for-hire, and academic sectors and serves an important role by providing recommendations to the Program. At least one member of this Committee also sits on each technical committee to provide industry feedback. The Committee also reviews and prioritizes project proposals with funding recommendations forwarded to the Coordinating Council.

2.19 Biological Review Panel

The Biological Review Panel is composed of stock assessment biologists, field supervisory personnel, and industry advisors appointed by partner agencies. The Panel develops ACCSP strategies and standards to obtain and manage biological data. Biological data includes length distributions, collection of aging structures, and tissue for basic life history research. The Panel biennially recommends target species, compiles sampling levels for biological sampling, and works with the Bycatch Prioritization Committee to integrate data collection protocols.

2.20 Bycatch Prioritization Committee

The Bycatch Prioritization Committee is composed of stock assessment biologists, observer personnel and protected species experts from partner agencies. The Committee develops ACCSP strategies and standards to collect and manage bycatch and protected species data. These data include at-sea and port discards and information on protected species interactions. The Bycatch Prioritization Committee biennially ranks fleets for funding priority based on fleet characteristics and stock assessment and management needs.

2.21 Commercial Technical Committee

The Commercial Technical Committee is composed of a variety of ACCSP partner personnel with hands-on experience implementing and conducting partner commercial fisheries statistics programs. The committee develops catch and effort data collection standards for all species commercially harvested on the Atlantic coast.

2.22 Information Systems Committee

The Information Systems Committee is composed of both developers and industry representatives implementing and using electronic data collection programs for commercial fisheries. The members identify software applications that can meet reporting needs and develop recommendations to improve SAFIS, a real-time web-based reporting system for seafood dealers.

2.23 Recreational Technical Committee

The Recreational Technical Committee is composed of partner personnel who specialize in survey design, statistical estimation of fishing effort, catch, participation, and operation of recreational sampling programs. The committee develops data collection standards for monitoring catch and effort of recreational and for-hire fisheries. They also serve as the coordination body for the partners to develop regional guidance on recreational projects, including the Atlantic Regional Implementation Plan and MRIP survey components.

2.24 Standard Codes Committee

The Standard Codes Committee works to develop and maintain standardized codes for Atlantic fisheries data.

3.0 COMMITTEE TASKING

Boards/Sections can task the appropriate Commission committee through Board/Section action or direction from the Board/Section Chair. Species-specific technical tasks should be directed to the appropriate ISFMP technical support group in writing by ISFMP staff or the Board/Section Chair. Boards/Sections may also consider referring broader scientific, law enforcement, habitat and social/economic issues to the MSC, the ASC, the LEC, the Habitat Committee, or the CESS. These committees may provide recommendations to Boards/Sections based on a more focused area of expertise.

Boards/Sections will develop specific and clear guidance whenever tasking committees for advice. ISFMP staff, in consultation with the Board/Section Chair and technical support group Chair, will develop the written charge. The charge will contain terms of reference to clearly detail all specific tasks, the deliverables expected, and a timeline for presentation of recommendations to the Board/Section. It is the responsibility of the ISFMP staff and any technical support group Chair present at Board/Section meetings to ensure the timeline can be met. Any problems or discrepancies encountered by the technical support group in meeting the charge will be discussed with the appropriate ISFMP staff and Board/Section Chair.

Any charge developed by a Board/Section to a technical subcommittee will be initially forwarded by ISFMP staff to the TC for review and input. It is not the responsibility of the TC to modify or approve a Board/Section charge, however, input on appropriate mechanisms to meet that charge should be provided. The TC will review products by a technical subcommittee before products are provided to a Board/Section to ensure the charge has been addressed.

The Boards/Sections are responsible for making decisions on allocation issues. However, they may task the TC with the development of technical options for addressing allocation. The Board/Section should develop specific guidelines and initial options for further development by the TC.

4.0 COMMITTEE MEMBER EXPECTATIONS

4.1 All Committee Members

Committee members should expect to attend several (1-4) meetings each year, depending on the specific management or assessment activities being pursued. As many of these meetings as possible will be held during one of the three scheduled Technical Meeting Weeks. Committee members should save those dates in their calendars until the agendas for each meeting week are set (typically immediately following each quarterly Commission Meeting so TCs can respond to Board tasks).

It is important that all members of a Commission committee fully participate in all meetings and activities of the committee. The appropriate Administrative Commissioner should be informed if a committee member is unable to commit to the level of participation required. Commission staff should be contacted by the committee member prior to the start of the meeting if he or she is unable to attend. The committee member should provide staff with the name of his/her proxy for that committee meeting in writing (email or letter). Proxies must be from the same state or jurisdiction or agency as the individual making the designation. Proxies shall abide by the rules of the committee.

Commission technical support groups are expected to provide scientific and technical advice to the Board/Section, PDT, and PRT in the development and monitoring of a FMP, amendment, or addendum. It is also important that each committee member provide periodic briefings to his/ her agency's Administrative Commissioner on the discussions and actions taken at all technical support group meetings. Specific activities conducted by TC and SAS members may include:

- Requesting, preparing, and objectively evaluating fishery-dependent and fishery-independent data,
- Conducting periodic stock assessments,
- Providing recommendations on the status of the stock and the fishery,
- Evaluating management options and harvest policies, conducting risk assessments, and assessing probable outcomes of various management options.

New TC members may wish to consult the Commission's Stock Assessment Training Program materials, manuals, and ASC working papers prior to participating in an assessment. Science staff may be contacted for a complete list of available training and guidance documents.

Even though all TC and SAS members have been appointed by a specific agency, it is not appropriate for TC members to represent the policies and/or politics of that agency. It is the responsibility of each committee member to use the best scientific information available and established stock assessment techniques consistent with the current state of scientific knowledge. All participants in the Commission process should act professionally and expect to be treated with respect. See Section 6.6 on meeting etiquette.

4.2 Committee Chairs and Vice-chair

Unless otherwise specified, all Commission committees and subcommittees will elect their own Chair and Vice-chair. Chairs serve two-year terms and chairmanship should rotate among members of the committee. The role of the Chair is demanding and only those willing and able to commit the time and energy required by the job should agree to serve. The Chair must be willing to perform the job and state/federal agencies must be willing to provide the Chair time to attend to Commission business. It is the responsibility of all officers to facilitate meetings in an objective manner and represent the viewpoints of all committee members, including opposing opinions and opinions in opposition to their own.

4.2 ASMFC Staff Roles and Responsibilities

4.2.1 ISFMP Staff
ISFMP staff (i.e., FMP Coordinator) is responsible for organizing all PDT, PRT, AP, and TC activities. ISFMP and Science staff will coordinate SAS activities. ISFMP staff shall serve as ex-officio members of all TCs and will chair the PDTs and PRTs. As an ex-officio member of the TC, ISFMP staff may not vote on issues before the TC. ISFMP staff will provide liaison among the PDTs, PRTs, SAS, TCs, APs, and the Boards/Sections. ISFMP staff will also provide liaison on species-specific issues to the LEC, MSC, TC subcommittees, and Habitat Committee. In consultation with the TC Chair and Vice-chair, is responsible for scheduling committee meetings, drafting agendas, and distributing meeting materials. Either the Habitat Coordinator or the ISFMP Director will provide primary organizational support for the Habitat Committee.

ISFMP staff, in consultation with the Board/Section Chair, will refer any relevant AP recommendations to the appropriate technical support group for evaluation. ISFMP staff, in consultation with the TC and Board/Section chairs, will assist in prioritizing tasks assigned to technical support groups. Staff should track committee meeting attendance and provide records upon request. ISFMP staff and the TC Chair should assist in clarifying the details of any tasks assigned to the TC by the Board/Section. The Board/Section Chair should provide assist in the development of the written charge, including all specific tasks, the deliverable expected, and a timeline for presentation of recommendations to the Board/Section.

4.2.2 Science Staff
The Scientific Committee Coordinator (Science Coordinator) is responsible for organizing all MSC, ASC, CESS, and special issue committee activities. The Science Director, with the assistance of Science staff, is responsible for coordinating Commission peer reviews. The Fisheries Science Coordinator is responsible for providing support to the MSC, ASC, and CESS with assistance on technical matters from other Science staff.

Stock Assessment Scientists' primary responsibility is to provide quantitative technical support to SASs, TCs, and special issue committee activities. For carrying out stock assessments, the Stock Assessment Scientist, in consultation with ISFMP staff, will be the default Commission staff responsible for maintaining the assessment timeline and identifying stock assessment meeting needs. Stock Assessment Scientists may serve as members of SASs, specifically as Chair, Lead Analyst, or as supporting member, as well as on other technical support groups (e.g., tagging and stocking subcommittees). Science staff may serve as Chair on other technical support groups. If a consensus cannot be reached, Science staff may vote on an issue before the SAS, however Science Staff may not vote on issues before the TC. Stock Assessment Scientists are also responsible for providing support to special issue committees (Fish Passage, Interstate Tagging, Gear Technology, Fish Ageing).

Science staff are not members of TCs but may provide technical support to TCs and also assist ISFMP staff with organizing TC and SAS activities, as needed. ISFMP staff are responsible for providing primary support to TCs and SASs. Primary support includes scheduling, coordinating, and working with the TC and SAS Chairs to facilitate calls and meetings. The ISFMP staff and assigned Science staff will discuss technical needs for each committee as they arise and coordinate roles and responsibilities based on schedules. The ISFMP and Science Directors will resolve workload and responsibility conflicts that may arise.

4.2.3 ACCSP Staff

The ACCSP Data Coordinator prepares, compares, and provides fishery-dependent data from state and federal sources for the TC. Data Coordinators are not members of TC's, but may provide technical support during calls and meetings. They also facilitate TC members request for confidential data access, and provide updates in coordination with FMP staff.

5.0 MEETING POLICIES AND PROCEDURES

For the purposes of Sections 6 and 7, a meeting can be an in-person, conference call or webinar unless specified.

5.1 Meeting Announcements

A public notice, via the Commission website (www.asmfc.org), will be provided at least two weeks prior to all in-person meetings of the Commission and its various committees, and at least 48 hours notice will be provided for any meetings held by conference call ; provided exceptions to these notice requirements may be granted by the Commission Chair. A non-committee member can request, through Commission staff, to be notified of committee meetings via email (Note: the public notice of the Commission website is the official notification of a scheduled meeting). Non-committee members may attend any in-person or conference call committee meeting, unless confidential data is being discussed.

If a non-committee member would like to attend a webinar he/she should contact Commission staff 24 hours prior to the webinar in order for staff to determine if space is available. If Commission staff is not contacted, priority for available webinar space will be given to committee members.

5.2 Materials Distribution

Meeting materials will be distributed to committee members prior to committee meetings via email or FTP site, if necessary. Agendas and documents for public review will be available via the Commission website. Draft materials with preliminary content and/or with confidential data will not be distributed outside of the committee. The Chair will explain at the outset of meetings that all data and analyses are preliminary and not to be shared until they have been finalized and distributed to the appropriate Board/Section.

5.3 Roles of Chair and Vice-chair at Meetings

It is the responsibility of the Chair of the technical support group to conduct and facilitate meetings. Chairs will lead committees through agenda items in consultation with staff, including items requiring specific action. The TC Chair should assist in clarifying the details of any tasks assigned to the TC by the Board/Section. Assistance should also be provided in the development of the written charge, including all specific tasks, the deliverable expected, and a timeline for presentation of results and/or recommendations to the Board/Section. The Chair should attend all Board/Section meetings and should be in frequent contact with the appropriate ISFMP staff. It is also the responsibility of the Chair of the technical support group to provide presentations to the relevant oversight committee on all findings and advice. All formal presentations should be conducted in a manner consistent with the guidance provided in 7.4.5.

The committee Chair is also responsible for clarifying the majority and/or minority opinions, where possible. **The overall goal of all technical support groups is to develop recommendations through consensus.** The Chair is responsible for facilitating committee discussion toward reaching a consensus recommendation for Board/Section consideration. If a consensus cannot be reached the committee shall vote on the issue. The majority opinion shall be presented to the Board/Section as the recommendation, defined as a simple majority, including a record number of votes in favor, against, and abstentions. The committee will also present the minority opinion prepared by a committee member(s) that voted in the minority, to the Board/Section. **Voting should be used only as a last resort when full consensus cannot be reached**. The Commission will periodically conduct meetings management and consensus-building seminars for all Chairs and Vice-chairs of technical support groups, and others as appropriate. Chairs and Vice-chairs should attend these seminars in order to improve your ability to conduct efficient meetings, objectively facilitate discussions and development of consensus recommendations, and objectively represent opposing viewpoints.

The vice-chair will act as Chair when the Chair is unable to attend a meeting or conference call. It is the role of the vice Chair of committees to take meeting minutes that will be used to develop meeting summaries and committee reports. A member of the committee will be appointed by the Vice-chair to take minutes when the Vice-chair is acting as Chair.

5.4 Meeting Records

Meeting summaries are provided for all Commission committee meetings (a committee report or meeting minutes can serve as the meeting summary). If the Vice-chair is unable to take minutes or there is no Vice-chair, another committee member will be appointed to take minutes. Meeting summaries will be distributed by ISFMP staff to all committee members for review and modification. Meeting summaries should be finalized and approved by the committee no later than 60 days following the meeting. Draft meeting summaries will only be distributed to committee members for review. The Chair should ensure that all committee member comments are addressed prior to approval and public distribution of meeting summaries and committee reports.

Commission staff should ensure that meeting summaries of all Commission technical support groups are distributed to other appropriate support groups, including APs, TCs, LEC, and MSC. All

Board/Section meeting summaries, and appropriate documentation, should also be provided to technical support groups. Upon approval, these documents will also be posted to the Commission website.

5.5 Public Participation at Meetings

Public comment or questions at committee meetings may be taken at designated periods at the discretion of the committee Chair. In order for the committee to complete its agenda, the Chair, taking into account the number of speakers and available time, may limit the number of comments or the time allowed for public comment. The Chair may choose to allow public comment only at the end of the meeting after the committee has addressed all its agenda items and tasks. Where constrained by the available time, the Chair may limit public comment in a reasonable manner by: (1) requesting individuals avoid duplication of prior comments/questions; (2) requiring persons with similar comments to select a spokesperson; and/or (3) setting a time limit on individual comments. The Commission's public participation policy is intended to fairly balance input from various stakeholders and interest groups. Members of the public are expected to respectful of guidelines outlined in Section 6.6, meeting etiquette.

Members of the public may be invited to give presentations at committee meetings if the Board/Section has tasked the committee with reviewing their materials, or if members of the public have been invited in advance by the committee Chair to respond to a request from the committee for more information on a topic. Invitations will be offered in advance of the meeting. Public presentations will not be allowed without these invitations. See Section 8 for additional details regarding public participation in stock assessment data, assessment, and peer review workshops.

5.5.1 General Submission of Materials

Public submissions of materials for committee review outside of the benchmark assessment process must be done through the Board/Section Chair (see Section 4.0). The Chair will prioritize the review of submitted materials in relation to the existing task list. Materials provided by the public should be submitted to the Chair at least one month in advance of the meeting. A committee is not required to review or provide advice to the Board/Section on materials provided by the public unless it is specifically tasked to do so by the Chair in writing or from Board/Section. Materials will be distributed to committees by Commission staff.

5.5.2 Benchmark Assessment Submissions

The Commission welcomes the submission of data sets, models, and analyses that will improve its stock assessments. For materials to be considered at data or assessment workshops, the materials must be sent in the required format with accompanying methods description to the designated Commission Stock Assessment Scientist at least one month prior to the specific workshop at which the data will be reviewed; see Section 8.6.1. The Commission will issue a press release requesting submissions at the start of the assessment process. The press release will contain specific deadlines and submission requirements for materials to be considered in the benchmark stock assessment process.

5.6 Meeting etiquette

It is the role of the Chair to ensure participants (committee members and members of the public) are respectful of the following meeting guidelines. The Chair should stop a meeting if a participant is not following the guidelines. Commission staff should note when these guidelines are not being followed if the Chair does not do so. If a participant is being disruptive the Chair may ask the individual to leave the meeting.

- **Come prepared.** Read the past meeting summary prior to the meeting. Bring something to write on and with. All presenters should ensure their handouts, presentations, etc., are organized and complete.
- **Be respectful of others.** Hold your comments until the Chair asks for comments, unless open discourse throughout the meeting is encouraged. Do not interrupt other attendees. Wait to speak until the Chair recognizes you. Hold your side comments to others until a meeting break or after the meeting is adjourned. Side conversations are disruptive to other participants and inconsiderate of the group.
- **Mute electronics.** Turn all cell phones on vibrate or turn off completely. Do not answer your phone while in the meeting.
- **Attend the entire meeting.** Make travel arrangements to allow participation in the entire meeting. Early departure by committee members disrupts the meeting and impacts the development of consensus recommendations and decisions.

If complaints arise they can be brought to the Chair of the committee, Commission staff, or the Commission's Executive Director.

6.0COMMUNICATIONS POLICIES AND GUIDELINES

6.1 Email Policies

For the purposes of distributing draft committee documents, distribution will be limited to committee members. Non-committee members may request to receive notices of committee meetings, agendas, approved meeting summaries and final committee reports.

6.2 Recordings

Committee meetings are open for the public to attend and as such may be recorded (audio or video) by any participant (public or committee member) with notification to the Chair and staff prior to the start meeting, and so long as those recordings are not disruptive to the meeting. The Chair and/or staff will notify committee members prior to the start of the meeting that they will be recorded. Staff may record meetings for note taking purposes, but the official meeting record is the meeting summary or committee report. Staff recordings will not be distributed.

6.3 Webinars
While committee members are encouraged to attend all technical meetings in person, the Commission acknowledges occasional travel constraints or other impediments to attendance in person. If a committee member cannot attend a technical meeting in person, that member may request that a webinar be arranged to accommodate them. However, the Commission cannot guarantee that the audio or visual quality of the webinar will be sufficient to allow complete participation in the meeting by remote committee members. Committee members should contact Commission staff at least twenty-four hours in advance if they require a webinar, and those requests may be accommodated as feasible.

If a committee meeting is held via webinar (i.e., there is no in-person meeting), it shall be open to the public. As with in-person meetings, public comment or questions at committee webinars may be taken at designated periods at the discretion of the committee Chair (see Section 6.5 for more detailed guidance on public participation in committee meetings). Certain agenda items may not be open to the public; these include discussion of confidential data and preliminary model results. Non-committee members will be asked to leave before confidential issues are discussed. To ensure that enough bandwidth is reserved for the meeting, members of the public who wish to attend the webinar must contact staff 24 hours prior to the webinar to ensure there is available space.

Commission policy on meeting etiquette (Section 6.6) applies to webinars as well as in-person meetings. In addition, participants are asked to mute their phone lines when not speaking to reduce background noise that may disrupt the call.

Quarterly Commission Board Meetings are broadcast via webinar and information on listening to those meetings will be available via the Commission's website.

6.4 Reports
All reports developed by an Commission committee should include, at a minimum, the following components (1) the specific charge to the committee, (2) the process used by the committee to develop recommendations and/or advice, (3) a summary of all committee discussions, and (4) committee recommendations and all minority opinions. All committee reports are a consensus product of the committee, not an individual member.

6.4.1 Non-Committee Member Reports
Outside of the benchmark stock assessment process, a non-committee member may submit reports for committee review through the Board/Section Chair (see Section 6.5.1). The Board/Section Chair will determine if the report should be reviewed by the appropriate committee and specify tasks to be completed in the review. Non-committee reports will follow the same formatting guidelines and distribution procedures as Commission committee reports.

6.4.2 Distribution of Committee Reports
Draft committee reports will only be distributed to committee members. All committee member

comments should be addressed prior to approval and distribution of committee reports. Stock assessment and peer review reports will not be distributed publicly until the Board/Section receives and approves the reports for management use. Results of a stock assessment may not be cited or distributed beyond the committee before the assessment has gone through peer review and been provided to the Board/Section. Commission staff will distribute reports to the appropriate Boards/Sections and post committee reports on the website following Board approval.

6.4.3 Corrections to Reports

Corrections to published stock assessment reports can be made on rare occasions when mistakes are found after Board/Section approval. All corrections will be highlighted in yellow within the report. A new publication date will be added below the original publication date on the cover of the report, e.g., *Corrected on March 29, 2012.* An explanation of the correction will be included in the introduction or executive summary and highlighted.

6.4.4 Templates

Appendices 4, 6, 7, and 8 contain outlines for FMPs, addenda, amendments, FMP Reviews, and stock assessment and peer review advisory reports.

6.4.5 Presentations

Chairs and committee members will be responsible for presenting technical reports to Boards/Sections, APs, and other committees who may have a limited technical background. It is important to effectively present technical information to fishery managers and stakeholders in a straightforward and understandable manner.

All presentations should be developed using a Power Point template provided by Commission staff. Staff can assist in the development of presentations. A copy of the presentation should be provided to staff prior to the meeting. Presentations should be developed consistent with guidelines for other professional presentations, such as the American Fisheries Society. Some general guidelines include:

- Keep visuals simple, limit one idea per slide.
- Prepare figures and tables specifically for your presentation. Copies from manuscripts or papers usually contain too much detail for a presentation.
- When working with words, think brevity. Use a maximum of 6 words per line with 5 or 6 lines per slide. Use key phrases to emphasize important points.
- Tables should be simple with a maximum of 3 columns and 5 rows or vice versa.
- Graph/table values should be in a large enough font to be clearly viewed.
- Visuals appear confusing when too many colors are used; limit to 2 to 4 contrasting colors.

6.5 Board Meetings

Committee Chairs should present the committee report and answer any specific questions relevant to the report at Board/Section meetings. Committee Chairs may ask clarifying questions of the Board. They should not present their own viewpoints during Board/Section deliberations.

7.0STOCK ASSESSMENTS

7.1 Definitions

7.1.1 Stock Assessment Update

A **stock assessment update** consists of adding the most recent years of data to an existing, peer-reviewed, and Board-accepted stock assessment model without changing the model type or structure. Correction of mistakes in existing, peer-reviewed, and Board-accepted stock assessment models are permitted during an assessment update.

7.1.2 Benchmark Stock Assessment

The term **benchmark stock assessment** refers to either a new stock assessment or a stock assessment for which existing data inputs and model structure are modified and must therefore be subject to an external peer review. Benchmark changes to data, parameterization, and model type or structure are often made in response to previous peer review recommendations.

7.1.3 Peer Review

Peer review is the critical evaluation by independent (i.e., unbiased) experts of scientific and technical work products. In fisheries science, the periodic review of a stock assessment evaluates the validity of the assessment data, model, and assumptions used, and determines if the science conducted is adequate for informing management. A peer review by independent assessment peers that have had no involvement, stake or input into the assessment provides a judgment on the quality and completeness of the science used in a stock assessment. Peer reviewers are selected who have no conflict of interest with regard to the technical committee members or the fishery being assessed (see Appendix 5).

7.2 The Assessment Process

The ASC provides oversight for the benchmark data and assessment workshop process (see below), and the MSC provides oversight for the peer review workshop process. All changes to the assessment process are reviewed and approved by the ISFMP Policy Board.

The Commission plans and monitors stock assessments of all managed species via the long-term benchmark stock assessment and peer review schedule. The ASC reviews the schedule biannually to assist the ISFMP Policy Board in setting overall priorities and timelines for conducting all Commission stock assessments in relation to scientist workloads. The Policy Board is responsible for reviewing the schedule, prioritizing stock assessments, and approving the finalized schedule. The schedule is based on a recommendation by the ASC to conduct a benchmark stock assessment and peer review for all species every five years. The ASC and the ISFMP Policy Board should prioritize benchmark stock assessments and associated peer reviews based on the following criteria:

- Assessments for fisheries with unknown stock status
- Assessments for fisheries with new fishery management plans (FMPs)
- Assessments with a major change in the stock assessment data or model
- Assessments for existing FMPs undergoing amendments
- Assessment reviews for species that have not undergone an external review in at least five years

Using the approved schedule, Boards/Sections task TCs to conduct assessments. Once a stock assessment has been peer reviewed, the Chairs of the SAS and peer review panel will draft reports on the results of the stock assessment and peer review panel those reports will be sent to the Board/Section. The Board/Section considers acceptance of the reports for management use. If accepted, the Board may task the TC and AP to review the reports, perform follow-up tasks, and report back within a specified timeframe.

An alternative stock assessment for a Commission-managed species developed by external groups must be brought to the attention of the Board/Section Chair during a benchmark stock assessment process if the group would like their assessment to be considered for management use. Alternative assessments are subject to the same standards, documentation, and process as assessments developed by the Commission, including SAS, TC, and independent peer review. External groups must notify the Commission one month in advance of an assessment workshop regarding their interest in presenting an alternative assessment at the workshop. Any analyses submitted outside the benchmark process may not be considered for management until the next Commission benchmark assessment. For more details, see Section 8.6.2 below.

7.3 Assessment Frequency and Benchmark Triggers

Assessment frequency for a given species is recommended by the TC, keeping in mind FMP requirements and the biology of the species (especially the number of years necessary to begin to detect the anticipated effects of new management actions). Update assessments are conducted for a select group of Commission species and are performed on a regular schedule, typically every 1-3 years between benchmark assessments. Annual updates are generally not needed for species that are not overfished and overfishing is not occurring. Requests for additional update assessments may be made by the Board/Section to the Policy Board and are granted based on prioritization of the existing stock assessment schedule, relative workloads of assessment scientists, and available funding. Changes in stock indicators may trigger an update or benchmark assessment to be completed as outlined in the FMP, with TC consultation.

Before requesting an additional assessment, the Board/Section should task the SAS with determining if an update or benchmark assessment is warranted. If the SAS is unsure, the ASC may be consulted. In the case of multispecies models (MSVPA), MSTC, recommends the timing of a benchmark assessment for approval by the Policy Board, and updates of the model are performed before each menhaden assessment.

An assessment update will need to be converted to a benchmark assessment if a benchmark trigger occurs (see trigger examples below). The Policy Board must approve the scheduling of new benchmark assessments, including when new methods or data streams are presented. If scheduling a benchmark is not approved, the update will continue and will only use the previous methods and data streams. The Commission has employed a default five-year benchmark frequency to prevent excessive time from elapsing between peer reviews of each species assessment used by management. More or less time may be scheduled between benchmarks depending on the biology and management needs of the species. The following are examples actions that would trigger a benchmark (not inclusive):

- Change in stock unit definitions or boundaries.
- Change in model type
- Change in input data sources used (additions, deletions, major modifications)
- Change in input parameters (e.g., natural mortality, selectivity, steepness, etc.)
- Change in model configuration (e.g., estimation vs. specification of parameters, changes in stock-recruitment or selectivity parameterization, etc.)
- Appearance in update assessment of severe retrospective pattern or other diagnostics indicating a significant problem with the model that was not identified during the last peer review.
- Changes to reference point model or type

Requests for additional benchmark assessments and associated peer reviews may be made by the Board/Section to the Policy Board and are granted based on prioritization of the existing stock assessment and peer review schedule, relative workloads of assessment scientists, and available funding.

Assessments rejected at a peer-review should not undergo projections, updates, or benchmark assessment and peer review until the deficiencies identified by the review are addressed or a different model is used that is appropriate for the existing data. This is intended to: 1) match the assessment technique to the available data, rather than management requirements that exceed the available data, and 2) ensure that the necessary research/work is done to improve data for a species before conducting an assessment using a method that is appropriate with the available data. Species TCS should review and evaluate whether or not the assessment deficiencies identified in previously rejected assessments have been addressed. When making recommendations for the benchmark assessment and peer review schedule, the ASC will consider whether or not those deficiencies have been addressed.

On rare occasions an analytical error in a stock assessment is discovered after either peer review or management Board acceptance. Corrections to the assessment will be added to the previous versions of the accepted assessment report and highlighted in order to document the development of assessment results, including stock status (see Section 7.3.3 above). Simple errors in calculations that do not change the peer-reviewed structure of the data or model will not require additional review. Errors in model structure and primary inputs (e.g., survey indices, catch-at-age tables) will require review in the form of written correspondence from the original reviewers. The SAS and TC Chairs, Management Board Chair, and Commission Science Director will determine the need for and means of subsequent peer review.

Commission-managed species display numerous life history strategies and have data sets that vary greatly in quantity and quality. To reflect this variability, specific time lines should be set by each TC and Board/Section to account for the specific requirements of each species assessment. Planning should begin at least 24 months in advance of the expected peer review date. For species with no accepted benchmark stock assessment, the assessment process might need to begin as early as 36 months in advance of a scheduled peer review.

Should a SAS determine that an assessment is unable to meet its stock assessment timeline; the SAS Chair will present a revised time line and an explanation for the revised time line to the TC for review and possible approval. If the new time line is accepted by the TC then the TC Chair will go before the Board and explain the need for a new time line. The TC Chair, in consultation with the SAS Chair, will explain to the Board the TC's reasons for requesting a new time line. The Board will then vote to approve the new time line or continue with the established time line.

7.4 Data Confidentiality

State and federal laws requires all those who view or receive copies of confidential data have up-to-date clearance with the agency that provided the data. Confidential data access for each state and federal partners can be applied to through the ACCSP, for more information please visit public Data Warehouse section on confidentiality. All TC and SAS members and other workshop participants who wish to view confidential data should be prepared to prove their confidential data clearance status and explain the nature of the agreement before viewing or receiving confidential data. Data providers are responsible for identifying confidential data submitted to the Commission and fellow committee members or workshop participants. Confidential data should only be handled and viewed by those with the required clearance. Data presented to those who do not have appropriate clearance must be compiled so that confidentiality is maintained; if sharing or display of non-confidential data is not adequate for the TC or SAS to complete their tasks, portions of data and assessment workshops will be closed to the public.

7.5 Assessment Updates

Assessments updates typically consist of one or two SAS workshops to review updated data and modeling results, troubleshoot any problems that arise, and organize the report and presentation to the Board/Section. Once the update is complete, the TC holds a meeting or conference call to review the update report results, conclusions, and recommendations. All update SAS workshops are facilitated by the SAS Chair and all TC meetings are facilitated by TC Chair. The SAS will prepare the update assessment which is to be approved by the species TC prior to distribution to the Board/Section. For species managed cooperatively by the Commission and the regional councils, a stock assessment report may be developed by NOAA Fisheries Northeast or Southeast Fisheries Science Centers (NEFSC and SEFSC).

7.6 Benchmark Assessments

The SAS will prepare the benchmark assessment, which is to be approved by the species TC prior to peer review. For species managed cooperatively by the Commission and the regional councils, a stock assessment report will be developed by the NEFSC or SEFSC. Prior to the start of the benchmark assessment process, a meeting or conference call with the TC Chair, SAS Chair, and Commission staff will be conducted to initiate assessment planning, review the stock assessment checklist (Appendix 1), and develop a draft time line for subsequent assessment-related meetings and milestones. The TC, in consultation with the SAS, will draft the terms of reference for the assessment. Both the draft time line and draft terms of reference will be approved by the TC and presented to the Board/Section for approval. The Board/Section may modify the timeline, if necessary. Generic terms of reference for Commission benchmark assessment and peer review are provided in Appendix 2.

Prior to the start of a benchmark assessment, the species TC in consultation with the MSC and ASC, will determine the appropriate assessments needs including SAS membership, potential modeling approaches, and data needs. Integrated reviews will be considered for assessments that did not pass previous review, or passed with major recommendations for improvement. The integrated reviewer's recommendations will serve as supplementary expert guidance for the SAS to consider, and decide on whether alternative approaches should be pursued, or not. Further guidelines for the use of integrated reviewers can be found in the Commission's *Protocol for Integrated Peer Review*. The benchmark assessment process involves a minimum of three workshops, namely the data workshop, assessment workshop, and peer review workshop. Additional intermediate workshops, such as a Methods Workshop, may be conducted if necessary to complete the assessment. The Data Workshop is facilitated by the TC Chair, and the Methods and Assessment Workshops are facilitated by the SAS Chair.

7.6.1 Committee Member Roles and Responsibilities during a Stock Assessment

<u>Technical Committee (TC)</u>

TC Chair: Facilitate planning calls/webinars leading up to the Data Workshop and the Data Workshop itself. This includes keeping the TC on track and moving through the agenda during workshops and calls, facilitating committee discussion toward reaching consensus, and making sure decisions and action items are clearly stated. Consult with Commission Staff and SAS Chair to formulate an agendas for all workshops and calls/webinars. The TC chair also serves as a Stock Assessment Subcommittee member.

TC Vice-chair: Take meeting minutes that will be used to develop meeting summaries and committee reports; serve as chair during calls and meetings when the chair cannot attend (task another TC member with taking minutes in this event).

FMP Coordinator: Coordinate meeting and call/webinar logistics; in consultation with Stock Assessment Scientist, TC Chair and SAS Chair (as relevant) to develop meeting and call/webinar agendas.

Commission Stock Assessment Scientist: Provide technical support to TC and SAS; assist FMP Coordinators with organizing TC and SAS activities as needed; maintain and update stock assessment timeline as work progresses; serve as SAS member; coordinate data submissions and maintain all data submitted for the assessment; consult with FMP Coordinator and TC and SAS Chairs to formulate agendas for all workshops and calls/webinars; identify materials to be included with the agenda for review ahead of workshops and call/webinars.

ACCSP Data Lead: Work with TC members and agency data contacts to provide comprehensive landings time-series and special-use tools such as biosampling databases; assist TC and SAS members with acquiring access to confidential data and confirm all necessary members have access.

Technical Committee Members:

- Provide data from their jurisdiction (including universities) in the format requested by Staff. This includes but is not limited to fishery independent data (raw, tow-by-tow or haul-by-haul data and the state-calculated index, raw bio-sampling data including lengths and ages) and fishery dependent data (raw age and length data).
- Provide a description of the sampling programs that generated these data and the jurisdiction's opinion on the utility of each dataset and any caveats associated with its use.
- Attend planning calls/webinars leading up to the Data Workshop and participate in the Data Workshop. This includes presenting agency data and contributing to data decisions such as the inclusion or elimination of datasets and the treatment of all datasets considered for inclusion in the stock assessment.
- Provide additional data support throughout the assessment process, as needed by the SAS.
- Review the completed draft assessment report prepared by the SAS and provide feedback. Participate in the discussion about whether to accept the report and forward to the peer-review panel.

- ➔ Staff will work with the TC chair to develop a timeline for data submission to ensure that the assessment stays on track. During the planning process, TC members will have an opportunity to comment on the timeline and the data submission template to make sure that the necessary data are available by the proposed deadline (e.g., if the deadline is May 1, but age data for that year won't be available until June, let Staff know during the process). If data are not submitted in a timely manner, Staff will work with TC members and possibly Administrative Commissioners to find a solution.
- ➔ TC Members may also volunteer to conduct supporting analyses such as standardizing indices, developing catch-at-age, developing life history inputs, etc., as necessary to support the assessment, and would be responsible for providing the text, tables, and figures describing methods and results of those analyses, even if they are not members of the SAS.

<u>Stock Assessment Subcommittee (SAS)</u>

SAS Chair: Facilitate and lead SAS planning calls/webinars occurring after Data Workshop; facilitate the Method and Assessment Workshop(s); participate in the Data and Peer-Review Workshops as well as intermediary calls; consult with Commission Staff to formulate agendas for all workshops and calls/webinars; work with Science Staff to finalize the Stock Assessment Report; present the stock assessment to the TC and the Board for their approval

Lead Analyst: Take responsibility for developing and running the preferred model, if one has been identified; provide guidance on data needs and formats to facilitate data submission; provide the text, tables, and figures describing model structure and results, including characterizing uncertainty; participate in the Data, Methods, Assessment, and Peer-Review Workshops as well as intermediary calls.

Supporting Modelers: Take responsibility for developing and running complementary/supporting model(s); provide the text, tables, and figures describing model structure and results, including characterizing uncertainty; participate in the Data and Assessment Workshops as well as intermediary calls; participate at the Peer-Review Workshop if necessary.

Supporting Analysts: Conduct supporting analyses such as standardizing indices, developing catch-at-age, developing life history inputs, etc., as necessary to support the assessment; provide the text, tables, and figures describing methods and results of those analyses; update or develop other Stock Assessment Report sections as necessary; participate in the Data and Assessment Workshops as well as intermediary calls; participate at the Peer Review Workshop if necessary.

FMP Coordinator: Coordinate meeting and call/webinar logistics.

Commission Stock Assessment Scientist: Provide technical support to SAS by serving in one of the above positions; assist FMP Coordinators with organizing TC and SAS activities as needed; maintain and update stock assessment timeline as work progresses; coordinate data submissions and maintain all data submitted for the assessment

- ➔ The SAS is a small group of individuals and everyone involved needs to contribute to the roles above in order to complete the assessment on time. One individual taking on multiple roles (e.g., Lead Analyst and SAS Chair) is discouraged; however, if that is necessary, some responsibilities of those roles will be shifted to other SAS members to reduce the burden on that person. For assessments where a single preferred model has not been identified, and/or where multiple stocks are being assessed, the role of Lead Analyst will be shared by the SAS members responsible for the various models considered, and Supporting Modelers may not be necessary. If a SAS member is unable to complete their work in a timely fashion, Staff will reach out to the appropriate Administrative Commissioner to find a solution.

7.6.2 Data Workshop

The objectives of data workshops are to coordinate the collection, preparation, and review of available data. TC members are responsible for gathering and submitting data from their jurisdiction for stock assessments. This includes data from other agencies or institutions within their jurisdiction (e.g., inland divisions, academic institutions) as well as participating in commercial data review with ACCSP and the appropriate data contacts within their jurisdiction. Data workshop participants will include the TC, SAS, ISFMP staff, Science staff and ACCSP staff, and other interested or invited parties. For species with significant recreational harvest, staff from the Marine Recreational Information Program (MRIP) will be invited to attend the data workshop to present and review recreational fishing estimates and their PSEs. MRIP staff will also be asked to compare historical and current data collection and estimation procedures and to describe data caveats that may affect the assessment.

Stakeholders will be encouraged to attend Commission data workshops and share any information or data sets that might improve the stock assessment. A public announcement will be made prior to the data workshop to call for data and analyses of which the TC may not already be aware. Commission staff will send notifications to known interested parties soliciting data and inviting participation from a wide range of stakeholders, agencies, and academics to attend at their own expense. For data sets to be considered at the data workshop, the data must be sent in the required format, with accompanying methods description, to the designated Stock Assessment Scientist by the specified submission deadline.

Prior to the data workshop, data availability spreadsheets (Appendix 3) will be distributed by the Stock Assessment Scientist to all new data holders to obtain detailed descriptions of available data. For each data set identified, the Stock Assessment Scientist will distribute data submission instructions to data holders. All data holders should follow the requested formatting and metadata requirements and meet the data submission deadline for their data to be considered.
Data workshop products include a comprehensive database of acquired data sets, a table of data

sets and reasons for inclusion or exclusion, a timeline and task list with assignments, and a summary report documenting data decisions. After the data workshop, the drafting of the first five sections of the stock assessment report should begin (see Appendix 4). All decisions and recommendations will be documented by the TC Vice-chair or dedicated note taker. At the conclusion of the data workshop, if time permits, participants will initiate a discussion of the possible approaches for conducting the assessment based on available data; if the data are not finalized and/or there is not enough time to complete this discussion, a methods workshop (see Section 8.6.2) may be conducted to review potential stock assessment approaches in more depth. Participants will also assign tasks and due dates to prepare for the next workshop (methods or assessment workshop). If follow-up tasks are identified, participants will consider the necessity and timing of conference calls and webinars prior to the next workshop to provide input and feedback on work in progress. Commission staff will maintain all stock assessment data files, final reports, working papers and additional materials on a secure server at the Commission as well as an FTP site.

7.6.3 Methods Workshop

The objectives of the methods workshop (sometimes called Assessment Workshop I) are to finalize the data sets to be used in the assessment, to determine which methods make the best use of the available data to assess the stock, and to determine what metrics or reference points should be used to determine the status of the stock. The methods workshop is optional; species with well-established assessments may not need a methods workshop before the assessment workshop. Methods workshop participants shall include the SAS, TC Chair, and ISFMP and Science staff; TC members who are responsible for completing additional analyses assigned at the data workshop may also be invited to attend. All Commission meetings are open to the public. However, all participants will be responsible for abiding by confidentiality agreements for data used at the methods workshop and those without confidential access to data being presented will be asked to temporarily leave the room.

Additional data preparation and analysis tasks identified at the data workshop should be completed prior to the methods workshop so that the SAS may review the results and make a final determination on the inclusion and treatment of those datasets in the assessment. If additional relevant data are identified during or within two weeks after the data workshop, then the new data should be reviewed and approved at the methods workshop by the SAS. As a rule, data identified more than two weeks after the data workshop may not be considered, unless the SAS ascertains the addition of such data may have a significant impact on the assessment outcome. These data must meet the same quality standards as those provided on a timely basis through the data workshop. Late, missing, or unavailable data that are identified should be discussed to determine the impact on SAS's ability to conduct a comprehensive stock assessment, and may result in the delays in the completing the stock assessment.

Once the datasets for the assessment have been finalized, the SAS will discuss potential stock assessment approaches and select the method(s) or model(s) that make the best use of the available data. The SAS will identify a preliminary base case for each method or model, as well as sensitivity run configurations.

In addition to the assessment approach, the SAS will also discuss reference points and make a recommendation on the best metrics to evaluate stock status based on the available data and the output of the methods and models being considered.

At the conclusion of the methods workshop, a Lead Analyst will be assigned for the preferred model; if multiple stocks are being assessed, or a preferred method or model has not be identified, a Lead Analyst will be assigned for each stock or candidate method/model. Supporting analysts will also be assigned for supporting models and any additional follow-up work. Due dates for model runs will be established; initial model runs should be completed in advance of the assessment workshop so that the results can be reviewed at that workshop. Participants will consider the necessity and timing of conference calls and webinars prior to the assessment workshop to provide input and feedback on work in progress.

7.6.4 Assessment Workshop

The objectives of the assessment workshop are to rigorously evaluate the methods and stock assessment models developed, to ensure appropriate use of the data in models, and to determine the status of the fishery examined. Assessment workshop participants shall include the SAS and ISFMP and Science staff. All Commission meetings are open to the public. However, all participants will be responsible for abiding by confidentiality agreements for data used at the assessment workshop and those without confidential access to data being presented will be asked to temporarily leave the room.

Preliminary model runs should be performed before the assessment workshop to ensure proper model function and to minimize the time spent at workshops correcting computer issues. Conducting and reviewing model runs are the focal points of the assessment workshop.

SAS members will present on the stock assessment methods and models that have been developed. Data use, model formulation, results, diagnostics, and conclusions should be presented. Each analysis will be critically evaluated, a table of strengths and weaknesses of each approach will be constructed, and the SAS will select the best approach(es) for assessing the stock. It is recommended that other peer-reviewed models be explored in addition to the model(s) currently used in an assessment. The Commission encourages development of new models (ones that have not been peer reviewed). These exploratory models should be compared with existing peer-reviewed models and submitted as part of the peer-reviewed benchmark assessment. If the new model passes peer review, it can be used as the primary model.

Stakeholders will be encouraged to attend Commission assessment workshops and share any analyses that might improve the stock assessment. A public announcement may be made prior to the assessment workshop to call for analyses of which the SAS may not already be aware. For analyses to be considered for the assessment, the analyses must be sent in the required format, with accompanying methods description, to the Stock Assessment Scientist by the specified submission deadline. Anyone participating in the assessment workshop and presenting results from an analysis or assessment model is expected to supply all source code, executables, and input files used in the generation of those analyses or models along with a detailed methods description to ISFMP or Science staff by the specified submission deadline. These measures allow transparency and a fair evaluation of differences between models being considered.

7.6.5 Peer Review Workshop

The purpose of an external peer review is to obtain judgment of the value and appropriateness of the stock assessment for use in management and to provide recommendations for future research and assessment improvements. The peer review will not provide specific management recommendations.

The Commission may choose among 6 venues for conducting a peer review:

1. Commission Review Process
2. NEFSC's SAW/SARC or "research and operational assessment" process
3. SAFMC's SEDAR process
4. TRAC process
5. CIE desk review
6. Other formal review process using the structure of existing organizations (i.e., American Fisheries Society, International Council for Exploration of the Seas, National Academy of Sciences).

The SAW/SARC (Northeast) and the SEDAR (Southeast) processes will be utilized as fully as possible. The Commission staff will serve on the Northeast Coordinating Council (formerly the SAW Steering Committee) and the SEDAR Steering Committee.

The procedures and logistics for planning a stock assessment peer review are dependent on the type of review to be conducted. For information on options 2-6 above, consult the coordinating agency. For the Commission Review Process, the Science Director will initiate selection of the peer review panel. The ASC and SAS should provide suggestions on peer reviewers as soon as the final assessment workshop is complete. A small group of rotating MSC members (2-3 people) is to assist the Science Director in making the final decision on review panel membership. When possible, the MSC group should consist of representation by states outside the management range of the species. Criteria for selection of peer review panel members include:

- Knowledge of the life history and population biology of the species under review;
- Proficiency in utilizing quantitative population dynamics and stock assessment models;

- Knowledge of broader scientific issues as outlined in the terms of reference, and;
- Professional objectivity and credibility.

All peer reviewers participating on a Commission review panel must sign a conflict of interest statement in addition to the peer review panelist contract (Appendix 5). Panel members involved with the Commission's peer review must not have been involved with the Commission stock assessment and management process for the species under review. In addition, at least one panel member should be from outside the range of the species. Once reviewers are under contract to serve on the peer review panel, their names can be released upon request, but will not be posted on the website. Commission Science staff will advise that no contact be made between the panelists and SAS before the peer review workshop.

Terms of reference for the peer review will be developed by the TC and SAS at the initiation of the assessment. The terms of reference will be approved by the Board/Section. The approved stock assessment report for peer review and supporting documentation will be distributed by the Commission's Science Director to the peer review panel approximately four weeks prior to the review workshop. The Commission's Science staff will coordinate all review workshop logistics in consultation with panel members. Workshop information will be distributed by the Commission's Science Director.

The Commission peer review involves a multi-day meeting of the panel to review the stock assessment for a single species. Commission peer reviews will be coordinated by the Commission's Science Director. For Commission review workshops, the full SAS, Board/Section Chair, and AP Chair will be invited to attend the review. At review workshops, stakeholders may attend as observers and provide comment at the discretion of the Review Panel Chair. Only members of the TC, SAS, the review panel, and Commission staff will be invited to engage in discussions regarding the assessment.

The panel should select one member to serve as Chair of the review. Duties of the Panel Chair include focusing discussion on the issues of the review, developing consensus within the review panel, taking the lead role in writing the advisory report, and presenting the finalized advisory report to Commission Boards/Sections.

Panel members may request specific presentations of other issues, including minority opinions. Requests for presentations should be made to the Science Director prior to the review Workshop to allow the presenter ample preparation time.

The review workshop will include a period for the presentation of the stock assessment report and any additional presentations, a period of open discussion among the review panel and SAS, a period for the review panel to ask specific questions of the assessment and supplemental reports, and a closed session for the development of the advisory report. During a review workshop, minor edits to the stock assessment report can be made with the concurrence of the SAS Chair, Review Panel Chair, and Science Director, if edits do not change the intent of the report. If major edits are made, notification of the modified report will be sent to the TC for their approval. The final assessment report, made publicly available on the Commission website, will include highlighted changes and a description of how and why the document was changed from the version presented at the review workshop.

The review panel will develop an advisory report during the review workshop, or shortly thereafter. The report will address each term of reference individually as well as the advisory report requirements outlined in Appendix 6. The advice included in the report should be a consensus opinion of all review panel members. It is the Review Panel Chair's responsibility to ensure the contents of the advisory report provide an accurate and complete summary of all views on issues covered by the review. In the event consensus cannot be reached on an issue, the Chair will incorporate all reviewers' opinions in the report. Development of the advisory report will be coordinated by the Science Director or a designated Commission Stock Assessment Scientist.

If the review panel has questions or needs clarification on the stock assessment report, the questions should be directed to the Science Director, who will work with the SAS Chair to provide the panel with an answer. In certain situations, the panel may wish to communicate with the SAS before completing the advisory report, or before the Board/Section meeting. Post-review communication will be limited to Chair-to-Chair interaction, and the Science Director will be involved in those conversations.

The advisory report will be distributed to all relevant species committees (Board/Section, TC, SAS, AP) upon completion and approximately two weeks prior to presentation of the results. Advisory reports will not be distributed publicly, except for the meeting week briefing materials, until accepted by the Board/Section. Following distribution of the advisory report, the TC will review the advisory report findings and to evaluate the feasibility for each research recommendation made in the stock assessment and advisory reports. The TC shall provide the Board/Section with a timeline outlining the expected delivery of each item, ranging from 'ASAP to 'pending funding,' where applicable. The TC shall also indicate whether each item, once addressed, can be used in a future assessment update, or whether incorporating that item would trigger a benchmark assessment (see Section 8.3).

If the TC/SAS and the review panel cannot reach agreement, the following process for reconciling the differences between the review panel and the TC will be followed:

- Results of the peer review will be presented by the Review Panel Chair to the Board/Section.
- The Board/Section will refer the peer review results to the TC and SAS for review and action.
- The TC and SAS will revise the stock assessment report based upon the peer review advice. If the SAS and TC do not agree with the peer review advice, they will provide justification for not incorporating the advice, and provide alternate analyses.

- The final assessment, including the peer review and post-review actions, will be presented to the Board/Section by the TC.
- The Board/Section will make the final determination on status of stock and reference points.

For all reviews, after the Board/Section has received the presentation of the peer review results, the Board should indicate that it ‘accepts’ or ‘does not accept’ the stock assessment report and peer review advisory report for management use.

APPENDIX 1. GENERAL CHECKLIST FOR TRACKING PROGRESS OF COMMISSION BENCHMARK STOCK ASSESSMENTS

Pre-Assessment Leadership Webinar
Who: TC Chair and SAS Chair, Commission FMP Coordinator and Stock Assessment Scientist, and ACCSP Data Lead
When: Two years before scheduled peer-review

- ☐ Stock Assessment Scientist drafts timeline with milestones (Data, Methods and Assessment Workshops, related TC meetings, the peer review and report to Boards/Sections). The timeline will be presented to the TC and to the Board/Section for approval.
- ☐ Stock Assessment Scientist develops draft terms of reference to be distributed prior to the TC webinar.
- ☐ Review and discuss stock assessment process and policies. All should have read this document before meeting.
- ☐ Review and discuss the roles and responsibilities for participants of the benchmark workshops (Data, Methods, Assessment, and Peer Review).
- ☐ After the webinar, the FMP Coordinator will distribute draft terms of reference, draft timeline, and other relevant stock assessment materials to the TC and SAS.

Pre-Data Workshop Technical Committee Webinar
Who: TC and SAS, Commission FMP Coordinator and Stock Assessment Scientist, and ACCSP Data Lead
When: Timing is determined during pre-assessment webinar and will be several months in advance of data workshop
Facilitator: TC Chair

- ☐ TC Chair and Commission staff develop and distribute draft data workshop agenda, terms of reference and timeline prior to webinar
- ☐ Commission staff review goals and objectives of the benchmark stock assessment and peer-review process.
- ☐ Review SAS membership, edit, and forward to Board/Section for approval.
- ☐ Review draft terms of reference, edit, and forward to Board/Section for approval.
- ☐ Review draft assessment timeline, edit, and forward to Board/Section.
- ☐ Review draft Data Workshop agenda.
- ☐ Review data submission templates and distribute to the TC and SAS members. Set deadline for TC and SAS members to return data submission templates based on timing of data availability.
- ☐ Determine additional data sources to contact, as needed, including other state and federal agencies, universities, consulting agencies, utility companies, etc.
- ☐ Develop assignments and due dates for TC and SAS members and Commission staff for the Data Workshop. Each task should be assigned to a specific person with the date initially assigned and due date noted. Some specific tasks include:
    - For each data set, prepare data set for submission in proper format, provide a written

description of the methods, preliminary analyses, and metadata, and prepare a short presentation.
  - SAS chair should prepare a short presentation reviewing the previous stock assessments as a working paper, conduct or update the literature review (life history/habitat and other relevant work).
- ACCSP Data Lead identifies members of TC and SAS who may need to obtain confidential data clearance, remind all members of confidentiality rules, and provide instructions on how to obtain confidential access, if needed.
- Finalize date and location for Data Workshop.

Data Workshop Preparation

When: Between pre-assessment TC webinar and Data Workshop

- Stock Assessment Scientist sends data submission template and Data Workshop announcement to newly identified data holders. Staff also requests that these data holders submit data, working paper and presentations prior to data workshop. Commission staff will provide data submission instructions to additional data holders that respond to initial inquiry.
- Stock Assessment Scientist compiles data submitted by TC and SAS members, as well as other identified data holders.
- Stock Assessment Scientist sends data workshop FTP instructions to TC and SAS.
- Stock Assessment Scientist makes data submissions available to TC members (with proper confidential access, as appropriate).
- FMP Coordinator forwards recommended SAS membership, and draft assessment time line and terms of reference to board/section.
- Stock Assessment Scientist and SAS Chair track data submission and assignment progress.
- Commission staff work with TC Chair to develop and distribute data workshop agenda.
- ACCSP Data Lead monitors progress of data confidential access requests.

Data Workshop

Who: TC and SAS, Commission FMP Coordinator and Stock Assessment Scientist, ACCSP Data Lead, invited data holders and interested stakeholders.

When: Timing determined at pre-assessment meeting, about 3-6 months after TC webinar.

Facilitator: TC Chair

- Review goals and objectives of data workshop and terms or reference.
- Review summary of previous stock assessments.
- Review summary of literature review (life history/habitat and other relevant work).
- Review all data sets.
- Develop preliminary list of included and excluded data sets.
- Develop list of data analysis and report-writing assignments and due dates; form working groups if necessary to complete additional analyses.
- Determine SAS assignments and due dates for methods workshop and/or assessment workshop if applicable (additional data analyses, modeling approaches); determine timing for follow-up webinars, if necessary.

- ☐ Finalize date and location of methods and assessment workshops.

Post-Data Workshop Follow-Up Webinar(s)
Who: TC and SAS and/or working group members, FMP Coordinator and Stock Assessment Scientist, ACCSP Data Lead as necessary, invited data holders as necessary
When: Timing determined at data workshop
Facilitator: SAS Chair

- ☐ Review progress on additional data analyses requested at the Data Workshop.
- ☐ Provide feedback to analysts and address questions or issues that have arisen.

Methods Workshop Preparation

- ☐ TC chair, SAS chair, and Commission FMP Coordinator and Stock Assessment Scientist compile data components of assessment report.
- ☐ FMP Coordinator sends assignments and due date reminders to SAS.
- ☐ SAS and TC members complete assigned tasks and submit results by the due date.

Methods Workshop
Who: SAS, FMP Coordinator and Stock Assessment Scientist
When: Timing determined during pre-assessment workshop meeting
Facilitator: SAS Chair

- ☐ Review goals and objectives of methods workshop and terms of reference.
- ☐ Review any additional data analyses, and conduct final evaluation of each data set for use in assessment and list reasons data sets were included or not.
- ☐ Determine best approach or approaches for assessing stock.
- ☐ Determine most appropriate reference points for establishing stock status.
- ☐ Determine SAS assignments and due dates for assessment workshop.
- ☐ Determine timing for follow-up webinars, if necessary.

Post-Methods Workshop Follow-Up Webinar(s)
Who: SAS, FMP Coordinator and Stock Assessment Scientist
When: Timing determined at methods workshop
Facilitator: SAS Chair

- ☐ Review progress on modeling analyses determined at the methods workshop
- ☐ Provide feedback to analysts and address questions or issues that have arisen

Assessment Workshop Preparation

- ☐ Stock Assessment Scientist ensures finalized datasets are available to SAS on FTP site.
- ☐ TC chair, SAS chair, and Commission FMP Coordinator and Stock Assessment Scientist finalize data components of assessment report. FMP Coordinator sends draft report to SAS.
- ☐ FMP Coordinator sends assignments and due date reminders to SAS.
- ☐ SAS and TC members complete assigned tasks and submit results by the due date.
- ☐ Fisheries Science Director and Stock Assessment Scientist begin identifying review panel

members if Commission peer review is the selected venue.

Assessment Workshop
Who: SAS, Commission FMP Coordinator and Stock Assessment Scientist
When: Timing determined during pre-assessment workshop meeting
Facilitator: SAS Chair

- ◻ Review goals and objectives of assessment workshop and terms of reference.
- ◻ Review continuity run of previously accepted assessment model, if available.
- ◻ Review model runs, sensitivity analyses, model diagnostics, and uncertainty estimates, as appropriate.
- ◻ Decide on base case of preferred and supporting model(s), and any additional sensitivity runs.
- ◻ Develop consensus recommendation of stock status.
- ◻ Develop prioritized research recommendations.
- ◻ Develop list of follow-up analyses to complete base case model runs and sensitivity runs.
- ◻ Assign tasks for writing up final sections of draft stock assessment report.

Post-Assessment Workshop Follow-up

- ◻ SAS members complete final writing assignments for stock assessment report.
- ◻ Stock Assessment Scientist works with FMP Coordinator to assemble the first draft of the full assessment report.
- ◻ SAS chair and FMP Coordinator make final edits to full report; this draft report is sent to the SAS for review.
- ◻ SAS approves the report for TC review via a call/webinar.
- ◻ FMP Coordinator plans full TC meeting to review and approve stock assessment report.
- ◻ FMP Coordinator sends stock assessment report to TC two to four weeks prior to meeting.
- ◻ Fisheries Science Director finalizes peer review panel and Review Workshop logistics for ASMFC External Reviews.

Technical Committee Review of Stock Assessment Report
Who: TC, SAS Chair, Lead Analyst, Commission FMP Coordinator and Stock Assessment Scientist
Facilitator: TC Chair

- ◻ SAS chair and lead analyst(s) presents terms of reference and final stock assessment report.
- ◻ TC reviews assessment and either approves the stock assessment report for peer review or returns it to the SAS to address TC concerns.
- ◻ If the stock assessment report is approved by the TC, it will be distributed to the appropriate peer review venue.
- ◻ If the stock assessment report is not approved by the TC, then the TC will return the report with comments to the SAS. The SAS will address the comments and re-submit the report to the TC for its approval.

Preparation for Peer Review

- ◻ Stock assessment report and supporting materials submitted to review panel one month

before review meeting.
- ◻ SAS chair and other SAS members prepare presentations for the review workshop.

Pre-Review Workshop Webinar
Who: SAS, Commission FMP Coordinator, Stock Assessment Scientist, Fisheries Science Director, and Review Panel
When: 1-2 weeks before Review Workshop
Facilitator: Science Director
- ◻ SAS chair or Stock Assessment Scientist provides a brief overview of the assessment.
- ◻ Review Panel identify questions or areas they would like more details on during the Review Workshop.
- ◻ Review agenda for Review Workshop.

Review Workshop
Who: SAS Chair, 1-3 SAS members as necessary, Commission FMP Coordinator and Stock Assessment Scientist and Science Director, Review Panel, Board Chair
- ◻ SAS chair and other SAS members present assessment to peer review panel and conduct additional analyses from panel's prioritized list as time allows.

Post-Review Workshop
- ◻ SAS and panel chairs prepare presentations for board
- ◻ FMP Coordinator and Stock Assessment Scientist finalize stock assessment report and Science Director finalizes peer-review report for Commission Meeting Materials.
- ◻ Follow-up TC webinar held if issues arise that need to be addressed before board/section meeting.
- ◻ Stock Assessment Scientist drafts layman's stock assessment overview to accompany board/section meeting press releases.

Board/Section Meeting
- ◻ SAS chair and/or Lead Analyst, and panel chair presents to board/section.
- ◻ Board/section accepts or does not accept assessment and review for management; additional tasking of SAS or TC may occur in response to assessment and review.

Post-Board/Section Meeting
- ◻ Final edits to assessment and peer-review reports and stock assessment overviews conducted and all relevant documents placed on website.
- ◻ Stock Assessment Scientist files final draft of stock assessment report, all working papers, all data sets and other stock assessment materials on secure server.
- ◻ TC evaluates the feasibility and timeline for each research recommendation made in the stock assessment report and peer-review report; determines whether each item, once addressed, can be used in a future assessment update, or whether it will require a benchmark assessment.

APPENDIX 2. GENERIC TERMS OF REFERENCE

Generic ASMFC Terms of Reference for Stock Assessment Process

1. Characterize precision and accuracy of fishery-dependent and fishery-independent data used in the assessment, including the following but not limited to:
    i. Provide descriptions of each data source (e.g., geographic location, sampling methodology, potential explanation for outlying or anomalous data)
    ii. Describe calculation and potential standardization of abundance indices.
    iii. Discuss trends and associated estimates of uncertainty (e.g., standard errors)
    iv. Justify inclusion or elimination of available data sources.

2. Discuss the effects of data strengths and weaknesses (e.g., temporal and spatial scale, gear selectivities, aging accuracy, sample size) on model inputs and outputs.

3. Review estimates and PSEs of MRIP recreational fishing estimates. Request participation of MRIP staff in the data workshop process to compare historical and current data collection and estimation procedures and to describe data caveats that may affect the assessment.

4. Develop models used to estimate population parameters (e.g., F, biomass, abundance) and biological reference points, and analyze model performance.
    a. Describe stability of model (e.g., ability to find a stable solution, invert Hessian)
    b. Justify choice of CVs, effective sample sizes, or likelihood weighting schemes.
    c. Perform sensitivity analyses for starting parameter values, priors, etc. and conduct other model diagnostics as necessary.
    d. Clearly and thoroughly explain model strengths and limitations.
    e. Briefly describe history of model usage, its theory and framework, and document associated peer-reviewed literature. If using a new model, test using simulated data.
    f. If multiple models were considered, justify the choice of preferred model and the explanation of any differences in results among models.

5. State assumptions made for all models and explain the likely effects of assumption violations on synthesis of input data and model outputs. Examples of assumptions may include (but are not limited to):
    a. Choice of stock-recruitment function.
    b. No error in the catch-at-age or catch-at-length matrix.
    c. Calculation of M. Choice to use (or estimate) constant or time-varying M and catchability.
    d. Choice of equilibrium reference points or proxies for MSY-based reference points.
    e. Choice of a plus group for age-structured species.
    f. Constant ecosystem (abiotic and trophic) conditions.

6. Characterize uncertainty of model estimates and biological or empirical reference points.

7. Perform retrospective analyses, assess magnitude and direction of retrospective patterns detected, and discuss implications of any observed retrospective pattern for uncertainty in population parameters (e.g., F, SSB), reference points, and/or management measures.

8. Recommend stock status as related to reference points (if available). For example:
    a. Is the stock below the biomass threshold?
    b. Is F above the threshold?

9. Other potential scientific issues:
    a. Compare trends in population parameters and reference points with current and proposed modeling approaches. If outcomes differ, discuss potential causes of observed discrepancies.
    b. Compare reference points derived in this assessment with what is known about the general life history of the exploited stock. Explain any inconsistencies.

10. If a minority report has been filed, explain majority reasoning against adopting approach suggested in that report. The minority report should explain reasoning against adopting approach suggested by the majority.

11. Develop detailed short and long-term prioritized lists of recommendations for future research, data collection, and assessment methodology. Highlight improvements to be made by next benchmark review.

12. Recommend timing of next benchmark assessment and intermediate updates, if necessary relative to biology and current management of the species.

Generic ASMFC Terms of Reference for External Peer Review

1. Evaluate the thoroughness of data collection and the presentation and treatment of fishery-dependent and fishery-independent data in the assessment, including the following but not limited to:
    a. Presentation of data source variance (e.g., standard errors).
    b. Justification for inclusion or elimination of available data sources,
    c. Consideration of data strengths and weaknesses (e.g., temporal and spatial scale, gear selectivities, aging accuracy, sample size),
    d. Calculation and/or standardization of abundance indices.

2. Evaluate the methods and models used to estimate population parameters (e.g., F, biomass, abundance) and biological reference points, including but not limited to:
    a. Evaluate the choice and justification of the preferred model(s). Was the most appropriate model (or model averaging approach) chosen given available data and life history of the species?

b. If multiple models were considered, evaluate the analysts' explanation of any differences in results.
c. Evaluate model parameterization and specification (e.g., choice of CVs, effective sample sizes, likelihood weighting schemes, calculation/specification of M, stock-recruitment relationship, choice of time-varying parameters, plus group treatment).

3. Evaluate the diagnostic analyses performed, including but not limited to:
    a. Sensitivity analyses to determine model stability and potential consequences of major model assumptions
    b. Retrospective analysis

4. Evaluate the methods used to characterize uncertainty in estimated parameters. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

5. If a minority report has been filed, review minority opinion and any associated analyses. If possible, make recommendation on current or future use of alternative assessment approach presented in minority report.

6. Recommend best estimates of stock biomass, abundance, and exploitation from the assessment for use in management, if possible, or specify alternative estimation methods.

7. Evaluate the choice of reference points and the methods used to estimate them. Recommend stock status determination from the assessment, or, if appropriate, specify alternative methods/measures.

8. Review the research, data collection, and assessment methodology recommendations provided by the TC and make any additional recommendations warranted. Clearly prioritize the activities needed to inform and maintain the current assessment, and provide recommendations to improve the reliability of future assessments.

9. Recommend timing of the next benchmark assessment and updates, if necessary, relative to the life history and current management of the species.

10. Prepare a peer review panel terms of reference and advisory report summarizing the panel's evaluation of the stock assessment and addressing each peer review term of reference. Develop a list of tasks to be completed following the workshop. Complete and submit the report within 4 weeks of workshop conclusion.

APPENDIX 3. EXAMPLE DATA AVAILABILITY SPREADSHEETS

Introduction

Overview

* The purpose of this request is to develop a catalog of the types of fisheries-dependent and fisheries-independent data available on SPECIES X. An evaluation of the available data will serve as a starting point for the selection of stock assessment methods. Prior to the Data Workshop, the Stock Assessment Subcommittee will put forth a request for the necessary data, including the preferred format for data submission.

Directions

* For ***each*** source of data available from your state/jurisdiction (including historical data sets), please fill-in the appropriate sheet as described below.
The forms on the following sheets are intended to assist with the stock assessment process. The data sources described in the 'Key' sheet represent the types of information typically collected by the states/jurisdictions.

Additional Information

* Please review the 'Additional Info' sheet and provide responses where appropriate. For each item, provide contact information for individuals who manage each data set.

Please submit a completed data availability file for your state to Pat Campfield at pcampfield@asmfc.org

Key

Species X Data Availability by State

Years Available - include the range of years in which data are available; if there are breaks in a time series, please describe missing years in N**otes**

if Gear Type, Units Effort, or other data became available after the time series started, identify the first year this information is available (e.g., counts, lengths taken throughout the time series; started collecting ages later)

Temporal Resolution - check a box describing level of detail (select one only)

date - check if full date known

season - check if only season (Spring, Summer, Fall, Winter) and year are known

year - check if only the year landed, caught in survey, etc. is known

Spatial Resolution - check a box describing level of detail (select one only)

latitude and longitude - check if detailed coordinates known

NMFS statistical area - check if area known, but greater detail (lat/long) unknown

state waters - check if only the state in which fish were landed, caught, etc. is known

Gear Type - check if fishery or survey gear (trawl, pound net, etc.) is known

Units Effort - check if some measure of effort (tow duration, hours net set, catch per day, etc.) is known and can be used to calculate CPUE

Counts - check if number of individuals in each sample

known **Weight** - check if individual or aggregate

sample weights known **CPUE** - check if pre-calculated

CPUE is available

Sex - check if sex was determined for some or all of sampled fish (i.e., mature individuals)

Subsample - check if sub-sample size used to estimate landings, discards, survey tow total catch, etc. is known

Variance - check if pre-calculated measure of variance is available

File Type - are the data in SAS, xls, Access, ascii, field sheets, etc?

Notes - provide more details to clarify available data

(e.g., length measurements in FL; scale or otolith age samples)

Commercial Data

Source:	Commercial Fishery	YEARS AVAILABLE		TEMPORAL RESOLUTION			SPATIAL RESOLUTION			GEAR TYPE	UNITS EFFORT	DATA								File Type	NOTES
TYPE	INFO	From	To	date	season, yr	year only	lat / long	NMFS stat area	state waters			Counts	Lengths	Weights	Ages	Sex	CPUE	Subsample	Variance		
Landings	ME																				
	NH																				
	MA																				
	RI																				
	CT																				
	NY																				
	NJ																				
	DE																				
	PA																				
	MD																				
	VA																				
	NC																				
	SC																				
	GA																				
	FL																				
	NMFS																				
Discards	ME																				
	NH																				
	MA																				
	RI																				
	CT																				
	NY																				
	NJ																				
	DE																				
	PA																				
	MD																				
	VA																				
	NC																				
	SC																				
	GA																				
	FL																				
	NMFS																				

Recreational Data

Source: Recreational Fishery		YEARS AVAILABLE		TEMPORAL RESOLUTION			SPATIAL RESOLUTION			GEAR TYPE	UNITS EFFORT	DATA								File Type	NOTES
TYPE	INFO	From	To	date	season, yr	year only	lat / long	NMFS stat area	state waters			Counts	Lengths	Weights	Ages	Sex	CPUE	Subsample	Variance		
Landings	ME																				
	NH																				
	MA																				
	RI																				
	CT																				
	NY																				
	NJ																				
	DE																				
	PA																				
	MD																				
	VA																				
	NC																				
	SC																				
	GA																				
	FL																				
	NMFS																				
Discards	ME																				
	NH																				
	MA																				
	RI																				
	CT																				
	NY																				
	NJ																				
	DE																				
	PA																				
	MD																				
	VA																				
	NC																				
	SC																				
	GA																				
	FL																				
	NMFS																				
eleased Alive	ME																				
	NH																				
	MA																				
	RI																				
	CT																				
	NY																				
	NJ																				
	DE																				
	PA																				
	MD																				
	VA																				
	NC																				
	SC																				
	GA																				
	FL																				
	NMFS																				
Total Catch	ME																				
	NH																				
	MA																				
	RI																				
	CT																				
	NY																				
	NJ																				
	DE																				
	PA																				
	MD																				
	VA																				
	NC																				
	SC																				
	GA																				
	FL																				

Fisheries-Independent Survey Data

Source: Fishery-Independent Surveys		YEARS AVAILABLE		TEMPORAL RESOLUTION			SPATIAL RESOLUTION			GEAR TYPE	UNITS EFFORT	DATA								File Type	NOTES
TYPE	INFO	From	To	date	season, yr	year only	lat / long	NMFS stat area	state waters			Counts	Lengths	Weights	Ages	Sex	CPUE	Subsampl e	Variance		
Catch	ME																				
	NH																				
	MA																				
	RI																				
	CT																				
	NY																				
	NJ																				
	DE																				
	PA																				
	MD																				
	VA																				
	NC																				
	SC																				
	GA																				
	FL																				
	NMFS																				

Example

Source: EXAMPLE Fishery-Independent Surveys		YEARS AVAILABLE		TEMPORAL RESOLUTION			SPATIAL RESOLUTION			GEAR TYPE	UNITS EFFORT	DATA								File Type	NOTES
TYPE	INFO	From	To	date	season, yr	year only	lat / long	NMFS stat area	state waters			Counts	Lengths	Weights	Ages	Sex	CPUE	Subsampl e	Variance		
Catch	ME	1985	present																	Excel	lengths in TL
	NH	1990	present	X					X	X		X	X	X	99	X				Excel	
	MA	1985	present	X					X	X		X								SAS	relative inde
	RI	2000	present	X				X		X	X	X	X	X	X	X	X	X	X	Excel	
	CT	1990	2002	X			X			X		X								SAS	
	NY	1990	2002		X			X		X		X	X	X	01					Excel	
	NJ	1995	present		X			X		X	X	X								Excel	Age-0 index
	DE	2002	2005			X		X		X		X	X	X	X					ascii	
	PA	1990	present			X			X	X		X								Access	
	MD	1980	present	X			X			X	X	X	X	X	X	X				Access, SAS	
	VA	1980	present	X			X			X	X	X								Access	late summe
	NC	1980	present	X			X			X	X	X	X	X	X	X	X	X	X	SAS	lengths in FL
	SC	1995	present	X			X			X	X	X	X	X	95	X	X	X	X	Excel	
	GA	1995	present			X		X		X	X	X								Excel	
	FL	1980	present			X		X		X	X	X								Access, SAS	movement,
	NMFS	1980	present	X			X			X	X	X	X	X	X	X	X	X	X	Excel	
				X				X		X	X	X	X	X	X	X	X	X	X		

Additional Information

ADDITIONAL INFORMATION

1. Is your state's **SPECIES X** regulatory history available? Please provide contact information for the best source of this information.

Contact Info

AGENCY ________________________________

CONTACT ________________________________

ADDRESS ________________________________

____

____

PHONE ____________________

FAX ____________________

E-MAIL ____________________

NOTES ________________________________

____

____

____

____

2. Are there additional sources of information or data sets from your state that would be useful for stock assessment? This could include discard mortality studies, natural mortality studies, stock identification studies, tagging studies, citation program data.

Data

SOURCE: ________________________________

TYPE: ________________________________

INFO: ________________________________

Contact Info

3. Does your state engage in **SPECIES X** stock enhancement? If yes, please provide the types of data collected in enhancement efforts and/or information for the appropriate contact.

Data

SOURCE: ________________________________

TYPE: ________________________________

INFO:

4. Are individual fish lengths-weights available for any data sources from your state?

Data

SOURCE:
TYPE:
INFO:

Contact Info

AGENCY

CONTACT

ADDRESS

PHONE

FAX

E-MAIL

NOTES

5. If age data are available for one or more of your state's data sources, are the age-length keys used to generate those data available?

Data

SOURCE:
TYPE:
INFO:

6. Are you aware of any SPECIES X socio-economic publications or data that would be useful for stock assessment or projections?

Data

SOURCE:

TYPE: ______________________________

INFO: ______________________________

Contact Info

AGENCY ______________________________

CONTACT ______________________________

ADDRESS ______________________________

____

____

PHONE ____________________

FAX ____________________

E-MAIL ____________________

NOTES ______________________________

____

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____

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APPENDIX 4. COMPONENTS OF THE ASSESSMENT REPORT

Acknowledgements

Executive Summary

Table of Contents

List of Tables

List of Figures

Terms of Reference
(written by SAS and approved by species technical committee and management Board)

1.0 Introduction
- 1.1 Brief Overview and History of Fisheries
- 1.2 Management Unit Definition
- 1.3 Regulatory History
- 1.4 Assessment History
  - 1.4.1 History of stock assessments
  - 1.4.2 Historical retrospective patterns

2.0 Life History
- 2.1 Stock Definitions (include tagging, genetic information, if available)
- 2.2 Migration Patterns
- 2.3 Age
- 2.4 Growth
- 2.5 Reproduction
- 2.6 Natural Mortality

3.0 Habitat Description
- 3.1 Overview – brief review of habitat requirements relevant to assessment results (e.g., temperature, depth, salinity, DO, pH, flow, substrate, vegetation)
  - 3.1.1 Spawning, egg, and larval habitat
  - 3.1.2 Juvenile and adult habitats

4.0 Fishery-Dependent Data Sources
- 4.1 Commercial (include all appropriate subsections - subsections may be removed or added as necessary)
  - 4.1.1 Data Collection and Treatment
    - 4.1.1.1 Survey Methods (including coverage, intensity)
    - 4.1.1.2 Biological Sampling Methods (including coverage, intensity)
    - 4.1.1.3 Ageing Methods

4.1.1.4 Catch Estimation Methods (e.g., catch-at-age)
4.1.2 Trends
4.1.2.1 Commercial Catch Rates (CPUE)
4.1.2.2 Commercial Landings
4.1.2.3 Commercial Length/Weight/Catch-at-Age
4.1.2.4 Commercial Discards/Bycatch
4.1.3 Potential Biases, Uncertainty, and Measures of Precision

4.2 Recreational (include all appropriate subsections - subsections may be removed or added as necessary)
4.2.1 Data Collection and Treatment
4.2.1.1 Survey Methods (including coverage, intensity)
4.2.1.2 Biological Sampling Methods (including coverage, intensity)
4.2.1.3 Ageing Methods
4.2.1.4 Catch Estimation Methods (e.g., catch-at-age or -length)
4.2.2 Trends
4.2.2.1 Recreational Catch Rates (CPUE)
4.2.2.2 Recreational Landings
4.2.2.3 Recreational Length/Weight/Catch-at-Age
4.2.2.4 Recreational Discards/Bycatch
4.2.3 Potential Biases, Uncertainty, and Measures of Precision

5.0 Fishery-Independent Data
5.1 Surveys (include all appropriate subsections - subsections may be removed or added as necessary)
5.1.1 Data Collection and Treatment
5.1.1.1 Survey Methods (including coverage, intensity)
5.1.1.2 Biological Sampling Methods (including coverage, intensity)
5.1.1.3 Ageing Methods
5.1.1.4 Catch Estimation Methods (e.g., catch-at-age or -length)
5.1.2 Trends
5.1.2.1 Catch Rates (Numbers)
5.1.2.2 Length/Weight/Catch-at-Age
5.1.2.3 Abundance and Biomass Indices (-per-unit effort)
5.1.3 Potential Biases, Uncertainty, and Measures of Precision

6.0 Methods
6.1 Background (on models and software used)
6.1.1 Assessment Model Description (discuss assumptions and any differences from previously published applications)
6.1.2 Reference Point Model Description (discuss assumptions any differences from previously published applications)
6.2 Configuration (include all appropriate subsections - subsections may be removed or added as necessary)

6.2.1 Assessment Model(s)
6.2.1.1 Spatial and Temporal Coverage
6.2.1.2 Selection and Treatment of Indices
6.2.1.3 Parameterization
6.2.1.4 Weighting of Likelihoods
6.2.1.5 Estimating Precision (e.g., ASEs, Likelihood profiling, MCMC)
6.2.1.6 Sensitivity Analyses
6.2.1.6.1 Sensitivity to Input Data
6.2.1.6.1 Sensitivity to Model Configuration
6.2.1.7 Retrospective Analyses
6.2.1.8 Projections
6.2.2 Reference Point Model(s)
6.2.2.1 Parameterization
6.2.2.2 Estimating Uncertainty
6.2.2.3 Sensitivity Analyses

7.0 Results (include all appropriate subsections - subsections may be removed or added as necessary)
7.1 Assessment Model(s)
7.1.1 Goodness of Fit
7.1.2 Parameter Estimates (include precision of estimates)
7.1.2.1 Selectivities and Catchability
7.1.2.2 Exploitation Rates
7.1.2.2 Abundance or Biomass Estimates
7.1.3 Sensitivity Analyses
7.1.3.1 Sensitivity to Input Data
7.1.3.2 Sensitivity to Model Configuration
7.1.4 Retrospective Analyses
7.1.5 Projection Estimates
7.2 Reference Point Model(s)
7.2.1 Parameter Estimates
7.2.2 Sensitivity Analyses (e.g., to M, selectivities)
7.3 Results Uncertainty (e.g., interpretation of alternate model results)

8.0 Stock Status (discuss current BRPs & any new proposed BRPs separately, if applicable)
8.1 Current Overfishing, Overfished/Depleted Definitions (define targets, thresholds, and control rules)
8.3 Stock Status Determination
8.3.1 Overfishing Status
8.3.2 Overfished Status
8.3.3 Control Rules
8.3.4 Uncertainty

9.0 Research Recommendations

10.0 Minority Opinion (if applicable)

  10.1 Description of Minority Opinion

  10.2 Justification from Majority (on why not adopted)

11.0 Literature Cited

12.0 Tables - suggested tables include the following:

Landings (numbers and weights)
Catch-at-Age
Lengths/Weights-at-Age
Fecundity/Maturation Schedule
Natural Mortality Schedule
Age-Length Keys
Survey or Index Values
Model Configuration and Inputs
Model Outputs, Parameter Estimates and Precision
Results (e.g., Abundance, Biomass, SSB, and Fishing Mortality)

13.0 Figures - suggested figures include the following:

Landings by Year, all states
Landings by Year, by state
Length/Weight-at-Age
Observed Survey Values by year
Observed and Predicted Survey Values by year
Residuals
Results (Abundance, Biomass, SSB) by year
Stock Abundance and Catch by year
Sensitivity Plots
Retrospective Plots

Appendices 1-X (if applicable)

APPENDIX 5. INSTRUCTIONS FOR PEER REVIEWERS AND CONFLICT OF INTEREST STATEMENT

Overview

The Atlantic States Marine Fisheries Commission (Commission) Benchmark Peer Review Process provides a framework for the critical evaluation by independent experts of fish population models upon which fishery management decisions are based. For full details, see the Commission document "Technical Support Groups Guidance and Benchmark Stock Assessment Process". The term benchmark stock assessment refers to an assessment that goes through an independent peer review. Benchmark assessments are prompted by new fishery management actions, a major change in stock assessment model or data, or a Commission or regional fishery management council time-trigger. Stock assessment reviews evaluate the validity of the models used, the input data, parameters, and model results, alternative assessment methods, and additional research needs. A review by independent assessment scientists that have no involvement, stake, or input into the assessment provides a judgment on the quality and completeness of the science used in a stock assessment. Peer review panel decisions are based on science; discussions and deliberations shall not consider possible future management actions, agency financial concerns, or social and economic consequences.

Preparation for the Review Workshop

In general, peer reviews are conducted within 6 to 8 weeks of the completion of the stock assessment report. A Commission stock assessment review panel is composed of 3-5 scientists (state, federal, university, or private). Review panel members should possess:

- Knowledge of the life history and population biology of the species under review
- Proficiency in utilizing quantitative population dynamics and stock assessment models
- Knowledge of broader scientific issues as outlined in the terms of reference, and
- Professional objectivity and credibility.

Panel members involved with a Commission peer review ***must not*** have involvement with the Commission stock assessment and management process for the species under review. In addition, at least one panel member should be from outside the range of the species.

The stock assessment report, all supporting materials, and instructions for peer reviewers will be distributed to the review panel by the Commission's Science Director one month before the review meeting. Reviewers shall read the documents to gain an in-depth understanding of the stock assessment, the resources and information considered in the assessment, and their responsibilities as reviewers. The Science Director will organize the review workshop in coordination with panel members and the SAS.

The Review Workshop

A Commission peer review involves a multi-day meeting of the review panel to evaluate the stock assessment for a single species. The full SAS, TC Chair and Vice-chair, Board/Section Chair and Vice-chair, and Chair and Vice-chair of the advisory committee should be invited to attend the review. Stakeholders shall be invited to attend Commission peer reviews, but not as panel members, and the review panel Chair will encourage public comment.

The workshop will begin with introductions and a short overview of the review workshop objectives presented by the Science Director. Panelists should then select one member to serve as panel Chair. Duties of the panel Chair include focusing discussion on the issues of the peer review, developing consensus within the review panel, taking the leading role in development of the advisory report, and presenting the finalized advisory report to appropriate Commission Boards/Sections.

The review workshop will include a period for the presentation of the stock assessment report and any additional presentations, a period of open discussion for all attendees, a period for the review panel to ask specific questions of the SAS, a closed door session for the review panel to reach consensus on the review, a period for the panel to review the major points of their consensus opinion on each term of reference with the SAS, and a closed door session for development of the advisory report. Presentation of the stock assessment report and any minority reports will occur on the first day(s) of the meeting. Panel members may request specific presentations on other issues. Requests for presentations should be made to the Science Director prior to the workshop to allow the presenter ample preparation time. During a review workshop, minor changes to the stock assessment report can be made with the concurrence of the Science Director, SAS Chair, and review panel Chair. Minor changes/results will appear as an appendix to the stock assessment report, and an explanation for the change will be referenced in the advisory report. Only clarifications will be allowed during the review workshop.

The review panel will develop and author an advisory report during the review workshop, or shortly thereafter. The findings and advice included in the advisory report will be a consensus opinion of all peer review panel members. Panels are expected to reach conclusions that all participants can accept, which may include agreeing to acknowledge multiple possibilities. It is the review panel Chair's responsibility to ensure the contents of the advisory report provide an accurate and complete summary of all views on issues covered by the review. In the event consensus cannot be reached on an issue, the Chair will incorporate all reviewers' opinions in the report.

Development of the advisory report will be coordinated by the Science Director or designated Fisheries Science staff. The report will include all content outlined in Appendix 1. Each term of reference will be addressed individually by number in Section II, including discussion of majority versus minority reports when present. A clear statement will be made indicating whether or not the task(s) outlined in each term of reference was satisfactorily completed by the SAS using the best available data and stock assessment methodology; specifically, is the assessment suitable for use by managers in exploring management options? The advisory report also includes advice on the issues listed in Appendix 1, Section III. Comments on topics not listed in Appendix 1 are encouraged and will be included in the Other Comments section.

If the review panel finds a term of reference deficient to the extent that SAS members present cannot correct the deficiencies during the course of the review workshop, or the SAS Chair deems that desired modifications would result in an alternative assessment, then the review panel shall reject that term of reference. If a term of reference is rejected, the panel should include in the advisory report 1) a justification for rejection (i.e., a complete description of the deficiency) and 2) specific, constructive suggestions for remedial measures or alternate approaches to correct the assessment.

Presentation of Peer Review Results
Results of the peer review will be presented within 4 weeks of the completion of the peer review. The advisory report will be distributed to all relevant committees (Board/Section, TC, SAS, AP) upon completion and approximately two weeks prior to presentation of the results. The results of the peer review will be presented by the Chair of the review panel to a meeting of the Board/Section.

The advisory report and presentation will not include specific management advice. The stock assessment report and the advisory report will be posted on the Commission website (www.asmfc.org) after acceptance by the Board/Section.

Commission Peer Review Code of Conduct

- Review panel decisions shall be based on science. Discussions and deliberations shall not consider possible future management actions, agency financial concerns, or social and economic consequences.
- Personal attacks will not be tolerated. Advancement in science is based on disagreement and healthy, spirited discourse is encouraged. However, professionalism must be upheld and those who descend into personal attacks will be asked to leave by Commission staff.
- Review panelists are expected to support their discussions with appropriate text and analytical contributions. Each panelist is individually responsible for ensuring their points and recommendations are addressed in workshop reports; they should not rely on others to address their concerns.
- Panelists are expected to provide constructive suggestions and alternative solutions; criticisms should be followed with recommendations and solutions.

Expectations of the Peer Review Process

The peer review WILL:

- Provide a judgment of the value and appropriateness of the science and scientific methods which produced the assessment
- Provide recommendations for future research and improvements of future assessments

- Evaluate all input parameters and biological characteristics incorporated into the model
- Evaluate the stock assessment methods
- Evaluate status of stocks relative to current FMP goals

The peer review WILL NOT:

- Resolve all issues
- Answer all questions
- Provide specific management recommendations
- Provide options to reach management targets

ATLANTIC STATES MARINE FISHERIES COMMISSION PEER REVIEWER CONFLICT OF INTEREST STATEMENT

The Commission stock assessment peer review process involves establishing a peer review panel composed of 3-5 scientists (state, federal, university, or private) who will provide judgment on the quality and completeness of the science used in the stock assessment. It is of the utmost importance that input provided by peer reviewers be unbiased.

Potential reviewers should declare themselves not eligible to serve on the review panel for the species under review if they have a relationship with persons involved in the assessment under review that might be construed as creating a conflict of interest.

Conflict of interest may include (but is not limited to):

- Involvement, stake, or input to the Commission stock assessment or with the management process for the species under review.
- Involvement with state, federal, or international management, the fishing industry, or any other interest group regarding the species under review.
- A well-formed position or history of advocacy for a specific viewpoint on a subject relevant to the stock assessment under review.
- Current association as a thesis or postdoctoral advisor or student of scientists involved in the stock assessment.
- Collaboration (within the last 3 years, currently, or planned) on a project, book, or paper with scientists involved in the stock assessment under review.
- Financial partnerships (consulting, business, or other financial connection) with the persons involved in the stock assessment under review.
- Spouse, child, or general partner relationship with scientists involved in the stock assessment under review.

I______ hereby certify, to the best of my knowledge, I do not have a conflict of interest and am not likely to give appearance of a conflict of interest, impropriety, or impairment of objectivity with respect to the stock assessment I am asked to review.

____

Signature Date

APPENDIX 6. ADVISORY REPORT OUTLINE

The advisory report will be developed by the review panel, with assistance from the Commission's Science staff. The report will provide an evaluation of each term of reference and be followed by an advisory section providing general scientific advice on the topics outlined. The advice included in the report should be a consensus opinion of all review panel members.

Standard Contents

I. *Introduction*

II. *Terms of Reference (addressed individually by number)*

III. *Advisory Section*

- Status of Stocks: Current and projected
- Stock Identification and Distribution
- Management Unit
- Landings
- Data and Assessment
- Biological Reference Points
- Fishing Mortality
- Recruitment
- Spawning Stock Biomass
- Bycatch
- Other Comments

IV. *Sources of Information*

V. *Tables*

VI. *Figures*

* for all sections, "information not available" should be indicated where appropriate

APPENDIX 7. FISHERY MANAGEMENT PLAN OUTLINE

DRAFT FMP OUTLINE
(approved by ISFMP Policy Board - May 1999)

This document outlines the contents of Commission FMPs developed by the ISFMP. It contains FMP elements required by the ISFMP Charter as well as suggestions on other sections, should information on these elements be available.

It is intended that this outline be a working document for use by PDTs, PRTs, and others in drafting, compiling, and reviewing FMPs as guidance in FMP development and implementation. The ISFMP Charter, Section Six, lists the required elements of a FMP.

This outline was adopted by the ISFMP Policy Board during the Spring Meeting in Atlantic Beach, North Carolina on May 20, 1999. Suggestions for additional changes to the FMP outline are welcomed and should be forwarded to ISFMP Staff.

EXECUTIVE SUMMARY
ACKNOWLEDGEMENTS/ FOREWORD TABLE
OF CONTENTS
LIST OF TABLES LIST
OF FIGURES

1.1 INTRODUCTION
- 1.2 Background Information
  - 1.2.1 Statement of the Problem
  - 1.2.2 Benefits of Implementation
    - 1.2.2.1 Social and Economic Benefits
    - 1.2.2.2 Ecological Benefits
- 1.3 Description of the Resource
  - 1.3.1 Species Life History
  - 1.3.2 Stock Assessment Summary
  - 1.3.3 Abundance and Present Condition
- 1.4 Description of the Fishery
  - 1.4.1 Commercial Fishery
  - 1.4.2 Recreational Fishery
  - 1.4.3 Subsistence Fishing
  - 1.4.4 Non-Consumptive Factors
  - 1.4.5 Interactions with Other Fisheries, Species, or Users
- 1.5 Habitat Considerations
  - 1.5.1 Habitat Important to the Stocks
    - 1.5.1.1 Description of the Habitat
    - 1.5.1.2 Identification and Distribution of Habitat and Habitat Areas of Particular Concern
    - 1.5.1.3 Present Condition of Habitats and Habitat Areas of Particular Concern
    - 1.5.1.4 Ecosystem Considerations

- 1.6 Impacts of the Fishery Management Program
  - 1.6.1 Biological and Environmental Impacts
  - 1.6.2 Social Impacts
    - 1.6.2.1 Recreational Fishery
    - 1.6.2.2 Commercial Fishery
    - 1.6.2.3 Subsistence Fishery
    - 1.6.2.4 Non-consumptive Factors
  - 1.6.3 Economic Impacts
    - 1.6.3.1 Recreational Fishery
    - 1.6.3.2 Commercial Fishery
    - 1.6.3.3 Subsistence Fishery
    - 1.6.3.4 Non-Consumptive Factors
  - 1.6.4 Other Resource Management Efforts
    - 1.6.4.1 Artificial Reef Development/Management
    - 1.6.4.2 Bycatch
    - 1.6.4.3 Land/Seabed Use Permitting
- 1.7 Location of Technical Documentation for FMP ***(refers reader to citations only)***
  - 1.7.1 Review of Resource Life History and Biological Relationships
  - 1.7.2 Stock Assessment Document
  - 1.7.3 Social Assessment Document ***(if available)***
  - 1.7.4 Economic Assessment Document ***(if available)***
  - 1.7.5 Law Enforcement Assessment Document ***(if available)***
  - 1.7.6 Habitat Background Document ***(if available)***

2.1 GOALS AND OBJECTIVES

- 2.2 History and Purpose of the Plan
  - 2.2.1 History of Prior Management Actions
  - 2.2.2 Purpose and Need for Action
- 2.3 Goals
- 2.4 Objectives
- 2.5 Specification of Management Unit
  - 2.5.1 Management Areas
- 2.6 Definition of Overfishing
- 2.7 Stock Rebuilding Program ***(if appropriate)***
  - 2.7.1 Stock Rebuilding Targets
  - 2.7.2 Stock Rebuilding Schedules
  - 2.7.3 Maintenance of Stock Structure
- 2.8 Resource Community Aspects
- 2.9 Implementation Schedule

3.1 MONITORING PROGRAM SPECIFICATIONS/ELEMENTS

- 3.2 Assessment of Annual Recruitment
- 3.3 Assessment of Spawning Stock Biomass
- 3.4 Assessment of Fishing Mortality Target and Measurement
- 3.5 Summary of Monitoring Programs
  - 3.5.1 Catch and Landings Information
  - 3.5.2 Biological Information
  - 3.5.3 Social Information
  - 3.5.4 Economic Information
  - 3.5.5 Observer Programs
- 3.6 Stocking Program ***(if appropriate)***

3.7 Bycatch Reduction Program
3.8 Habitat Program

4.1 MANAGEMENT PROGRAM IMPLEMENTATION
- 4.2 Recreational Fisheries Management Measures
- 4.3 Commercial Fisheries Management Measures
- 4.4 For-Hire Fisheries Management Measures
- 4.5 Habitat Conservation and Restoration
  - 4.5.1 Preservation of Existing Habitat
  - 4.5.2 Habitat Restoration, Improvement, and Enhancement
  - 4.5.3 Avoidance of Incompatible Activities ***(see sturgeon FMP)***
  - 4.5.4 Fisheries Practices ***(see sturgeon FMP)***
- 4.6 Alternative State Management Regimes
  - 4.6.1 General Procedures
  - 4.6.2 Management Program Equivalency
  - 4.6.3 *De minimis* Fishery Guidelines
- 4.7 Adaptive Management
  - 4.7.1 General Procedures
    - 4.6.1.1 Procedural Steps
  - 4.7.2 Circumstances Under Which Change May Occur
  - 4.7.3 Measures Subject to Change
  - 4.7.4 Schedule for State Implementation
- 4.8 Emergency Procedures
- 4.9 Management Institutions ***(Policy Bd, Mgmt Bd, TC, AP, etc.)***
- 4.10 Recommendations to the Secretaries for Complementary Actions in Federal Jurisdictions
- 4.11 Cooperation with Other Management Institutions ***(i.e., for Atl. herring - Cooperation with Canada)***

5.1 COMPLIANCE
- 5.2 Mandatory Compliance Elements for States
  - 5.2.1 Mandatory Elements of State Programs ***(as applicable)***
    - 5.2.1.1 Regulatory Requirements
    - 5.2.1.2 Monitoring Requirements
    - 5.2.1.3 Research Requirements
    - 5.2.1.4 Law Enforcement Requirements
    - 5.2.1.5 Habitat Requirements
  - 5.2.2 Compliance Schedule
  - 5.2.3 Compliance Report Content
- 5.3 Procedures for Determining Compliance
- 5.4 Recommended (Non-Mandatory) Management Measures
- 5.5 Analysis of Enforceability of Proposed Measures

6.1 MANAGEMENT AND RESEARCH NEEDS
- 6.2 Stock Assessment and Population Dynamics
  - 6.2.1 Biology/Community Ecology
- 6.3 Research and Data Needs
  - 6.3.1 Biological
  - 6.3.2 Social
  - 6.3.3 Economic
  - 6.3.4 Habitat

7.1 PROTECTED SPECIES

- 7.2 Marine Mammal Protection Act (MMPA) Requirements
- 7.3 Endangered Species Act (ESA) Requirements
- 7.4 Protected Species with Potential Fishery Interactions
- 7.5 Protected Species Interactions with Existing Fisheries
  - 7.5.1 Marine Mammals
  - 7.5.2 Sea Turtles
  - 7.5.3 Seabirds
- 7.6 Population Status Review of Relevant Protected Species
  - 7.6.1 Marine Mammals
  - 7.6.2 Sea Turtles
  - 7.6.3 Seabirds
- 7.7 Existing and Proposed Federal Regulations/Actions Pertaining to Relevant Protected Species
- 7.8 Potential Impacts to Atlantic Coastal State and Interstate Fisheries
- 7.9 Identification of Current Data Gaps and Research Needs

8.0 REFERENCES

9.0 APPENDICES

APPENDIX 8. FMP ADDENDUM OUTLINE

1.1 Introduction

- Management authority (state/federal waters)
- Management unit
- Amendment the document is working under
- Purpose/goal of the document (list out issues if there is more than one being considered in the document)

2.1 Overview

2.2 Statement of the problem

- Why the Board is considering a change in management
- This paragraph should be short, simple, and to the point

2.3 Background

- Events leading to the consideration for a change in management

3.1 Management Options

- If the management options are replacing a previous management action be sure to state upfront that this section will replace section X of Amendment/Addendum Y
- Almost always include status quo as first option
- Committee Recommendations/Comments (if necessary)

If there is more than one issue being considered you would repeat the three sections above **(3.1-3.2)**

4.1 Compliance

- Due dates for proposals, plan reviews, implementation dates

4.2 Recommendation for Federal Waters

- Not all plans will have this section

APPENDIX 9. FISHERY-INDEPENDENT DATA USE POLICY

(Approved by ISFMP Policy Board - May 2015)

Introduction

Data collected by fishery-independent sampling programs are commonly used in Commission stock assessments and provided to Stock Assessment Subcommittee and/or Technical Committee members. Providing raw data for Commission stock assessments is one purpose for which sampling information is used for the benefit of the public and Atlantic coast fisheries. Fishery- independent data also often support analyses outside of stock assessments, including analyses described in journal manuscripts with the intent of enhancing the scientific understanding of a species or ecosystem. Data used for both purposes may be collected by state agencies, federal agencies, or academic institutions. Because the Commission does not own fishery-independent datasets, the Data Use Policy defines how fishery-independent data are to be treated within and outside of Commission stock assessments. The objective of the Commission's Data Use Policy is to achieve the fullest potential for application of data to stock assessments in order to inform fisheries management decisions, while protecting the rights of data providers.

In Stock Assessments

In many cases, public dollars in the form of federal or state agency funding are used to support fishery-independent data collection. Therefore, raw data are to be made available to the Commission staff and SAS committee members for stock assessment purposes by any agency or institution whose sampling programs are publicly funded. For stock assessments and other technical analyses used to provide scientific advice to fisheries managers, Principal Investigators (PIs) are asked to provide raw catch, biological, tagging and other data to the lead assessment analyst for a given species, along with metadata detailing current and past sampling methodology. Expert assessment scientists on committees will consider methods and account for changes when developing new indices or other inputs to assessment models, a procedure required and regularly conducted in all stock assessments. Analysts will also communicate with the sampling program leads to ensure data are being applied, or excluded, appropriately. Fishery- independent summary data, metadata, and resulting analyses will be included in Commission Stock Assessment Reports. Principal Investigators and their institutions will be acknowledged in Reports and other presentations of assessment results for Commission purposes. The Reports are considered grey literature and do not violate duplicative publishing rules of scientific journals.

Outside of Stock Assessments

Committee members who have received copies of fishery-independent data as part of a Commission assessment may also be interested in using the data for non-assessment purposes. In such cases, authors of journal manuscripts or other analyses must communicate directly with all Principal Investigators/data collectors to obtain permission to use their data in journal publications or other non-assessment uses. Data requests from non-committee members to the Commission will be handled in the same manner; the requestor will be directed to the PIs to obtain raw data. The Commission is obligated to and will provide summary level data that are already included in assessment reports (e.g., index values, but not raw data). The Commission Stock Assessment Scientist or Fishery Management Plan Coordinator involved in the stock assessment at hand should be contacted to obtain lists of data collectors and their contact information, or if there are questions about the Data Use Policy in general. Responsibility for contacting PIs will be with the authors of manuscripts or non-assessment analyses.

Policy Relevance

Failure to adhere to the Commission's Data Use Policy jeopardizes the quality of stock assessments, in the event that PIs discontinue data sharing when their permission or rights in publishing have been violated. The Commission encourages open communication among committee members and scientists collecting fishery-independent data in order to both use data for fisheries assessment and management applications, and to promote the quality of research being conducted at fisheries science institutions.

Atlantic States Marine Fisheries Commission

Draft Work Group Meeting SOPPS

As Modified by the Executive Committee

In recent years, Commission management boards have established Work Groups (WG) to efficiently further explore complex management issues. The process and procedures in which individual WG and boards follow have varied by issue and/or board. As the practice to use WG to address issues by boards becomes more frequent, it is important standard policies and procedures are established so there is consistency and transparency in the process. Below are draft SOPPS for Executive Committee review.

Establishment

- WGs can be established by a Species Management Board or the ISFMP Policy Board.
- Membership should be a limited subset of Board members approved by the Chair of the Board or the Board itself. Ideally, members will represent diverse perspectives on the issue at hand. WGs can request non-Board members to provide information to the WG but will not be members of the WG itself.
- Each WG should have a designated Chair, to the extent possible Commission staff should not be the Chair of the WG. Chairs of the WG do not have to be the Board Chairs. The Board Chair will appoint the chair of the WG.
- The WG Chair will facilitate and lead all WG meetings and conference calls.
- The Board should fully describe the task or issue the work group is to address. There should be a clear directive of deliverables and established timeline to bring issues back for Board for review.
- Membership of a WG should be limited to ensure efficiency.

Purpose

- WGs are established when the Board needs extra time outside of quarterly meetings to work through an issue.
- WGs are not deliberative nor decision-making bodies of the Board. They are intended to explore and present a range of strategies that have the potential to address an issue the Board is trying to address.
- WGs are intended to deliver strategies to address issues for Board deliberation. Approaches the full Board believes have merit would then be fleshed out and analyzed by a technical committee or plan development team for further consideration.

Function

- At the start of each WG meeting the Chair should remind the WG of the task assigned by the Board.
- WG meetings and calls will be posted on the Commission web page at least 48 hours before each call. All meetings and calls are open to the public unless addressing confidential data.
- WG should be used to present ideas and engage in constructive discussion.
- WG members should reach out to other Board members for ideas, and the Board should reach out to WG members if they have ideas or are interested in an update on the progress of the WG.
- WG progress reports will be given to the Board at the mid-point between quarterly meetings when possible (via email) and at quarterly meetings by the WG Chair or Commission staff.
- All ideas from the WG should be presented to the Board, as well as key considerations for the Board to take into account.

National Fish Habitat Action Plan

Atlantic Coastal Fish Habitat Partnership

FY2020 PROJECT APPLICATION FORM

Please see application instructions located on the Atlantic Coastal Fish Habitat Partnership (ACFHP) website at: https://www.atlanticfishhabitat.org/fy2020-atlantic-coastal-fish-habitat-partnership-application-cycle/ to ensure that you correctly complete the application form.

Cover Page:

A. Project Title
B. Project Location (State, County, City, Congressional District)
C. ACFHP Subregion
D. Applicant Information
    i. Name of Organization
    ii. Executive Director
    iii. Address of Organization
    iv. Phone
    v. Fax
    vi. E-mail
    vii. Congressional district of applicant
    viii. DUNS Number and TIN

E. Project Contact
    i. Lead Project Officer and Title (if different from above)
    ii. Alternate contacts (if appropriate)
    iii. Address (if different from above)
    iv. Phone (if different from above)
    v. Fax (if different from above)
    vi. Email (if different from above)

F. U.S. Fish and Wildlife Service Coordination Information
    i. Date coordination began and Service involvement
        __ process grant/coop agreement __ assist with permit applications
        __ assist with project design __ provide heavy equipment operators
        __ provide engineer plans __ pre- and post- project monitoring
    ii. FIS Database Activity Number (obtained from Service contact)
    iii. Service Sponsoring Office
    iv. Name of Service contact
    v. Address
    vi. Phone
    vii. Email

    viii. Letter or email of support from Service contact

G. Funding Information

i. Funding being sought for: __ Construction, __Design, __Planning, __Monitoring, __Outreach
ii. Funding amount requested
iii. Total cost of the project
iv. Total Federal Matching
v. Total Non-Federal Matching

I. **Project Eligibility** (please answer 'yes' or 'no' to the following)**:**

A. Are the actions proposed mandated by a regulatory program, court order or decree?
B. Will any amount of the requested funds be applied to previous expenditures?
C. Will the requested funds be used for realty costs associated with the project?
D. Will the requested funds be used for operation or maintenance of facilities?
E. Is the project primarily a research study?
F. Will the requested funds be used for incentive payments (Annual payments to encourage participation (e.g. some NRCS Farm Bill programs))?

II. **Project Description and Scope of Work:**

A. Project description (max characters: 500)
B. Project footprint (if applicable) and affected area (max characters: 100)
C. For fish passage projects, provide the number of barriers between this project and the ocean.
D. Importance of the project to the resource (max characters: 350)
E. Problem and specific cause of the problem (max characters: 350)
F. The objective of the project with reference to the problem (max characters: 350)
G. Proposed methods (max characters: 350)
H. Additional Information (no character limits)
    a. Technical Design
    b. Permits
    c. Pre- and post-project monitoring
    d. Outreach

III. **Landscape Description of the Project:**

A. Provide **one** map of the project area
B. Provide the GPS coordinates for the project using UTM NAD 83
C. Provide digital pictures of the project area (up to five)
D. If applicable, describe how this project will reduce the impacts of climate change on fish or aquatic wildlife habitat.

IV. **Evaluation Questions:**

A. Does the project support or address an ACFHP Subregional Priority Habitat?
B. Does the project support or address an ACFHP fish habitat but not one that is a Priority for the Subregion in which this project resides?

C. Does the project address one or more of the ACFHP Habitat Conservation Objectives? *Please note that if you are applying for funding to enhance fish passage, you must submit separate proposals for each barrier (e.g. if you are removing a dam and fixing a culvert in the same river, you must submit two separate proposals).*
D. Is the project located in a priority area identified in an approved state or federal management plan?
E. How will the project address a root cause and contribute to a long-term, self-sustaining solution to the problem(s) described above?
F. Does the project address the habitat needs of trust species?
G. Using the Species-Habitat Matrix Tool, which life stages and fish species ranked high or very high in the habitat you are restoring, and will benefit from this project? (the table below is an example, please add/change line items as needed)**:**

Habitat Type	Species	Life Stage	Rank
Coastal Headwater Pond	Alewife	Egg & Larva	Very High
Coastal Headwater Pond	Alewife	Juvenile & YOY	Very High
Moderate Gradient Tributary	Alewife	Juvenile & YOY	Very High
Moderate Gradient Tributary	Alewife	Spawning Adult	Very High

H. Are there direct social or economic benefits of the project? If so, please describe those benefits.
I. If applicable, what is the project's rank in the following location-appropriate decision support tool (for fish passage projects): Southeast Aquatic Connectivity Assessment Program (SEACAP), Northeast Aquatic Connectivity Project, or Chesapeake Fish Passage Prioritization (see page 1 in the application instructions for more details)?

V. **Qualifications** (not to exceed 1 page total)**:**

VI. **Budget Table** (the budget table below is an example, please add/change line items as needed)**:**

Item	**Total Cost**	**ACFHP Requested Funds**	**Partner Funding**
Coordination			
Travel	$1,500		$1,500
Project Coordinator Salary to Monitor Contracts	$3,000		$3,000
Outreach/Education	$1,000		$1,000
Contracted Services			
Heavy Equipment Rental and Operation	$15,000	$5,000	$10,000

Contractual Labor	$30,000	$17,000	$13,000
Design and Permitting	$1,000		$1,000
Monitoring			
Pre- and post- project physical and biological monitoring	$5,000	$5,000	
Total Costs	$56,500	$27,000	$29,500

VII. **Partners** (the partner table below is an example, please add/change line items as needed (e.g. Maryland DNR instead of State Agency))**:**

Project Partner	Amount	Cash/In-Kind	Federal or Non-Federal	Pending/Received
State Agency	$10,000	Cash	Non-Federal	received
XYZ Foundation	$1,500	In-Kind	Non-Federal	pending
Federal Agency	$15,000	Cash	Federal	received
Watershed Association	$3,000	In-kind	Non-Federal	pending
Total	$29,500			

VIII. **Timeline of Project Activities** (the table below is an example, please add/change line items as needed)**:**

Project Activity	Anticipated Dates of Implementation
Project design	January 15-March 30, 20xx
Permitting process	February 25-June 1, 20xx
Pre-project monitoring	5 events, March 15-May15, 20xx
Construction	July 1-July 15, 20xx
ACFHP/Service Annual Report	January 15, 20xx
Post-project monitoring	1 year, beginning January 20xx

Atlantic States Marine Fisheries Commission

Business Session

Wednesday, August 7, 2019
10:30 – 10:45 a.m.
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Introductions (*J. Gilmore*)	10:30 a.m.
2.	Committee Consent • Approval of Agenda • Approval of Proceedings from May 2019	10:30 a.m.
3.	Public Comment	10:30 a.m.
4.	Consider Approval of Atlantic Cobia Amendment 1 **Final Action**	10:35 a.m.
5.	Consider Noncompliance Recommendations (if necessary) **Final Action**	10:40 a.m.
6.	Other Business/Adjourn	10:45 a.m.

The meeting will be held at the Westin Crystal City, 1800 S. Eads Street Arlington, Virginia 22202; 703.486.1111

Atlantic States Marine Fisheries Commission

Spiny Dogfish Management Board

August 7, 2019
11:00 a.m. - 12:00 p.m.
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Call to Order *(R. O'Reilly)*	11:00 a.m.
2.	Board Consent • Approval of Agenda • Approval of Proceedings from October 2018	11:05 a.m.
3.	Public Comment	11:10 a.m.
4.	Consider Draft Addendum VI for Public Comment (*K. Rootes-Murdy*) **Action**	11:20 a.m.
5.	Other Business/Adjourn	12:00 p.m.

The meeting will be held at the Westin Crystal City, 1800 S. Eads Street, Arlington, Virginia; 703.486.1111

MEETING OVERVIEW

Spiny Dogfish Management Board
August 7, 2019
11:00 a.m. – 12:00 p.m.
Arlington, Virginia

Chair: Rob O'Reilly (VA) Assumed Chairmanship: 10/17	Technical Committee Chair: Scott Newlin (DE)	Law Enforcement Committee Representative: Moran
Vice Chair: Chris Batsavage (NC)	Advisory Panel Chair: VACANT	Previous Board Meeting: October 23, 2018
Voting Members: ME, NH, MA, RI, CT, NY, NJ, DE, MD, VA, NC, NMFS, USFWS (13 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from October 2018

3. Public Comment – At the beginning of the meeting public comment will be taken on items not on the Agenda. Individuals that wish to speak at this time must sign in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Draft Addendum VI (11:20 a.m. – 12:00 p.m.) Action
Background • In 2018, the Board approved a 46% reduction to the commercial quota for the 2019/2020 fishing year based on the 2018 Stock Assessment Update that indicated a decline in biomass in recent years. • In May, the Policy Board recommended the Board initiate an addendum to consider allowing commercial quota transfers between regions to enable full utilization of the coastwide quota (**Briefing Materials**)
Presentations • Overview of draft Addendum VI for public comment by K. Rootes-Murdy
Board actions for consideration at this meeting • Approve draft Addendum VI for public comment

5. Other Business/Adjourn

Spiny Dogfish

Activity level: Low

Committee Overlap Score: low (some overlaps with Coastal Sharks)

Committee Task List
• TC – July 1st: Annual compliance reports due

TC Members: Scott Newlin (DE, TC Chair), Tobey Curtis (NOAA), Jason Didden (MAFMC),Lewis Gillingham (VA), Greg Skomal (MA), Mike Frisk (NY), Lee Paramore (NC), Conor McManus (RI), Greg Hinks (NJ), Angel Willey (MD), Matt Gates (CT), Kathy Sosobee (NOAA), Michael Frisk (NY), Matt Cieri (ME), Kirby Rootes-Murdy (ASMFC)

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

SPINY DOGFISH MANAGEMENT BOARD

The Roosevelt Hotel
New York, New York
October 23, 2018

These minutes are draft and subject to approval by the Spiny Dogfish Management Board.
The Board will review the minutes during its next meeting.

TABLE OF CONTENTS

INDEX OF MOTIONS

1. **Approval of agenda** by consent (Page 1).

2. **Approval of proceedings of October 2017 by consent** (Page 1).

3. **Move that the spiny dogfish quota for 2019-2020 be set at 20,522,832 pounds; 2020-2021 be set at 23,194,835 pounds; 2021-2022 be set at 27,421,096 pounds** (Page 9). Motion by Maureen Davidson; second by David Borden. Motion carried (Page 11).

4. **Move to establish a 6,000 lb. trip limit for the 2019-2021 fishing seasons for the northern region (Maine-Connecticut** (Page 11). Motion by David Borden; second by David Pierce. Motion carried (Page 11).

5. **Move to approve the nomination of Thomas Lyons (NH), Doug Freeney (MA), John Whiteside (MA), Scott MacDonald (VA) to the Spiny Dogfish Advisory Panel** (Page 12). Motion by Ritchie White; second by Ray Kane. Motion carried (Page 12).

6. **Move to nominate Chris Batsavage as Vice-Chair to the Spiny Dogfish Board** (Page 12). Motion by Mike Luisi; second by Ray Kane. Motion carried (Page 12).

7. **Move that the Spiny Dogfish Board explore the pros and cons of removing the federal trip limit with the intent to report to the Board at Winter Meeting. The Board requests that a letter be sent to the MAMFC requesting that federal trip limits be a 2019 priority item** (Page 14). Motion by David Borden; second by Ritchie White. Motion carried (Page 14).

8. **Motion to adjourn** by consent (Page 14).

ATTENDANCE

Board Members

Pat Keliher, ME (AA)
Steve Train, ME (GA)
Renee Zobel, NH, proxy for D. Grout (AA)
G. Ritchie White, NH (GA)
Sarah Ferrara, MA, proxy for Rep. Peake (LA)
David Pierce, MA (AA)
Raymond Kane, MA (GA)
David Borden, RI (GA)
Eric Reid, RI, proxy for S. Sosnowski (LA)
Justin Davis, CT, proxy for P. Aarrestad (AA)
Bill Hyatt, CT (GA)
Michael Falk, NY, proxy for Sen. Boyle (LA)
Emerson Hasbrouck, NY (GA)
Maureen Davidson, NY, proxy for J. Gilmore (AA)
Joe Cimino, NJ, proxy for L. Herrighty (AA)
Tom Fote, NJ (GA)
John Clark, DE, proxy for D. Saveikis (AA)
Roy Miller, DE (GA)
Russell Dize, MD (GA)
Mike Luisi, MD, proxy for D. Blazer (AA)
Rob O'Reilly, VA, proxy for S. Bowman (AA), Chair
Chris Batsavage, NC, proxy for S. Murphey (AA)
Michael Blanton, NC, proxy for Rep. Steinburg (LA)
Peter Burns, NMFS

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Staff

Robert Beal
Toni Kerns
Kirby Rootes-Murdy
Jessica Kuesel

Guests

Jason Didden, MAFMC

The Spiny Dogfish Management Board of the Atlantic States Marine Fisheries Commission convened in the Terrace Ballroom of the Roosevelt Hotel, New York, New York; Tuesday, October 23, 2018, and was called to order at 1:30 o'clock p.m. by Chairman Rob O'Reilly.

CALL TO ORDER

CHAIRMAN ROB O'REILLY: Okay I'm going to call the Spiny Dogfish Board Meeting to order.

APPROVAL OF AGENDA

CHAIRMAN O'REILLY: My name is Rob O'Reilly; and first thing I would like to ask the Board. You have a copy of the agenda. Are there any changes to the agenda? If there are raise your hand and we'll tackle that. Seeing no changes; by consent the agenda is approved.

APPROVAL OF PROCEEDINGS

CHAIRMAN O'REILLY: Also, looking for approval of the proceedings from the October, 2017 meeting, do I see anyone who is in opposition to approving that? The answer is no; so by consent we will approve the proceedings from October, 2017.

PUBLIC COMMENT

CHAIRMAN O'REILLY: We'll have public comment. I don't have any slips of anyone who signed up for public comment.

Nonetheless, if you have something that's pretty quick, and you wanted to talk to the Board, now is your opportunity. Is there anyone who wishes to do so? No, there isn't.

REVIEW THE 2018 STOCK ASSESSMENT UPDATE

CHAIRMAN O'REILLY: The next thing we're going to do is, Jason Didden is here from the Mid-Atlantic Council and he's going to Review the 2018 Stock Assessment Update. Jason.

MR. JASON T. DIDDEN: I'll dive right into it again; an overview of the Stock Assessment Update and then kind of what that has meant for ABC projections and recommendations coming out from the Council's SSC. The last benchmark, so it's been quite a while since we've had a benchmark. We do have on the tentative NRCC schedule for another benchmark in 2021.

For the recent assessment update, not overfished in 2018, no overfishing in 2017, it's a little unusual that it's two different years. But it's just because of how that particular assessment works. I'll get into that in a bit later; but they do make the determinations on two different years with this particular assessment.

Overfishing not occurring is a bit below the reference point; and not overfished, but only at 67 percent of the target, so kind of getting down close to that 50 percent range on biomass. There are a lot of bells and whistles with any assessment; but with the spiny dogfish assessment it's basically coming almost straight out of the spring, Northeast Fisheries Science Center Survey.

That is what drives the bus on this assessment. It includes information coming out on pups, it includes information about uncertainty and the variance in the survey that it's getting, but the core thing is what that Science Center Spring Trawl Survey that really is the assessment. It's a fairly basic, swept area biomass calculation, again with some bells and whistles. We'll get into as you can see here. The black line here, those are just the individual survey data points. You can see that those bump around a lot from year to year. Those points, there is a three-year smoothing that goes on to try to eliminate some of that variability.

But I think it's still kind of an open question about how much the signal, even with the smoothing is real trends in biomass and how much is noise. There has been a variety of research in recent years that there is likely strong availability of the issues; both in terms of depth of where spiny dogfish are and spatially, in terms of the habitat they use and the area that the survey samples.

Again there is a three-year smoothing that goes on there. You'll see a couple different color points right at the end there. The Council and the Council's SSC explored a couple different ways of smoothing the data. You can see; and the two blue lines that is basically the standard one coming out of the last benchmark, and that is what's used and that's what the SSC used.

They also looked at either excluding that low point in the second to last low point also considered looking at a Kalman filter; which is just kind of another slightly fancier smoothing feature that considers some of the variance in each data point. Ultimately they came back to the basic three year; but you can see that depending on exactly how you smooth that data, you get some pretty substantial changes.

There is a lot of noise that is being smoothed out here, and how exactly you smooth can effect where you think you are. One thing I wanted to flag was kind of where are we now relative to where we thought we would be. The dark blue line is just the projections that came out of the last assessment update we had back in 2015.

That line is where we projected we would be. Then I've got the 95 and 5 percent confidence intervals on those projections; the big single blue dot that is our current estimate. You can see we're basically fairly close to where we thought we would be, at least in terms of how the assessment is working; only a little bit lower than what is projected, and well within those confidence intervals.

Now again, how much of any of this is noise versus true trends in abundance is open to question. I think we'll probably get a lot of discussion at the next benchmark; but this is what we have now. That is where we thought we were. That is where we thought we would be now. Then this is the 2008 estimate in terms of biomass. I forgot about those handy dandy little pop ups I had.

That is biomass; the other kind of component is on the fishing mortality side. It is basically looking what percent of the population is caught relative to the overall population. There is a lot that goes into that. I'm not going to go into all the details; but it's considering the information about growth, about recruitment, and then looking at basically what percent of the stock are you killing.

These are the fishing mortality estimates; again the blue line is kind of the basic method of the final terminal smoothing that came out of the last assessment. But again you can see depending on exactly how you smooth, your perspective on whether or not you're overfishing or not can change. But what the SSC went with is what came out of the last benchmark. There was a lot of discussion about whether or not to eliminate that low data point; that 2017 low data point, but in recent years that is actually the only year that the survey ran as it's supposed to run.

The year before and the year after there are a variety of survey performance issues; it left late, had to cut a bunch of stations in 2018. The SSC ultimately said yes, it seems low given life history. Is that what we think spiny dogfish is changing that much biomass? No, but given the low year was actually the only year of the three that it ran; that the survey performed in terms of timing and stations normally, they didn't see a reason to just totally jettison it.

Pup production again is one thing that goes into the projections. I can see the last four years have been kind of in the middle; not super high, not super low. You have the stock status, you've got fishing mortality, and then the projections are going forward. You're starting at one place; you've got a certain amount of fish coming in, a certain amount of fish going out, lots of details kind of typical things.

It's looking at the growth is sex specific, fishing mortality is sex specific. The reproduction, scales of the biomass. You have more biomass, more reproduction. It's not just fish in, fish out. But that is basically what they're trying to figure out here. It's all by length. We can kind of dive back into some of the details later; but again, basically the projections are making certain assumptions about growth, about recruitment, to try to determine starting at Place A, fish in, fish out.

This is using the standard three-year averaging; and the Council's risk policy advises the SSC on how to do these really what kind of projections to use. I have a quick kind of primer on the Risk Policy. One thing is really simple. If you have a lower stock size you're taking a certain percentage of that out, catch is going to be lower.

But the Council also says when stock size is lower we want a lower probability of overfishing. There is kind of a bit of a synergistic effect there. I kind of liken it to imagine you're entering a school zone, with that flashing yellow light. You're going to slow down for two reasons; one the speed limit is just lower that's like the stock size is lower.

But, I'm also going to slow down because there is a risk element, at least in Dover, Delaware where they really like to have speed traps in those zones, and so I've cut back partially because it's gone from 35 to 25. But I've also cut back partially because the risk of getting a ticket in that area is higher.

There is kind of a synergistic between A, just the stock size, and B the Council's risk of overfishing changes with the lower stock size. Then there is a third component; that is what our risk is. But that is also informed by our sense of uncertainty. The Council has basically said to the SSC; look at the uncertainty that comes out of the assessment, and make a judgment call.

Is the assessment accurate? That's the C.V., coefficient of variation, is that low or high? The way I kind of think of it is if you had a real accurate speedometer on a car or an assessment; that's like a low CV. I'm driving this car, and let's say a speeding ticket is overfishing. Let's say the speed limit is 55. On that car if the speedometer says 60, I think probably a really low chance of getting a ticket. Now let's say you have a really inaccurate speedometer; which is like an inaccurate assessment.

Let's say you're driving this. Same situation, yes maybe you can't go 60, but that's another question. If the speedometer on this car says 60, I'm probably not real certain of my real speed; so I'm going to slow down maybe a bit more if I really want to avoid a ticket. The SSC also kind of imposes what its sense of uncertainty on that. If the SSC puts higher uncertainty, the calculations dial back.

You kind of have three things that really drive these projections. What is the stock size? Has it gotten low enough that the Council says we want to be less risky? Then given the uncertainty, and our desire to avoid that risk of overfishing, more uncertainty. We have to cut back even more. There are a couple things.

Stock size is below the target. Typically the Council wants 40 percent probability of overfishing; but since we're below the target those are the probabilities, around 26, 27, or 30 percent. As the stock size starts to increase the Council says, oh a little higher probability of overfishing is okay. The SSC bumped the CV up to 100 percent; and in order to achieve those probabilities of overfishing, it lowers the projections.

These are what they are. When you run it through the model you use that risk policy that sense of uncertainty; these are the ABCs total catches that both staff recommended and the SSC recommended, and the Council used. When you run those through the projection model, you can see that the stock slowly increases over the time of the specs.

I just have a few things again, so that assignment of uncertainty is important. It is part of what drives things. Just highlighting a few of the things that the SSC noted, A; those big jumps in the survey are unlikely to be representative of what's really occurring, some kind of availability, is it changes that work.

There is uncertainty in the size structure, concerns about how selectivity may change in the fishery between the sexes, concern about uncertainty and survival of dogfish that are discarded, just the general uncertainty in the biomass and the pup abundance estimates. Again, you saw those four different colors.

You know depending on how you smooth things it changes your answer a lot. The fact that small changes in how you're going to do some smoothing at the end has such a big influence on where you are. That indicates you have a fair bit of uncertainty. We're just using one survey. NEMAP isn't in there, and that is it for me, I'll stop. Thanks.

CHAIRMAN O'REILLY: We'll have a few questions; but I wanted to ask you, Jason. You mentioned the benchmark; and I talked to you a little before the meeting. That's scheduled for 2021 is my understanding.

MR. DIDDEN: Yes.

CHAIRMAN O'REILLY: The other idea is you had the fishing mortality rate graph up there; but the 2017 fishing mortality rate was about 0.21? It was not adjusted with Kalman and 2017 was kept in, is that correct?

MR. DIDDEN: Yes, the fishing mortality rate estimate for 2017 yes was 0.2.

CHAIRMAN O'REILLY: Questions for Jason. David Pierce.

DR. DAVID PIERCE: Jason, you and I have had a back and forth conversation about the status of the stock and what the SSC did. Could you put the figure back up that shows the SSB for over time, and of course the lines connecting all the years? I just need to clarify one particular point. That right there, right. Now the value of female spawning stock biomass that was used in the three-year-moving average, 2016, '17, and '18 that's not the blue dot right that would be the one that's lowest on the graph, the black line?

MR. DIDDEN: The black lines are the actual annual estimates. There are two blue lines. The open circles are the swept area SSB; and then the light blue triangles that is with the dotted line. The blue triangles are the three-year-moving average and the closed blue circles are the stochastic SSB estimates. Again, it's basically the three-year average with some bells and whistles. Black is the year to year, the blues are the SSB estimates.

DR. PIERCE: Okay, so the three-year-moving average included the historically low 2017 estimates. All right, it's historically low; as it was back in the 1990s that led to a decision by the Mid-Atlantic Council to basically stop all landing of dogfish, and then that decision was revised. Can you again help us understand, help me understand?

Why, in light of the fact that we're no overfished, overfishing is not occurring, biomass is still on the high side? Why was that year 2017 used; especially when it indicated that we dropped from 175,000 metric tons down to 25,000 metric tons in one year, and that's impossible? I recognize there is uncertainty; nevertheless, why use it and not throw it out?

MR. DIDDEN: I guess you could always flip the question of given that was the only year where the survey ran kind of properly; why would you not keep it? I had substantial discussions with the Science Center on this same question. The Science Center I think did kind of an extra dive into the data; to kind of see is there anything about the performance of the survey that would suggest there is some issue besides it being low to throw it out.

I think the SSC said; just because it's low, there would have to be some other reason to discard it, other than it just being low. I mean my general sense is given how, especially given some of the papers that have come out on availability and distribution. I think the ramp up from 2005 to 2012, and then the drop down from '12 to now. Both are probably artifacts of availability.

I did do one kind of personal analysis; and it's in one of my supporting slides here. Could you flip like almost towards the end? On this it's really simple. I just graphed discards of female dogfish on trawl trips; what's the average amount of female dog greater than 8 centimeters discarded on your average trawl trip? You know you've got thousands of trawl trips; you have however many hundreds of trips get observed. I've kind of plotted on there the blue is the survey estimates. The orange there is my kind of personal index of metric tons of female discards per trawl trip. Now I suspect this is more of what's going on since fishery management started in the 2000s.

They've kind of had a slow and steady increase. That's kind of what you more would expect with the biology of spiny dogfish. I don't know, hopefully the benchmark, we kind of dive into some of those availability issues. If we get some more information on how that availability may be driving things; and maybe at that point folks decide to kill that 2017 data point. But I think folks were hesitant to kill it; just because it was low without any other rationale.

DR. PIERCE: One more question, Mr. Chairman.

CHAIRMAN O'REILLY: Go right ahead.

DR. PIERCE: This historically low data point will likely be used in the three-year-moving average as we move into the future; which is why I raised this question. Now back when the dogfish resource was in very sad shape, back in the 1990s, late 1990s, because fishermen were convinced and encouraged to remove the dogfish; because they compete with gadids. When dogfish are up the cod and other gadids are down. Back then we were told that the average size of the females, mature females was going down; and we were told that the average size of the pups was going down, and we were told that the number of pups was very, very low, and you showed that on a previous graph.

Did the SSC consider, as part of their evaluation of where the numbers should be; the fact that according to the assessment the average size of females is still inclining upwards, the average size of pups is still going up, and the number of pups is still you know modest, not the way it was, although I still have problems with the pup index. Anyways that is all positive sign; so did that factor into any of the discussion about the use, for example, of that 2017 figure?

MR. DIDDEN: It certainly factored into their general discussion. I had thrown this up for them also; which again as you said shows that kind of slow increase since management started in the size of mature female spiny dogfish. You know I think they were also considering going with some of the methods that would have resulted in a more drastic reduction. I think some of these other kind of slow and steady increases that they saw, were probably a part of the reason why they went with what they did an not even something potentially substantially lower. But they did look at it.

DISCUSS ADJUSTMENTS TO FEDERAL COMMERCIAL TRIP LIMIT

CHAIRMAN O'REILLY: Other questions for Jason. Okay seeing none; we're going to move forward. You probably know that we have about an hour altogether. Kirby Rootes-Murdy will make a presentation now concerning the adjustments to the federal commercial trip limit.

MR. KIRBY ROOTES-MURDY: Just getting my presentation up. We structured this to have the Board consider if they want to make any recommendations on the federal trip limit before setting specifications. I just ask that you kind of keep in mind the presentation Jason gave you; and we'll come back when we get to the actual 2019 to 2021 specifications.

With that said I'll go through my presentation now. It's just an outline; I'm going to give a little bit of background, some of the recent management actions that the Mid-Atlantic Council and the New England Council took over the last month and a half, and then talk about considerations as you move into what you want to consider and put in place for 2019 through 2021 specifications. Then we can talk about next steps.

In terms of the federal trip limit, there is a federal specification process as you all are aware; that specifies what the commercial quota will be, as well as any recommendation of additional measures. The federal trip limit has become one of those things that are annually specified by the Mid-Atlantic Council and New England Fishery Management Council.

As you all know they have a joint management plan; and they can do multiyear specifications under that. I bring up this point that there are a number of measures that they can recommend. But the federal trip limit is not actually a component that says that they have to by the provisions of the FMP, the federal FMP, set one every year.

It's become kind of the norm that it's in place. Leaving that aside. On our end, on the Commission side, the state specification process kind of mirrors somewhat the federal FMP; as we have a complementary plan to it, and that the Board sets commercial quotas and trip limits for the northern region.

That was established through the Commission's FMP back in 2002. Multiyear specifications was established through Addendum II, and then the northern region trip limit, which is what this Board will have to specify later on in this meeting. That was outlined in Addendum III. New York through North Carolina set their own trip limits based on the quota they have.

This Board does not set that up annually or on a multiyear basis; it's left up to the states to manage the quota as best they see needed. As you probably saw we had in the briefing materials a letter that was sent to both this Board and the Mid-Atlantic Council; discussing the possibility of not setting a federal trip limit, and discussing that concept with Mid-Atlantic Council staff, GARFO staff, and New England Fishery Management Council staff.

Doing so that is just not setting a federal trip limit would likely require a framework or an amendment to the federal FMP; and the reason why is that that change would be a significant change, in terms of the annual process. Depending on what kind of change it is, whether it's setting a much higher trip limit or something different from a set per trip poundage.

It may require either an amendment, which would be more significant. Or it could be done through a framework. I also include here what the federal trip limits have been over time. As you can see from 2007 through 2012, it was set at 3,000 pounds; and then over the years it's kind of ramped up a bit, up to where we are now where the 2016 to 2018 specifications had it set at 6,000 pounds. In terms of recent action; as I mentioned we have the letter that David Borden wrote to the Board and Mid-Atlantic Council. The New England Fishery Management Council recommended that the Mid-Atlantic increase the federal trip limit to 8,000 pounds; and that an action be considered removing it altogether.

Earlier this month the Mid-Atlantic Council in turn decided to recommend that the federal trip limit be set at 6,000 pounds for the next specification process; so for the next three years it would be set at 6,000 pounds. The Mid-Atlantic Council also made a motion to address the federal trip limit through action; which would include either potentially removing it, by adding it to the list of priorities for the 2019 year.

In doing so it could be something that would be addressed by staff; working with us and GARFO to determine whether a framework or amendment is needed. But that will be up for the Mid-Atlantic Council to consider in December. For you guys considerations today, the Board could have a discussion on whether to make any recommendations for setting the federal trip limit at a different level than 6,000 pounds.

Again that would just be a recommendation. The Board does not annually have to do that; rather the Board is just going to set the specifications for state waters, in particular the trip limit for that northern region of Maine through Connecticut. As I said; in December the New England Fishery Management Council will actually make their recommendation to NOAA on what the federal trip limit should be.

It should be clear that if there is a disagreement between what the Mid-Atlantic Council put forward in their recommendation to NOAA Fisheries, and what the New England Council puts forward in their recommendation, then NOAA Fisheries can pretty much set the federal trip limit at anything that was not rejected by both councils. Again, the Mid-Atlantic Council will set their work priorities in 2019 in December. With that I will take any questions.

CHAIRMAN O'REILLY: Eric Reid.

MR. ERIC REID: Kirby, I'm pretty sure that New England's action was up to 8,000 pounds; not 8,000 pounds. It was some number between 0 and 8,000.

MR. ROOTES-MURDY: Thank you Eric, that is correct. That's an important distinction.

CHAIRMAN O'REILLY: David Pierce.

DR. PIERCE: Kirby, you gave a very good summary of the background material. I need you to refresh my memory if you can. I believe that the reason for there being no trip limits, federal limits, from New York to the south was that there was an expectation that the processors or some processors would actually come into play; that there would be processing capacity in the Mid-Atlantic, because at that time and now the processors are in Massachusetts. That's where the processors are in Massachusetts. Am I right with that background statement that there was an expectation that there would be processors in the Mid-Atlantic to take advantage of all the dogfish that would be coming in with no limits?

MR. ROOTES-MURDY: David, I would actually defer to you on that. I have not worked on this plan long enough to know for sure. Just to clarify. The federal trip limit applies to federal waters; so it goes up and down the coast. The states of North Carolina through New York, they set their trip limit for state waters.

What that means is you have federally permitted fishermen going out and fishing. They're held to whatever the more restrictive measure is; so in turn if the state trip limit is higher and they have a federal permit, then they have to abide by the federal trip limit.

CHAIRMAN O'REILLY: David, I think that was one of the ideas. I can't remember that that was really a driving force on having the processors in the Mid-Atlantic. But there certainly was talk at the time of developing that; and as you know that didn't develop. But I mean we could look back and make certain as to what was the driving force.

MR. DIDDEN: When our Advisory Panel meets we get kind of a wide range on input; everything from no trip limits for North Carolina reduction fishery to lower the trip limits from where they are now to make sure that there aren't closures. Again, some of the Rhode Island stuff maybe some shipping would be easier with certain things.

New York would like maybe some kind of bi-monthly trip limit; and since there are differential impacts on the regions of changing that federal trip limit, I think was one of the reasons why the Council thought shift that discussion to a framework. Then the public kind of would have more warning, more opportunity to participate and kind of express those concerns.

CHAIRMAN O'REILLY: Are there any other questions? Eric Reid.

MR. REID: Just to David Pierce's point to his question. The ability to take advantage of economies of scale is really what, the way I understand it, drove the southern trip limit. Dogfish is a relatively inexpensive protein. If your trip limit is 4,000 pounds for example; pick a number any number. To fill a truck it takes you several trips or several days; however you want to look at it.

The processors currently are all in New Bedford. There was at one time in Virginia; but it burnt down many years ago. I'm not sure if the fire is out yet or not; but it burnt down some time ago. That was the driving factor; it was the pure economics of an inexpensive protein, and getting it to where it actually can be processed, and being able to take advantage of a pretty substantial economy of scale.

CHAIRAMN O'REILLY: Anyone else on the federal trip limit issue? If not; we're going to move towards some action items that will require some motions, and Kirby will be first.

REVIEW AND SET 2019-2021 SPECIFICATIONS

MR. ROOTES-MURDY: I'll go through the 2019 through 2021 Fishery Specifications for Spiny Dogfish. Just an overview, I'm going to give some background, the Advisory Panel report, some landings update, and then those specifications that were approved by the Mid-Atlantic Council.

As I walked through in the previous presentation, it's a jointly managed plan between the Mid-Atlantic Council and the New England Fishery Management Council. The Board, the Commission has a complementary plan to that joint plan. We are in the last year, the ending year of a three-year specification cycle.

What's before the Board today will be setting specifications for 2019 through up to 2021. The Advisory Panel met back in, I believe it was September, and some of the big things that came up that are not uncommon on the Advisory Panel reports are that market and that demand is really driving the fishery, in terms of the catch.

There is currently a weak market demand; and in turn that's why when we get to the landings you'll see that they're not tracking quite as closely with the quota, in terms of possibly hitting the quota by the end of the year. As Jason noted, the other thing that came up during the AP call was whether abundance is truly being measured by the survey or not.

That applies also to catch. Boats have, we're hearing from AP members, have no problem catching the trip limit; it's just a matter of whether it's worth their while to go out and catch them. Issues were raised by AP members regarding the data from the Northeast Fisheries Science Center Trawl Survey; as well as the stock assessment, in terms of the overall stock size.

They expressed concern that the survey and the assessment don't really reflect what they are seeing on the water. In terms of looking at how a federal trip limit or state trip limits should change over time, many cautioned that it would be best that there was a more slow and steady approach if there is an interest in changing them; either increasing them or moving to some kind of more, broader weekly limit. This slide here just is trying to show you guys how landings have tracked with the quota over the years.

Pretty much from 2011 onward there has kind of been a big divergence between what the quota is and where landings have kind of landed at the end of the year. As you can see the gap probably was most pronounced in 2015-2016; as the quota, there was a big drop off in 2016 in the last specification process. It was about a 30 percent reduction from the previous year. As you can see landings have also kind of tracked downward.

But there has been, as you can see, quite a bit of a gap between where those two are. In looking at the landings report through October 17, you can see here that we have if you were to equally parse out the landings through the end of the year to hit the quota; that's the green line. The orange line shows you where the overall track of landings was for the previous year.

The blue line here shows you where we're at relative to those kind of too. You can see that for this year so far, we're actually tracking well below what we were last year; and likely well below hitting the quota for the 2018-2019 seasons. This is what the breakdown is at the state-by-state and regional level; in terms of landings through this point.

As you can see the big number to keep in mind at the bottom right is that we're at about 21 percent of the overall coastwide quota. Jason noted the recommendations from the Mid-Atlantic Council. They applied their risk policy; and the ABC was calculated using 100 percent CV. I think Jason's analogy I think was very helpful. Hopefully you guys better understand how a CV is set, and what it means for setting the Acceptable Biological Catch. The Monitoring Committee didn't recommend any changes to the ABC or quota from the SSC; and they also didn't specify any management uncertainty.

REVIEW MID-ATLANTIC FISHERY MANAGEMENT COUNCIL'S RECOMMENDED 2019-2021 SPECIFICATIONS

MR. ROOTES-MURDY: As we noted, the Mid-Atlantic Council approved the commercial quota as derived from the SSC's recommended Acceptable Biological Catch.

This table here shows you what that breakdown is from the OFL, the overfishing limit down to the ABC, all the way down to what the commercial quota is. For 2019 what that results in is a quota starting at 20.5 million pounds. That is about a 46 percent reduction from the 2018 quota; which is at 38 million pounds.

For 2020 and then 2021, it ramps back up increasing to 23.1, and then 27.4 million pounds. In summary, as the AP noted catch is driven by markets and price. The assessment update shows the decline in 2017, a slight increase in 2018, but not enough to overcome that and therefore we are dealing with a much lower quota. It was noted in the assessment and by AP members there are concerns about whether the survey is tracking abundance or availability.

Landings for the first half of the year, as I said, are about 21 percent of the quota; and the Mid-Atlantic approved harvest specifications for 2019 through '21, and recommended the federal trip limit be at 6,000 pounds. As I noted, it's about a 46 percent decrease from our current year's commercial quota. For next steps, this Board needs to set the commercial quota; as well as set the northern region trip limit in state waters. With that I'll take any questions.

CHAIRMAN O'REILLY: Questions for Kirby. Seeing none; I think we have some motions prepared. If we could do the coastwide quota first that would be good; and we'll get someone to make that motion and second it. Thank you, Maureen.

MS. MAUREEN DAVIDSON: I move that the spiny dogfish quota for 2019-2020 be set at 20,522,832 pounds; 2020-2021 be set at 23,194,835 pounds; 2021-2022 be set at 27,421,096 pounds.

CHAIRMAN O'REILLY: Is there a second to that motion; David Borden? Is there discussion on the motion; David Pierce and then David Borden?

DR. PIERCE: Yes, I recognize that landings have been down far lower than what the quota has been; and I recognizes the fact that indeed market demand has, you know price to fishermen and price to process as market demand has been very instrumental in causing that shortfall; that is catch not equaling or approaching the quota that has been available. I appreciate all of that because of a paper that was prepared by my agency, you know by the Division of Marine Fisheries.

Actually, we asked for this paper to be produced and it was prepared by some contractors. This was done on behalf of our Seafood Marketing Program; the Steering Committee. The copies are on the table and I hope that as this Board progresses and continues this discussion about quotas down the road, and about trip limits that this economic analysis be appreciated. Some good work was done by the contractors to highlight the economic problems that the industry faces regarding taking full advantage of the quotas that are available. Now I'm not going to support the motion for one reason only; and I've made it clear that I do not believe that that 2017 data point should have been used. It's historically low. It should have been discarded.

I recognize why the SSC did not discard it, why they included it. But it has life; that historical low data point has life, it will be used in the next year's three-year-moving average, and then it impacts these numbers, it creates these numbers. Just a matter of principle and my understanding of how these assessments are done, I'm not going to support the motion.

CHAIRMAN O'REILLY: David Borden.

MR. DAVID V. BORDEN: I similarly have qualms about the 2017 data point, but where I really see this sitting is that we have a couple of choices. We either accept it, we reject it, we remand it back to the Mid-Atlantic Council and request them to have the SSC revisit it, for reasons that have not been entered into the record today. As far as I'm concerned this is really the only option we have.

CHAIRMAN O'REILLY: Roy Miller.

MR. ROY W. MILLER: Mr. Chairman, the motion itself should be adjusted. The word million should be removed the three times that it appears.

CHAIRMAN O'REILLY: Thank you, Roy that will be done. Are there any other comments, Tom Fote?

MR. THOMAS P. FOTE: I have to say this. I'm in agreement with Dave Pierce for about the same reasons. I also realize that if the projections would have showed that dramatic increase instead of reduction we would have basically been told; well we don't have any confidence in the numbers, and we wouldn't have gotten the increase. That is what always upsets me on this. I'm not about to support outliers that basically make decisions that are drastic. I'm on the mind with Dave.

CHAIRAMN O'REILLY: Emerson Hasbrouck.

MR. EMERSON C. HASBROUCK: I have two questions. One is I don't recall the numbers from one of the previous slides. But I'm wondering what these quota numbers are relative to what the catch has been for the past couple of years. What's the difference between these quota numbers and what the catch was the last couple years? That's the first question; and then I have a second question.

CHAIRMAN O'REILLY: Jason, do you have those numbers? I think it is 18 million currently; around there. But I think 2016 was 24 million. But Jason may have the hard data.

MR. ROOTES-MURDY: I don't have the exact number off the top of my head; but what we do have, I think for you to help kind of get a visual sense of it, is on my Slide 5 on my presentation. You can see where it's tracked between 20 and 30 million pounds; and so it has kind of bounced around that. Then in 2017 as you can see it was below it at about 17 million pounds, I think is what we were saying for 2017.

CHAIRMAN O'REILLY: Emerson, another question.

MR. HASBROUCK: My second question is, and maybe I missed it, because I was personally distracted here doing something else. If we're not overfished and overfishing is not occurring; why is there a need for the significant reduction in quota, Jason, without having to go through your presentation again about uncertainty and so forth?

MR. DIDDEN: I think just at the catches that we've observed overfishing has not occurred. But if catches had been much higher along the kind of what the maximum quota could have been; I think you probably would have gotten into that overfishing realm. It's basically to keep it from overfishing, and also it's only at 63 or 67 percent of the target. In order to let it build back up to 100 percent of the target, it's a combination of those two things really driving. Again, not reducing landings, but reducing the quota.

CHAIRMAN O'REILLY: Any final comment before we caucus? Go ahead, let's have a one minute caucus and then we'll take a vote on the next three years of quota specs. Did everyone have enough time? I'm going to read the motion into the record; and then we'll take the vote.

Move that the spiny dogfish quota for 2019-2020 be set at 20,522,832 pounds; that the 2020-2021 spiny dogfish quota be set at 23,194,835 pounds; and also for the 2021-2022 season, the spiny dogfish quota be set at 27,421,096 pounds.

All those who are in favor of the motion please raise your hand; and we'll try and count you; 11, opposed like sign. All opposed like sign; I don't see anybody, abstentions, and null votes, 11, 0, 0, 1 null, motion carries. Next thing is to have a motion concerning the northern region; and I think that's already been prepared as well. Okay we'll need someone to make that motion, apparently on the trip limits to the northern region.

MR. BORDEN: Mr. Chairman.

CHAIRMAN O'REILLY: Someone needs to save a motion. David Borden.

MR. BORDEN: Well, I don't have a motion, but did the staff prepare a draft motion on this? If they could put it up on the board that would be helpful.

CHAIRMAN O'REILLY: I think we're having dueling ideas here on that. Dave Borden.

MR. BORDEN: I'll make that as a motion with a 6,000 pound trip limit.

CHAIRMAN O'REILLY: Thank you David and David Pierce second. When the motion is up there I'll read it; and then I'll first ask if there is any objection to the motion. **The motion is; Move to establish a 6,000 lb trip limit for the 2019-2021 fishing seasons for the northern region (Maine through Connecticut.) Is there any opposition to that motion? Seeing no opposition the motion passes.** Thank you, not quite done.

NOMINATIONS TO THE SPINY DOGFISH ADVISORY PANEL

CHAIRMAN O'REILLY: Tina Berger is going to give us information concerning there are four nominees to the Advisory Panel, so Tina is joining us.

MS. TINA BERGER: Thank you, Mr. Chair. I offer for your consideration and approval four nominees to the Spiny Dogfish AP; they are Thomas Lyons, a commercial gill netter from New Hampshire, Doug Feeney, a commercial hook and line and gill netter from Massachusetts, John Whiteside, a commercial industry attorney, also from Massachusetts, and Scott MacDonald, a processor from Virginia.
CHAIRMAN O'REILLY: Are there any questions or comments from the Board concerning the nominees; would one or more of you, okay Ritchie White?

MR. G. RITCHIE WHITE: Move to approve the slate of nominees as presented by Tina.

CHAIRMAN O'REILLY: Is there a second; second from Ray? Are there any other comments or discussion on the four nominees**? I'm going to read this into the record. Move to approve the nomination of Thomas Lyons (NH), Doug Feeney (MA), John Whiteside (MA), and Scott McDonald (VA) to the Spiny Dogfish Advisory Panel.**

Is there any opposition to this motion? Seeing no opposition; we have some new Advisory Panel members, thank you everyone.

ELECTION OF VICE-CHAIR

CHAIRMAN O'REILLY: If you're following along, we're on Number 8 in the agenda. What we need now is a recommendation. There is no current Vice-Chair, and looking for someone to make that recommendation. Mike Luisi.

MR. MICHAEL LUISI: I move to nominate Chris Batsavage to serve as Vice-Chair to the Spiny Dogfish Board.

CHAIRMAN O'REILLY: Thank you, Mike, is there a second; second from Ray.

MR. LUISI: Chris would be taking over as soon as the 2017 data point falls out of the three-year average; so good luck, Chris.

MR. CHRIS BATSAVAGE: That works for me; thanks, Mike.

CHAIRMAN O'REILLY: Are there any other nominations? Nomination is closed and by acclamation we welcome Chris Batsavage to the 2017 data point.

I understand we have a little bit of other business. David Borden.

OTHER BUSINESS

MR. BORDEN: Basically, I had submitted a letter to the Board; to Rob and the Mid-Atlantic Council during the monitoring discussions. I'll just give you a quick background and keep this fairly short. The request was to have the process basically review the pros and cons of eliminating the federal trip limit. I would note while I'm on this, the discussion by Jason and the Mid-Atlantic Advisors.

I've listened to that and reviewed the documents for a number of years. It's a really useful piece of input; in terms of what the Advisors recommend. This year I listened to that discussion. At the end of the discussion I basically made the suggestion and submitted the letter regarding the removal of the federal trip limit. Some common themes that run through those Advisory comments, and I'll make these really brief. Not harvesting the quota, the discard rates were extremely high as the staff noted; some of which is caused by the federal trip limits for the regulatory discards.

There is a lack of flexibility on the part of particularly the northern states to kind of address their particular situation. Eric Reid commented on the issue of economy of scale, Peter Kendall in New Hampshire made almost identical comments at the New England Council meeting. A general conclusion, my conclusion from listening to the comments is this one sized rule fits all doesn't necessarily work the way we intend it to work.

As both Jason and Kirby noted, we manage these two fisheries differently; the Mid-Atlantic Council has a quota system; and then the freedom within state waters to adopt their own trip limits. New England Council has a regional quota and a standardized federal trip limit. But as soon as the Mid-Atlantic boats in the fishery move into federal waters, then they have to adhere to the federal trip limit.

Since we're not achieving the quotas in these areas that makes little sense to me. I asked myself, why do we need a federal trip limit? My conclusion from all of that was we ought to have a discussion about eliminating the trip limit. The Mid-Atlantic Council and the New England Council both have taken the position that they want to examine the pros and cons of this strategy.

I think the Mid-Atlantic Council and Jason correct me if I misspeak, basically concluded that that might be a priority that they would set in December. But we won't know until December. I think there are two questions for the Board. You've got two Councils that are kind of pursuing that. The National Marine Fisheries Service voted in favor of the strategy when it came up at the Council meetings; I was in the audience. I think the votes on the part of the states that are represented around this table were almost unanimous; if you looked at the individual votes.

The first question is to the group, do we want to participate in that discussion, and my answer is yes. I think it's useful to do that. Then I think if we get a consensus on that point, then I can suggest a course of action that we could follow, which would kind of simplify it. I guess my question to you, Mr. Chairman, as to the Board; do we want to consider the pros and cons of eliminating a trip limit? I can make a motion; but I don't think it's necessary.

CHAIRMAN O'REILLY: What I didn't mention earlier, there has not been a Spiny Dogfish Board Meeting since last year. But in the meantime there were two Working Group meetings that were held; Raymond Kane and David Borden, Adam Nowalsky, Doug Grout, myself, Jason Didden, representative from New England Council, representatives from NMFS, and there were conference calls. But perhaps that's the way to start this and get the pros and cons that way, David. That would be my suggestion. David.

MR. BORDEN: That would be fine. Let me just make a process suggestion. If the Board is willing to do this, then I think we've got the time. I'm not asking the Board to take any action at this point; and by that I'll be explicit. I'm not asking the Board to start an addendum. I'm saying just carry on a dialogue on this issue; and flesh it out some more. We have the advantage of there is a New England Council meeting in December; there is also a Mid-Atlantic Council meeting in December. If we had for instance, a conference call as you suggest between now and then.

It might be useful to have a conference call that involves the Mid-Atlantic States, because they have a different factual basis for making any determination on that; and a conference call that would involve the New England States. Then possibly we could discuss it in conjunction with those meetings that are already scheduled; and then bring some kind of recommendation back to the Board.

CHAIRMAN O'REILLY: David Pierce.

DR. PIERCE: I agree with David Borden. The discussion should continue; and now that discussion can be informed by the analysis that I referenced earlier on, the economic analysis of spiny dogfish historical trends, future markets and implications for management action. This particular analysis was not made available to the Mid-Atlantic Council for its consideration.

It was made available to the Executive Director of the New England Council; and it was not distributed to the New England Council members for their consideration. It's now out there. It can be used; along with whatever else, to again inform discussion following the procedure that David suggested.

CHAIRMAN O'REILLY: David Borden, I think we just talk a little bit more and figure out how to get those conferences going.

MR. BORDEN: Would you like a motion? Would it simplify this if I made it?

CHAIRMAN O'REILLY: I think the whole Board should say that this is a good idea.

MR. BORDEN: Okay, so I'll make a motion that we move that the Dogfish Board explore the pros and cons associated with removing the federal trip limit with the intent to report to the Board at the winter meeting.

CHAIRMAN O'REILLY: Seconded by Ritchie White, discussion on the motion that you can't see but I hope you heard it. It all involves this push about moving away the federal trip limit; any comments? Since it started out really as a straw process by David Borden to get something going here; I think it's probably enough just to ask you if you have any opposition to what you heard that we move forward with this. If there is no opposition that sounds great, thank you very much, Mike Luisi.

MR. LUISI: In putting on my Council Chair hat at the Mid. As has been mentioned during the presentations earlier, the Executive Committee of the Mid-Atlantic Council added this consideration of a potential change or removal of the federal trip limit to their draft 2019 priorities, which will be discussed in December and finalized. I'm trying to figure out how this Board can strengthen that suggestion that the Mid-Atlantic Council leave that bullet in their 2019 priorities. Like I said, it's a draft right now; the priorities will be discussed by the Full Council in December. By the passing of this motion I'm looking at it as intent to explore that concept of changes and/or removal perhaps of the federal trip limit. Mr. Chairman, I don't know if that message could come from you at the time when we're having this discussion at the Council, or do you think there might need to be more of a formal statement from the Board to the Mid-Atlantic Council to leave this issue in their 2019 priorities for consideration at a future date?

CHAIRMAN O'REILLY: I certainly don't mind doing that. But it would be better to have the Board behind that if we had a letter to go along with that. That would be the way to do that. Is that okay, Bob?

EXECUTIVE DIRECTOR ROBERT E. BEAL: I think a letter would carry the full intent of the Board. **One option could be to just add a second sentence to this and say the Board requests that a letter be sent to the Mid-Atlantic Council requesting that the trip limit issue be a priority for their 2019 Action Plan.**

CHAIRMAN O'REILLY: Dave is that okay with you; Ritchie, okay thank you? Okay, well good discussion and I would love to have a motion to adjourn.

CHAIRMAN O'REILLY: Oh, Kirby is reining me in. **Okay, we have to vote on this. We did do a no objection; but we'll do it again if you would like. Can we do a no objection? Is there any objection to the motion on the board? Okay that sounds like before.** Thank you very much. We're not going anywhere yet. Jason has a second idea here for you.

MR. DIDDEN: Just a small technical thing. The Massachusetts report was provided to the Mid-Atlantic SSCs and the Mid-Atlantic Council and briefing materials during their deliberations. That's all, just clarification.

ADJOURNMENT

CHAIRMAN O'REILLY: Thank you, Jason; we are adjourned, thank you.

(Whereupon the meeting adjourned at 2:36 o'clock a.m. on October 23, 2018)

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Atlantic States Marine Fisheries Commission

DRAFT ADDENDUM VI TO THE SPINY DOGFISH INTERSTATE FISHERY MANAGEMENT PLAN FOR BOARD REVIEW

Commercial Management: Quota Transfers between Regions

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

This draft document was developed for Board review and discussion at the August 2019 meeting week. This document is not intended to solicit public comment as part of the Commission/State formal public input process. However, comments on this draft document may be given at the appropriate time on the agenda during the scheduled meeting. Also, if approved, a public comment period will be established to solicit input on the issues contained in the document.

August 2019

Atlantic States Marine Fisheries Commission Seeks Your Input on Spiny Dogfish Management

The public is encouraged to submit comments regarding this document during the public comment period. Comments will be accepted until 5:00 p.m. EST on **DAY, MONTH 2019**. Regardless of when they were sent, comments received after that time will not be included in the official record.

You may submit public comment in one or more of the following ways:

1. Attend public hearings held in your state or jurisdiction.
2. Mail, fax, or email written comments to the following address:

Kirby Rootes-Murdy
1050 North Highland St., Suite 200 A-N
Arlington, VA 22201
Fax: (703) 842-0741
comments@asmfc.org (subject line: Spiny Dogfish Draft Addendum VI)

You may also refer comments to your state's members on the Spiny Dogfish Management Board or Spiny Dogfish Advisory Panel; however, only comments submitted to the Commission or given at a public hearing will be included in the public comment summary presented to the Board. If you have any questions please call 703.842.0740.

Commission's Process and Timeline

May 2019	ISFMP Policy Board Tasks Staff to Develop Draft Addendum VI
May – July 2019	Staff Develops Draft Addendum VI for Public Comment
August 2019	**Spiny Dogfish Board Reviews Draft Addendum VI and Considers Its Approval for Public Comment**
August – September 2019	Board Solicits Public Comment and States Conduct Public Hearings
October 2019	Board Reviews Public Comment, Selects Management Options and Considers Final Approval of Addendum VI
TBD	Provisions of Addendum VI are Implemented

1. INTRODUCTION

The Atlantic States Marine Fisheries Commission (ASMFC) is responsible for managing spiny dogfish (*Squalus acathias*) in state waters (0–3 miles from shore) under the authority of the Atlantic Coastal Fisheries Cooperative Management Act, and has done so through an interstate fishery management plan (FMP) since 2003. The states of Maine through North Carolina have a declared interest in the fishery and are responsible for implementing management measures consistent with the interstate FMP.

Spiny dogfish is managed in federal waters (3–200 miles from shore) through a joint FMP of the Mid-Atlantic Fishery Management Council (MAFMC) and the New England Fishery Management Council (NEFMC). These two councils make recommendations on management to the National Oceanographic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries), which is responsible for implementing management based on the input from the two councils and per the requirements of the Magnuson-Stevens Fishery Conservation and Management Act.

At its May 2019 meeting, the ASMFC's Interstate Fisheries Management Program Policy Board approved the following motion:

Move to direct the Spiny Dogfish Management Board to initiate an Addendum to allow unused quota allocated to the northern states collectively to be transferred in the second half of the fishing year to the states that have state-specific allocations. This action is intended to promote full utilization of the overall commercial quota. It is intended that these proposed transfers shall only be allowed if there is unanimous consent among the northern states regarding the timing and the amount. Also, the Board shall include quota overage forgiveness language similar to that in Addendum XX of the Summer Flounder, Scup, and Black Sea Bass FMP where in the event the overall annual quota of black sea bass and scup (during the summer) among the states is not exceeded, then individual state overages are forgiven.

In response to this motion, the Spiny Dogfish Plan Development Team drafted this addendum with the following recommendations: 1) to consider a more general approach to allowing quota transfers that include a region (e.g., not just from northern states to southern states); and 2) to discard the concept of quota overage forgiveness due to the complications presented by the existing unused quota rollover provision. Accordingly, this draft document considers options to add quota transfer abilities for multi-jurisdictional regions for the commercial spiny dogfish fishery along the U.S. Atlantic coast.

2. OVERVIEW

2.1 Statement of the Problem

Interstate management of the spiny dogfish commercial fishery includes both state-specific and regional shares of the coastwide quota. At present, quota transfers are only possible between states with individual state quotas, whereas regions have not been granted the authority to donate or receive quota via transfers. Consequently, regions are unable to share in the benefits of quota transfers, which include assisting in the full utilization of the coastwide quota and avoiding quota payback requirements for unintended quota overages. This situation may be exacerbated during the 2019–2020 fishing year due to a 46% reduction in the coastwide quota. If landings in the 2019-2020 fishing year remain status quo, the coastwide quota would not be exceeded but some states could face an early quota closure.

2.2 Background

2.2.1 ***Quota Management***

The spiny dogfish commercial fishery operates on a May 1–April 30 fishing year (FY; e.g., FY 2019 refers to 5/1/2019 to 4/30/2020). The Federal FMP includes an annual coastwide quota, the amount of which is specified by the Councils and Commission and implemented by NOAA Fisheries. Since the implementation of the Federal FMP in 2000 (MAFMC and NEFMC, 1999) and the Interstate FMP in 2003 (ASMFC, 2002), the coastwide quota has been allocated in several variants of seasonal and regional quotas.

In 2011, under Addendum III (ASMFC, 2011), the interstate FMP established regional (ME–CT) and state-specific (NY, NJ, DE, MD, VA, and NC) allocations of the coastwide quota, which remain in place (Table 1). States have the responsibility to close the spiny dogfish commercial fishery in their state once their (state or regional) quota has been reached. Addendum III also authorized quota transfers, but only for states with individual quotas. State-to-state quota transfers were common practice for other Commission-managed species at the time, and a process for quota transfers involving a region was not considered.

Table 1. Spiny Dogfish Allocations since 2011

	Northern Region (ME-CT)	NY	NJ	DE	MD	VA	NC
Allocation	58%	2.707%	7.644%	0.896%	5.92%	10.795%	14.036%

2.2.2 Commercial Fishery

U.S. commercial spiny dogfish landings along the Atlantic coast follow the seasonal migration of spiny dogfish. In recent years, the highest proportions of landings in the northern region (ME–CT) have occurred during the months of July, August, and September (Figure 1). For the states of New York to North Carolina, nearly all landings occur from November through April (Figure

2). The fishery in the northern region is largely concluded by November, just as the fisheries to the south ramp up.

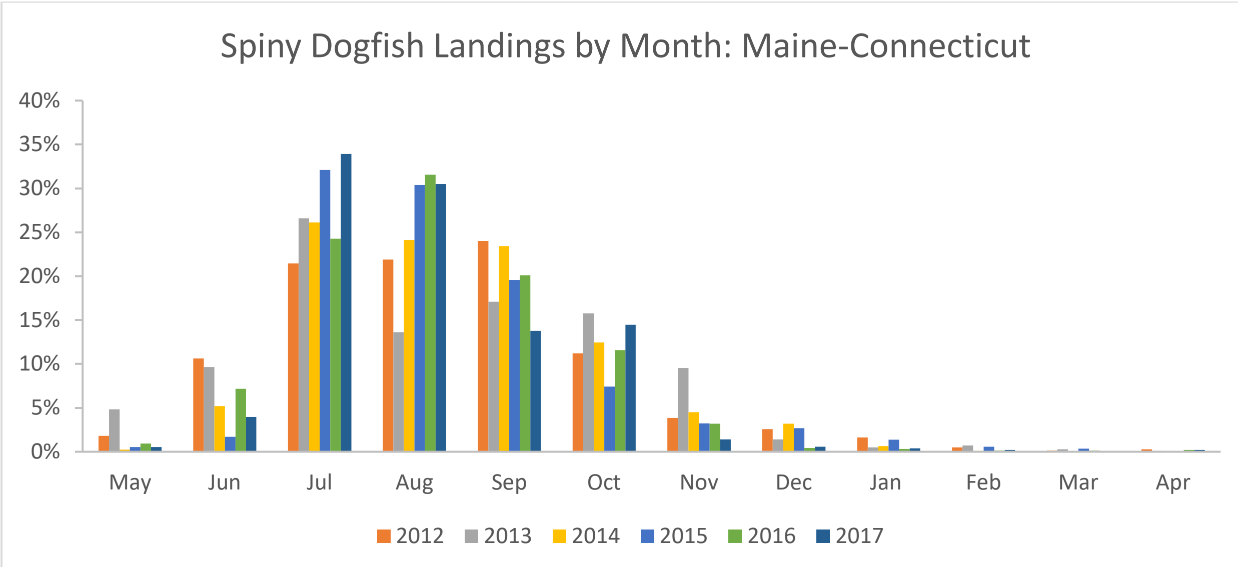

Figure 1. Proportion of Landings by Month for the Maine–Connecticut, FYs 2012–2017. Source: ACCSP 2019.

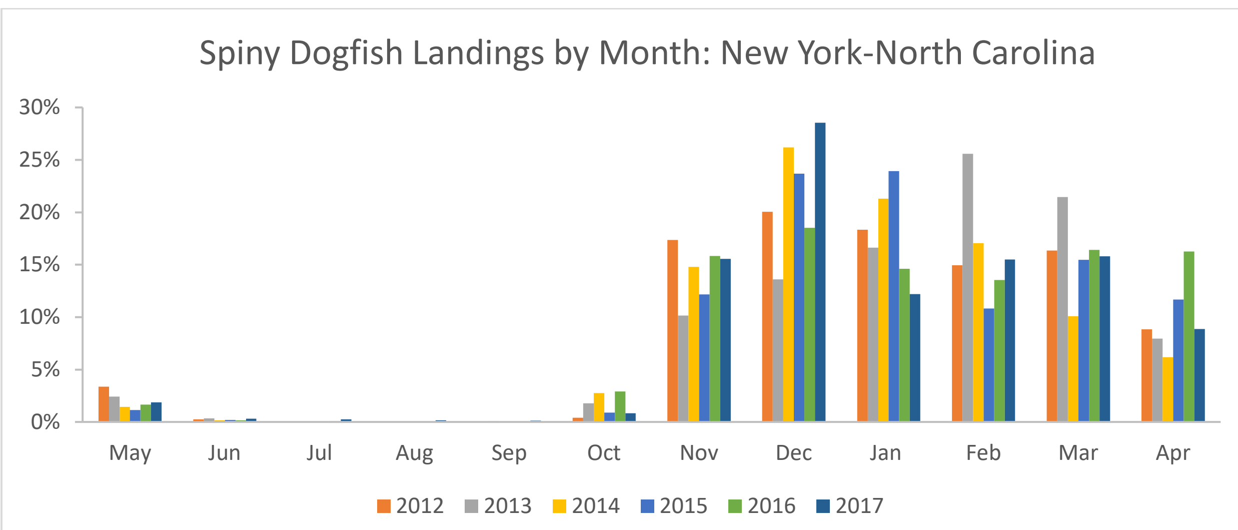

Figure 2. Proportion of Landings by Month for New York–North Carolina, FYs 2012–2017. Source: ACCSP 2019.

Total commercial landings closely tracked the coastwide quota for most of the first 12 years of quota management (FY 2000–FY 2011), after which the landings plateaued while the quota continued to increase (Figure 3). Landings during FY 2012–FY 2018[1] averaged 20.93 million

[1] Commercial landings for FY2018 are preliminary and subject to change.

pounds, while the coastwide quota averaged 42.02 million pounds. For FY2019, the coastwide quota has been reduced to 20.52 million pounds to avoid overfishing the stock amidst declining biomass (NEFSC, 2018). Over the last three years (FY2016–2018), less than half of the cumulative coastwide quota has been landed, though similar landings in FY2019 would achieve nearly 100% of the newly reduced quota level.

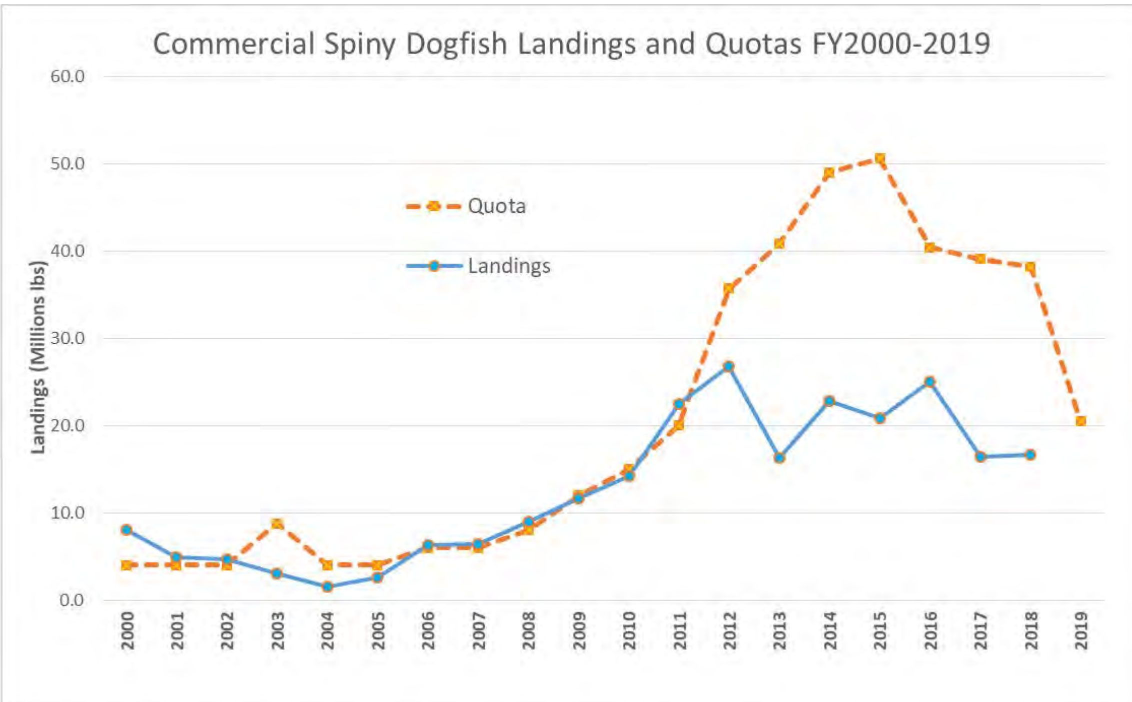

Figure 3. Coastwide Landings and Quotas FY2000-2019. Source: Unpublished NOAA dealer reports

At a more local level, fishery performance relative to quotas varies both among states/regions and year-to-year within a state/region. During the last three years (FYs 2016–2018), the percent of annual quota used by a state or region ranges from 0% to 94%, and up to 118% exclusive of transfers (Table 2). Only Virginia has had consistently high landings compared to available quota, notably including FY 2018 when a quota transfer was necessary to avoid an early closure of the state's fishery. While more variable, the fisheries of the northern region, New Jersey, and Maryland have demonstrated the capacity to land a majority of their quota on a single year basis. North Carolina's landings are significant, yet the fishery has taken less than half the state's available quota in each of the last three years. New York's and Delaware's landings qualify for de minimis status.

While only Virginia's landings in FY 2018 (and FYs 2016 and 2017) would exceed its FY 2019 quota, three additional states/regions (ME–CT, NJ, and MD) had landings in at least one of the last three years that would surpass their FY 2019 quotas. These trends suggest that there may not be enough quota among the states with state-specific quotas to satisfy all their fisheries, while it's possible the northern region could have unused quota to share.

Table 2. State/Regional Spiny Dogfish Quota and Percentage of Quota landed from FY 2016 to 2018. FY 2019 included for comparison. **Source: FY 2016-2017 State data for ME-DE; VA-NC from ACCSP 2019. MD FY 2016-2019 and all state FY 2018 from Preliminary NOAA Quota Monitoring Reports.**

State/Region	FY 2016		FY 2017		FY 2018		FY 2019
	Quota^	Landings *% of Quota*	**Quota**	Landings *% of Quota*	**Quota**	Landings^^ *% of Quota*	**Quota**
ME-CT	**24,876,989**	15,758,302 *63.34%*	**22,677,836**	10,807,726 *47.66%*	**22,153,577**	8,471,582 *38.24%*	**11,903,243**
NY	**1,161,069**	40,692 *3.50%*	**1,058,429**	48,212 *4.56%*	**1,033,961**	46,487 *4.50%*	**555,716**
NJ	**3,278,616**	2,853,557 *87.04%*	**2,988,782**	1,860,862 *62.26%*	**2,919,689**	1,271,966 *43.57%*	**1,568,900**
DE	**384,307**	150 *0.04%*	**350,333**	0 *0.00%*	**342,235**	0 *0.00%*	**183,893**
MD	**2,539,169**	2,378,766 *93.68%*	**2,314,703**	550,536 *23.78%*	**2,261,193**	719,676 *31.83%*	**1,214,957**
VA	**4,630,122**	3,605,861 *77.88%*	**4,220,814**	2,530,376 *59.95%*	**6,123,239**	4,870,717 *79.54%**	**2,215,484**
NC	**6,020,231**	418,860 *6.96%*	**5,488,036**	757,279 *13.80%*	**3,361,166**	1,367,414 *40.68%*	**2,880,640**
Coastwide	**42,890,503**	25,056,188 *58.42%*	**39,099,717**	16,541,575 *42.31%*	**38,195,060**	16,747,942 *43.85%*	**20,522,832**

^FY 2016 Quotas include 5% Quota Rollover
^^2018 Landings are preliminary and subject to change
*Virginia's final quota for FY 2018 includes a 2 million pound transfer from North Carolina; Virginia's FY 2018 landings represent 118% of its initial quota level.

3. PROPOSED MANAGEMENT PROGRAM

This addendum considers modifying the current quota transfer provisions as outlined in *Section 3.2*: *State Quota Transfers* of Addendum III to the Interstate Fishery Management Plan for Spiny Dogfish.

Quota Transfers Options:

Option 1: Status Quo

Under this option, the quota transfer provisions as outlined in Section 3.2 of Addendum III remain unchanged. Quota transfers are allowed only for states with an individual (not regional) quota.

Option 2: Allow Quota Transfers between all states and regions

Under this option, quota transfer is allowed between all states and regions. This alternative adds the ability for a region to participate in a quota transfer through the mutual agreement of each state in the region. Specifically, the Administrative Commissioner (or proxy) from each state in the region must agree to the transfer in writing. The Executive Director or designated ASMFC staff will review and approve all transfer requests before the quota transfer is finalized.

As with transfers between states, transfers involving regions do not permanently affect the shares of the coastwide quota. Agreements for transfer of quota are to be forwarded to the Board through Commission staff. Once a quota transfer is finalized, quota management for the year (i.e., quota closures and overage accountability) is based on the transfer-adjusted quota amount. All quota transfers must occur within 45 days of the end of the fishing year.

4. COMPLIANCE SCHEDULE

If the existing spiny dogfish management plan is revised by approval of this draft addendum, the measures would be effective immediately.

5. LITERATURE CITED

Atlantic States Marine Fisheries Commission (ASMFC). 2002. Interstate Fishery Management Plan for Spiny Dogfish. 107p.

Atlantic States Marine Fisheries Commission (ASMFC). 2011. Addendum III to the Interstate Fishery Management Plan for Spiny Dogfish. 7p.

Mid-Atlantic Fishery Management Council (MAFMC) and New England Fishery Management Council (NEFMC). 1999. Spiny Dogfish Fishery Management Plan. NOAA Award No. NA57 FC0002. 292 pp.

Northeast Fisheries Science Center (NEFSC). 2018. Update on the Status of Spiny Dogfish in 2018 and Projected Harvests at the Fmsy Proxy and Pstar of 40%. Report to the Mid Atlantic Fishery Management Council (MAFMC) Scientific and Statistical Committee (SSC) August 31, 2018. 82 pages.

Atlantic States Marine Fisheries Commission

Summer Flounder, Scup, and Black Sea Bass Management Board

August 7, 2019
1:00 p.m. - 3:45 p.m.
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Call to Order *(R. Ballou)*	1:00 p.m.
2.	Board Consent • Approval of Agenda • Approval of Proceedings from May 2019	1:00 p.m.
3.	Public Comment	1:05 p.m.
4.	Review Potential Black Sea Bass Commercial Management Strategies and Consider Initiating Management Action to Address Commercial Allocation *(C. Starks)* **Possible Action**	1:15 p.m.
5.	Update on the Summer Flounder Management Strategy Evaluation: A Recreational Fishery Project *(J. McNamee)*	2:05 p.m.
6.	Report from the Atlantic Coastal Fish Habitat Partnership/Mid-Atlantic Fishery Management Council Project: Characterizing Black Sea Bass Habitat in the Mid-Atlantic Bight *(B. Stevens)*	2:35 p.m.
7.	Discussion on Discard Mortality *(C. Starks)*	3:05 p.m.
8.	Progress Update on the Recreational Management Reform Working Group *(C. Starks*)	3:35 p.m.
9.	Other Business/Adjourn	3:45 p.m.

The meeting will be held at the Westin Crystal City, 1800 S. Eads Street, Arlington, Virginia; 703.486.1111

MEETING OVERVIEW

Summer Flounder, Scup, and Black Sea Bass Management Board
August 7, 2019
1:00 p.m. - 3:45 p.m.
Arlington, Virginia

Chair: Bob Ballou (RI) Assumed Chairmanship: 10/17	Technical Committee Chair: Greg Wojcik (CT)	Law Enforcement Committee Representative: Snellbaker (NJ)
Vice Chair: Adam Nowalsky (NJ)	Advisory Panel Chair: Vacant	Previous Board Meeting: May 1, 2019
Voting Members: MA, RI, CT, NY, NJ, DE, MD, PRFC, VA, NC, NMFS, USFWS (12 votes)		

2. Board Consent
- Approval of Agenda
- Approval of Proceedings from May 2019

3. Public Comment – At the beginning of the meeting public comment will be taken on items not on the agenda. Individuals that wish to speak at this time must sign-in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Review Potential Black Sea Bass Commercial Management Strategies and Consider Initiating Management Action to Address Commercial Allocation (1:15-2:05 p.m.) Possible Action
Background • In May, the Board reviewed a report from the Black Sea Bass Plan Development Team (PDT) including analysis of several potential management options to address changes in stock distribution and abundance. The approaches supported by the Board for further development included 1) a dynamic allocation approach (referred to as TMGC) that gradually shifts allocations over time based on a combination of historical landings information and current biomass distribution information, 2) a trigger-based allocation approach, and 3) hybrid approaches. **(Briefing Materials)** • Additional options were submitted for consideration by Connecticut. One option addresses Connecticut's disproportionately small commercial black sea bass allocation by reallocating a small amount from states that either do not have fisheries or that have relatively large allocations. The second option combines a trigger approach with the TMGC approach. **(Briefing Materials)**
Presentations • Review of Potential Management Strategies for Commercial Black Sea Bass by C. Starks

Board Actions for Consideration

- Consider draft goal statement
- Initiate a management document to address commercial black sea bass management

5. Update on the Management Strategy Evaluation Project for the Summer Flounder Recreational Fishery (2:05-2:35 p.m.)

Background

- This project uses a Management Strategy Evaluation framework to conduct a set of model forecast simulations of alternative management options for the recreational summer flounder fishery to compare the expected performance of policy alternatives.
- The objective is to provide decision support tools to assist in the specification setting process for summer flounder.

Presentation

- Update on the Management Strategy Evaluation Project for the Summer Flounder Recreational Fishery by J. McNamee

6. Report from the ACFHP/MAFMC Project: Characterizing Black Sea Bass Habitat in the Mid-Atlantic Bight (2:35-3:05 p.m.)

Background

- Dr. Brad Stevens and his lab at the University of Maryland Eastern Shore recently completed a three-year study on black sea bass habitat utilization in the Mid-Atlantic Bight. **(Briefing Materials)**
- This project was funded by the Mid-Atlantic Fishery Management Council through the Atlantic Coastal Fish Habitat Partnership.
- Key findings on habitat structure and fish preference, seascape connectivity and fish abundance, and feeding ecology of black sea bass at natural and artificial reefs will be presented.

Presentation

- Characterizing Black Sea Bass Habitat in the Mid-Atlantic Bight by B. Stevens

7. Discussion on Discard Mortality (3:05-3:35 p.m.)

Background

- Recently several Board members have expressed an interest in reviewing available information on discard mortality in the summer flounder, scup and black sea bass fisheries.
- In particular, there has been some concern that the black sea bass recreational discard mortality rate assumed in the assessment may not be reflective of the true mortality rate. A recent study funded by the Collaborative Research Program of the Mid-Atlantic Fishery Management Council (MAFMC) estimated mean discard mortality rates of 21% for vented and 52% for unvented black sea bass following capture and release in 45 m depth, as opposed to the 15% discard mortality rate assumed in stock assessments and management plans. **(Briefing Materials)**

Presentation • Review of Discard Mortality in the Summer Flounder, Scup and Black Sea Bass Fisheries by C. Starks
Board Discussion • The Board may wish to define specific areas (i.e. species or sectors) and ways (e.g. regulatory, education) in which discard mortality should be addressed. **(Supplemental Materials)**

8. Progress Update on the Recreational Management Reform Working Group (3:35-3:45 p.m.)
Background • At the March 2019 joint meeting with the MAFMC, the two bodies agreed to form a joint working group to address the topic of recreational management reform. Specifically, the group's objective is to propose strategies reform recreational management to increase management flexibility and stability for summer flounder, scup, and black sea bass while reducing the year-to-year workload required to evaluate and establish measures. • The working group includes representation from ASMFC, MAFMC, and NOAA Fisheries. • The group has convened twice since its formation to gather information related to management requirements and discuss potential pathways to achieving the objective.
Presentation • Progress Update on the Recreational Management Reform Working Group by C. Starks

9. Other Business/Adjourn

Summer Flounder, Scup, & Black Sea Bass 2019 TC Tasks

Activity level: High

Committee Overlap Score: High (Multi-species committees for this Board)

Committee Task List

- September 2019: In person meeting to review operational assessments and develop recommendations on 2020-2021 specifications (coastwide quota and RHLs) for scup and black sea bass, and review 2020 specifications for summer flounder
- November 2019: In person meeting on 2020 recreational measures

TC Members: Greg Wojcik (CT, TC Chair), Alex Aspinwall (VA), Julia Beaty (MAFMC), Peter Clarke (NJ), Dustin Colson Leaning (ASMFC), Karson Coutre (MAFMC), Kiley Dancy (MAFMC), Steve Doctor (MD), Emily Gilbert (NOAA), Jeff Kipp (ASMFC), John Maniscalco (NY), Jason McNamee (RI), Gary Shepherd (NOAA), Caitlin Starks (ASMFC), Mark Terceiro (NOAA), Todd VanMiddlesworth (NC), Richard Wong (DE)

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

SUMMER FLOUNDER, SCUP AND BLACK SEA BASS MANAGEMENT BOARD

The Westin Crystal City
Arlington, Virginia
May 1, 2019

These minutes are draft and subject to approval by the Summer Flounder, Scup and Black Sea Bass Management Board.
The Board will review the minutes during its next meeting.

TABLE OF CONTENTS

INDEX OF MOTIONS

1. **Approval of agenda** by consent (Page 1).

2. **Move to approve Paul Caruso from MA to the Advisory Panel** (Page 26). Motion by Nichola Meserve; second by Emerson Hasbrouck. Motion carried (Page 26).

3. **Move to adjourn** by consent (Page 26).

ATTENDANCE

Board Members

David Pierce, MA (AA)
Raymond Kane, MA (GA)
Sarah Ferrara, MA, proxy for Rep. Peake (LA)
Bob Ballou, RI (Chair), proxy for J. McNamee (AA)
David Borden, RI (GA)
Eric Reid, RI, proxy for Sen. Sosnowski (LA)
Justin Davis, CT (AA)
Bill Hyatt, CT (GA)
Sen. Craig Miner, CT (LA)
Maureen Davidson, NY, proxy for J. Gilmore (AA)
Emerson Hasbrouck, NY (GA)
Joe Cimino, NJ (AA)
Tom Fote, NJ (GA)
Adam Nowalsky, NJ, proxy for Sen. Andrzejczak (LA)
John Clark, DE, proxy for D. Saveikis (AA)
Roy Miller, DE (GA)
Craig Pugh, DE, proxy for Rep. Carson (LA)
Mike Luisi, MD, proxy for D. Blazer (AA)
Russell Dize, MD (GA)
Phil Langley, MD, proxy for Del. Stein (LA)
Rob O'Reilly, VA, proxy for S. Bowman (AA)
Sen. Monty Mason, VA (LA)
Chris Batsavage, NC, proxy for S. Murphey (AA)
Jerry Mannen (GA)
Marty Gary, PRFC
Emily Gilbert, NMFS
Mike Millard, USFWS

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Staff

Robert Beal
Toni Kerns
Kirby Rootes-Murdy
Caitlin Starks
Jessica Kuesel

Guests

Julia Beaty, MAFMC
Casey Brennan, NMFS
Mike Celestino, NJ DFW
Heather Corbett, NJ DFW
Kiley Dancy, MAFMC
Lynn Fegley, MD DNR
Matthew Gates, CT DEEP
Pat Geer, VMRC
Doug Grout, NH (AA)
Jon Hare, NOAA
Pat Keliher, ME (AA)
Adena Leibman, Ofc. Sen. Whitehouse, DC
Arnold Leo, E. Hampton, NY
Loren Lustig, PA (GA)
Conor McManus, RI DEM
Jay McNamee, RI (AA)
Nichola Meserve, MA DMF
Stew Michels, DE DFW
Alan Risenhoover, NMFS
Steve Train, ME (GA)
Jack Travelstead, CCA
Megan Ware, ME DMR
Chris Wright, NMFS

The Summer Flounder, Scup, and Black Sea Bass Management Board of the Atlantic States Marine Fisheries Commission convened in the Jefferson Ballroom of the Westin Crystal City Hotel, Arlington, Virginia; Wednesday, May 1, 2019, and was called to order at 10:45 o'clock a.m. by Chairman Robert Ballou.

CALL TO ORDER

CHAIRMAN ROBERT BALLOU: Good morning and welcome. I'm going to call this meeting of the Summer Flounder, Scup, and Black Sea Bass Management Board to order. My name is Bob Ballou. I have the honor of serving as Board Chair. I would like to start out by welcoming two new members to the Board, Phil Langley from the state of Maryland, welcome, and Jerry Mannen from the state of North Carolina, welcome.

APPROVAL OF AGENDA

CHAIRMAN BALLOU: Having dispensed with Item 1 on the agenda, we're on to Item 2, which is the agenda itself. Before I ask whether any members of the Board have any requested changes, I do have one and that is a brief report out on the outcomes of the three Board votes, done via polling on the two conservation equivalency proposals for recreational fluke, submitted by Rhode Island and New Jersey, and the Virginia proposal for accounting for recreational black sea bass harvest during their February fishery.

Is there any objection to adding that brief update? Seeing none, we'll add that between Items 3 and 4. Then also under other business I would like to briefly address agenda items for our next Board meeting in August, in particular, a suggestion for a focused discussion on discard mortality in the recreational black sea bass fishery. Are there any other recommended changes or modifications to the agenda? Tom Fote.

MR. THOMAS P. FOTE: It's not a change or a modification, but I wanted to say just a few words. I put Jersey Coast Newsletters back there, because I wrote an article on summer flounder. I basically commented to what a great job NMFS actually did with handling the MRIP numbers. They don't get credit for what they do.

But they did the job right by expanding the numbers out, and basically reevaluating what the stock was, instead of just saying we were overfished and overfishing is taking place. I really wanted to make sure I thanked them for doing that. But the bad part of it was that if you accepted those numbers, which I thought the commercial fishery should have got the 49 percent increase, and you're telling me you're accepting those numbers to increase by 49 percent.

We've been under for the last five years, up to the last three years 15 percent. They could have given us the 3.5 percent. I know the shut down came and stopped a lot of the paperwork, but that is not sitting well with the recreational community. They understand why the 49 percent was put there, but if you are trusting them to give a 49 percent increase and can't do a 3.5 percent increase on us, based on the 15 percent that we've been under for the last three years, it doesn't sound good.

CHAIRMAN BALLOU: Are there any other recommended changes to the agenda? Seeing none is there any objection to approving the agenda as modified?

PUBLIC COMMENT

CHAIRMAN BALLOU: Seeing none, the agenda as modified stands approved by consent, and we're on to Item 3, which is public comment. No one has signed up.

But is there anyone here from the public who would like to address the Board on any issue that is not on today's agenda?

REPORT ON CONSERVATION EQUIVALENCY PROPOSALS

CHAIRMAN BALLOU: Seeing no hands, we are on to the next item, and that is the item that I asked to be added, and that is just a brief report out on the votes taken by the Board on the three issues. I believe Kirby has a quick update on that, Kirby.

MR. KIRBY ROOTES-MURDY: As Bob noted, there was an e-mail vote regarding a conservation equivalency on summer flounder for Rhode Island, for New Jersey, and then for Virginia regarding black sea bass. Rhode Island had proposed to have a shore site for summer flounder allowing anglers to harvest fish at 17-inch minimum size and a 2-fish bag limit.

That is in addition to their current 19-inch size limit, and the state has a 6-fish bag limit. In total, anglers can harvest up to six fish from those sites; four of them may be at 19 inches, two have to be at 17 inches. For New Jersey they proposed to adjust their season by one day on either end of the start and end, so their new season for 2019 is a start date of May 24, and an end date of September 21.

Regarding Virginia, the change in their black sea bass measures is specific to their season, accounting for the February fishery that took place this year. They had a February fishery that lasted from February 1 to February 28. They now have an opening in May for two weeks, starting May 15 through May 31, and then opening again from June 22 through December 31. With that I'll take any questions but, as noted earlier, these proposals were approved without objection.

REVIEW PLAN DEVELOPMENT TEAM ANALYSIS OF BLACK SEA BASS COMMERCIAL MANAGEMENT STRATEGIES TO ADDRESS FISHERY SHIFTS

CHAIRMAN BALLOU: Any questions for Kirby? Seeing none, we're on to Item 4, which is a Review of the Plan Development Team a/k/a PDT analysis of the Black Sea Bass Commercial Management Strategies to Address Fishery Shifts. Our meeting materials include two reports, one from the PDT the other from the Joint Advisory Panel meeting held to review that PDT report.

Our plan today, this is really the heart of the agenda. We'll be spending the majority of today's meeting on this agenda item. Our plan is to first have Caitlin provide a presentation on both reports, and that will be followed by Board review and discussion. With that Caitlin the floor is all yours.

MS. CAITLIN STARKS: Actually, before I get into the PDT report, the Board Chair had asked me to quickly go over the items that this Board has on its plate and has recently dispensed with. I'm going to do that really quickly, just to make sure everyone is on the same page with where we are today. Some of the recent actions this Board has taken included the Board and Council jointly recommending approval of the Summer Flounder Amendment at the joint meeting in March, and the Board and Council approving Addendum XXXI in December, and the Board approving Addendum XXXII in December as well.

Then as for ongoing activities and actions, this Board is looking at again the Summer Flounder Amendment will be considered for final approval by the Business Section today, so I just wanted to note that. Then black sea bass commercial management has been ongoing through the PDTs work, so we will review today the PDTs report, and have a possible action on that item.

Black Sea Bass Recreational Reform is also continuing work through a working group, jointly with the Council as well, and meetings on that likely will occur over this summer. Then lastly, for the Black Sea Bass and Scup Operational Assessments, we're scheduled to have those available for Board review in October, 2019. I just wanted to quickly lay out the field for us before getting into the PDT report, and if there are any questions on that I can take them.

CHAIRMAN BALLOU: Are there any questions for Caitlin on that review? Seeing none, why don't we move on to the next agenda item, thank you?

PLAN DEVELOPMENT TEAM REPORT

MS. STARKS: Again I'll be going over the Plan Development Team's report, and going over the work that they've done in the last couple of months on additional analyses of potential approaches for black sea bass commercial management. I'll start out with some background information, and then review the problem statement that the Black Sea Bass Commercial Working Group presented at the last meeting in February.

Then go over the analysis that the PDT has put together on these potential management strategies that are related to commercial state-by-state allocations, and those include, the TMGC approach, a trigger approach, a quota option approach and some hybrid approaches. Then I'll present some of the general decision points that the PDT identified for these approaches, and wrap up with next steps for the Board and take questions.

In August 2018, the Board established a Commercial Working Group, in response to a Board motion last May to identify actions that would address changes in black sea bass abundance and distribution. The purpose of the Working Group was specifically to identify issues in commercial black sea bass fishery related to these changes, and brainstorm some ideas for management that could address those issues.

The Working Group presented their report in February, and after that point the Board established the Plan Development Team, to continue fleshing out and analyzing the proposed management strategies that the Working Group identified, as well as a few others put forward by Board members. After that PDT was formed in February, the Board met jointly with the Mid-Atlantic Council in March to discuss this work on commercial issues that had been done at the Board.

At that meeting the Council initiated an amendment to address commercial issues, namely allocation and other related issues. The action taken by the Council at that meeting was mostly procedural at this point, as it will allow them to direct some of their staff resources towards supporting and contributing to the Board's ongoing work, and allow the Council and Board to coordinate on the development of options that would require Council involvement. As a result, the Council staff has participated on the PDT, and will continue to do so as their work continues, and we also held a joint Advisory Panel meeting at the beginning of April, to get feedback from the advisors of both bodies on the approaches that have been discussed by the PDT.

That leads us to today, where the Board will consider the PDT's report as well as the AP's feedback, and determine the best path forward for commercial management issues. Before getting into the PDT's work, I just want to quickly review the commercial issues that the Working Group identified and the Board supported in February.

The first of those issues was that the commercial state allocations, which were set back in 2003 under Amendment 13, are not reflective of the current distribution of the resource. These allocations were loosely based on landings for the period from 1980 to 2001, and they resulted in 33 percent of the quota being distributed between the states of Maine to New York, and 67 percent between New Jersey and North Carolina.

The Working Group noted that these allocations have remained unchanged, though there have been some substantial changes observed in the distribution of the stock over the past 15 years. Those changes are shown by this figure, which is derived from the last stock assessment, and it shows the spawning stock biomass estimates for north and south of Hudson Canyon.

SSB in the southern region is shown by the blue line, and the orange line shows SSB in the northern region, and around 2007 you can see that orange line increases rapidly, while the blue line also increases but to a lesser extent. As of 2015, the majority of the spawning stock biomass is occurring north of Hudson Canyon.

The open circles at the end of the time series there, represent the retro adjusted regional values that were peer reviewed in late 2016, early 2017, and that have been used for management and projections since then. The second issue that the Working Group identified was related to the coastwide quota management by NOAA Fisheries, which can create the possibility for the fishery to be closed as soon as the coastwide quota is exceeded.

That could potentially leave states who have not harvested their full quota without the ability to do that. At the joint meeting in March with the Council, the Board and Council did discuss this issue, and noted that it could be addressed in collaboration with the Council and NOAA Fisheries, so the PDT did not focus on this issue.

Instead, the PDT focused on that first issue of commercial state-by-state allocations, and they specifically focused on the management strategies that were proposed in the Working Group Report, and those that were offered up in February by Board members. Those options are listed on this slide.

First is status quo, which is of course an option the Board can consider. The next three approaches that have been proposed are a change from the current state allocation system. The first of those is the dynamic approach referred to as TMGC, which gradually shifts allocations over time, based on a combination of historical landings information and current biomass distribution information. Second is a trigger-based allocation approach, similar to that which was recently adopted for summer flounder. Third is a quota auction approach or ASQ, and fourth is the option of combining approaches to create a hybrid approach.

In addition to those, the Board could also consider establishing a timeline or a trigger, for reevaluating allocations on a regular basis. But this was not something that the PDT discussed. What is circled in red here is what the PDT focused on, and what I'll be going over in the next slides.

First is the TMGC approach, and again this approach was put forward by the Working Group, as a potential strategy for phasing in a new dynamic approach to allocation setting for the black sea bass fishery. It was modeled after the TMGC approach, which was originally used to adjust allocations for shared Georges Bank resources between the United States and Canada.

Essentially, the strategy uses a formula to gradually adjust state-by-state allocations, by transitioning from allocations that are based mostly on resource utilization or historic landings, and then over time shifting those allocations to be based more on regional resource distribution, or biomass information.

In the first years of implementation of this strategy, the historic landings or the current allocations would be the most important part in the formula, and then gradually over time that would shift, so that the distribution of the stock is more important in determining allocations for the states.

The equation that establishes the gradual transition is pretty flexible in how it can be set up, and also because the current biomass distribution is what eventually becomes the most important factor in determining allocations. This equation can result in allocations that fluctuate in either direction, so it does allow for quota to move back and forth between areas, rather than from one area to another.

The last thing I'll say about this before showing some examples is that the strategy also has the option to establish a control rule, so that in any year the total allocation given to a region could not change by more than an established amount, and that can add some stability to this process as well. To give you an idea of the flexibility in this approach, these are the dials that can be adjusted within that formula, to determine how allocations would change over time.

For one, you can change the way the resource utilization and distribution information are weighted in that equation. For example, you could start out setting it at 90 percent utilization, 10 percent distribution at the beginning, and then at the end have that transition to 10 percent utilization versus 90 percent distribution at the end.

That can be modified so you can use different percentages if you would like. You can also increase or decrease the transition speed, so how frequently adjustments are made to allocations. They could either be set at annual or biannual adjustments. The total time that it takes for that transition to occur can also be altered, so that you either have a longer or shorter timeframe over which that transition occurs. The state allocations that you start out with for the resource utilization information can also be altered. They could either be set at status quo, or they could be changed to accommodate different objectives, for example maybe adjusting the states quotas that are deemed inequitable or disproportionate to their current resource availability.

For example, the Working Group did note in their report that Connecticut and New York have disproportionately low quotas, compared to what their resource availability is now. Then lastly there is that Control Rule again that can be adjusted to restrict the maximum amount that the allocations can change each time they're adjusted.

This is a visual aid to show how the different types of information in the allocation formula are applied over time. As I mentioned, you start out with the historic resource utilization or the current allocations being the larger contributor to the resulting allocations, and the weighted importance of that historic information is shown here in blue.

Then in red you have the importance of the resource distribution information, or the regional biomass information. What you see happening over time in this example is that each year, or however frequently you are setting those adjustments to occur, the percent contribution of the historic information decreases, as the percent contribution of the resource distribution information increases.

Eventually you get to a point where the allocations that are being produced by the equation are mostly being influenced by the resource distribution, rather than the historic information. In this example the ending weights are set at 90 percent resource distribution and 10 percent historic landings, but again those proportions could be modified to something like 70/30.

This is an example of how the actual allocations would shift over time, if you were to apply the weights that I showed on the last slide to those two types of information that go into the equation. In this example, the formula uses the current allocations as the starting point, or the resource utilization information, and the regional spawning stock biomass estimates from the last stock assessment as the resource distribution information.

It also has a Control Rule set, which caps the regional allocation change at a maximum of 3 percent per year, and the lines on the graph represent the state allocations that come out of the equation. To highlight the difference in the regional effects, the states between Massachusetts and New York are shown in shades of blue, and New Jersey to North Carolina are shown in shades of red or pink.

For this example, the TMGC equation was applied retrospectively to allocations in recent years. Starting in 2007, you have the current allocations, and then in 2008 that formula starts to transition the weights, so that the historic information contributes 90 percent to the allocation and the resource distribution contributes 10 percent.

Then in each year after that the weights continue to shift by 10 percent, so by 2015 it reaches a level where historic information contributes 10 percent, and resources distribution contributes 90. What you see in the allocations over time is that because the equation is gradually applying more weight to the resource distribution, and during this time period that proportion of spawning stock biomass in the northern region is increasing, you see the allocations of Massachusetts through New York generally increasing proportionally as well, while the southern region is proportionally decreasing.

But what I also want to point out is that from 2014 to 2015 you see the direction of those changes flips, so that the southern states are increasing and the north is decreasing, and that's because there was a change in the biomass distribution from the assessment during that year. I just wanted to point that out so you can see how this approach can result in multidirectional change in allocations to each region.

I also wanted to note that the PDT report does provide several retrospective examples of how this approach could be used with different configurations, and it shows how those allocations would have changed in each of those scenarios, but for time I obviously couldn't go through all of those here. But just know that they are there to compare.

The next management strategy that the PDT discussed is the trigger-based allocation approach, and this approach would establish a quota trigger, or a base level of quota that is always allocated using the current state allocations, and then it would evenly allocate any quota above that trigger value to the states of Massachusetts through North Carolina.

As proposed, Maine and New Hampshire would receive a smaller allocation percentage, based on their historically low participation in the fishery. With this option there were two different trigger levels that were proposed, and those were 3 million and 4 million pounds. The first is approximately based on the average coastwide commercial quota between 2003 and 2018, but excluding the years where we were using the constant catch approach.

The second trigger is approximately based on the highest quota in our time series, which was 4.12 million pounds. This graph is just to show you how those two trigger values compare to the coastwide quotas from 1998 to 2018, and looking at the 3 million pound quota trigger, which is represented by the orange line, you have 10 coastwide quotas since 1998 that exceeded that trigger, and with the 4 million pound trigger shown by the green line, you have only the 2017 quota exceeding that trigger.

This table shows the percent allocations that would be distributed to each state for the quota up to and including the trigger, and those are the current allocations. Then the proportions that each state would get of the quota above the trigger, so you can see in that last column that each state from Massachusetts to North Carolina gets 10.89 percent of the quota above the trigger, while Maine and New Hampshire get 1 percent of that additional quota.

This second table is to show how the final state allocations would look, if this trigger approach were applied to the 2017 quota of 4.12 million pounds using a 3 million pound trigger. You can see the final state allocations in the third column, and then in the last column you see the percent change from that state's current allocation. I just want to note here that you see allocation increases in the states whose original allocations were lower than the percent of additional quota, so 10.89 percent that they receive of the quota above the trigger value, and that would be true regardless of what trigger value is used. Those states are Maine, New Hampshire, Connecticut, New York and Delaware. As the PDT discussed this approach they also considered how it could be modified to address changes in black sea bass distribution. The idea that was put forward was to still allocate the quota up to and including the trigger with the current allocations.

But instead of distributing the quota above the trigger evenly to the states of Massachusetts through North Carolina, they suggested instead allocating the quota above the trigger based on regional biomass. In the examples that the PDT put together for this modification, they used the Rho-adjusted regional SSB in 2015, which is the terminal year of the stock assessment, and those values result in regional biomass proportions of 86 percent for the northern region and 14 percent for the southern region.

Using this approach, additional quota above the trigger would first be allocated to each region based on those proportions. Then for allocating that additional quota within each region, the PDT proposed two different options. One would be to allocate equally to the states within each region, and the other is to allocate to the states within each region based in proportion to their historic allocations. There are examples of both methods in the PDT report.

This slide here is just to visualize the trigger approach as it was originally proposed. You have the quota up to the trigger in blue, distributed based on the current allocations. Then here the quota above the trigger shown in green is being distributed to the states equally, except for Maine and New Hampshire, which get 1 percent each.

Then you can compare that to the modification developed by the PDT, and you can see in this case the quota above the trigger is being split up regionally, based on those biomass distribution proportions from the stock assessment, and then split equally or proportionally to the states within each region. The percent allocation that each state would end up with would be dependent on which of those two methods are chosen.

I want to point out here that this modified trigger approach does maintain the smaller proportion for Maine and New Hampshire, but here they are getting that 1 percent each, but it's coming directly from the northern region's proportion rather than from the coastwide quota above the trigger. For the trigger approach, the PDT also highlighted a few considerations that might require some more thought if this option were to move forward.

First they noted that though 3 and 4 million pounds were proposed as two options for a trigger value, there may also be other appropriate options to consider, depending on what the desired outcome is. Second, they noted that again there is multiple ways to choose how to allocate quota above the trigger, whether that's evenly or in proportion to historic allocations, or in some other proportions. That would be another decision point for this approach.

Then lastly, the group also brought up the idea of using a soft trigger instead of a hard trigger, and a soft trigger would be allocating a certain percentage of the quota above a trigger based on the current allocations, and the rest of it based on a different set of allocations. The PDT thought that this might also be something the Board would want to consider. The last of the quota allocation strategies that the PDT discussed is the idea of an auctioned seasonal quota or ASQ System. To be clear in this case, the season refers to the full fishing year, so this option would occur on an annual basis. The idea that was put forward is to annually set aside a small portion of the quota, probably 10 to 20 percent to start looking at this option. That would be available for option to harvesters in the black sea bass management unit with all the required permits.

The auctionable quota would then be divided into smaller auction blocks by whichever agency is administrating the auction, and there could be certain rules established to limit the amount of quota that any one permittee can get in any year, in order to reduce quota consolidation. All interested participants would be able to bid on those quota blocks, and then the highest bidders would be awarded with that quota, and any funds gained from the auction would be funneled back into administration and enforcement of the auction.

This is the idea as it was generally laid out in the proposal. But there are obviously a lot of additional details that would need to be hammered out if this is of interest. Quickly I'll just provide a summary of the pros and cons that the PDT discussed with this approach. There is more detail on this in the PDT report as well.

But on the positive side, the auction could potentially increase fishery efficiency, by directing quota to harvesters with the greatest capacity to take advantage of that quota, and it could also be a relatively flexible way of allocating quota independently from state allocations. However, the PDT did highlight a number of concerns and challenges involved with running and administering this type of program, and because of the nature of this program it would need to be administered by either NOAA Fisheries or by ASMFC.

Both of those organizations have a number of concerns about running this type of program. For NOAA, this includes the fact that if they were running it they would only be able to auction quota to vessels with federal moratorium permits under the FMP regulations, and that would exclude state-only-permitted vessels.

They also noted that they would not be able to monitor landings at the vessel-specific level, so that would make enforcement difficult. There is also a concern that a quota auction could lead to consolidation of quota in the hands of operations with the most capital, and there is also uncertainty about how this program would interact with the ITQ systems that are already established in some of the Mid-Atlantic States.

Lastly, because we don't have the appropriate socioeconomic data at this point, it would be really difficult for us to analyze and predict the impacts of this type of program. The PDT emphasized that if this program is of interest it would require a high level of effort to develop. They felt that if it moves forward it would need to be the sole focus of the PDT.

In addition to those three strategies, the PDT also talked about the possibility of combining options to create a hybrid approach. For example, it could take 50 percent of the quota and allocate it using status quo allocations, and allocate the other 50 percent using something like TMGC or the trigger approach. But the PDT noted that if this is of interest, it would be important to weigh any potential flexibility that is gained from using a hybrid approach against any potential increases in complexity, and possible confusion among the public, since combining approaches might make it more difficult to parse out what the impacts of each component of the hybrid approach are. At the end of the PDT report, after considering all of these different approaches. They laid out some broader decision points, to help the Board think through the potential management strategies that have been proposed related to black sea bass commercial state allocations.

First, the PDT noted that it might be beneficial to set a clear understanding of the Board's intentions or objectives with looking at commercial allocation changes, in order to provide some direction to the PDT if a management action moves forward. The PDT also noted that for the options where there is a regional component, the Board should consider the best way of allocating to states within each region, as was mentioned during the discussion of the trigger approach.

Additionally, the PDT emphasized that the regional biomass information that we have, and that we used in the examples, that may change depending on the outcome of the Operational Assessment. It is still uncertain whether that assessment will be able to produce regional biomass estimates, and if it doesn't then the Board may need to consider using something else like federal survey data, or a combination of federal and state survey data to get regional information.

Another decision point is how to define the regional configurations in these approaches. Most of the examples that the PDT put together used Massachusetts through New York as the northern region, and New Jersey through North Carolina as the southern region. But the Board could consider some different configurations if it was deemed more appropriate.

For example, the discussion about Maine and New Hampshire was something the PDT brought up, and how to treat those two states, as well as potentially treating New Jersey as a separate region like it was done in recreational black sea bass. Lastly, the PDT discussed the idea of stability in the fishery.

Maintaining stability has been a concern for a number of states as we've had these discussions, and it's not clearly defined what stability means, so it might be useful for the Board to define stability, in terms of either a maximum percent change in allocations, or a minimum allocation or quota level that states would be comfortable with.

To wrap up my presentation, I have some next steps here for the Board. Today the Board may consider initiating a management action to address black sea bass commercial allocation issues, and as the PDT noted, it might be helpful to determine what the objectives of that management action would be, in order to guide the Board in choosing which strategies should be considered.

I'll also note here that the type of management document needed would probably depend on the options the Board wants to consider. The Board might also want to think about a potential timeline for developing a management action. For reference, this is an example timeline of what it could look like if an addendum were initiated today.

A draft document could be developed this summer with the options the Board is interested in considering. Then those options could be reviewed in August, but they likely wouldn't be fully fleshed out. The Board will not be able to review the operational assessment until October, so it might be appropriate to wait until October to consider approving a draft addendum for public comment, until we have that updated stock size and distribution information. If the Board were to approve a document for public comment in October, then public hearings could be held from November to December, and the Board could consider the document for final approval in February, 2020 at the earliest.

If it was approved in February 2020 that would make it difficult to implement for the 2020 fishing year, so it might be necessary to consider an implementation date of 2021. That is what I have for this presentation. Thank you for bearing with me, and I think we could take a second for any quick questions.

CHAIRMAN BALLOU: We have the AP Report, and I was thinking that it might be good to run through that sort of next in sequence, and then get to questions and then get to discussion. If it's okay with the Board, I would like to just encourage Caitlin to move through the AP presentation next. Then we'll circle back to questions and discussions, so why don't we do that Caitlin.

MS. STARKS: Alright, sounds good. The Advisory Panel did have a meeting jointly with the Council Advisory Panel on April 2, to go over these potential management options for commercial black sea bass. At that meeting we had 12 Commission advisors in attendance and 16 Council advisors in attendance. Fourteen of those were representatives of the commercial sector, ten of the recreational sector, and three that overlapped with both.

Six additional comments were sent to us via e-mail after the meeting, and those were included in the summary as well. In the next few slides I'll just go over the APs comments related to each of the proposed approaches that we just discussed. Regarding status quo, 10 advisors were in support of status quo commercial allocations.

The reasons that they gave included that the southern states are still catching their full quotas, and that there is too much uncertainty regarding both what the resource distribution looks like now, a few years after the stock assessment, as well as the impacts of the proposed approaches for reallocation. Two advisors opposed status quo, referencing that resource availability in the northern states is high, but the current quotas do not allow them to have the ability to take advantage of that availability.

For TMGC, 6 advisors opposed that approach, most of whom were from New Jersey to North Carolina. The reasons that they gave for the opposition were that they felt the results of the approach are too uncertain, and that it's unfair to the southern states, and that the allocations would not actually respond in real time to changes in biomass distribution, and lastly that there are still concerns about using the Northeast Fisheries Science Center Trawl Survey data to inform regional allocations.

There were also two advisors from Massachusetts and New York that supported the TMGC approach, and then one general comment that was given on this approach was that a minimum allocation level should be set in the approach, so that state allocations can't drop too low.

Looking at the trigger approach, there were 3 advisors that commented in support, and their comments included that this option would protect investments in the fishery, that areas where black sea bass has expanded should be able to get some of that excess quota, and that it is a start towards more flexibility for the northern region.

Six advisors said that they supported continued evaluation of this approach, though they didn't necessarily support it at the time. They noted that it needs further development before they could support it, and the focus should first be on getting updated stock information before looking into an approach like this.

As for the ASQ approach, 8 advisors opposed it, and only 1 supported it, and those opposing comments included that it would cause the same issues as the research set aside program, but under a different name, that it would produce more Carlos Rafaels, and that those with more capital shouldn't necessary get more quota.

The supporter of the ASQ comment said that maybe a Letter of Authorization program could be used to improve enforcement of a program like this. The advisors also gave a few more general comments on black sea bass commercial management, and one theme that they addressed was that changes to allocation shouldn't be made until after the Operational Assessment is complete.

Another comment that was given by multiple advisors was that the black sea bass stock is not shifting to the north, but rather expanding. One advisor also commented that it makes more sense to include New Jersey in the northern region than it does in the southern region. Another commented on the need to reduce bycatch mortality, and suggested that quotas could be subdivided by gear type.

Finally there was a comment that abundance should also be considered in the regional approaches, in addition to biomass. That is what I have for the AP report, and I just figured I would just put this slide back up to bring us back to the Board's discussion for today. With that I can take any questions.

CHAIRMAN BALLOU: Thanks so much, Caitlin and I really do want to just pause briefly and just thank the members of the PDT for what I think has been yeoman's work on this initial analysis. I think the report was extremely well written, and I think Caitlin's presentation was excellent.

I also want to thank the members of the AP, the joint AP, both from the Council and Commission for their input, which again was I thought very meaningful and helpful, and well detailed in the report. With that we're going to first take questions on the presentation that Caitlin just provided. We'll then be spending the rest of the meeting pretty much on a discussion regarding these issues. We'll move to that discussion after we take questions. First will be questions. Adam Nowalsky.

MR. ADAM NOWALSKY: The presentation on timelines showed a timeline for an addendum. Should we be considering this as an amendment process as well, or if we go through this process it would be by addendum only?

MS. STARKS: You could choose to do this through an addendum, if it was just an action that was to alter the state-by-state allocations. But something like the ASQ approach would require an addendum. It really just depends on the options that are wanting to be considered.

CHAIRMAN BALLOU: I think she meant would require an amendment for the latter; Adam, a follow up.

MR. NOWALSKY: ASQ would require an amendment, TMGC or trigger could be done through addendum, but could either of those first two. Could we choose to do it through an amendment process if we so desired?

CHAIRMAN BALLOU: Yes, I think that's the Board's prerogative. Either option is available. Additional questions, David Borden.

MR. DAVID V. BORDEN: I'm looking at one comment by Mr. Ruhle on Page 3, and I was just wondering if anybody could explain what the basis for the comment. I'll just read it, it's short. He's talking about the performance of the NOAA trawl project. He is quoted as saying "49 percent of the tows are invalid by their own admission." Is there any basis for that? Is there a factual basis for that statement?

CHAIRMAN BALLOU: I see Mike Luisi's hand up.

MR. MICHAEL LUISI: To the question. I can't say whether or not that value is accurate, I would assume that Mr. Ruhle in his work with the Northeast Trawl Advisory Panel that I sit on as a member of the Mid-Atlantic Council. The Council has been working with the Northeast Fisheries Science Center in evaluating the trawl survey.

Over the last year there has been the identification by the Science Center for a high number of their trawls. This is getting outside of the specifics of what I understand about how trawls work. But the geometry of the trawl has been outside of what has been defined as an optimal trawl setting.

Therefore, it's been agreed that a high number of these trawls that have been conducted over the years have been outside of that, which means that they're not fishing at that optimum geometry to capture the fish being targeted. I saw Dr. Hare here earlier. I don't want to necessarily want to put him on the spot. He might be better to explain and answer your question. I just thought I would give you what I know. Jon.

CHAIRMAN BALLOU: Dr. Hare, are you better able to explain and respond, and if you are please do so.

DR. JONATHAN A. HARE: I'll try, and you can determine if I'm better able. How's that? Jon Hare, Northeast Fisheries Science Center, Director, you know we very much appreciate working with Captain Ruhle on NEAMAP and working with the Trawl Advisory Panel. I don't know if 49 percent is the right number or not. But there are some large number of Northeast Fishery Science Center trawls which are outside of the specific bounds that are placed, in terms of the sort of how the trawl has worked on NEAMAP. It's an issue which the Northeast Trawl Advisory Panel and the Northeast Fisheries Science Center is looking at. The way we've been approaching it is several fold. One is doing field work, both on the Bigelow and on commercial vessels to understand the magnitude.

Captain Ruhle uses the word invalid. I wouldn't use the word invalid. But there is the catchability of a trawl when it's not the optimal shape is a question, and we're trying to sort of quantify what that catchability is in these different trawl performance areas, sort of deepwater mid-shelf and shallow water.

The other approach that we are taking is we are going to do some flume tank work to look at the trawl under different sort of spreads. That work was scheduled for January, because of the shutdown we were unable to do it, and we're in the process of rescheduling that work. That will also be open to the Trawl Advisory Panel as a group.

Then the third approach that we are taking is looking at, as we do an assessment, looking at the potential impact of catchability in the trawl, in the range of tows and how that would sort of impact the index that's coming out of the Bigelow, and then how that would impact an assessment. We've done it so far with yellowtail flounder.

Yellowtail flounder step distribution is in sort of a mid-range, which is where the trawl is performing well, so there is minimal impact. It was also looked at in the summer flounder assessment. The Bigelow time series was adjusted for catchability as the NTAP group thought that the catchability might be impacted.

That was included in the assessment. We are going to continue to work on this. I think the term invalid, I wouldn't use that term, but there are a large percentage of trawls which were outside of the narrow bounds, which the

NEAMAP survey is conducted under. But we are going to continue to work on this.

CHAIRMAN BALLOU: David. Did you have a follow, David?

MR. BORDEN: Please. Thank you, Dr. Hare. Just so I'm clear in my own mind. Is this a problem with the NOAA trawl project or the NEAMAP project or both?

DR. HARE: No, it's a Northeast Fisheries Science Center Trawl Survey issue. The NEAMAP Survey has very tight protocols, and Captain Ruhle fishes very efficiently, uses the protocols and then they throw out any trawl which is outside of the bounds. Just to be clear, it's not an issue of the NEAMAP Survey, it's an issue of the Northeast Fisheries Science Center Trawl Survey.

MR. BORDEN: Thank you very much.

CHAIRMAN BALLOU: Additional questions, Nicola Meserve.

MS. NICOLA MESERVE: With regards to the trigger approach. The PDT offered up two trigger levels, a 3 and 4 million pound trigger. Looking at the 4 million pound trigger there is only one year in the time series where he would have been above that. I guess I'm looking for a little more context as to the PDTs discussion as to how that would have provided for meaningful reallocation, and possibly whether it was based on assumption that we might have higher quotas in the future, similar to what happened with fluke recently in the new assessment.

CHAIRMAN BALLOU: Caitlin.

MS. STARKS: The PDT didn't put those two options forward. That was put forward with the original proposal by Rob O'Reilly. He might have something to say about those two options, but the PDT did suggest that there might be other levels that could be considered.

CHAIRMAN BALLOU: Rob, do you want to weigh in?

MR. ROB O'REILLY: Thank you, Caitlin for your report. Yes that is exactly it. We came through a very nice assessment result in 2016. We keep hearing about the tremendous biomass and abundance of black sea bass throughout the range. I think there should be an expectation that quotas will indeed remain somewhat on the higher end than they have since 2003 overall.

If that's the case, then it makes sense to bracket this trigger point evaluation with a high value. That is the only reason to do that. The 3 million pound trigger point is a little different in that is the average over time, with the exception of the years where constant catch was what the fishery was bound by.

Really, I think it's just a matter of one comment that we just looked at was from the AP, was let's see essentially what the next assessment looks like as well. Then there is a choice there. There is a choice; you have a 3 million pound trigger which you saw has quite a few entries of quotas above that and then the 4 million only one now.

It's sort of planning for the future. That is what we hope the future looks like. The other part, if I may Mr. Chair, to talk about that option for just a second more is that certainly putting in the option and having the PDT come out with the variation is fine, on the soft trigger. It's just that I'm wondering if it was looked at as a way to have an intersection with the TMGC approach, where I realize it's early.

Nothing was really done on the soft trigger. There was sort of a recommendation there that if it was 50 percent and a couple of examples are given in the document, but clearly that is sort of bridging the two approaches a little bit, because the TMGC would also at some point, some number of years, end up with that situation as a soft trigger would as well. I'm wondering did the PDT have a discussion about that? Was that the rationale for the soft trigger?

CHAIRMAN BALLOU: I'm not sure, but Caitlin you want to take a stab at that?

MS. STARKS: Sure. I don't know if it was exactly the rationale for looking at a soft trigger. But it was just another idea that was brought up by the PDT of something that could be done. It does kind of intersect with the hybrid approaches part of the PDT report. You could choose to use kind of a soft trigger to set 50 percent that's going to be allocated based on the current allocations. Then something above that could be allocated using TMGC, but it could also be allocated using the trigger approach, and it could also be allocated in a different way. It was just a suggestion that they also put forward for consideration.

CHAIRMAN BALLOU: Any other questions, yes, Joe Cimino?

MR. JOE CIMINO: Thank you, Caitlin. That was a great presentation. I think you may have a slide that we didn't have. Could you bring up the TMGC example? Well actually, it might help if I speak to this a little bit. What we saw in the document was some very smooth lines that looked like they had long time periods. With examples, it talks about regional distribution assumptions being based on spawning stock biomass by region from the assessment time period 2004 to 2012.

I don't know if I'm putting you or Jay on the spot. In those long time periods in the projections that we have in the document is that a single value for the biomass, and then just using all the other levers if you will to slowly adjust it over time? Is this doing something different? I guess it must be, because it's changing throughout.

CHAIRMAN BALLOU: Caitlin is going to take a stab at that.

MS. STARKS: I'll try, and if Jay is around maybe he can correct me if I'm wrong. But I believe the examples that were provided in the report are also retrospective, which did allow them to use the changing biomass information from the stock assessment. It shouldn't be a constant value that was used for those projections.

CHAIRMAN BALLOU: I see Jay in the back nodding his head in the affirmative. He is concurring with Caitlin's response.

MR. CIMINO: Then there was the potential for each year. It could have been a jagged line. It's shifting towards the northern states, but a year or two later for whatever reason; the Trawl Survey would bring it back to the southern states. That's happening in the projections. Okay that is something that was not clear.

CHAIRMAN BALLOU: Adam.

MR. NOWALSKY: Let me build on that question then. In the examples that we saw, the quotas that were shown in a given year, how far did the assessment lag, in terms of the information used for that decision? Were we essentially seeing a quota in a given year was based on distribution from four or more years prior in those examples?

I understand the TMGC approach talked about, and the PDT review talked about, the concerns about the lag between an assessment and actually using it, which would be on this four-year timeline approximately, versus possible using state surveys or something else. But for the examples that we're looking at, are we looking at essentially a four-year lag between when we're going to have a quota for fishermen to utilize, and the distribution that that would have been based on?

CHAIRMAN BALLOU: I think the answer is yes that the projections were based on the assessments that were done, and the projections associated with those assessments. Yes to your comment. There was a lag, there is a lag, there always is, with regard to looking back on the most recent assessment. I believe that's how these projections were developed.

Right, and each time there is an update that would get folded in. That is the concept and that was the attempt made here, with regard to these examples, to show how it would have played out had this process been in place, and based on the information we had in hand. It looks like that answered the question. Mike Luisi.

MR. LUISI: Based on Adam's question. Could we assume that the same lag would be part of the formula that would go into the regional biomass example for the trigger alternative, rather than an equal distribution of the extra fish above the trigger? I mean I would assume that there would be some basis to assign those differences within the region, which would also be lagged. Can we assume that?

MS. STARKS: Yes, I believe that's the case.

CHAIRMAN BALLOU: Any further questions? Nicola.

MS. MESERVE: To this point, Mr. Chairman. The assessments are on a two-year schedule, right, moving forward. The next one is in 2021. That would include data through 2020. But in 2021 we get the assessment, there is only a one-year lag between incorporating data on regional biomass from 2020 into the approach for the next year.

If you were doing it on an every two year basis that is all of the assessment. I'm not seeing as much concern about a multiyear lag in incorporating stock information into that approach. Right now we're not doing it at all. It is certainly an improvement beyond that.

CHAIRMAN BALLOU: With that let's see if we can pivot now to discussion. I'm just going to kind of reset that discussion briefly. The Working Group Report, which preceded the PDT Report, identified two main issues. The first being, state commercial allocations implemented in 2003 do not reflect the current distribution of the resource, which has expanded significantly north of Hudson Canyon.

Two, federal coastwide quota management can limit harvest opportunities for some states, if another state's harvest overage results in a coastwide fishery closure. That second issue, identified by the Working Group is slated to be addressed in collaboration with the Mid-Atlantic Council and NOAA Fisheries, and will likely be brought back for consideration at our next joint meeting in October, or as early as that.

The first issue is what we want to focus on today. The PDT undertook an initial analysis of management options and alternatives suggested by members of the Board. As noted in the report, and by Caitlin in her presentation, some of the options relate well to the problem statement, others less so. Thus it would behoove the Board to offer a clearer sense of direction to the PDT regarding the Board's intent on the issue of reallocation. In other words, what is the primary purpose for revisiting allocations for commercial black sea bass, and what is the primary goal for the options and alternatives to be further developed and considered? One version offered solely for the purposes of seeding today's discussion, might be something like this.

Given the shift in resource distribution and abundance, the Board should consider changes in commercial allocation to provide fair and equitable access to the resource, by better aligning allocations with updated scientific information on resource distribution and abundance, while affording due consideration to the socioeconomic needs and interest of coastal communities.

That straw man language draws from the initial problem statement developed by the Working Group, and comports with key relevant provisions in the Commission's Strategic Plan. I reviewed that plan and I have them in front of me. But I can circle back to them if anybody wishes. I'm game to put that straw man goal statement that I just offered up on the screen, for purposes of seeding today's discussion upon request, but won't do so unless so requested.

I just wanted to kind of set the stage, and now open the floor to discussion on a proposed goal statement, and any other set of objectives related thereto, that's one. Two, some clarification and guidance as to which management strategies the PDT should continue developing, and three, what our potential timeline should be as we move forward with this initiative.

Those are the sort of three. I want to frame this discussion with regard to those three issues. I think it was bracketed the same way in Caitlin's slide, so just kind of resetting this next phase of our meeting today. With that I will now open the floor to discussion, comments, and suggestions. I don't anticipate the need for motions.

We're not adopting anything today. We're really just in a mode of trying to provide guidance on these issues. But it's an important step in the process, because it will inform what happens over the next several months. With that the floor is open for anyone who wishes to weigh in on any of those questions, or any of the issues that have been raised. Who would like to go first? Tom Fote.

MR. FOTE: I asked a while ago about when we're doing biomass, and we basically put it in numbers of fish, and compare the numbers of fish over the period of time, because as we know black sea bass like summer flounder, if you put higher size limits you reallocate by doing that because the bigger fish move north.

I'm looking at what were the figures by numbers of fish that basically has that change over the period of time. I can understand why they get bigger fish, because basically like summer flounder, black sea bass they do the old go out to the Canyon and come back further north, as they get larger.

We've been providing a nursery for the south for the big fish to go north. When we started raising the size limit, we did over the years from the smaller size limit on black sea bass and summer flounder, we started doing the reallocation ourselves of where the biomass, because the bigger fish are up north. I've asked for that a couple of times. I wonder if we could get that and we can probably start really looking at this.

CHAIRMAN BALLOU: Before I go to the next hand, I just want to note that I misspoke when I said no motion would be needed. A motion would clearly be needed if we were to initiate a management action today. I just want to clarify that point. On these issues, who is ready to weigh in and provide guidance on some of these areas? David Borden.

MR. BORDEN: I don't have a problem with the statement that you put up there. I do have some issues with some of the options that are in the document; specifically the Auction Option. I think should be taken out, unless somebody can convince me that they've fixed the problems that manifested themselves with the RSA project. If you want to just focus on this, I'm happy with this statement.

CHAIRMAN BALLOU: Just to keep the meeting moving along well. How does the Board feel about this straw man proposal for a goal statement? I say this. I'm pointing to the language that's up on the board. Again, this was just offered based on what I drew from, based on drawing from the sort of record if you will, the problem statement developed by the Working Group, principles that I drew upon from the Commission's Guiding Documents.

Does this speak to the purpose upon which this Board is looking to move forward with this issue of revisiting commercial allocation? If there is no objection, again we are not formally adopting anything today. We're just making sure that we're clear on what it is that we're looking to achieve. Is there any objection or any recommended changes to this language? John Clark.

MR. JOHN CLARK: It would just be a clarification, Bob. I'm just wondering by having a goal like this. Are we saying as we get further into these discussions, which if summer flounder was any indication are going to be long and excruciating, that we would have to base any allocation on, you know we said in our goal we were going to allocate based on the new distribution of the species.

It almost seems that this goal would say the status quo is not an option. I know from just from what we saw from the AP report for example, status quo is favored by a lot of the fishermen in our region. I just want to make it clear that if that goal is in there, there could be a situation where status quo is something that would not be seen as an option.

CHAIRMAN BALLOU: My response would be status quo is always an option, and the key word here is the first word, consider. This is just indicating the purpose by which this initiative would move forward. It doesn't mean that anything has to be adopted, but it would guide the development of the options and alternatives. John.

MR. CLARK: I understand Dave said to remove the Auction Option. I had come up with that. I just didn't put much effort into that because I didn't figure it would go anywhere. But one of the real advantages that was not really brought up in the PDT report, was that it would take us out of this allocation effort here, because we would have a situation where the allocation would be allocated based on whoever would be best able to take advantage of it.

I think what I've heard from some of the joint meetings is there is already a de facto reallocation going on, and that some of the quota from permit holders in some of the southern states has been bought by commercial boats in other states. In any event, as I said, I certainly understand the difficulties with going to that. But it would be one thing to think about for the future, to try to avoid these long-drawn-out-allocation arguments.

CHAIRMAN BALLOU: Understood, thanks. Mike.

MR. LUISI: I'm comfortable with what's on the board and what we're discussing here, and I'm happy that the first sentence doesn't reference shifts or expansion, and that we've kind of steered clear of that and we're talking more about distribution and abundance. I think there is a debate still over whether or not the stock is shifting, or if it's just been redistributed and expanding in certain areas. I think that I would be happy to leave that alone.

Last, just for the record, I'm assuming that reading the last part of the sentence, "the socioeconomic needs and interest of coastal communities," is in reference to what's been developed over the time that the allocations have allowed for those states to capitalize and put forth in their communities the harvest of that resource at the level that they're harvesting now. I think in my mind this does address the issue, but it also secures to some degree that historical nature of the fishery as an important element as we move forward.

CHAIRMAN BALLOU: I think you put it well. That is certainly my take. Eric Reid.

MR. ERIC REID: I just have a question about our current utilization of the resource. Is there any state that is underperforming on their current quota?

CHAIRMAN BALLOU: Well, I'm going to let Caitlin answer that. She just whispered in my ear, if you want to I can put that on the record.

MS. STARKS: I have taken a look at the recent years, and there isn't any state that is significantly and consistently underperforming. It does alter from year to year, and there has only been a couple states in the last few years that have been under their quota, but it's only been by a few percent.

CHAIRMAN BALLOU: Why don't we by consensus, agree that the goal statement that's on the Board is worth adopting. But I use that word loosely with a small "a" for the purposes of guiding future development. I was next going to turn to the management strategies and options, but Adam you have your hand up, go ahead.

MR. NOWALSKY: My one concern with this approach is that it tells us, in my opinion relatively prescriptively, that fair and equitable access is based on resource distribution and abundance. I don't disagree with the statement that resource distribution and abundance should be one of the considerations.

But I have a level of discomfort with this statement as written, whereby fair and equitable access to the resource by better aligning allocations. I would be more comfortable with replacing "by better" with something along the lines of "including consideration of," whereby we're clearly identifying this as something we want to consider. But I appreciate the effort you put here, in terms of trying to guide us. I'm just uncomfortable with the focus on that as the means for equitable access.

CHAIRMAN BALLOU: I appreciate that. I would just kind of revisit Mike Luisi's comment and that is that the last part is aimed at identifying a second key factor, socioeconomic needs and interest of coastal communities. You could say balanced by or in due consideration to that. I sort of read this as addressing two key factors, the one that you just spoke to is one, but it's not limited to that.

It's also sort of balanced by or also complemented by that last part. But to your point, if the language were changed to just say, including consideration of, it leaves it more open ended. It means that other factors could be introduced, and I guess the point that I would want to focus on today is what would those other factors be? If so, let's try and identify them now. If this is missing pieces, let's try to get those missing pieces in. Adam.

MR. NOWALSKY: I think historical allocation is the first one that was highlighted by the Working Group here. I don't disagree that while affording due consideration touches on that. I don't think it's as clear that saying historical allocation or whatever it might be. I don't think we have to list them all.

I think having gone through the summer flounder process; we've touched on a lot of the issues. I'm just looking to whatever they may be, whether they're here today. I don't view this as a guiding principle for the next three weeks, three months, or three years, Mr. Chairman. I think this is something this Board could hold true for a longer period of time potentially.

I think it's important that we don't box ourselves into a corner by saying fair and equitable access is defined by aligning allocations with updated scientific information, without stating that that is just one of the items we want to. If you specifically need another, I would offer historical allocation as an item to have here as another example if you needed one.

CHAIRMAN BALLOU: Responses to Adam's suggestion. Toni, sounds like you've got an idea.

MS. TONI KERNS: I just have a question, Adam. Maybe it's by interpretation, which will be subject to question or something, I don't know. But by saying that we're trying to better align allocations with updated scientific information on resource distribution in abundance, I would say that underlying that is the historical allocation, so that's what you're starting with is historical allocation.

Then this is saying that you want to consider changes to take those historical allocations and somewhere realign. How much you realign is a big question with this updated information on distribution and abundance. I'm trying to think like how to fit that in, because this sort of goal statement or whatever we're going to call it, is telling you what you're considering the options to shift to. If you already have historical allocation as the underlying current allocation, then how do you blend that in here? Do you know what I'm saying?

CHAIRMAN BALLOU: Adam.

MR. NOWALSKY: This is the crux of the issue is that is resource distribution and abundance the right way to reallocate? That is the question that is put before us. My point is that's one consideration. I'm not comfortable leaving this room with that being the phrase that we're using as the means for fair and equitable access.

I think the AP was very clear in highlighting that. I think we would be doing the AP process a huge disservice by essentially disregarding that. Again, I was fine with leaving it. My specific suggestion, which is replacing "by better" with "including consideration of," I thought that left this as a focus, but didn't explicitly say this was our means for fair and equitable access.

I think it comes down to if you are in favor of abundance distribution as the means for reallocation, then you could say okay, this includes historical allocation. This includes all the other things, because you like this. If you have concerns that that way forward is not necessarily the best way forward, I think it's clear where I land on the issue here.

I think you're going to have some more considerations, and you're going to look for a little bit more consideration of the other side of the coin. I don't know what more I could say than that. I mean this is a decision the Board ultimately has to make in how we moveforward, and that's my proposed way forward is by changing "by better" to "including consideration of."

CHAIRMAN BALLOU: I'll take Tom, and then we do want to kind of come to terms on this, move to the other issues, and we're about 15 minutes away from I think needing to wrap up. We do have to move through this as quickly as we can. Tom Fote.

MR. FOTE: As I read this it says that we haven't been fair and equitable in the way we've been managing black sea bass. That is what you just said here; consider changes in commercial allocation to provide fair and equitable. Are we not doing that now, as by doing it historically? Now we're talking differently. I mean I agree with Adam. This wording is not the right wording.

CHAIRMAN BALLOU: Eric.

MR. REID: Other than I'm trying to avoid a nervous breakdown at this moment. I do agree with Adam, because my definition of better is going to be substantially different than maybe Rob O'Reilly's for example. I agree with Adam that we should change that a little bit.

CHAIRMAN BALLOU: Okay. What I'm thinking is that we don't necessarily have to arrive at a finite decision today on the exact wording. We can certainly take the Board's input, and work on continuing to craft this goal statement. We're trying to move the ball forward. It doesn't mean we have to score a touchdown today. But we do need to get through a couple of other issues, so I'll take two or three additional comments; Joe, Matt, and Rob, and then we'll need to move on to the next issue. Joe Cimino.

MR. CIMINO: I think to me socioeconomic means more than just the historical allocation. The fact that we're going to set something in motion that is constantly shifting, I think. We've seen the concerns with summer flounder industry saying, even in Rhode Island where they're saying we might benefit at town dock, but this does not seem safe to us.

A concept of telling sea bass fishermen, you know you're going to lose this quota for ten years, but don't worry you may get it back. In that amount of time if they had to sell their sea bass pots to survive, getting it back in ten years isn't exactly helpful to them. I think moving forward, socioeconomic needs puts a lot of onus on us to do something we don't always do, and have good information on the gear types, on the capacity of the fisheries, on the capacity of the docks and stuff like that.

CHAIRMAN BALLOU: Matt Gates.

MR. MATTHEW GATES: I think the allocations originally set in 2003 were probably what people thought at the time is fair, and probably were fair at the time, because the change in resource distribution has created a situation where it's a lot I think less fair for certain states, Connecticut being one of them, with a 1 percent share of the allocation. I think I like keeping the term better aligning with allocation with updated scientific information. I wouldn't want to make it worse than it is now. I think keeping better in there is a good descriptor of that.

CHAIRMAN BALLOU: Got you. Let me go to Rob and Maureen, and then we're going to move on. Rob.

MR. O'REILLY: Joe has covered my thoughts there, so thank you.

CHAIRMAN BALLOU: Maureen.

MS. MAUREEN DAVIDSON: Right now the Board is considering changes in the commercial allocation to black sea bass. Obviously, we can foresee which states might want change, and which states don't want to change. Are we considering changing our commercial allocations to black sea bass?

If we're not, for historical reasons, for socioeconomic reasons, fine. But I think that if we're going to change the allocations for black sea bass, we have to have some justification for why we're changing it, and the direction we're going to go in the change, and what we're going to use as the basis for making these decisions.

I know this is hard. I got to watch parts of the summer flounder discussion. I don't want to go back to the basics, but I really want to ask, do we want to change it? I mean I'm from New York, I want to change it. But there are other states that are comfortable where they are now. Before we start arguing, are we willing to consider real change to our black sea bass commercial allocation?

CHAIRMAN BALLOU: I'm going to take this position. We have not reached consensus on a goal statement. We have some language that I think is something that we can circle back to, incorporating input received today by the Board, and then bring it back before the Board at our next meeting. I don't think we're going to achieve any sort of sense of finality on this today. What I would like to do next is just see if, and this is a little awkward, because the next issue has to relate to this first issue.

But are there any alternatives or options that are currently being analyzed by the PDT that should be struck, or are there any new options or alternatives that should be added? This would be for the purpose of giving guidance and direction to the PDT, and their continuing efforts to work on this issue. I would like to get some input on those questions, they are related. Anything new to be added, anything that is in there now to be struck? Emily Gilbert.

MS. EMILY GILBERT: GARFOs input on the ASQ Approach, the Auction Seasonal Quota Approach, was already discussed a bit during the presentation. It's discussed more in the PDT Document itself. But I just wanted to reiterate that given the difficulty in effectively enforcing, monitoring and managing such a program, in addition to the limitations of staff and resources to administer an auction. These are thoughts similarly shared by the Commission staff. We would have strong reservations over our ability to ultimately be able to successfully implement that program. That's my comment.

CHAIRMAN BALLOU: That echoes sentiments that David Borden mentioned earlier. Are there any other thoughts on this, and I would put it in the form of is there any objection to removing the, we're calling it the Auction, I'm sorry I forget the name, the ASQ Option. Is there any objection to removing that from the document for now?

Sorry John, appreciate, it was teed up well and I thought it actually received a good amount of analysis. I don't sense that you're objecting to removing it for now. It can certainly be placed on a back burner and be brought forward again, but for now in terms of focusing our resources, is there any objection to pulling that third option?

I see no objection, so we'll take that as a consensus opinion on the part of the Board. Then the last issue is the timeline, and this does relate to the sort of core final issue, and that is whether or not there is any interest in formally initiating an addendum or any sort of management action. I guess it could be an amendment today. That doesn't need to happen. It could, but certainly it relates to the timeline, and Caitlin if you could put that timeline, the one that you had offered up back on the board to help that would be wonderful. Rob O'Reilly.

MR. O'REILLY: I didn't know you were closing the door on the option, so I do have a comment on that if I may.

CHAIRMAN BALLOU: Oh sure, I'm sorry, thank you.

MR. O'REILLY: In February meeting, winter meeting at the very end. The Chair allowed other options to be brought forward, and at the time just speaking about my thought process, having one option available at that time, the TMGC, with four key decision points, which I could see would be a big hurdle to overcome to figure out when, where, and who is going to make those decisions with that approach. I did supply both you and Caitlin with the trigger point approach, and I think the PDT certainly is welcome to flesh out other options. But by putting in the soft trigger, it sort of mutes the effect of what I had intended when I supplied that. Now granted, I borrowed that from elsewhere, you know from the flounder document, the Summer Flounder Commercial Amendment Document, and made some modifications for the constant catch to not include that.

But to see in the document that there's going to be taking that particular option, putting a 50 percent would be the approach, which would rest with historical allocation. The other 50 percent would be with some other type of allocation. To me that's a pretty big departure. I don't mind that departure, as long as the documentation is separated.

That is not really something that was introduced for that purpose; it was introduced so that there could be a stepping stone to reallocation that would be a little more moderate. My supposition early on, based on Nicola's question was that yes, 3 million pounds is something that would prove to be a pretty good trigger point.

If we come back after the next assessment and the assessment after that, and this resource is showing that 5 million, 6 million pound quotas are available, well then yes the Board can come back, the Board and the Council can get together and say, well you know what? We really do have something that we can rely on here.

But in the meantime, to put in the soft trigger does mute the effect of putting in that option, and so I would request that as this goes further that that be set aside, and not included as part of the trigger point option. It may be included however the PDT wishes to characterize it. But clearly it's confounding, and I just want to make that statement for the record.

CHAIRMAN BALLOU: Caitlin, do you want to respond to that?

MS. STARKS: Sure, I just want to say understood, and if the Board didn't want that option in there at all that is also your prerogative. I think right now I'm looking for some direction, on which of the things the PDT put forward as additional ideas you guys are interested in moving forward, versus not interested in moving forward. That's helpful feedback, Rob, and I think if that stays in based on the rest of the Board's will, we can definitely separate it out as a different kind of option than the trigger option.

CHAIRMAN BALLOU: Adam.

MR. NOWALSKY: Just continuing in that vein. The quotas that we see coming out of the next assessment, as a result of the revised MRIP numbers, I'm not sure we're comparing apples to apples anymore, in quotas that we have for 2022 and beyond, relative to where we were in 2012, 2015, because they're going to be based on very different information.

I would request, I support moving forward with further development of a trigger based option. But I would ask the PDT to specifically look at what this means, and we now have the example of summer flounder to look at, where our quota for 2019 now means something very different. Even though the quota went up, it's not to say that the quota went up because suddenly the resource doubled in size. That is not what happened. The resource didn't change in size, our understanding of it did. What the quota means today is very different relative to where we are. I would ask for that consideration. In terms of a timeline moving forward, I'm of the opinion that allocation should not be done through an addendum process.

I think if you're trying to hold this meeting to a timeline today, a motion to initiate a management document today is probably going to take you significantly over the time that's been allocated. That would be your discretion where we go from there. But I would be a proponent, if we're going to go through an allocation it should be done through an amendment timeline process.

CHAIRMAN BALLOU: I'm going to take two more comments and then try to bring this to a conclusion. I think, was it David? Did you have your hand up? Yes, go ahead.

MR. BORDEN: I'll just follow up on Adam's point. I look at the whole MRIP recalibration as an opportunity for us to fix problems. In other words, given the experience that we've all had on summer flounder, where the quota went up by 72 percent. Had we had the benefit of actually taking a step back and taking some portion of that quota, and I'm just using this as an example, not to argue summer flounder at a black sea bass meeting, but had we taken advantage of that 72 percent increase, and tried to fix some of the problems that some of the states around the table have been having, particular New York and Connecticut. It was a way forward, and a painless way forward.

In other words, the states wouldn't have had to give up their basic allocations. We could have fixed the problems, and then figured out a way to move forward. We're going to have, at least my own understanding of where we're going to be is we're going to be in almost that exact same position on black sea bass, if things transpire the same way.

I'm more inclined to pick up the pace of this, and try to pick up the pace of it so that we can take advantage of that opportunity to try to solve, particularly the situation with Connecticut and New York on black sea bass is feeling intolerable. Connecticut gets 1 percent of the allocation, it's just unheard of.

They've got 1,400 square miles of area in Long Island Sound that's packed with black sea bass that didn't exist back in the initial timeline. But we've got the opportunity to fix that if the quota goes up. I'm more inclined to accelerate this rather than slow it down.

CHAIRMAN BALLOU: Nicola Meserve, and then we're going to have to try to bring this to a conclusion. Nicola.

MS. MESERVE: With regards to the trigger option. I think it's really important to note that the PDT said that in its original design, it does not respond to the problem statement. Moving forward, I would oppose to continuing with a trigger approach that has equal shares of the quota above the trigger level. What that does is distribute the extra quota to states, indifferent of their geographic location along the coast. It doesn't respond to the statement of the problem. I am much more interested in a modification to the trigger approach, as provided by the PDT, that would include the regional resource availability, and how the quota above the trigger level is distributed.

CHAIRMAN BALLOU: Duly noted. I think that would be good guidance that we'll be able to draw upon. At this point what I want to do is try to bring this portion of the meeting, this agenda item to a conclusion. One way to do that is to entertain a motion to initiate a management action. If anyone feels a burning desire to do that I'll entertain it.

Another way forward is to just pause. You know hit that pause button as we sometimes do. Our next meeting is in August. We could take the guidance provided today on all the issues that we discussed, work to further massage and develop the document, bring it back in August, see where we are, maybe drill down a little bit more to some of these issues we discussed today.

That is a second option. Is there any preference on the part of any Board member to move forward with one versus the other, and I'll take that in the form of is there anyone who wishes to make a motion pertaining to initiating a management action today? Seeing no hands, I'll assume there is consensus on the second approach that I just mentioned. I think with that do we need anything else today? Caitlin, what else do you need today?

MS. STARKS: I think if you're going this route of continuing PDT work on developing management options that could be considered in August, then the PDT would definitely need some more direction from you all on which of those options to include. I obviously heard that you would prefer to scratch the ASQ Option, so they won't look at that anymore.

But with the TMGC and Trigger Approach they've put forward several examples, so it would be very helpful to know which of those you're interested in. Are there other examples that you would like to see of how those two options could be configured? I heard Nicola say to keep looking at a modification that would take into account regional biomass information. But are there other things that the PDT could do from now until August, to bring back to the Board?

CHAIRMAN BALLOU: That's a good question. It's a question asked three minutes following what was supposed to be the end of this meeting. I wish we had more time to delve into that. I'm not sure that we do. But if anyone has any immediate thoughts, I really want to honor Caitlin's request.

On the other hand I'm not sure we have enough time to really get into. Well, e-mailing is fine. The problem with e-mailing is it doesn't necessarily represent the consensus view of the Board, it represents individual interest. That said there is no harm done given where we are in the process, to open the door to individual suggestions from individual Board members, provided to Caitlin via e-mail. Any such input will be vetted at our August meeting.

We're not going to move forward in any new direction or any particular direction based on any individual Board member's wishes. But it is invited. It will be conveyed to the PDT, if anyone wishes to weigh in. I don't know how else I can handle this at this point, given where we are with regard to timing. But if any Board member has a different take on how best to proceed, I'm open. Otherwise I want to try to move on to our last agenda item. Matt, it looks like you had a thought. Did you want to offer something?

MR. GATES: I just had one suggestion for Caitlin, but I can handle it in an e-mail if you like.

CHAIRMAN BALLOU: Yes, why don't we do that? Why don't we live up to that suggestion? E-mail input is open; the door is open to that. Rob.

MR. O'REILLY: I'll be very brief. The trigger point option we saw what the AP thought, so three AP members thought go forward, six thought it can go forward, give it some idea. I think what I am objecting to is the open-endedness that I saw in the document. If the PDT wants to refine that and take into consideration the resource, then that's fine, but there has to be some decisions on how that goes in time.

For example, the current trigger option that came out the Summer Flounder Commercial Amendment, it is cut and dried. You reach a certain point, allocation changes. The PDT can change the allocations, not make them evenhanded to the states. That is fine. That is a different option and that's fine. Then there has to be a decision on how much, so there has to be some information on how much of the range, not just throw out 50 percent and say well, here is some examples of 50 percent.

It has to be worked up with data. Unfortunately, when we went through the Summer Flounder Commercial Amendment, I don't think a lot of the states at the time had everything worked out as to how that actually changed allocation, and what amount of poundage was transferred through the trigger point option, for example. That is my recommendation; I'll put it in e-mail as well.

CHAIRMAN BALLOU: Toni.

MS. KERNS: I guess Rob just gave one piece of a question for the PDT. In that though, you know the PDT isn't making these management decisions. You all are making those management decisions, and then they are working up those examples for you. The PDT really needs advice on what more do you want from them, outside of what they have here?

Based on the discussion today, I'm not really sure they are going to provide you anything different than what you have here today, unless you say I want a TMGC Approach with no more than 1 percent movement per year, and a trigger here. That's what they need from you all, in order to bring you a document, or you can say we want a range of these pieces.

But they can't make those management decisions. That's what this body is here to do. They've built the program for you, and I think they did an excellent job with this document, to provide you all with some really good background and backbone to then turn into a document. But they need that advice back. I'm just not sure they're going to give you anything new from what they already have, so I just hope that there is not this big expectation that you're going to get much of a different document.

CHAIRMAN BALLOU: I think that is a fair comment. I think that seems to be where we are. I'll just leave it at that. Again, I'm trying to wrap up, but I see Adam's hand up. I realize I didn't go to the audience, so Arnold I will allow you to offer a comment. But go ahead, Adam.

MR. NOWALSKY: Taking those comments to heart, I would propose we leave here with a date, May 15 maybe, of anyone who wants to provide specific things they want to see, or comments on the variation to get back to staff. This is what we would like the PDT to do for us. You could give that to them. You could distribute it if you felt so inclined to the entirety of the Board, so they knew what everybody was doing. That might be a way forward where we are, given the timeframe today, and hopefully get something back then for our next meeting.

CHAIRMAN BALLOU: Here is how we're going to resolve it. I'm going to take Adam up on his suggestion, but it's with a caveat, and that is by May 15 we will, with staff. I will review any and all input provided. If I think that input veers off from what I would consider to be a direction that the Board as a whole would support, I'm going to really hit the pause button and wait until we reconvene in August.

Because I do not want to see the PDT engaging in analysis on options and alternatives that may be of interest to a particular Board member, but might not be shared by the Board as a whole. I'll make that judgment call as to whether the input provided by May 15, based on this meeting and any additional input provided by May 15, warrants continued work by the PDT.

I'll consult with staff obviously, and with my Vice-Chair, and we'll try and make that determination. I will be very vigilant on behalf of the Board to make sure that we don't put too much time and effort into any new ideas or options that haven't been sort of cleared by the Board. With that we may end up not making a whole lot more progress until August.

But, I will challenge you to be ready in August to kind of get a little bit more concrete in our direction forward. But I think this is a process of the ball moving forward, I think we have moved the ball forward today, and I appreciate that. I'm ready to wind it up, but Arnold I will give you this opportunity to comment, and while he's coming up Tina, if you're not already ready. I'm going to be calling on Tina next for the AP membership issue. Go ahead, Arnold.

MR. ARNOLD LEO: Thanks, a recommendation to include in the possible addendum. It has occurred to me that when it comes to these questions of allocation among the states or the user groups, they're always stalled, because obviously the states or user groups who are going to lose will oppose change, and those who might gain will be in favor of change.

We're constantly stalled at making any progress. I wonder if it's not time to consider the appointment of a wholly independent body, say consisting of three marine scientists from like Iceland, England, and Portugal who don't have a dog in this fight, to consider the allocation questions, and make the decision that obviously is a torturous process for the Commission to make the way it's presently set up. That would be my suggestion for an item to be included. Thanks.

REVIEW AND POPULATE ADVISORY PANEL MEMBERSHIP

CHAIRMAN BALLOU: Thank you. Any other input from the public on this matter? Seeing none; we'll move on to our next agenda item, which is to review and populate AP membership, Tina, welcome, thank you.

MS. TINA BERGER: I offer for your consideration and approval the nomination of Paul Caruso, a recreational angler from Massachusetts as an addition to the Summer Flounder, Scup, and Black Sea Bass AP.

CHAIRMAN BALLOU: **Thank you is there a motion to approve the appointment of Paul Caruso, made by Nicola Meserve, seconded by Emerson Hasbrouck. Is there any objection to the motion? Seeing no objection, Paul is appointed.** Thank you and we welcome Paul to the AP.

OTHER BUSINESS

AGENDA ITEMS FOR AUGUST BOARD MEETING

CHAIRMAN BALLOU: Under other business, I just want to briefly speak to an issue that I had referred to earlier.

For our next Board meeting in August, I am anticipating that there will be a report out on the status of the ongoing preliminary work being done by the Recreational Working Group regarding management reform. That effort being undertaking initially by a relatively small group, involving myself and Adam Nowalsky, as well as Caitlin and Toni.

Mike Luisi and Rob O'Reilly on behalf of the Mid-Atlantic Council, along with staff from the Mid-Atlantic Council, as well as staff from GARFO, is seeking to frame a set of priority issues associated with recreational management, particularly the desire to achieve more inter-annual stability that is obviating or at least lessening the need to engage in our annual process of chasing the RHL.

As part of that effort, or as a corollary to that effort, I would like to engage in a long overdue discussion on reducing discard mortality in our recreational fisheries, particularly black sea bass, but perhaps summer flounder as well. My good friend and colleague, Ray Kane, who I thought was here but may have left, from the Commonwealth of Massachusetts, has been pushing for consideration of this issue, backed by the results of a couple of recent studies.

We've been so inundated with issues over the past year, and as a result this issue of discard mortality has unfortunately gotten pushed back in line time and again. But I think the time is a good one now to bring this to the fore at our next meeting in August. I am therefore proposing we do that. If there are no objections to the idea, I will work with staff to ensure that we get that teed up, and invite all

Board members to contact us if you have any specific ideas related to the project.

Again, this is picking up on an issue that has been recommended to me by one Board member repeatedly, and I just want to honor that request by acknowledging that it will be folded into our August meeting.

ADJOURNMENT

With that is there any other business to be brought before the Board? Seeing no hands is there any objection to adjourning? Seeing no objection, we are adjourned. Thank you very much.

(Whereupon the meeting adjourned at 12:30 o'clock p.m. on May 1, 2019)

Caitlin Starks

From: Comments
Sent: Monday, July 15, 2019 11:01 AM
To: Caitlin Starks
Subject: FW: BSB potential commercial measures

Public comment

-----Original Message-----
From: Fishthewizard [mailto:fishthewizard@aol.com]
Sent: Sunday, July 14, 2019 5:43 PM
To: Comments <comments@asmfc.org>
Subject: BSB potential commercial measures

To Whom It May Concern:

There should be no change in state allocations of BSB, unless NJ is getting a larger percentage. We already gave up 18%, and if anything, should have a larger share. The fish are abundant, and we have no problem catching our quota. Any cut in the allocation will lead to economic hardship and discards. The coastwise quota should be increased to reflect the population of fish available.

Joan Berko
Commercial fisherman

Plan Development Team Report: Black Sea Bass Commercial Management

Prepared by:

Black Sea Bass Plan Development Team
Caitlin Starks, Chair, ASMFC Staff
Alex Aspinwall, VMRC
Jeff Brust, NJ DEP
John Maniscalco, NYS DEC
Jason McNamee, RI DEM
Julia Beaty, MAFMC
Emily Gilbert, NOAA Fisheries

April 22, 2019

Table of Contents

I. Introduction

The Commission's Summer Flounder, Scup and Black Sea Bass Management Board formed a Commercial Black Sea Bass Working Group in August 2018 to identify management issues related to changes in stock distribution and abundance, and propose potential management strategies for Board consideration. In February 2018, the Board reviewed the Working Group report, which identified two main issues: (1) state commercial allocations implemented in 2003 do not reflect the current distribution of the resource, which has expanded significantly north of Hudson Canyon, and (2) federal coastwide quota management can limit harvest opportunities for some states if another state's harvest overage results in a coastwide fishery closure (Appendix A). In February, the Board requested the Plan Development Team (PDT) perform additional analyses and further develop proposed management options related to the issue of state-by-state commercial allocations. The second issue identified by the working group will be addressed in collaboration with the Mid-Atlantic Council (Council) and NOAA Fisheries.

This document presents the analyses and findings of the PDT. For each of the proposed management strategies, the PDT discussed potential variations of the strategy that could be implemented to achieve different management objectives or outcomes. The PDT also highlighted additional considerations the Board should take into account when evaluating these approaches.

II. Potential Management Strategies for Adjusting Commercial Allocations

A. Status Quo

One potential management option is to maintain the current state allocation percentages. The current allocations were originally implemented by the Commission in 2003 as part of Amendment 13, loosely based on historical commercial landings by state from 1980-2001 (Table 1). In a complementary action, the Council adopted an annual coastwide quota system to facilitate the state-by-state quota system adopted by the Commission. Each state sets measures to achieve, but not exceed, their annual state-specific quotas. The annual coastwide quota is implemented and administered by NOAA Fisheries. The fishery is closed when the coastwide quota is projected to be taken, regardless of whether individual states still have unutilized quota.

Table 1. Current black sea bass commercial state-by-state allocations.

State	% Allocation
ME	0.5
NH	0.5
MA	13.0
RI	11.0
CT	1.0
NY	7.0
NJ	20.0
DE	5.0
MD	11.0
VA	20.0
NC	11.0

B. TMGC Approach

The first approach to adjusting the state-by-state allocations discussed by the Black Sea Bass Commercial Working Group, and then the PDT, is a dynamic approach for gradually adjusting state-specific allocations using a combination of resource utilization (historical allocations) and current levels of resource distribution. The alternative is modeled after the Transboundary Management Guidance Committee (TMGC) approach, which was developed and used for the management of Georges Bank resources shared by the United States and Canada. Though the approach proposed here for black sea bass differs from the TMGC approach used for Georges Bank, in this document the black sea bass allocation approach will also be referred to as TMGC.

This new strategy sets forth a formulaic approach that balances stability within the fishery, based on historical allocations, with gradual allocation adjustments, based on regional shifts in resource distribution derived from updated stock assessments or surveys. The former recognizes traditional involvement and investment in the development of the fishery since the beginning of black sea bass management, and the latter addresses the changing distribution of the black sea bass resource and the resulting effects within the fishery. Through incremental adjustments over time, the state allocations become less dependent on the historical allocations and more dependent on regional resource distribution.

This option proposes use of the existing state-by-state allocations to reflect initial values for historical participation (resource utilization) and proposes use of the 2016 benchmark stock assessment results (NEFSC 2017) to determine the values for resource distribution; the two values are then integrated in the form of regional allocation shares. An alternative to using the stock assessment would be to use synoptic trawl survey information. Two regions are proposed, as defined in the assessment: (1) ME - NY, (2) NJ - NC. They emanate from the spatial stratification of the stock into subunits that generally align with those used for the assessment, which used Hudson Canyon as the dividing line based on several pieces of evidence that stock dynamics had an important break in this area. The regional allocation shares are then subdivided into state-specific allocations. Appendix B includes a complete description and examples of the TMGC approach retrospectively applied to recent years.

1. TMGC Variations

The TMGC approach affords considerable flexibility, both with regard to initial configuration and application of the allocation formula over time. A key feature involves the use of control rules to guard against abrupt shifts in allocations. The overall approach can be modified by the Board and Council in various ways. For example, sub-alternatives can be developed for:

- the regional configuration (e.g., alternative regions to those proposed here);
- the values for historical participation/resource utilization (e.g., current, status quo allocations, or some variant thereof);
- the starting and ending weighting values for resource utilization and resource distribution (e.g. 90:10 to 10:90, or some variant thereof);
- the increment of change in the weighting values per year (10%/year, or some variant thereof;)
- the periodicity of adjustments (e.g., annually vs. biannually);
- the overall time horizon for the transition between starting and ending weights for resource utilization and resource distribution (e.g., 8 years vs. 16 years).
- control rule (e.g., maximum regional allocation change of 3% per year, or some variant thereof)

Of the numerous potential configurations that could be created by adjusting these parameters, the PDT focused on four examples to evaluate potential effects on state-by-state allocations. In these examples, the resource distribution information is derived from the unadjusted regional spawning stock biomass proportions from the 2016 benchmark stock assessment. The other parameters of the formula vary in each example, as follows:

1. The first example represents a configuration resulting in a more liberal change in state allocations. The parameters are set as follows: 2 regions (ME - NY; NJ - NC); resource utilization = status quo allocations; transition from 90:10 to 10:90; 10% per year change in the transition from utilization to distribution; annual adjustments; the transition time to 90% weight on the resource distribution is 9 years; 10% control rule; regional distribution assumption is based on the spawning stock biomass by region from the assessment for the time period of 2004 - 2012; distribution of adjustments to states within a region based on historic allocations.
    a. Any TMGC configuration could also be modified to distribute the allocation adjustments equally to the states within each region, instead of distributing those adjustments proportionally to the historic state allocations. An example of this modification applied to the above configuration is shown in Figure 2 below.

2. This example represents a more conservative configuration, with more limited changes to state allocations. The parameters are set as follows: 2 regions (ME - NY; NJ - NC); resource utilization = status quo allocations; transition from 90:10 to 30:70; 5% per year change in the transition from utilization to distribution; annual adjustments; the transition time to 70% weight on the resource distribution is 12 years; 3% control rule; regional distribution assumption is based on the spawning stock biomass by region from the assessment for the time period of 2004 - 2015; distribution of adjustments to states within a region based on historic allocations.

3. The last example is intended to showcase a number of additional modifications that could be made to the approach to achieve certain objectives. In discussions amongst the PDT (and previously the Board regarding recreational black sea bass) it has been noted that it may be appropriate to treat New Jersey as an individual region due to its geographic position straddling the division of the Northern and Southern regions adjacent to Hudson Canyon. Additionally, some Board members have suggested modifying the "resource utilization" part of the equation to increase the allocations for Connecticut and New York due to their disproportionate allocations compared to their current resource availability. Lastly, the PDT discussed the option of holding Maine and New Hampshire's current allocations static throughout the transition.

    To demonstrate these modifications, the parameters are set as follows: 4 regions (ME and NH remaining as a non-dynamic region with static allocations; MA - NY; NJ as a stand-alone region; and DE - NC); resource utilization = CT and NY base allocations increased by 1% in each of the first three years; transition from 90:10 to 10:90; 10% per year change in the transition from utilization to distribution; annual adjustments; the transition time to 90% weight on the resource distribution is 9 years; 10% control rule; regional distribution assumption is based on spawning stock biomass by region from the assessment for the time period of 2004 - 2012, and assumes NJ is consistently 60% of the southern region distribution; distribution of adjustments to states within a region based on historic allocations.

The changes to the state allocations resulting in each of these examples are shown in Figures 1-4. A more detailed description of the methods applied in each example is included in Appendix B. It is important to note that the TMGC approach continually adjusts the state-by-state allocations beyond the time period over which the transition of the weights of resource utilization and resource distribution occurs. These adjustments would be made according to updated regional resource distribution information from either the stock assessment or synoptic trawl survey information as it becomes available, depending on which data source is selected.

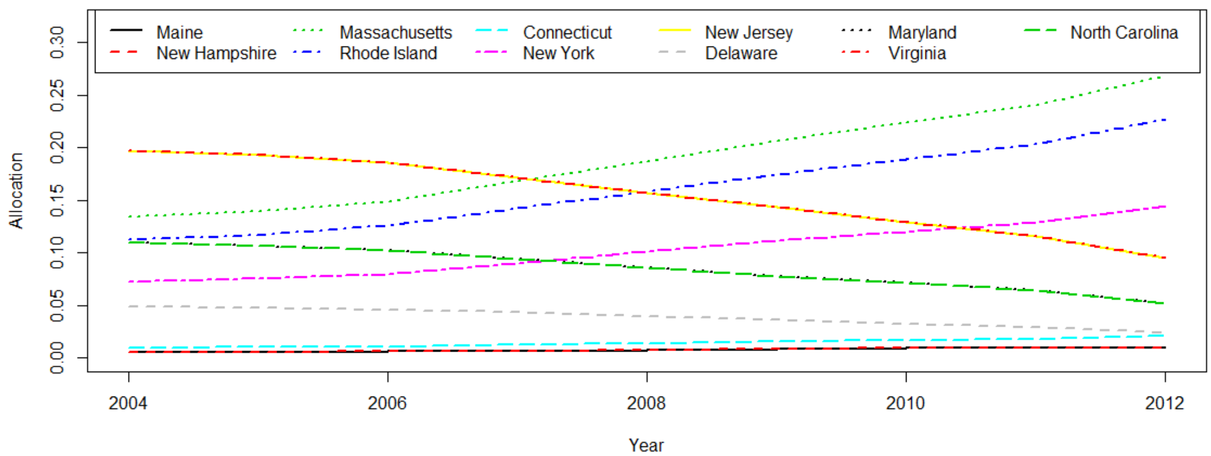

Figure 1. Allocation trajectory for all states under the parameters outlined in example 1 above. The control rule is not triggered in any year in this example. This is a retrospective analysis as if this method were in place beginning in 2004.

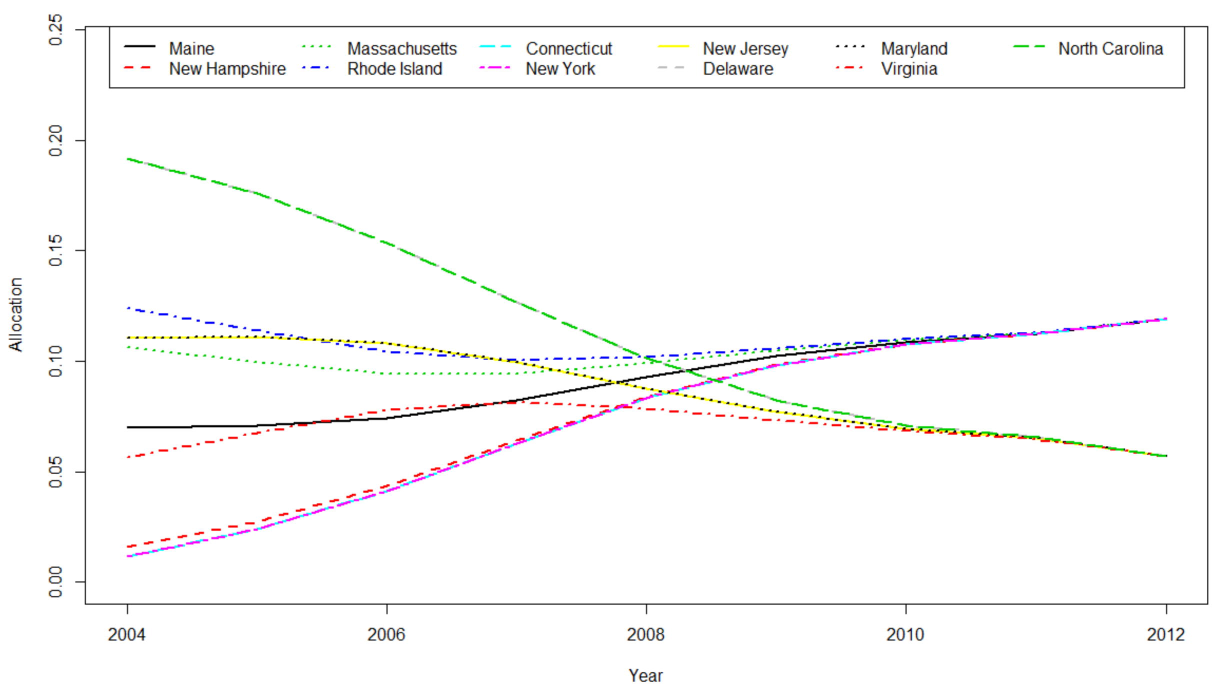

Figure 2. Allocation trajectory for all states under the parameters outlined in example 1a above (equal distribution to the states of regional allocation adjustments). The control rule is not triggered in any year in this example. This is a retrospective analysis as if this method were in place beginning in 2004.

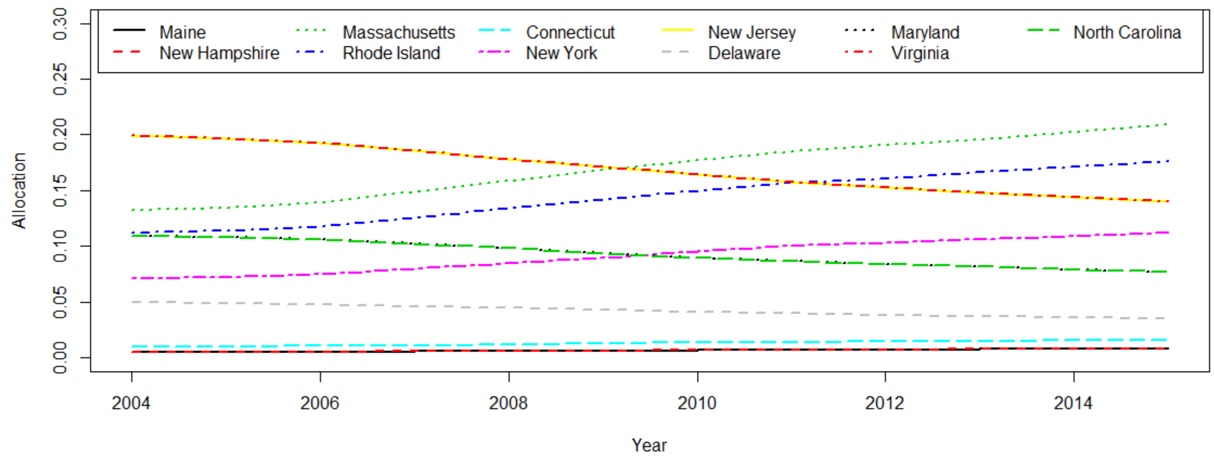

Figure 3. Allocation trajectory for all states under the parameters outlined in example 2 above. The control rule is triggered in each year from 2012 through 2015 in this example. This is a retrospective analysis as if this method were in place beginning in 2004.

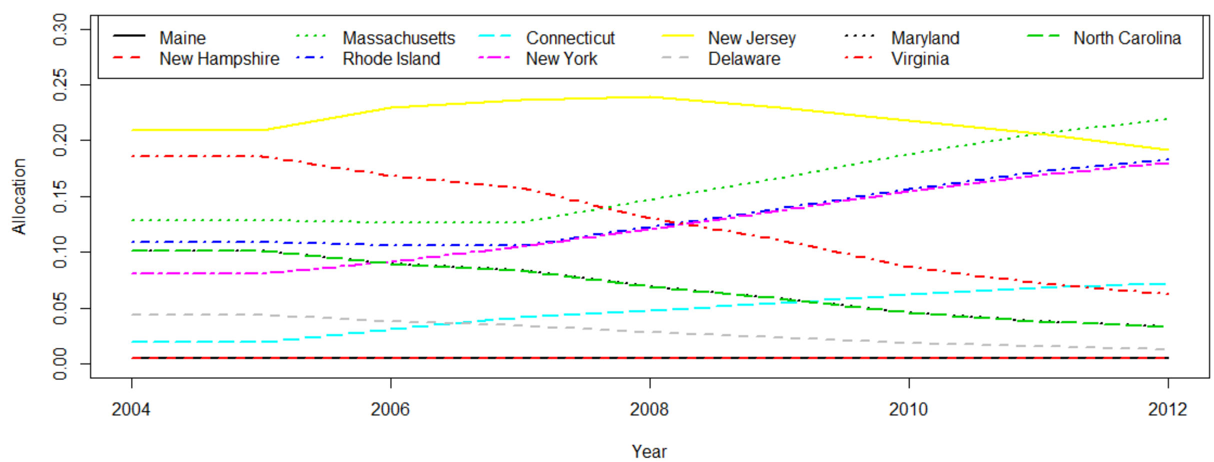

Figure 4. Allocation trajectory for all states under the parameters outlined in example 3 above. The control rule is not triggered in any year in this example. This is a retrospective analysis as if this method were in place beginning in 2004.

2. TMGC Considerations

There are two options for calculating the resource distribution. The first option is to use the spatial stock assessment to determine the amount of resource in each region (north = NY, CT, RI, MA, NH, ME; south = NJ, DE, MD, VA, NC). The spatial stock assessment calculates north and south spawning stock biomass values, which can then be turned in to a proportion. The benefit of this approach is the regional biomass values are calculated through a synthesis of many biological parameters and represent the best available science for the population. The drawback is that the assessment is updated periodically (not every year); thus updated resource distribution could not be produced annually but would depend on the assessment cycle[1]. Additionally, if the spatial stock assessment were to fail at some point in the future, this could impact the ability to implement the dynamic allocation calculations.

As an alternative to using the stock assessment information, values for resource distribution could be obtained and calculated using scientific surveys, with results apportioned into regions. Since surveys are undertaken annually, the values for regional resource distribution could be recalculated and updated annually, biannually, or upon whatever timeframe is deemed most appropriate, affording an opportunity to regularly adjust allocations in sync with shifts in resource distribution. Such shifts may, or may not, follow consistent trends. Accordingly, the technique affords a dynamic approach, consistent with actual changes in resource distribution as defined by the survey information. There are more options with regard to the regional configurations that could be established with this approach, whereas a two-region configuration is the only option with the assessment. The overall benefit of this approach is that it could be performed annually with the most contemporary data. The drawback is that survey data are prone to variability. Smoothing techniques and the proposed control rule are designed to account for some of this variability and prevent it from causing unreasonable changes in a single year.

C. Trigger Approach

The second approach the PDT discussed is a quota trigger approach. In this approach, a minimum coastwide quota would be established as a trigger for a change in allocations to the states. If the coastwide quota established by NOAA Fisheries in a given year were higher than the established quota trigger, then the quota would be distributed to the states in two steps: 1) the amount of coastwide quota up to and including the trigger is distributed to the states according to the current state-by-state allocations, as set forth in Amendment 13 in 2003; and 2) the amount of quota exceeding the established trigger is distributed equally to the states of Massachusetts through North Carolina, with Maine and New Hampshire receiving a smaller percentage based on their historically low participation in the fishery. Should the annual coastwide quota be less than or equal to the established quota trigger, allocation percentages would default to the current state-by-state allocations. This method limits fishery disruption by guaranteeing states some minimum level of quota based upon the 2003 allocations.

Two potential quota trigger options have been proposed: 3 million pounds, or 4 million pounds. The 3 million pound trigger represents approximately the average coastwide commercial quota from 2003 through 2018. Years in which specifications were set using a constant catch approach were excluded from the average (i.e., 2010-2015). Commercial quotas remained essentially the same from 2010 until 2013 when there was a slight change in the coast-wide quota established by the SSC in 2013 however, that was merely an extension of the constant catch that extended until 2016. The average commercial quota from 2003 through 2018 is 3.12 million pounds.

The 4 million pound trigger represents approximately the highest commercial quota from 2003 through 2017. The highest commercial quota was 4.12 million pounds in 2017. A 3 million pound trigger is lower than 10 out of the last 13 years (2008-2019) of coastwide commercial quotas established by the

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[1] The Northeast Region Coordinating Council approved an assessment prioritization process and management assessment track schedule in November 2018 that would provide management assessments for black sea bass every two years. Following the upcoming operational assessment, the next assessment would be available in 2021, with information available for management in 2022-2023.

National Marine Fisheries Service. A 4 million pound trigger is higher than all but one year of coastwide commercial quotas in the last 13 years (Figure 5). Table 2 shows an example of the quota trigger approach using a 3 million pound trigger and the 2017 coastwide quota of 4.12 million pounds. Additional quota trigger examples are provided in Appendix C.

Figure 5. Commercial BSB Quota over Time Compared to 3M Pound and 4M Pound Triggers

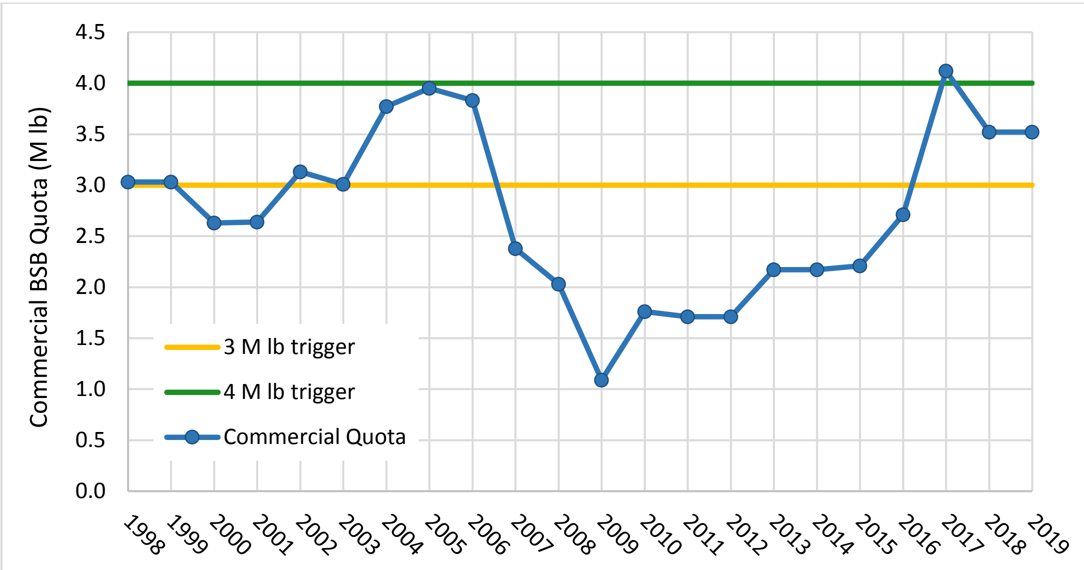

Table 2. Reallocation of black sea bass commercial quota above a 3 million pound trigger, based on the 2017 coastwide quota of 4.12 million pounds.

3 Million Pound Trigger					
State	**Current allocation (%) of quotas up to and including 3 million lbs**	**Status Quo distribution of first 3 million lbs of quota**	**Allocation (%) of additional quota beyond 3 million lb**	**Example state allocations (lbs) under a 4.12 million lb quota**	**Example state allocations (%) under a 4.12 million lb quota**
ME	0.5%	15,000	1.00%	26,200	0.64%
NH	0.5%	15,000	1.00%	26,200	0.64%
MA	13.0%	390,000	10.89%	511,956	12.43%
RI	11.0%	330,000	10.89%	451,956	10.97%
CT	1.0%	30,000	10.89%	151,956	3.69%
NY	7.0%	210,000	10.89%	331,956	8.06%
NJ	20.0%	600,000	10.89%	721,956	17.52%
DE	5.0%	150,000	10.89%	271,956	6.60%
MD	11.0%	330,000	10.89%	451,956	10.97%
VA	20.0%	600,000	10.89%	721,956	17.52%
NC	11.0%	330,000	10.89%	451,956	10.97%
Total	**100.0%**	**3,000,000**	**100%**	**4,120,000**	**100.00%**

1. Trigger Approach Variations

The PDT noted that the initial trigger approach proposals do not directly address the first problem identified in the Working Group's Report: the distribution of biomass has changed significantly since the state allocations were established in 2003, and the allocations do not reflect these changes. Changes in biomass distribution are supported by the 2016 stock assessment and peer reviewed literature.

To better address these changes within a trigger approach, the PDT discussed a modification that would distribute quota above the trigger based upon the proportion of coastwide biomass in each region, as informed either by the assessment models or fishery independent survey data. Fishery independent survey data may be required if the benchmark assessment regional model framework cannot produce valid regional results after inclusion of the updated MRIP estimates. The terminal year of the assessment can be used if retrospective bias adjustments to the assessment outputs of SSB are required, or the last three years of the assessment can be averaged if no adjustment is necessary. Tables 3-4 in Appendix C show examples of allocation above the trigger based on regional biomass, using the Rho adjusted regional model outputs from the terminal year of the 2016 benchmark assessment (2015). It should be noted that if this approach were selected, the Board would need to specify which regional biomass values to use. In the event that regional assessment outputs cannot or should not be used, a method to use fishery independent survey data must be developed – preferably one that utilizes a multi-year average or a smoothing approach (for instance, the approach described in the TMGC methods in Appendix B). The regional proportions used to distribute quota above the trigger should be updated every time appropriate new data is available.

Within the regions, quota above the trigger can also be distributed to individual states in different ways. One approach is to distribute quota above the trigger in equal shares to all states within the region (ME and NH receive a flat 1% of this additional quota from the northern region pool; this could be modified if they express increased interest in participating in the fishery) (Table 3, Appendix C). A second method would be to distribute quota above the trigger to all states within the region in proportion to their 2003 allocations (Table 4, Appendix C).

2. Trigger Approach Considerations

If a trigger-based approach is of interest, the Board would need to consider the most appropriate configuration based on the objective of reallocating black sea bass commercial quota. First, a quota trigger should be selected based on the amount of quota the Board feels should be distributed under the current allocations, versus the amount of quota that should be made available to the states using an alternative allocation scheme. The Board should also choose an allocation method for quota above the trigger that best addresses the issues facing the fishery (i.e. equal distribution of additional quota or distribution based on regional resource availability).

While the trigger approach as proposed establishes a hard quota of three or four million pounds, the PDT discussed the possibility of using a soft trigger, which would allocate a percentage of the quota using historical allocation, rather than a set number of pounds. Fluctuations in annual quota values would result in similar fluctuations in the poundage being allocated using historical values. For example, if a trigger is set at 50% of the quota, the historical allocations would apply to two million pounds of a 4 million pound quota, and 3 million pounds of a 6 million pound quota. Using a hard trigger, if the annual coastwide quota is below the trigger, then the full quota is allocated using the historic allocations. With a soft trigger, lower quotas would still allow some portion of the quota to be allocated using a distribution other than the historic allocations.

The PDT has explored several options for potential quota triggers, and allocation schemes for additional quota above the trigger. However, the Board may wish to consider alternative trigger levels or allocation schemes that are deemed more appropriate. Additionally, the size of the population and subsequent quota amounts may change due to the 2019 operational assessment for black sea bass. This should also be considered before selecting a trigger value if this method is eventually adopted.

D. Auctioned Seasonal Quota

The Auctioned Seasonal Quota (ASQ) approach was proposed by a Board member in February 2019. The proposed management strategy is to annually auction off part of the total commercial allocation under an ASQ. While all of the allocation could be auctioned, that would be disruptive to the current fishery, so it was proposed that this strategy could be applied only to 10-20% of the coastwide quota. The portion of the quota to be auctioned would be divided into auction blocks (e.g. 2,000 pounds, 5,000 pounds) by the agency charged with holding the auction. The proposal suggests the auction should be open to all fishers in the black sea bass management unit with the required federal and/or state permits. Rules could be set to limit the number of blocks that any one permittee can acquire. High bidders would be awarded the auction blocks. The proposal also indicated that auction funds received by the administrating agency should be used to administer and enforce the auction.

The rationale presented by the Board member who proposed the ASQ strategy is that it responds to several problems with the current quota allocation method:

- Quota allocated among states loosely based on landings from 1980-2001, so more recent shifts in black sea bass distribution are not reflected in state allocations.
- Quota allocation among states is a 'zero-sum game' – one state can only increase its allocation if another state(s) decreases its allocation.
- States have treated their allocations as permanent property and each state has stakeholders that depend on getting their share of the allocation, making it difficult for a state to agree to a reallocation plan that does not provide its stakeholders the same benefit.
- In three states, quota is allocated to individual permittees through Individual Transferable Quotas (ITQ). Participants in the fishery at the time the state allocations were established were grandfathered into the fishery and received ITQ. The distribution of ITQ makes it difficult for new participant to enter the fishery.

1. ASQ Considerations

a) Administration

The PDT discussed a number of considerations regarding administration of an ASQ program. For one, the group noted that because the auction would be open to harvesters from all states in the management unit, such a program could not be administered at the state level. Thus, either NOAA Fisheries or the Commission would need to manage the program.

Administering an ASQ program would pose numerous challenges for both bodies. From GARFO's perspective, initial concerns include the following:

- The limited access privilege program (LAPP) provisions of Magnuson-Stevens Fishery Conservation and Management Act (MSA) allow for auctions to establish allocations. GARFO has significant concerns about the resource and staffing needs it would take to host and monitor such an auction.
- The MSA allows funds from these auctions to be deposited into a Limited Access System Administration fund and would require a cost recovery fee (up to 3% of ex-vessel value of fish harvested) that would be applied to the costs of management, data collection, analysis, and enforcement activities related to this program. However, NOAA Fisheries would not be able to transfer this money to state agencies or state law enforcement to assist with monitoring and enforcing the program.
- GARFO is only able to establish this type of program for Federal moratorium permit holders, which would place state-only permitted vessels at a disadvantage. GARFO is unable to monitor vessel-specific landings for state-only permitted vessels. If the entire quota were eventually moved to an ASQ system, this would prevent state-only vessels from fishing for black sea bass. Even if a transfer program were to be developed that allowed state-only permitted vessels to lease in quota, GARFO would not be able to monitor that quota.
- Any ASQ or Individual Fishing Quota (IFQ) program requires very robust monitoring and reporting, and GARFO believes the current system in place for black sea bass is inadequate to support an ASQ system. Other similar IFQ/ITQ fisheries in the region and country require systems such as vessel monitoring systems and pre-landing reporting for effective monitoring.
- Having part of the quota be allocated coastwide and part of it available for auction is also problematic:
  - Without a more robust system to track individual allocations at a vessel level, it would be difficult to track which landings should be counted against the coastwide quota and which should count against the ASQ.
  - It has not yet been specified how vessels could use this additional quota. For example, would they use the purchased quota only if the coastwide quota was harvested and Federal waters were closed? If so, what if the coastwide fishery does not close? Or would the additional quota allow for increased possession limits for certain individuals? This would be very difficult to monitor and enforce.
  - Past experiences with the research set-aside quota auction system demonstrated that it can be very difficult to effectively monitor and enforce additional allocated landings beyond a coastwide/state-managed quota.
- Though the term ASQ implies that there are seasonal quotas, GARFO assumes the intent is to hold one auction per year. If the intent were to have multiple seasonal auctions, this increases the complexity and concerns mentioned above.

There is also uncertainty regarding the Commission's ability to administer an ASQ program. The Commission has concerns about the resource and staffing needs required to host and monitor such an auction. Currently, the Commission does not have a staff member that would be able to take on this role. In addition, the Commission does not have experience in administering ASQ or IFQ/ITQ systems; therefore a significant amount of staff time would be needed to determine the details of administering an auction. Based on past experiences, a quota auction system would likely be very difficult to monitor and enforce, therefore the Commission would need to determine if it would be possible to administer such a program with its current resources and authority.

b) Data Concerns

It has been suggested that commercial fishery efficiency may increase under the ASQ approach because the fishermen/vessels with the lowest operating costs relative to potential revenues may be most willing to purchase additional quota. The PDT noted that potential changes in fishery efficiency will be difficult to analyze based on available economic data and given that a variety of factors will likely influence fishermen's decisions regarding purchasing additional quota.

The PDT noted that some states may be better positioned to take advantage of additional black sea bass quota than others, depending on the scale of the increase in quota. For example, states with higher numbers of Federal black sea bass moratorium permits may be better able to utilize additional quota than states with lower numbers of moratorium permits. However, given the high demand for black sea bass and the high ex-vessel price compared to many other species (averaging $3.05 per pound in 2017), even states with lower numbers of permits may fully harvest additional quota. The PDT reviewed preliminary data on the number of federal moratorium permits issued each year from 1997 through 2017, as shown in Figure 6 below. The PDT cautioned that this analysis does not account for state-only permitted vessels, and some states may have robust fisheries in state waters.

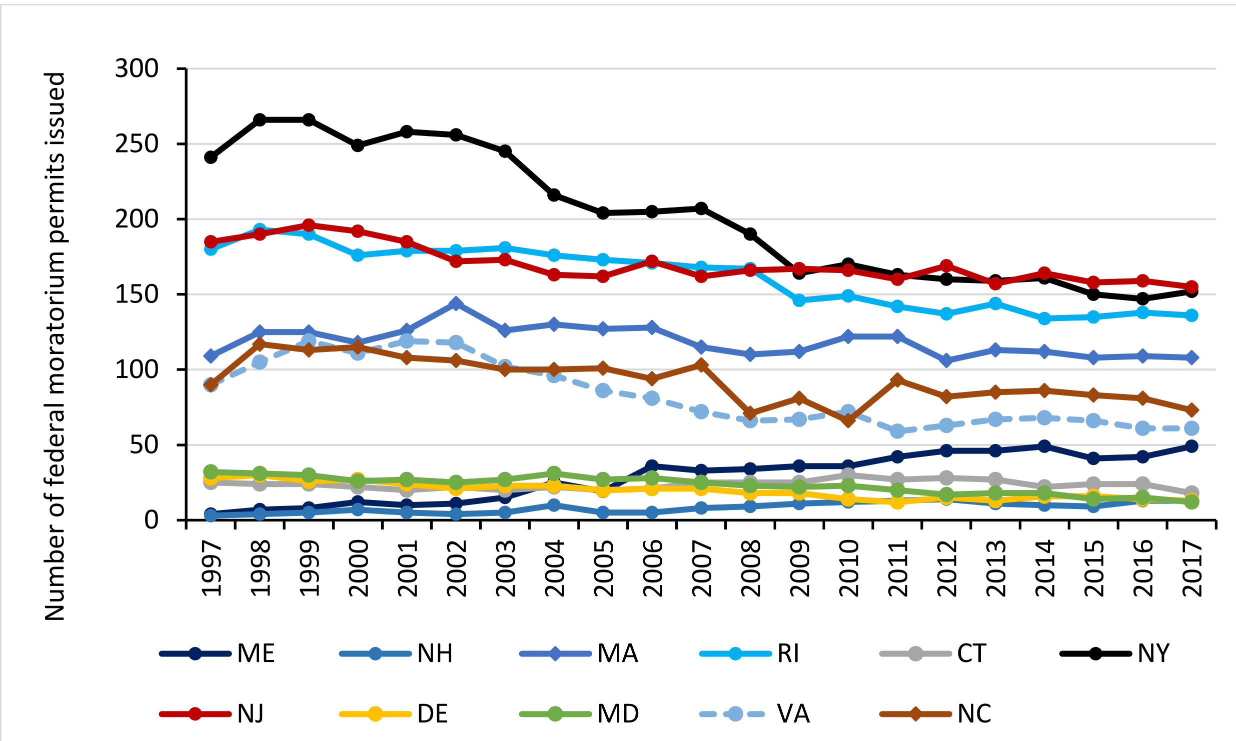

Figure 6. Number of vessels issued Federal moratorium black sea bass permits issued by state and year, 1997-2017. State is defined as the home port of the permitted vessel. Values should be considered approximate as they do not account for mid-year permit transfers and, as a result, may indicate higher numbers of moratorium permits than actually exist in a given year. Vessels in confirmation of permit history (i.e., eligible for a permit, but not issued a permit in a given year) are not accounted for.

c) Impacts of an ASQ Approach

As mentioned above, impacts of the ASQ approach to the black sea bass commercial fishery are inherently difficult to predict. The resulting quota distribution would be dependent on a number of factors, which could be related to economic forces as well as changes in the stock and the fishery. If the auction were to occur annually, there could be significant differences in the resulting ASQ allocations from year to year. Without reliable economic information on individual operations, it is difficult to estimate potential outcomes of this approach.

Some theoretical positive impacts that have been suggested are that an ASQ program could increase efficiency in the fishery, as top bidders would likely be those best able to catch the quota, and that it could provide more flexibility in allocation. Some possible negative impacts are: 1) it could allow for concentration of quota among those with more financial resources and/or larger operations which could disrupt the economies of many fishing communities; 2) states may want to consider an ITQ 'buy back' to compensate current ITQ holders, as ITQ has been a dependable source of income for these participants; 3) it would disadvantage state-only permitted vessels who would not be able to participate in an auction managed at the Federal level; and 4) increased complications of monitoring and enforcing such a program could result in compliance issues and exceeding the commercial quota without a clear way to pinpoint responsibility for the overage.

Considering the uncertainty and administrative concerns surrounding the ASQ approach, the PDT recommends careful consideration of this strategy. If the Board were interested in further developing the ASQ approach, the PDT feels it would have to focus *solely* on this approach, as adequately developing it will require an all-encompassing effort, and could not be done in parallel with multiple other options. It should also be noted that implementation of an ASQ program would require a joint amendment with the Council.

E. Hybrid Approaches

In addition to the individual methods presented above, the PDT discussed hybrid approaches where the coastwide quota is allocated among the states using two or more methods. This could essentially be an extension of the trigger approach (a portion of the quota, either a fixed amount or a percentage, up to the trigger value is distributed using historic allocation, and any remaining quota is distributed using equal allocation or biomass distribution), but could incorporate other options as the Board wishes. Use of a hybrid approach may offer flexibility and compromise for different perspectives, but at the cost of increased complexity. For example, a hybrid approach that incorporates a trigger, equal allocation, and regional allocation could be developed that assigns a portion of the coastwide quota using historic allocation to account for existing markets and fishing communities, a portion distributed equally to each state, and a portion to each region based on biomass distribution. Considerations and decision points for any hybrid approach would include all the considerations and decision points of each of the individual methods being combined. Additionally, depending on how a hybrid approach is developed, the drivers behind allocation adjustments could become unclear and difficult to track. Consideration of transparency is needed if selecting a hybrid approach, and additional work by the PDT may be required to clearly identify the impacts of each element of the approach.

III. Discussion

Throughout their discussions of each management strategy described above, the PDT highlighted a number of decision points the Board may need to consider in selecting the appropriate management programs for continued development. To come to a decision on some of these issues, it may be helpful to first define the Board's intention in considering changes to the black sea bass state-by-state allocations. Agreeing on a clear intention may guide the Board in focusing on the management strategies that best align with the objectives the Board seeks to meet.

Thus, the first general decision point would be to determine what the Board's goals are with regard to considering reallocation of the state-by-state commercial quotas. The key issue identified by the Commercial Working Group is that state commercial allocations implemented in 2003 do not reflect the current distribution of the resource. If the Board's goal is to address this issue by adjusting state-by-state commercial allocations to be more reflective of the current distribution of the resource, then the Board may want to focus on those strategies that incorporate regional information on resource distribution. If the Board's primary goal is to maintain historic access to the fishery, then it could consider options that place more weight on historic landings.

When considering approaches that address changes in resource distribution, another decision point arises in both the TMGC approach and the modified trigger approach: how to distribute quota to states within regions. Two general methods were discussed: equal distribution of regional quota, or distribution based on historic allocation. Though the PDT did not explore additional methods, it may be appropriate to consider distributing quota to states within the regions in a different way, depending on the purpose of reallocation. For example, if the Board aims to create more equality within the regions with regard to state quotas, then equal allocations of additional quota to the states in each region may be more appropriate (see TMGC Example 1a, and trigger Table 3, Appendix C). Alternatively, if the Board aims to maintain state access based on historic landings, it may be preferable to distribute quota to the states within each region based on their current allocations (see TMGC Examples 1 and 2, and trigger Table 4, Appendix C). Some compromises between these two goals could be addressed through a hybrid approach.

As mentioned in the considerations for the TMGC and modified trigger approaches, the ability to use regional biomass information from the stock assessment may change. It is uncertain whether incorporation of the new MRIP data will still produce biomass estimates for the northern and southern stock subareas. If not, it may be necessary to use survey information to do any resource distribution based approach. The Board should consider the implications of using either source of information to adjust allocations according to regional biomass. If regional biomass information from the stock assessment is available, the Board may need technical guidance on the most appropriate method for calculating regional proportions.

Another decision point the PDT discussed is regional configuration. In particular the group focused on how to incorporate Maine and New Hampshire, considering their historically low participation in the fishery, and how to incorporate New Jersey, as its geographic location adjacent to Hudson Canyon makes it difficult to place it in either the northern or southern spatial subarea of the stock. The PDT analyzed options that maintain static or proportionally lower allocations for Maine and New Hampshire, but these could be modified if the states were to express an interest in increased participation. The PDT also discussed potential methods for treating New Jersey as a stand-alone region, if deemed more appropriate than including it in the Southern Region. If a regional approach is taken, the Board should determine the most appropriate regional configuration.

The PDT also discussed the issue of stability in state commercial allocations. In prior discussions at the Working Group and Board level, some states expressed concerns about abrupt allocation changes that could disrupt the fishery. To better understand what constitutes abrupt change in order to avoid such disruptions, it may be helpful to define minimum quotas, or the maximum percent change per year with which the states would be comfortable. For comparison, Table 3 shows the coastwide quotas, and magnitude of change in quotas from year to year since 2003. On average, the coastwide quotas (and therefore the state quotas) have changed by 22% per year, excluding years where the constant catch approach was applied. It is important to bear in mind that state-by-state and coastwide quotas will continue to vary depending on the status of the stock, regardless of whether state-by-state allocations are modified.

Lastly, the PDT noted it could be important to establish a better understanding of where the fishery is occurring, and whether that has changed over time. Due to time limitations, the PDT was only able to analyze estimated commercial landings by state, year, and statistical area provided by the ACCSP. Preliminary results of this analysis are provided in Appendix D. If desired, the Board may request additional analysis of spatial data on black sea bass landings and or trips.

Table 3. Magnitude of annual change in black sea bass commercial quotas.

Year	Coastwide Quota (pounds)	% Change from Previous Year (absolute value)
2003	3,024,545	-
2004	3,768,575	25%
2005	3,966,345	5%
2006	3,832,312	3%
2007	2,385,390	38%
2008	2,025,763	15%
2009	1,093,190	46%
2010	1,758,610	61%
2011	1,711,080	3%
2012	1,710,000	0%
2013	2,174,312	27%
2014	2,174,312	0%
2015	2,212,923	2%
2016	2,702,867	22%
2017	4,120,000	52%
2018	3,520,000	15%
2019	3,520,000	0%
Average (excl. constant catch years)**		**22%**
Average (2016-2019)		**22%**

* Final adjusted quota after RSA

**Constant catch approach was used from 2010 to 2015

Appendix A. Black Sea Bass Commercial Working Group Report, February 2019

Working Group Members: David Borden (Chair, RI), Nichola Meserve (MA), Matthew Gates (CT), Joe Cimino (NJ), Rob O'Reilly (VA)

ASMFC Staff: Caitlin Starks, Toni Kerns

Additional Attendees: Julia Beaty (MAFMC), Greg Wojcik (CT), Jason McNamee (RI), Tiffany Vidal (MA)

Statement of the Problem

The working group has identified two problems associated with the current FMP. First, the commercial black sea bass allocations to the states were originally implemented in 2003 as part of Amendment 13, loosely based on historical landings from 1980-2001. The state shares in Amendment 13 allocated 67% of the coast-wide commercial quota among the states of New Jersey through North Carolina (North of Cape Hatteras) and 33% among the states of New York through Maine. These state commercial allocations have been unchanged for 15 years. Meanwhile, the resource has experienced shifts in distribution and abundance, and changes in fishing effort and fishing behaviors have occurred.

There is scientific information to support these shifts. For example, according to the last black sea bass stock assessment, which modeled fish north and south of Hudson Canyon separately, the majority of the stock occurred in the south prior to the mid-2000s. Since then the biomass in the north has grown considerably and currently accounts for the majority of spawning stock biomass (Figure 1). While the region specific models created for the assessment were never intended to be stand-alone, this shift in black sea biomass distribution has been supported by peer reviewed journal articles (e.g., Bell et al., 2015).

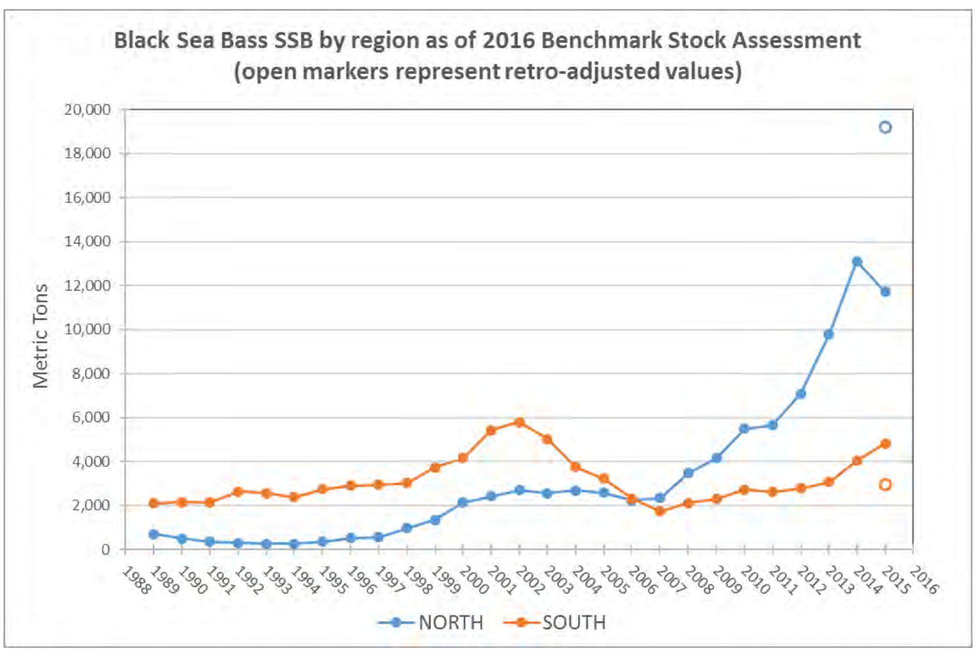

Figure 1: Black Sea Bass SSB by Region, 1989-2016. Source: 2016 Black Sea Bass Stock Assessment.

In some cases, expansion of the black sea bass stock into areas with historically minimal fishing effort has created significant disparities between state allocations and current abundance and resource availability. The most noteworthy example is Connecticut, which has experienced significant increases in black sea bass abundance and fishery availability in Long Island Sound in recent years but was only allocated 1% of the coastwide commercial quota based on landings from 1980-2001.

Any consideration of management changes by the Commission should be responsive to shifts in in black sea bass distribution, abundance, behavior, fishing effort and harvest by gear type. However, there are many additional factors requiring rigorous discussion and evaluation should reallocation be considered. Changes in allocations should take into account the following considerations and issues:

1. Allocations should be reviewed and revised on a regular basis to ensure equity of access and improve fishery efficiency (human safety, fuel use, and discards), using the latest and most appropriate data sources.
2. Changes in allocations should be linked to stock assessments to the extent practicable, or use other peer reviewed data sources. If such sources are unavailable, other scientific information such as state and federal survey indices could be used.
3. The relatively recent shift in spawning stock biomass does not mean that future abundance dynamics will proceed in the same manner, especially since a strong or weak year-class can provide an increase or decrease in abundance throughout the range or a portion of the range.
4. For states where resource availability has shifted significantly in recent years, the current allocations may provide either a disproportionate advantage or disadvantage if used as the basis for allocation adjustments (e.g. Connecticut's 1% allocation). Small changes to the original allocations may not reflect resource abundance, thus, adjustments may need to be made using a formula other than a simple percent change.
5. Participants in different areas have invested in the commercial fishery based on historic landing patterns as well as state management programs. For example, some mid-Atlantic states have adopted management through Individual Transferrable Quotas (ITQs), and the industry has invested in these fishing rights and infrastructure. To avoid unnecessary economic hardships and enhance the ability of the industry to respond and make long term business decisions, slow or gradual implementation of allocation changes should be considered.
6. Due to the high abundance relative to current allocations in the northern area, some states have lengthy closures that promote discards. Any reallocation formula should consider these factors and attempt to reduce closures and discards.
7. Review and reevaluation of commercial quota allocations should not occur in a vacuum and should take into account changes in recreational information. In particular, new recreational harvest estimates should be incorporated into the stock assessment before commercial changes are adopted.

A second problem relates to the provision in the FMP that prescribes a coastwide black sea bass quota managed by NOAA Fisheries. Under the current regulations, all states in the management unit are subject to fishery closures if a coastwide quota overage occurs, despite state-by-state quota management by the ASMFC. These closures can leave states with remaining commercial quota, especially ITQ, unable to utilize their full allocation of the resource. Management should aim to reduce impacts of state-specific commercial quota overages to other states. The working group recommends that the Mid-Atlantic Council consider actions to address this issue. For example, the working group suggested the Council consider allowing conservation equivalency for the commercial fishery, similar to what is allowed for recreational black sea bass and summer flounder.

Objectives and Goals to Address the Problem

The WG identified the following as management objectives for commercial black sea bass:

- Ensure fishing mortality and spawning stock biomass are maintained within established thresholds and targets, and the stock is not overfished nor experiencing overfishing
- Improve equity in access to the fishery among the states
- Improve fishery efficiency (e.g. use of time, fuel and other resources; reducing discards)

The WG discussed the need to determine what metric(s) would be used to evaluate equity in access to the fishery. Some ideas discussed were socioeconomic benefits or opportunities, as well as resource availability related to the distribution of exploitable biomass and abundance. The WG noted discard reductions and increased efficiency would likely result from allocations based on more current information on the resource's distribution along the coast. However it was noted that fishery efficiency may also be impacted by factors other than resource allocation (e.g., allowances to possess multiple states' limits in the same trip).

The WG proposed the following information, particularly for recent years, should guide further development of management objectives and strategies.

- Descriptions of each state's fishery including but not limited to: management program, participation, effort, landings by gear, distribution of landings and trips, commercial size distribution, and socioeconomic information
- A comprehensive review of survey data for black sea bass to inform understanding of stock biomass/abundance distribution and availability to state commercial fisheries
- Current scientific information on the geographic shifts in black sea bass biomass

Potential Management Strategies

The WG agreed a wide range of options should be considered, and that some management strategies may require coordination with the Mid-Atlantic Fishery Management Council. Some of the ideas the WG supported exploring further included:

1. Adjustments to the state-by-state allocations. Potential options include:
    a. Status quo
    b. Dynamic approach modeled after the Transboundary Management Guidance Committee (TMGC) approach (Appendix I)
2. Defined timeline or trigger for reevaluation of allocations
    a. Future consideration of a strategy similar to the scup model to increase equitability in access for federal vessels (i.e. winter coastwide quota management and summer state-by-state quota management) (Appendix II)

As indicated in the problem statement, consideration should be given to how management approaches may impact fishery stakeholders in each region, and efforts made to balance negative economic impacts with enhanced equity and efficiency of the fishery along the coast.

Appendix B. TMGC Approach

Proposed New Allocation Alternative For Black Sea Bass: Dynamic Transboundary Approach

Black Sea Bass PDT

22 April 2019

Introduction

This proposal offers a new alternative for modifying the allocation of the commercial black sea bass quota. It involves a dynamic approach for gradually adjusting state-specific allocations using a combination of resource utilization (historical allocations) and current levels of resource distribution. The alternative is modeled after the Transboundary Management Guidance Committee (TMGC) approach, which was developed and used for the management of shared Georges Bank resources between the United States and Canada.

As noted by Gulland (1980), the designation of units for management entails a compromise between the biological realities of stock structure and the practical convenience of analysis and policy making. For black sea bass, the Atlantic Coast states from North Carolina to Maine - acting through and by the MAFMC, ASMFC, and GARFO – use a single management unit encompassing the entire region occupied by the stock, from the southern border of North Carolina northward to the U.S.- Canadian border. While there is a general scientific consensus that the black sea bass population has shifted its center of biomass to the northen portion of its range (Bell et al. 2014 and NEFSC 2017), the current management structure, as reflected by current state-by-state allocations, does not recognize this new population dynamic.

This new alternative sets forth an approach that balances stability within the fishery, based on historical allocations, with gradual adjustments to the fishery, based on regional shifts in resource distribution emanating from updated stock assessments or surveys. The approach affords considerable flexibility, both with regard to initial configurization and application over time. A key feature involves the use of control rules to guard against abrupt shifts in allocations.

This new alternative draws upon established principles of resource sharing, which include consideration of access to resources occurring or produced in close spatial proximity to the states in the management unit and historical participation in the exploitation of the resources (Gavaris and Murawski 2004). The former has emerged from the changing distribution of the black sea bass resource and the effects this creates within the fishery. The latter recognizes traditional involvement and investment in the development of the fishery since the the beginning of black sea bass joint management in 1996. Both principles were incorporated in the TMGC approach; historical participation was initially afforded primary emphasis, then gradually down-weighted so that, after a nine-year phase-in period, the annual allocation was based primarily on resource distribution (Murawski and Gavaris 2004). The approach proposed here for black sea bass is similar; the proposal envisions a gradual transition, giving more weight to historical participation at first, then slowly phasing in the distributional aspects over time, and then implements changes to state specific allocations through a two-step process.

Details for the calculations used for the TMGC approach were described by Murawski and Gavaris (2004). Modifications to that approach are necessary, given key differences between the shared Georges Bank resources and the shared black sea bass resource. Those differences include the state-by-state allocation system currently in place for black sea bass, the need to translate from regional to state-specific allocations, and the need to accomodate multiple jurisdictional differences in the fishery.

This new alternative proposes use of existing state-by-state allocations to reflect initial values for historical participation (aka resource utilization) and proposes use of the 2016 benchmark stock assessment results(NEFSC 2017) to determine the values for resource distribution; the two values are then integrated in the form of regional shares. An alternative to using the stock assessment would be to use synoptic trawl survey information. This potential alternative is described in more detail below. The two regions as defined in the assessment are proposed: (1) ME - NY, (2) NJ - NC. They emanate from the spatial stratification of the stock in to units that generally align with those used for the assessment, which used the Hudson Canyon as the dividing line based on several pieces of evidence that stock dynamics had an important break in this area. These regional shares are then sub-divided into state-specific allocations.

The overall approach can be modified by the Board and Council in various ways. For example, sub-alternatives can be developed for:

- the regional configuration (e.g., other regions beyond those proposed here);
- the values for historical participation/resource utilization (e.g., current, status quo allocations, or some variant thereof);
- the percentage weighting values for Resource Utilization and Resource Distribution (90:10, or some variant thereof);
- the increment of change in these values from one year to the next (10%/year, or some variant thereof;
- the periodicity of adjustments (e.g., annually vs. biannually); and
- the overall time horizon for the transition (e.g., 9 years vs. 18 years).

The control rule can also be evaluated via two or more sub-alternatives (e.g., a cap that's higher or lower than 10%).

Data and Methods

Formula

Adapted from the TMGC application (TMGC 2002), the approach for calculating the respective regional shares, which takes historical utilization in to account and adapts to shifts in resource distribution, is as follows:

$$\%RegionalShare = (\alpha_y * \sum_r StateSpecAlloc) + (\beta_y * \%ResDistr_{r,y}) \quad (1)$$

Where α_y = percentage weighting for utilization by year; β_y = percentage weighting for resource distribution by year; $\alpha_y + \beta_y = 100\%$; $StateSpecAlloc$ = state specific allocation; $ResDistr$ = resource distribution; r = region; y = year

Proposed regions:
Two regions are proposed: (1) ME - NY, (2) NJ - NC.

Proposed values for historical participation/resource utilization:
See Resource Utilization section below.

Proposed values for resource distribution:
The current proposal is to use the distribution in the two regions based on the stock assessment biomass calculations. This could be altered to use synotpic trawl survey information, therefore resource distribution would be based on most recent trawl survey information in that case.

Proposed percentage weighting values for resource utilization and resource distribution:
The initial sharing formula is proposed to be based on the weighting of resource utilization (from historical allocations) by 90% and the weighting of resource distribution by 10%. Additional alternatives are prtesented below.

Proposed increments of change in the weighting values from one adjustment period to the next: Initially proposed at 10% per period. Thus, 90:10 to begin, then: 80:20, 70:30, 60:40, 50:50; 40:60; 30:70; 20:80, concluding at 10:90. Other alternatives are tested below.

Proposed periodicity of the adjustments:
Bi-annually based on stock assessment updates. If the survey alternative were used, this could be increased to annually.

Overall time horizon for the transition:
The initial proposal would conclude in 9 years. If commenced in 2020, it would conclude in 2028

With these - or alternative - parameters assigned, the region-specific shares then need to be prorated into the existing state-specific allocation structure. This can be accomplished by:

$$NewStateAllocation = \frac{Allocation_s}{\sum_r StateSpecAlloc} * \%RegionalShare \quad (2)$$

Where $Allocation_s$ = the specific state being calculated

Resource Utilization

Historical state-specific commercial allocations for black sea bass are codified in Amendment 13 to the Fishery Management Plan for Black Sea Bass (FMP) (MAFMC 2003) (Table 2). These allocations can serve as the basis for the resource utilization values in the allocation formula. These values, as used in the formula, would remain consistent throughout the reallocation process, even as the final state allocations change over time, based on equations 1 and 2. This is philosophically consistent with the FMP, as this portion of the allocation formula is meant to represent the historical fishing aspects of the black sea bass fishery.

However, alternative strategies (set forth in the form of sub-alternatives) could be used to set the initial allocation design. That is, the initial resource utilization portion of the allocation design could be adjusted, via revised state allocations, before transitioning into the formulaic approach to be used as the process moves forward.

One way to implement this type of approach would be the following, working from equation 2 above:

$$NewStateAllocation = \frac{Allocation_s + \lambda_s}{\sum_r StateSpecAlloc} * \%RegionalShare \quad (3)$$

Where λ = a state specific allocation additive or reduction factor and s = the state being calculated.

This formula allows for a shift in initial (status quo) allocations to account for potential discrepencies believed to be represented in the existing allocations.

Resource Distribution

This proposal offers two options for calculating the resource distribution. The first option would be to use the spatial stock assessment to determine the amount of resource in each region (north = NY, CT, RI, MA, NH, ME; south = NJ, DE, MD, VA, NC). The spatial stock assessment calculates a north and south biomass value, which can then be turned in to a proportion. The benefit of this approach is this number is calculated through a synthesis of many biological parameters and represents the best available science for the population. The drawback is that the assessment is updated periodically (not every year), therefore the information will not be evaluated every year, but would depend on the assessment cycle. Additionally, if the spatial stock assessment were to fail at some point in the future, this would impact the ability to do the dynamic allocation calculations. The current estimated allocation from the benchmark assessment would be 6,800 MT (January 1 biomass) in the south, 17,000 MT (January 1 biomass) in the north, equating to 29% of the biomass in the south and 71% of the biomass in the north (NEFSC 2017). It is important to note that these are the unadjusted biomass amounts from the assessment. Since data are readily available for this option, an example calculation and projection has been developed below. The process set forth below addresses total biomass, but it could be modified (and presented as a sub-alternative) to address exploitable biomass.

As an alternative, values for resource distribution can be obtained and calculated using scientific surveys, with results apportioned into regions. Since surveys are undertaken annually, the values for resource distribution, by region, can be recalculated and updated annually, biannually, or upon whatever timeframe is deemed most appropriate, affording an opportunity to regularly adjust allocations in sync with shifts in resource distribution. Such shifts may, or may not, follow consistent trends. Accordingly, the technique affords a dynamic approach, consistent with actual changes in resource distribution. Drawing upon the TMGC approach, a swept area biomass, considered a relative index of abundance, can be computed in each stratum, then summed to derive the biomass index for each region. The biomass index estimate derived from each survey would represent a synoptic snapshot of resource distribution at a specific time during a year. Combining the results of multiple surveys requires an understanding of seasonal movement patterns and how much of the biological year each survey represents. For this reason, it is proposed to use the National Marine Fisheries Service (NMFS) Trawl Survey in combination with the North East Area Monitoring and Assessment Program (NEAMAP) Survey. These are both well-established surveys, currently used in the stock assessment, and are synoptic, covering both offshore and inshore strata. As proposed in this alternative, the existing survey strata could be used to partition the survey information into two stock regions: (1) ME - NY, and (2) NJ - NC. The strata do not align perfectly with these two spatial configurations, but they are relatively close (Figures 1 and 2). Table 1 provides an example of how the strata could be applied for each region.

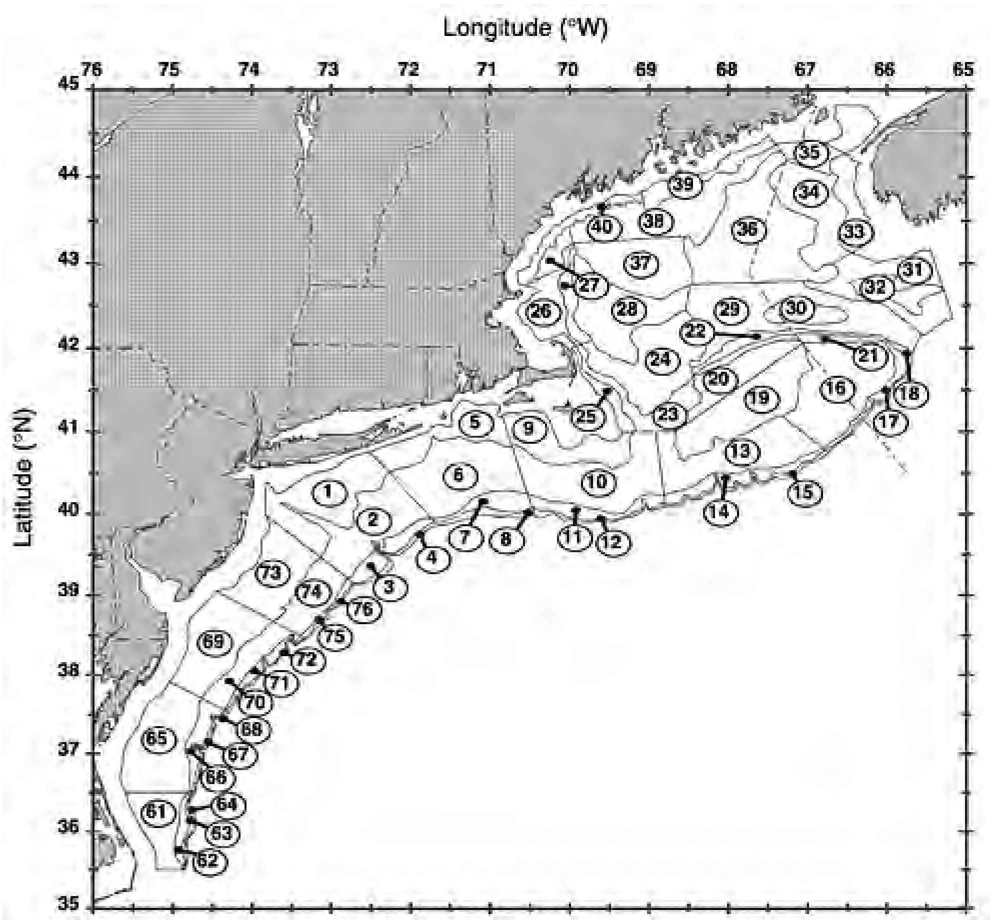

Figure 1: Map of National Marine Fisheries Service trawl survey strata.

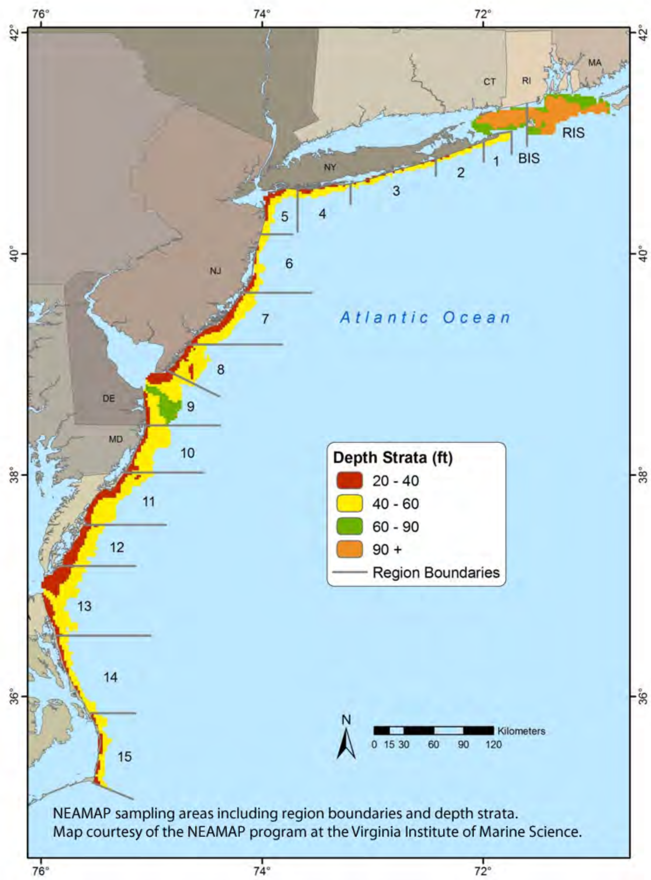

Figure 2: Map of North East Area Monitoring and Assessment Program trawl survey strata.

Table 1 - Strata or Region assigned to each region for resource distribution calculations.

Regions	NMFS Strata	NEAMAP Regions
Region 1: ME - NY	1 - 40	1 - 5, BIS, RIS
Region 2: NJ - NC	3, 61 - 76	6 - 15

*Note: This is a first cut, these should be finalized through discussions between the TC and survey staff.

This approach could be refined over time by developing area polygons that better align with the boards desired regional configuration. Then, using the spatial information from the surveys, the survey information could be partitioned into the polygons.

Additionally, there may be ways to use state survey information within the analysis – either directly by averaging those surveys into the swept area biomass calculations, or indirectly such as using them to verify or corroborate the information from the surveys used in the calculations. Such use of state survey information could be developed and integrated into the process over time via analysis and recommendations from the monitoring and technical committees.

A robust, locally weighted regression algorithm (Cleveland 1979), referred to as LOESS, could then be used to mitigate excessive variations in sampling results. Per the TMGC approach, a 30% smoothing parameter could be used. That level of smoothing was chosen because it reflected current trends, was responsive to changes, and provided the most appropriate results for contemporary resource sharing. The recommended default of two robustness iterations also was adopted (Cleveland 1979) in the TMGC approach and could also be adopted here. Resource distributions could then be updated annually by incorporating data from the latest survey year available and dropping data from the earliest survey used in the previous year so that a consistent window of data is maintained. After the surveys are combined, the LOESS smoother would be applied to the survey data. The fixed resource utilization (90% weighting in year 1) and the most recent resource distributions as calculated by the surveys (10% weighting in year 1) can then be applied to the sharing formula to determine regional allocation shares for the upcoming fishing year.

The benefit of this approach is that it could be performed annually with the most contemporary data. The drawback is that survey data are prone to variability. The LOESS smoothing and the control rule set forth below are designed to account for some of this variability to keep it from causing unreasonable changes in a single year.

As a final nuance to the survey alternative, a sophisticated modeling approach could be developed to achieve the same information as above. Techniques like the use of the VAST model (Thorson 2015) have been shown to be appropriate for this type of an analysis and could be adopted, in lieu of the swept area biomass technique, as a method for calculating resource distribution by region.

For this proposal, the assessment technique will be used as there is actual data that can be used to examine an example. With additional work, a retrospective analysis using trawl survey information could be developed.

Control Rule

In addition to the formula for calculating the regional allocations and then translating into the state specific allocations, additional measures could be added by way of a control rule. Such measures would enable various checks and balances to be incorporated into the process to guard against unintended consequences.

One such control rule, proposed here, is to guard against any abrupt change occurring to any regional allocation in any given year (or other time frame), and thus minimize short-term impacts, by capping the amount of any annual or bi-annual change to the regional shares at 10%. This can be shown as:

$$\%RegionalShare = \begin{cases} 10\%, & \text{if } \Delta AnnualChange > 10\% \\ \%RegionalShare, & \text{if } \Delta AnnualChange \leq 10\% \end{cases} \tag{1}$$

The effect would be to ensure that any changes to allocations occur incrementally, even in a case of large shifts in resource distribution in any given year or period. This control rule serves as an additional layer of protection against large changes, in addition to the other factors outlined above that are also built in to contend with uncertainty and variability.

Flexibility

A key attribute of this proposed new approach for modifying the allocation system is its flexibility. All of the decision points set forth in this proposal, once agreed to, can be adjusted as the process moves forward. Such adjustments, emanating from routine reviews by the Board and Council, can address any of the range of parameters initially set by the Board and Council. The Board and Council could define how changes to the system would be considered and enacted moving forward - e.g., via Addenda and Frameworks, the specifications process, or some other mechanism. The ranges of parameters/issues that readily lend themselves to such adjustment include:

- The α and β parameters can be adjusted to change the way the utilization and distribution are weighted in the equation;
- The increment of change in the α and β parameters can be adjusted to increase or decrease the transition speed;
- The time horizon for the transition can be changed;
- The initial state allocations can be set at status quo, or shifted to accommodate various objectives; and
- The control rule can be adjusted to be more or less protective of incremental changes.

Given such flexibility, the Board and Council could decide to implement a transition program that begins in 2020, with either current, status quo allocations, or some variant thereof, and based on assessment information through 2018 (same information used for the proposed 2019 operational stock assessment update), establish resource distribution values for each of the two regions. Using those parameters, and a weighting of allocations by 90% and resource distribution by 10%, enact new, slightly revised state-specific allocations for 2020. If the Board and Council opted for a transitional program involving 10% annual increments, until the weightings reached 10% utilization from historical allocations and 90% resource distribution, this sharing formula would transition from a 90:10 resource utilization-to-resource distribution weighting in 2020 to a 10:90 weighting by 2028. During every transitional period, the trawl survey information would be updated and factored into the resource distribution values. As such, each regional and associated state-specific adjustment would not necessarily be the same, whether in magnitude or direction.

Alternatively, the Board and Council could opt for a transitional program involving 10% increments every two years, or 5% annual increments, or 5% increments every two years, etc. Those alternatives would significantly slow the transition. Some of these variants are illustrated below as examples.

Example

The following are examples of how the new approach can be applied; it incorporates various proposed or strawman parameters, all of which can be modified upon review and consideration by the Board and Council:

- The assessment information is used to calculate the Resource Distribution values.
- Step 1: Apply the state-specific allocations and resource distribution information to equation 1.
  - Summed state allocations for Region 1 (sum of ME-NY)

```
sum.reg1
```

```
## [1] 0.33
```

  - Summed state allocation for Region 2 (NJ - NC)

```
sum.reg2
```

```
## [1] 0.67
```

- Step 2: Apply the Resource Distribution information to equation 1.
  - Strawman values:

```
dist.reg1 = 0.71
dist.reg2 = 0.29
```

- Step 3: Select α and β parameters for equation 1 for year 1:
  - The initial sharing formula is proposed to be based on the weighting of resource utilization (from historical allocations) by 90% and the weighting of resource distribution by 10%. Thus:

```
alpha = 0.9
beta = 0.1
```

- Step 4: Calculate the results, in the form of proportional regional shares, from equation 1:

```
# Region 1 equation and result
Reg1.Share = (alpha*sum.reg1) + (beta*dist.reg1)
Reg1.Share
```

```
## [1] 0.368
```

```r
# Region 2 equation and result
Reg2.Share = (alpha*sum.reg2) + (beta*dist.reg2)
Reg2.Share
```

```
## [1] 0.632
```

  - This does not account for any change to the original allocations, see step 6 below.

- Step 5: Determine need to apply the control rule

```r
# Control Rule
if (abs(Reg1.Share-sum.reg1) > 0.1 | abs(Reg2.Share-sum.reg2) > 0.1 ) {
  if (Reg1.Share-sum.reg1 > 0) {
    Reg1.Share = (sum.reg1*(0.1))+sum.reg1
    Reg2.Share = (sum.reg2*(-0.1))+sum.reg2

  }
  if (Reg2.Share-sum.reg2 > 0) {
    Reg1.Share = (sum.reg1*(-.1))+sum.reg1
  Reg2.Share = (sum.reg2*(0.1))+sum.reg2

  }

}
```

  - As proposed, the rule would cap any change at 10%. Since none of the resulting shares change by more than 10%, the control rule would not apply in this case.

- Step 6: Establish the state-specific allocation structure to be pro-rated by the regional shares. This example **does not** apply a λ value to alter the allocations per equation 3.
  - The state-specific allocations could be the current, status quo allocations; or they could be variants, established via equation 3.

Table 2 - Current state by state allocations.

State	Current Allocation
Maine	0.005
New Hampshire	0.005
Massachusetts	0.130
Rhode Island	0.110
Connecticut	0.010
New York	0.070
New Jersey	0.200
Delaware	0.050
Maryland	0.110
Virginia	0.200
North Carolina	0.110

Four hypothetical examples of state-specific allocations under the new program were performed and are presented below (Tables 3, 4, 5, and 6; Figures 3, 4, 5, and 6).

Example 1: The first example represents a configuration resulting in more liberal change in state allocations. The parameters are set as follows: 2 regions (ME - NY; NJ - NC); resource utilization = status quo allocations ; transition from 90:10 to 10:90; 10% per year change in the transition from utilization to distribution; annual adjustments; the transition time to 90% weight on the resource distribution is 9 years; 10% control rule;

distribution assumption is based on the biomass by region from the assessment for the time period of 2004 - 2012; distribution of adjustments to states within a region are based on historic allocations.

Example 2: Any TMGC configuration could also be modified to distribute the allocation adjustments equally to the states within each region, instead of distributing those adjustments proportionally to the historic state allocations. This example represents a configuration resulting in more liberal change in state allocations as noted in example 1. The parameters are set as follows: 2 regions (ME - NY; NJ - NC); resource utilization = equal allocations to each state within the region; transition from 90:10 to 10:90; 10% per year change in the transition from utilization to distribution; annual adjustments; the transition time to 90% weight on the resource distribution is 9 years; 10% control rule; distribution assumption is based on the biomass by region from the assessment for the time period of 2004 - 2012; distribution of adjustments to states within a region are based equal distribution.

Example 3: The third example represents a more conservative configuration, with more limited changes to state allocations. The parameters are set as follows: 2 regions (ME - NY; NJ - NC); resource utilization = status quo allocations; transition from 90:10 to 30:70; 5% per year change in the transition from utilization to distribution; annual adjustments; the transition time to 70% weight on the resource distribution is 12 years; 3% control rule; distribution assumption is based on the biomass by region from the assessment for the time period of 2004 - 2015; distribution of adjustments to states within a region are based on historic allocations.

Example 4: The final example is intended to showcase a number of additional modifications that could be made to the approach to achieve certain objectives. In discussions amongst the PDT (and previously the Board regarding recreational black sea bass) it has been noted that it may be appropriate to treat New Jersey as an individual region due to its geographic position straddling the division of the Northern and Southern regions adjacent to Hudson Canyon. Additionally, some Board members have suggested modifying the "resource utilization" part of the equation to increase the allocations for Connecticut and New York due to their allocations being disproportionate to their current resource availability. Lastly, the PDT discussed the option of holding Maine and New Hampshire's current allocations static throughout the transaction. To demonstrate these modifications, the parameters are set as follows: 4 regions (ME and NH remaining as a non-dynamic region with static allocations; MA - NY; NJ as a stand-alone region; and DE - NC); resource utilization = CT and NY base allocations increased by 1% in each of the first three years; transition from 90:10 to 10:90; 10% per year change in the transition from utilization to distribution; annual adjustments; the transition time to 90% weight on the resource distribution is 9 years; 10% control rule; distribution assumption is based on the biomass by region from the assessment for the time period of 2004 - 2012, and assumes NJ is consistently 60% of the southern region distribution; distribution of adjustments to states within a region are based on historic allocations plus the incremental change as noted above.

The allocations presented in these tables would be different if any of the parameters were changed. Additionally, note that these examples are based on a scenario where the approach was implemented in 2004. The example shows how the system would work and the effects to the states over the initial period of adjustment from Resource Utilization having the highest weight in the equation to Resource Distribution having the highest weight during a period of time where the biomass was rapidly changing.

Table 3 - Allocation trajectory for all states under the parameters outlined in example 1 above. The control rule is not triggered in any year in this example. This is a retrospective analysis as if this method were in place beginning in 2004.

State	2004	2005	2006	2007	2008	2009	2010	2011	2012
Maine	0.005	0.005	0.006	0.006	0.007	0.008	0.009	0.009	0.010
New Hampshire	0.005	0.005	0.006	0.006	0.007	0.008	0.009	0.009	0.010
Massachusetts	0.134	0.139	0.149	0.168	0.187	0.206	0.224	0.240	0.268
Rhode Island	0.113	0.117	0.126	0.142	0.158	0.174	0.189	0.203	0.227
Connecticut	0.010	0.011	0.011	0.013	0.014	0.016	0.017	0.018	0.021
New York	0.072	0.075	0.080	0.090	0.101	0.111	0.120	0.129	0.144
New Jersey	0.197	0.193	0.186	0.171	0.157	0.143	0.129	0.116	0.095
Delaware	0.049	0.048	0.046	0.043	0.039	0.036	0.032	0.029	0.024
Maryland	0.109	0.106	0.102	0.094	0.086	0.078	0.071	0.064	0.052
Virginia	0.197	0.193	0.186	0.171	0.157	0.143	0.129	0.116	0.095
North Carolina	0.109	0.106	0.102	0.094	0.086	0.078	0.071	0.064	0.052

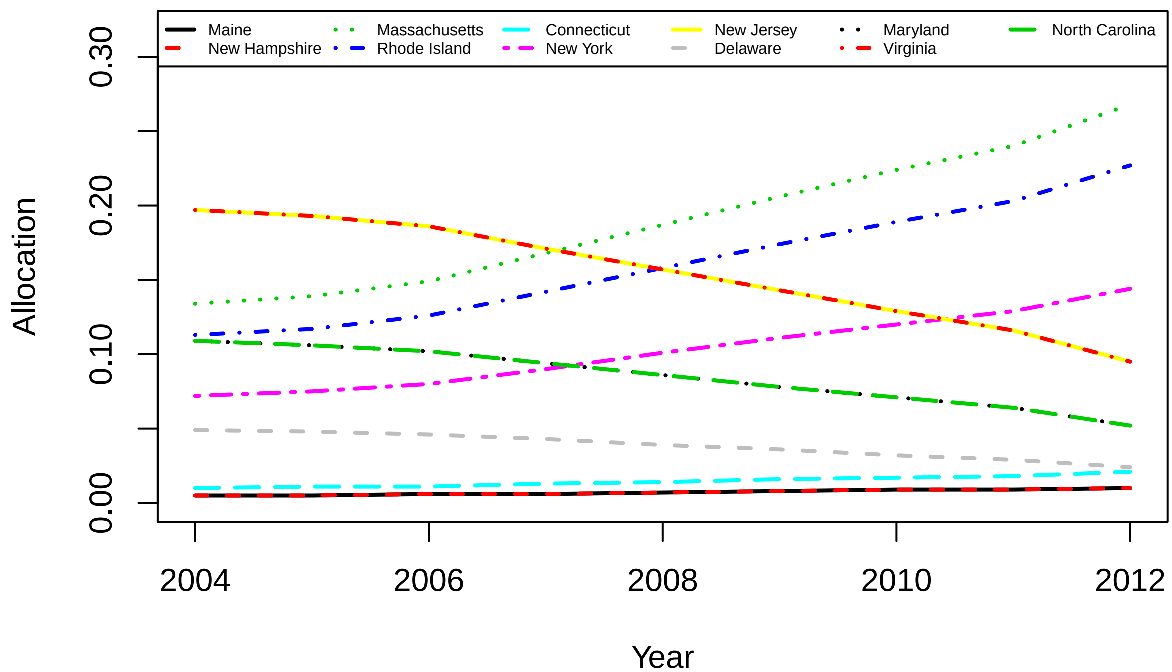

Figure 3: Allocation trajectory for all states under the parameters outlined in example 1 above. The control rule is not triggered in any year in this example. This is a retrospective analysis as if this method were in place beginning in 2004.

Table 4 - Allocation trajectory for all states under the parameters outlined in example 2 above. The control rule is not triggered in any year in this example. This is a retrospective analysis as if this method were in place beginning in 2004.

State	2004	2005	2006	2007	2008	2009	2010	2011	2012
Maine	0.070	0.071	0.074	0.082	0.093	0.102	0.109	0.112	0.119
New Hampshire	0.016	0.027	0.044	0.064	0.084	0.099	0.108	0.112	0.119
Massachusetts	0.106	0.099	0.094	0.094	0.099	0.105	0.110	0.113	0.119
Rhode Island	0.124	0.114	0.104	0.101	0.102	0.106	0.110	0.113	0.119
Connecticut	0.012	0.024	0.041	0.063	0.083	0.098	0.108	0.112	0.119
New York	0.012	0.024	0.041	0.063	0.083	0.098	0.108	0.112	0.119
New Jersey	0.111	0.111	0.108	0.099	0.088	0.077	0.069	0.065	0.057
Delaware	0.192	0.176	0.154	0.127	0.101	0.083	0.071	0.065	0.057
Maryland	0.111	0.111	0.108	0.099	0.088	0.077	0.069	0.065	0.057
Virginia	0.057	0.068	0.078	0.081	0.079	0.073	0.068	0.065	0.057
North Carolina	0.192	0.176	0.154	0.127	0.101	0.083	0.071	0.065	0.057

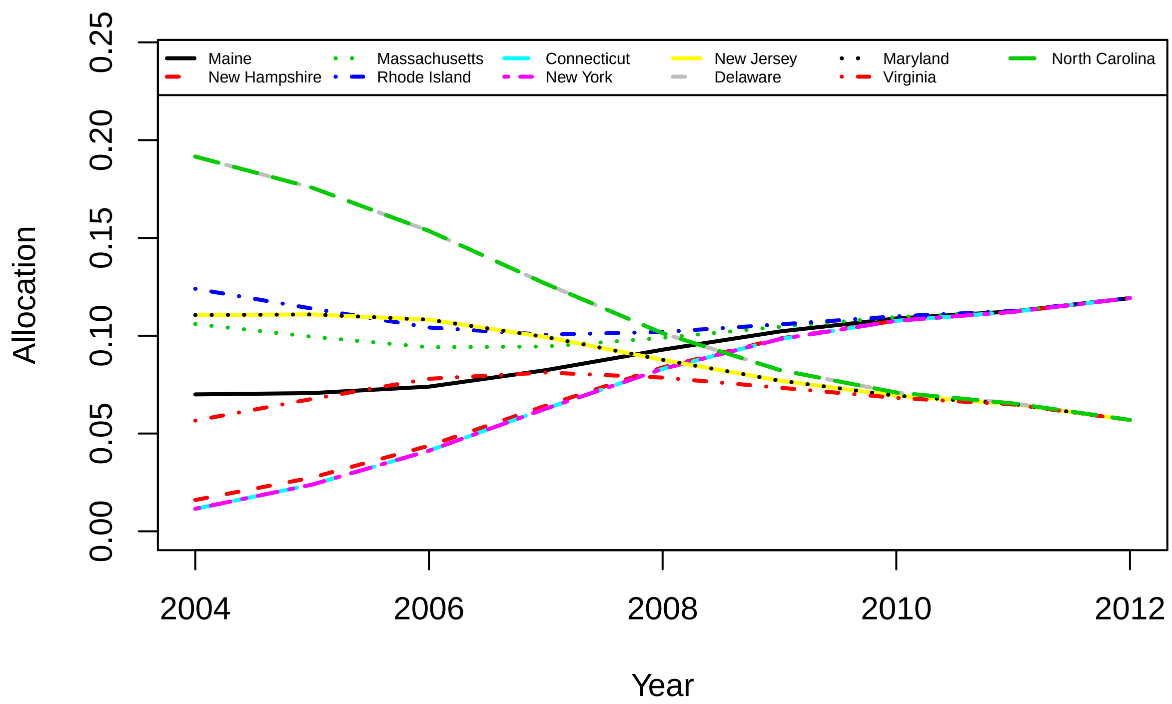

Figure 4: Allocation trajectory for all states under the parameters outlined in example 2 above. The control rule is not triggered in any year in this example. This is a retrospective analysis as if this method were in place beginning in 2004.

Table 5 - Allocation trajectory for all states under the parameters outlined in example 3 above. The control rule is triggered in each year from 2012 through 2015 in this example. This is a retrospective analysis as if this method were in place beginning in 2004. The control rule is triggered in 2012 - 2015 in this example.

State	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Maine	0.005	0.005	0.005	0.006	0.006	0.006	0.007	0.007	0.007	0.008	0.008	0.008
New Hampshire	0.005	0.005	0.005	0.006	0.006	0.006	0.007	0.007	0.007	0.008	0.008	0.008
Massachusetts	0.132	0.134	0.139	0.149	0.159	0.168	0.177	0.185	0.191	0.196	0.202	0.209
Rhode Island	0.112	0.114	0.118	0.126	0.134	0.142	0.150	0.157	0.161	0.166	0.171	0.176
Connecticut	0.010	0.010	0.011	0.011	0.012	0.013	0.014	0.014	0.015	0.015	0.016	0.016
New York	0.071	0.072	0.075	0.080	0.085	0.090	0.095	0.100	0.103	0.106	0.109	0.112
New Jersey	0.199	0.197	0.193	0.186	0.178	0.171	0.164	0.158	0.153	0.148	0.144	0.140
Delaware	0.050	0.049	0.048	0.046	0.045	0.043	0.041	0.040	0.038	0.037	0.036	0.035
Maryland	0.109	0.108	0.106	0.102	0.098	0.094	0.090	0.087	0.084	0.082	0.079	0.077
Virginia	0.199	0.197	0.193	0.186	0.178	0.171	0.164	0.158	0.153	0.148	0.144	0.140
North Carolina	0.109	0.108	0.106	0.102	0.098	0.094	0.090	0.087	0.084	0.082	0.079	0.077

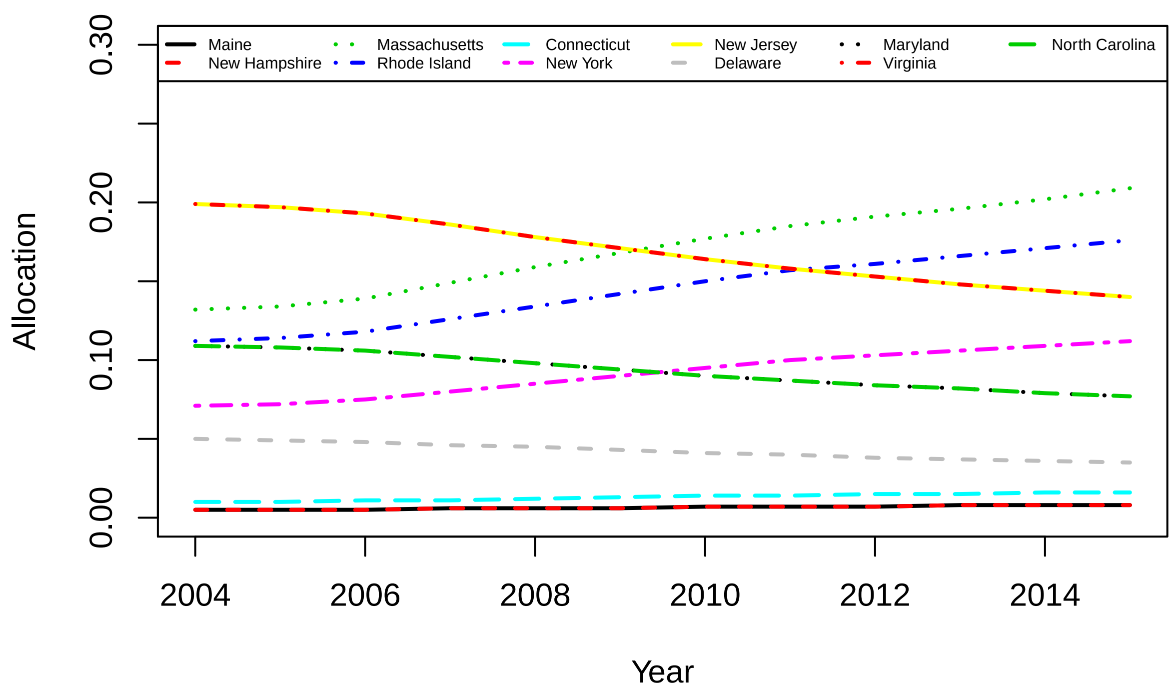

Figure 5: Allocation trajectory for all states under the parameters outlined in example 3 above. The control rule is triggered in each year from 2012 through 2015 in this example. This is a retrospective analysis as if this method were in place beginning in 2004. The control rule is triggered in 2012 - 2015 in this example.

Table 6 - Allocation trajectory for all states under the parameters outlined in example 4 above. The control rule is not triggered in any year in this example. This is a retrospective analysis as if this method were in place beginning in 2004.

State	2004	2005	2006	2007	2008	2009	2010	2011	2012	NA
Maine	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
New Hampshire	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Massachusetts	0.129	0.129	0.127	0.127	0.147	0.166	0.188	0.206	0.219	0.236
Rhode Island	0.109	0.109	0.106	0.106	0.123	0.139	0.157	0.172	0.183	0.197
Connecticut	0.020	0.020	0.031	0.042	0.048	0.055	0.062	0.068	0.072	0.078
New York	0.081	0.081	0.092	0.105	0.121	0.137	0.155	0.169	0.180	0.195
New Jersey	0.209	0.209	0.230	0.236	0.239	0.230	0.218	0.206	0.192	0.170
Delaware	0.044	0.044	0.038	0.034	0.028	0.024	0.019	0.016	0.013	0.011
Maryland	0.101	0.101	0.090	0.084	0.069	0.059	0.046	0.038	0.033	0.026
Virginia	0.186	0.186	0.168	0.158	0.130	0.111	0.087	0.072	0.062	0.049
North Carolina	0.101	0.101	0.090	0.084	0.069	0.059	0.046	0.038	0.033	0.026

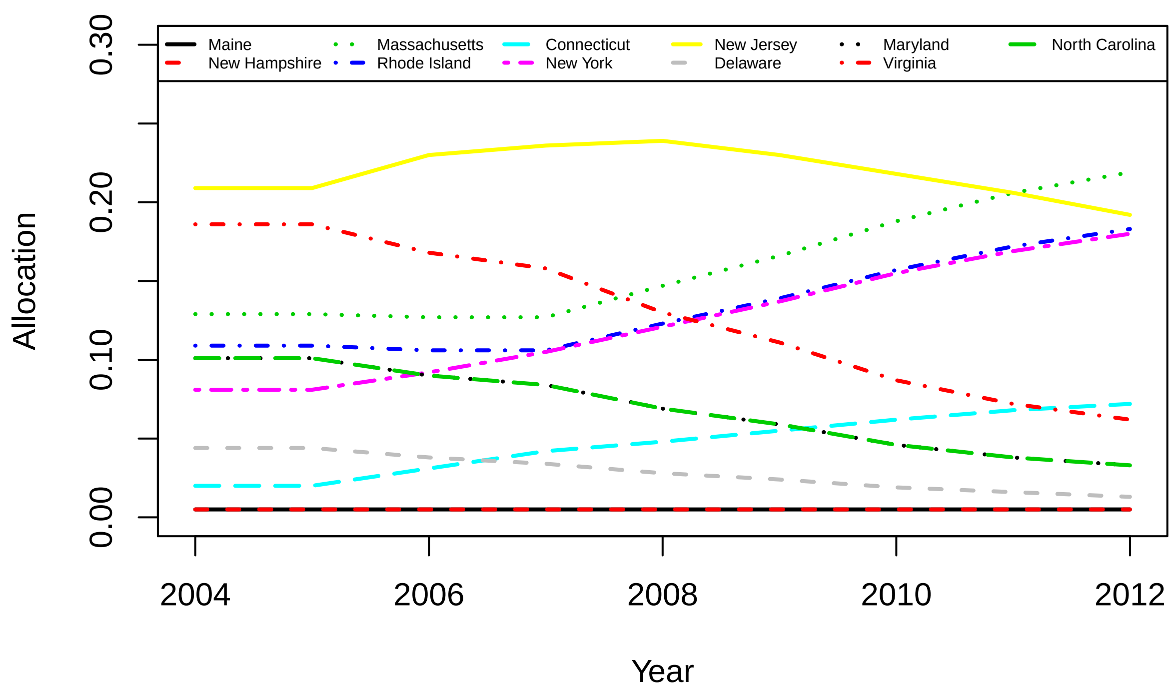

Figure 6: Allocation trajectory for all states under the parameters outlined in example 4 above. The control rule is not triggered in any year in this example. This is a retrospective analysis as if this method were in place beginning in 2004.

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Appendix C. Trigger Approach

Table 1. Reallocation of black sea bass commercial quota above a 3 million pound trigger, based on the 2017 coastwide quota of 4.12 million pounds. Quota up to and including 3 million pounds is distributed according to the status quo state allocations. Quota above the trigger is distributed equally to the states of Massachusetts through North Carolina, while Maine and New Hampshire are each allocated 1% of the quota above the trigger.

3 Million Pound Trigger					
State	**Current Allocation (%) of quotas up to and including 3 million lbs**	**Status Quo distribution of first 3 million lbs of quota**	**Allocation (%) of additional quota above 3 million lb**	**Example state allocations (lbs) under a 4.12 million lb quota**	**Example state allocations (%) under a 4.12 million lb quota**
ME	0.5%	15,000	1.00%	26,200	0.64%
NH	0.5%	15,000	1.00%	26,200	0.64%
MA	13.0%	390,000	10.89%	511,956	12.43%
RI	11.0%	330,000	10.89%	451,956	10.97%
CT	1.0%	30,000	10.89%	151,956	3.69%
NY	7.0%	210,000	10.89%	331,956	8.06%
NJ	20.0%	600,000	10.89%	721,956	17.52%
DE	5.0%	150,000	10.89%	271,956	6.60%
MD	11.0%	330,000	10.89%	451,956	10.97%
VA	20.0%	600,000	10.89%	721,956	17.52%
NC	11.0%	330,000	10.89%	451,956	10.97%
Total	100.0%	3,000,000	100%	4,120,000	100.00%

Note: Should an annual coastwide quota be equal to or less than 3 million pounds, allocation percentage defaults to current allocation percentage.

Table 2. Reallocation of black sea bass commercial quota above a 4 million pound trigger, based on the 2017 coastwide quota of 4.12 million pounds. Quota up to and including 3 million pounds is distributed according to the status quo state allocations. Quota above the trigger is distributed equally to the states of Massachusetts through North Carolina, while Maine and New Hampshire are each allocated 1% of the quota above the trigger.

4 Million Pound Trigger					
State	**Current Allocation (%) of quotas up to and including 4 million lbs**	**Status Quo distribution of first 4 million lbs of quota**	**Allocation (%) of additional quota above 4 million lb**	**Example state allocations (lbs) under a 4.12 million lb quota**	**Example state allocations (%) under a 4.12 million lb quota**
ME	0.5%	20,000	1.00%	21,200	0.51%
NH	0.5%	20,000	1.00%	21,200	0.51%
MA	13.0%	520,000	10.89%	533,067	12.94%
RI	11.0%	440,000	10.89%	453,067	11.00%
CT	1.0%	40,000	10.89%	53,067	1.29%
NY	7.0%	280,000	10.89%	293,067	7.11%
NJ	20.0%	800,000	10.89%	813,067	19.73%
DE	5.0%	200,000	10.89%	213,067	5.17%
MD	11.0%	440,000	10.89%	453,067	11.00%
VA	20.0%	800,000	10.89%	813,067	19.73%
NC	11.0%	440,000	10.89%	453,067	11.00%
Total	100.0%	4,000,000	100%	4,120,000	100.00%

Note: Should an annual coastwide quota be equal to or less than 4 million pounds, allocation percentage defaults to current allocation percentage.

Table 3. Reallocation of black sea bass commercial quota above a 3 million pound trigger according to the Rho adjusted regional biomass proportions produced by the 2015 stock assessment, applied to the 2017 coastwide quota of 4.12 million pounds. Quota up to and including 3 million pounds is distributed according to the status quo state allocations**. Quota above the trigger is distributed to the northern and southern regions according to their respective biomass proportions, and then equally to the states within each region, except Maine and New Hampshire which are each allocated 1% of the quota allocated to the northern region.**

3 Million Pound Trigger – Allocations of Additional Quota Based on Regional Biomass Proportions						
State	**Current Allocation (%) of quotas up to and including 3 million lbs**	**Status Quo distribution of first 3 million lbs of quota**	**2015 Assessment Rho Adjusted Regional Biomass Proportion**	**Allocation (%) of additional quota above 3 million lb**	**Example state allocations (lbs) under a 4.12 million lb quota**	**Example state allocations (%) under a 4.12 million lb quota**
ME	0.5%	15,000	0.86	1.0%	26,200	0.64%
NH	0.5%	15,000		1.0%	26,200	0.64%
MA	13.0%	390,000		21.0%	625,200	15.17%
RI	11.0%	330,000		21.0%	565,200	13.72%
CT	1.0%	30,000		21.0%	265,200	6.44%
NY	7.0%	210,000		21.0%	445,200	10.81%
NJ	20.0%	600,000	0.14	2.8%	631,360	15.32%
DE	5.0%	150,000		2.8%	181,360	4.40%
MD	11.0%	330,000		2.8%	361,360	8.77%
VA	20.0%	600,000		2.8%	631,360	15.32%
NC	11.0%	330,000		2.8%	361,360	8.77%
Total	100.0%	3,000,000	100.0%	100.0%	4,120,000	100.0%

Note: Should an annual coastwide quota be equal to or less than 3 million pounds, allocation percentage defaults to current allocation percentage.

Table 4. Reallocation of black sea bass commercial quota above a 3 million pound trigger according to the Rho adjusted regional biomass proportions produced by the 2015 stock assessment, applied to the 2017 coastwide quota of 4.12 million pounds. Quota up to and including 3 million pounds is distributed according to the status quo state allocations. **Quota above the trigger is distributed to the northern and southern regions according to their respective biomass proportions, and then distributed to the states within each region based on their current allocation proportions.** The highlighted state allocations for quota above the trigger are the product of multiplying each state's share of the regional biomass proportion by the regional biomass proportion.

3 Million Pound Trigger – Allocations of Additional Quota Based on Regional Biomass Proportions							
State	**Current Allocation (%) of quotas up to and including 3 million lbs**	**Status Quo distribution of first 3 million lbs of quota**	**2015 Assessment Rho Adjusted Regional Biomass Proportion**	**State Share of Regional Biomass Proportion Based on current allocations**	**Allocation (%) of additional quota above 3 million lb**	**Example state allocations (lbs) under a 4.12 million lb quota**	**Example state allocations (%) under a 4.12 million lb quota**
ME	0.5%	15,000	0.86	1.52%	1.30%	29,594	0.72%
NH	0.5%	15,000		1.52%	1.30%	29,594	0.72%
MA	13.0%	390,000		39.39%	33.88%	769,442	18.68%
RI	11.0%	330,000		33.33%	28.67%	651,067	15.80%
CT	1.0%	30,000		3.03%	2.61%	59,188	1.44%
NY	7.0%	210,000		21.21%	18.24%	414,315	10.06%
NJ	20.0%	600,000	0.14	29.85%	4.18%	646,806	15.70%
DE	5.0%	150,000		7.46%	1.04%	161,701	3.92%
MD	11.0%	330,000		16.42%	2.30%	355,743	8.63%
VA	20.0%	600,000		29.85%	4.18%	646,806	15.70%
NC	11.0%	330,000		16.42%	2.30%	355,743	8.63%
Total	100.0%	3,000,000	100.0%	100.0%	100.0%	4,120,000	100%

Note: Should an annual coastwide quota be equal to or less than 3 million pounds, allocation percentage defaults to current allocation percentage.

Appendix D. Spatial Distribution of Black Sea Bass Harvest, 2010-2017

The PDT examined data on the location of commercial black sea bass harvest during 2010-2017. Commercial landings by state, year, and statistical area were provided by the ACCSP. Landings by area were estimated based on a combination of state and federal VTR and dealer data.

Black Sea Bass landings in pounds prepared by year, state, and gear were validated with the states, with the exception of CT. Reported quantity of landings from the federal VTR data and state fishermen reports was queried and proportions by gear type and statistical area by year and state were calculated. These proportions were applied to the validated landings for all states with the exception of NY and NC, as these two states provided validated landings by gear and area. The PDT was provided with the original landings, the VTR and fishermen data, the calculated proportions, final landings with proportions applied, and a comparison of pounds by year and state.

In the most recent benchmark stock assessment, the NEFSC commercial statistical areas were partitioned into northern and southern spatial subunits, as defined in Table 1. The data suggest the proportion of total coastwide (i.e., ME-NC) commercial black sea bass landings caught in northern region statistical areas increased by about 11% between 2010-2013 and 2014-2017 (Figures 1-3, Table 2). This proportional increase was greater when considering just landings in the southern region (i.e., 19.56% if the southern region is defined as NJ-NC and 13.22% if the southern region is defined as DE-NC; Tables 5-6). Although the proportion of southern region landings caught in northern region statistical areas increased from 2010-2013 to 2014-2017, the pounds of southern region landings from southern region statistical areas increased over that time period.

New Jersey commercial harvest was close to evenly distributed between northern and southern region statistical areas during 2010-2017. A greater proportion of New Jersey harvest occurred in southern region statistical areas compared to northern region statistical areas during 2010-2013. Northern region statistical areas accounted for a greater proportion of New Jersey harvest, compared to southern region statistical areas, during 2014-2017 (Table 3).

Figures

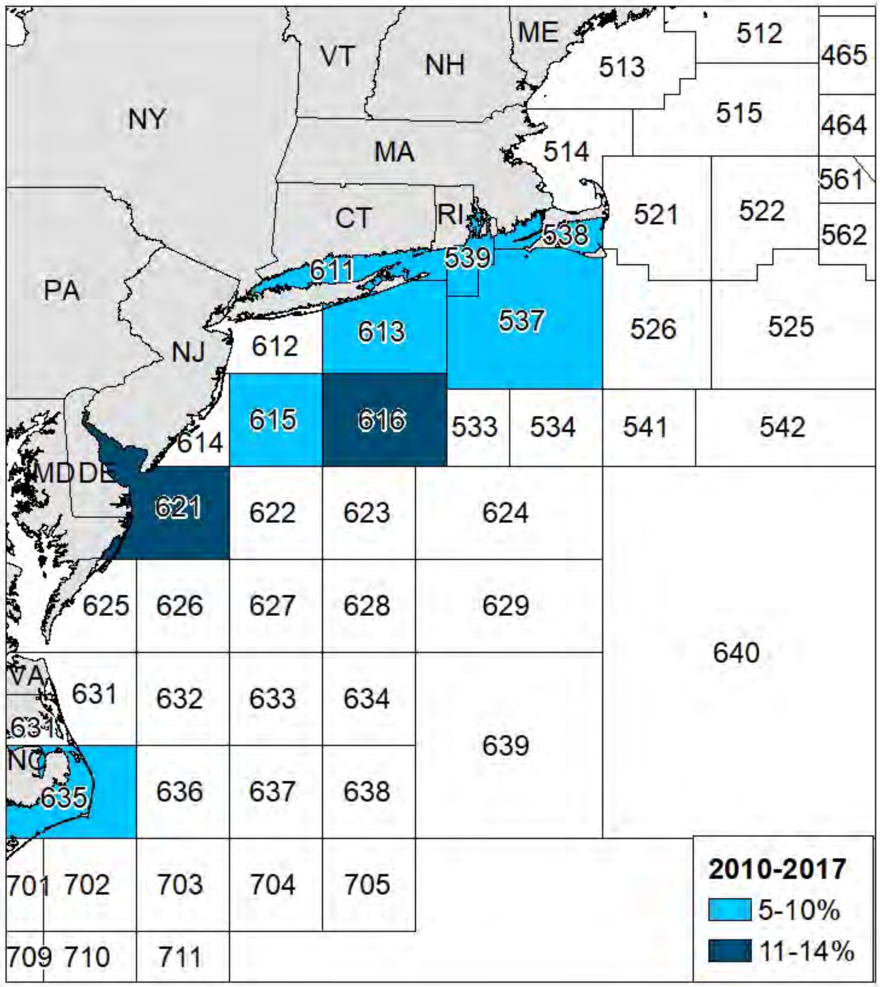

Figure 2. Proportion of commercial black sea bass landings, MA-NC, by statistical area, 2010-2017. Statistical areas accounting for less than 5% of total landings are not shown and collectively accounted for 22.79% of total landings. Only landings associated with valid northeast region statistical areas were included in the calculations. Data were provided by the ACCSP. Landings by area were estimated by applying VTR proportions of landings by area to dealer data.

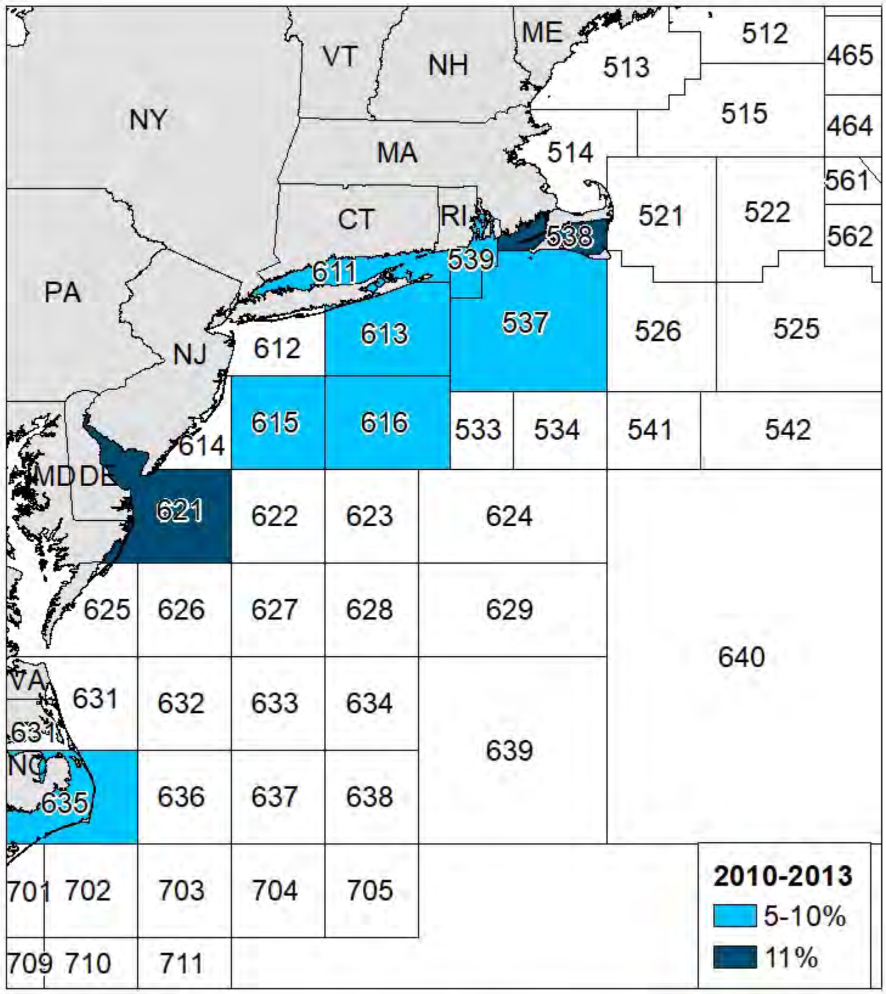

Figure 3. Proportion of commercial black sea bass landings, MA-NC, by statistical area, 2010-2013. Statistical areas accounting for less than 5% of total landings are not shown and collectively accounted for 17.20% of total landings. Only landings associated with valid northeast region statistical areas were included in the calculations. Data were provided by the ACCSP. Landings by area were estimated by applying VTR proportions of landings by area to dealer data.

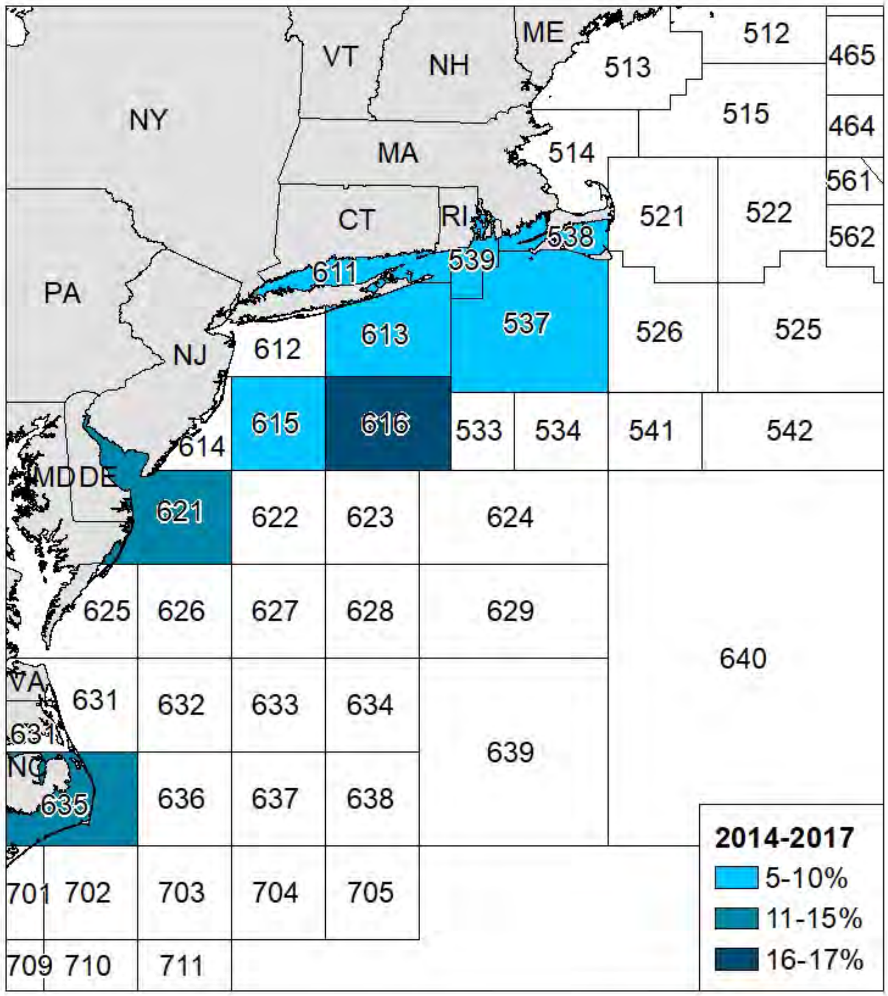

Figure 4. Proportion of commercial black sea bass landings, MA-NC, by statistical area, 2014-2017. Statistical areas accounting for less than 5% of total landings are not shown and collectively accounted for 12.87% of total landings. Only landings associated with valid northeast region statistical areas were included in the calculations. Data were provided by the ACCSP. Landings by area were estimated by applying VTR proportions of landings by area to dealer data.

Tables

Table 1. Regional partitioning of statistical areas for the black sea bass spatial stock assessment.

Statistical Areas in Northern Region	511, 513, 514, 515, 521, 522, 525, 526, 533, 534, 537, 538, 539, 541, 542, 543, 561, 562, 611, 612, 613, 616
Statistical Areas in Southern Region	614, 615, 621, 622, 623, 624, 625, 626, 627, 628, 631, 632, 633, 634, 635, 636

Table 2. Proportion of black sea bass commercial harvest, MA-NC, from northern and southern region statistical areas. Only landings associated with valid northeast region statistical areas were included in the calculations. Data were provided by the ACCSP. Landings by area were estimated by applying VTR proportions of landings by area to dealer data.

MA-NC Landings by Statistical Area						
	2010-2017		2010-2013		2014-2017	
	Proportion	Pounds	Proportion	Pounds	Proportion	Pounds
Total N areas	57.82%	9,805,213	51.54%	3,554,769	62.13%	6,250,444
Total S areas	42.18%	7,152,885	48.46%	3,342,576	37.87%	3,810,309
Total	100%	16,958,098	100%	6,897,345	100%	10,060,753

Table 3. Proportion of New Jersey black sea bass commercial harvest from northern and southern region statistical areas. Only landings associated with valid northeast region statistical areas were included in the calculations. Data were provided by the ACCSP. Landings by area were estimated by applying VTR proportions of landings by area to dealer data.

NJ Landings by Statistical Area			
	2010-2017	2010-2013	2014-2017
Total N areas	52.04%	34.40%	61.87%
Total S areas	47.96%	65.59%	38.13%
Total	100%	100%	100%

Table 4. Proportion of black sea bass commercial harvest, MA-NY, from northern and southern region statistical areas. Only landings associated with valid northeast region statistical areas were included in the calculations. Data were provided by the ACCSP. Landings by area were estimated by applying VTR proportions of landings by area to dealer data.

MA-NY Landings by Statistical Area						
	2010-2017		2010-2013		2014-2017	
	Proportion	Pounds	Proportion	Pounds	Proportion	Pounds
Total N areas	98.94%	6,270,079	98.66%	2,650,281	99.15%	3,619,799
Total S areas	1.06%	67,062	1.34%	35,970	0.85%	31,093
Total	100%	6,337,142	100%	2,686,251	100%	3,650,891

Table 5. Proportion of black sea bass commercial harvest, NJ-NC, from northern and southern region statistical areas. Only landings associated with valid northeast region statistical areas were included in the calculations. Data were provided by the ACCSP. Landings by area were estimated by applying VTR proportions of landings by area to dealer data.

NJ-NC Landings by Statistical Area						
	2010-2017		2010-2013		2014-2017	
	Proportion	Pounds	Proportion	Pounds	Proportion	Pounds
Total N areas	33.28%	3,535,133	21.48%	904,488	41.04%	2,630,645
Total S areas	66.72%	7,085,823	78.52%	3,306,606	58.96%	3,779,217
Total	100%	10,620,956	100%	4,211,094	100%	6,409,862

Table 6. Proportion of black sea bass commercial harvest, DE-NC, from northern and southern region statistical areas. Only landings associated with valid northeast region statistical areas were included in the calculations. Data were provided by the ACCSP. Landings by area were estimated by applying VTR proportions of landings by area to dealer data.

DE-NC Landings by Statistical Area						
	2010-2017		2010-2013		2014-2017	
	Proportion	Pounds	Proportion	Pounds	Proportion	Pounds
Total N areas	23.24%	1,606,816	15.53%	448,024	28.75%	1,158,791
Total S areas	76.76%	5,308,566	84.47%	2,436,253	71.25%	2,872,314
Total	100%	6,915,382	100%	2,884,277	100%	4,031,105

Caitlin Starks

From:	Gates, Matthew <Matthew.Gates@ct.gov>
Sent:	Wednesday, May 15, 2019 2:36 PM
To:	Robert Ballou
Cc:	Caitlin Starks; Justin Davis; WILLIAM HYATT; Sen. Craig A. Miner
Subject:	Black Sea Bass Commercial Options
Attachments:	Black Sea Bass Commercial Options_CT_5-13-19_MG.DOCX; BSB Commercial Proposal_GW.xlsx
Follow Up Flag:	Follow up
Flag Status:	Flagged

Hi Bob,
Attached are two potential options for the PDT to consider.

The first option addresses CT's disproportionately small commercial black sea bass allocation by reallocating a little from states that either do not have fisheries or that have relatively large allocations. This was an issue identified by the Commercial Working group.

The second option combines a trigger approach with the TMGC approach and has an example illustrated in the attached spreadsheet.

I view the first option as one that should be implemented prior to and in addition to, any of the options that dynamically reallocate the resource, to put CT on a more even playing field with the other states.

If you have any questions or concerns with these options, please give either me (860.235.9048) or Justin (860.447.4322) a call.

Thanks,

Matthew Gates
Supervising Fisheries Biologist
Marine Fisheries Program
Connecticut Department of Energy and Environmental Protection
333 Ferry Rd, Old Lyme, CT 06371
P: 860.447.4326 | F: 860.434.6150 | E: matthew.gates@ct.gov

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

www.ct.gov/deep

Conserving, improving and protecting our natural resources and environment;
Ensuring a clean, affordable, reliable, and sustainable energy supply.

Options for consideration by Black Sea Bass Commercial PDT

CT DEEP
5/13/2019

Option 1: Address Connecticut's disproportionately small allocation of the coastal quota

Connecticut has experienced a substantial increase in abundance of black sea bass in state waters over the last seven years (see Fig. 1 below). This increased resource availability has rendered Connecticut particularly disadvantaged by its current low allocation of the coastal quota (1%). This option addresses the disparity between abundance of black sea bass in Connecticut waters and Connecticut's quota allocation by increasing Connecticut's allocation to 5%, using the following approach:

1) Hold NY and DE allocations constant
    a. NY has experienced a similar substantial increase in black sea bass abundance in state waters; therefore, it would not be appropriate to reduce their allocation.
    b. DE current allocation is 5 %. As a "control rule", this option does not seek to make CT percent allocation larger than any other state.
2) Move 1/2 of ME and NH quotas to CT.
3) Move MA, RI, NJ, MD, VA, and NC allocation to CT. The amount moved from each state is proportional to that state's current percent allocation.

Figure 1. CT Long Island Sound Trawl Survey Spring Black Sea Bass Index.

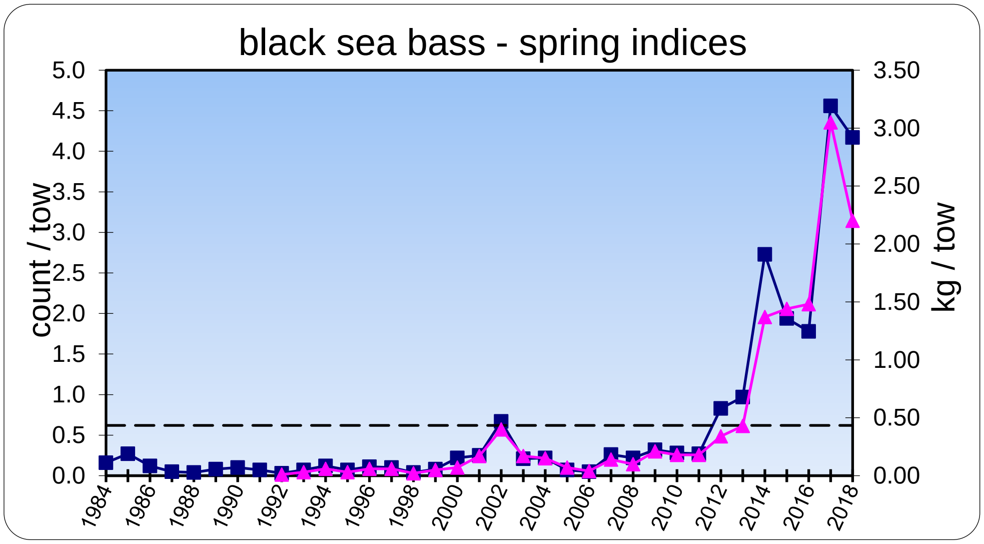

Table 1. Proposed changes in base allocations

State	Current % Allocation	Change in % Allocation	New % Allocation
ME	0.5%	-0.2500%	0.2500%
NH	0.5%	-0.2500%	0.2500%
MA	13.0%	-0.5260%	12.4740%
RI	11.0%	-0.4451%	10.5549%
CT	1.0%	4.0000%	5.0000%
NY	7.0%	0.0000%	7.0000%
NJ	20.0%	-0.8092%	19.1908%
DE	5.0%	0.0000%	5.0000%
MD	11.0%	-0.4451%	10.5549%
VA	20.0%	-0.8092%	19.1908%
NC	11.0%	-0.4451%	10.5549%

<u>Option 2</u>: Trigger option with adjustment of "base" allocations on an annual basis

This option uses a 3 million pound "trigger" while also incorporating the spirit of the TMGC approach (dynamic adjustment of allocations over time with consideration of resource availability and previous allocation regime). This option uses the following decision tree to allocate quota within a given year:

1) If the coastal quota is <u>less than or equal to 3 million pounds</u>:
    a. Allocate quota using the previous year's state allocation percentages.
2) If the coastal quota is <u>greater than 3 million pounds</u>:
    a. Allocate 3 million pounds of quota or "base" quota using the previous year's state allocation percentages.
    b. Allocate the remaining quota or "surplus" (amount above 3 million pounds) as follows:
        i. Split surplus quota to north vs. south region according to proportion of available biomass in each region (ME-NY = north region; NJ-NC = south region).
        ii. Further sub-divide surplus quota within each region according to existing intra-regional proportional allocation.

<u>This option provides the following benefits</u>:

1) By employing a 3 million pound trigger approach, ensures that there will not be substantial decrease to southern region state-by-state allocations in immediate future.
2) This option directly incorporates data on distribution of the resource. The proportions of available biomass in each region could be obtained from a periodic stock assessment, or could be determined annually using fishery-independent survey data.
3) This option allows state-by-state allocations to evolve over time as resource availability shifts (either north to south, or south to north). The rate of allocation shift is accelerated during periods of high resource availability (high quotas), and effectively "pauses" during periods of low resource availability (quotas below 3 million pounds).
4) Overall, year-year changes in state allocations will be moderate – only the "surplus" quota above 3 million pounds will be "shifted" in any one year. The allocation of the "base" quota of 3 million pounds will be the same as the previous year.

The attached Excel spreadsheet can be used to model outcomes during 2021-25 under various scenarios of regional resource distribution, coastal quota, and trigger points. The spreadsheet assumes 2021 implementation of the new regime; the 2020 quota is allocated according the existing state-by-state allocations.

- Use cells I3 through I7 to adjust annual north vs south biomass distribution.
- Use cells K3 through K7 to adjust annual coastwide commercial quota.
- Use cells L3 through L7 to adjust the trigger.

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: **Summer Flounder, Scup and Black Sea Bass Management Board**

FROM: **Robert Ballou, Board Chair**

DATE: **July 19, 2019**

SUBJECT: **Commercial Black Sea Bass Allocation – Review and Recommendations**

At the upcoming Board meeting on August 7, one of the first agenda items will be to review proposed black sea bass commercial management strategies and consider initiating a management action to address commercial allocation. To facilitate the Board's review of this issue, I am taking this opportunity to offer some recommendations in advance on how the Board may want to proceed with addressing the issue at our upcoming August meeting, and at our joint meeting with the Mid-Atlantic Council in October.

Our meeting on August 7 on this agenda item will begin with a brief staff presentation, highlighting the following:

- In August 2018, the Board formed a Working Group (WG) and tasked it with identifying management issues related to changes in stock distribution and abundance and proposing potential management strategies for Board consideration.
- In February 2019, the WG provided a report to the Board which identified two main issues:
  - State commercial allocations implemented in 2003 do not reflect the current distribution of the resource which has expanded significantly north of Hudson Canyon; and
  - Federal coastwide quota management can limit harvest opportunities for some states if another state(s) overage(s) result in a coastwide quota overage resulting in a coastwide fishery closure.
- In response to the WG Report, the Board formed a PDT and tasked the PDT to perform additional analyses and further development of proposed management options related to the issue of state commercial allocations.
- In March 2019, at the Board's joint meeting with the Mid-Atlantic Council, the Council initiated an Amendment to address commercial black sea bass issues. The key reasons for this action were to enable the Council to commit staff resources to the PDT, and to formalize the Council's interest in remaining engaged with the Board regarding commercial allocation and other related issues.
- In May 2019, the PDT provided a report to the Board, setting forth an initial analysis of proposed management strategies for modifying commercial allocations. The report also highlighted some key decision points for the Board to consider in selecting the most appropriate options/alternatives for further development. The first such decision point is to define the Board's goal(s) regarding the consideration of new allocation approaches, to enable the Board and PDT to focus on further development of those strategies that best align with the Board's goal(s).

M19-57

- Also in May 2019, the Board agreed to move forward with the continued development of the proposed management strategies set forth in the report (with the exception of the auctioned seasonal quota approach) and to allow for additional suggestions from Board members within the two-week period following the Board meeting.

Staff will then present on the two new proposals submitted by Board members.

As the next order of business, I would like to take up the matter of reaching consensus on a goal statement for the pending action pertaining to commercial allocation. I would like to seed the discussion with the same draft language presented to the Board at our last meeting in May. That draft language is provided below. Please come to the meeting prepared to either lend support to this wording or offer suggested changes. Once consensus is reached, Board discussion will shift to further consideration of the existing suite of options/alternatives, including the new proposals offered since our last meeting.

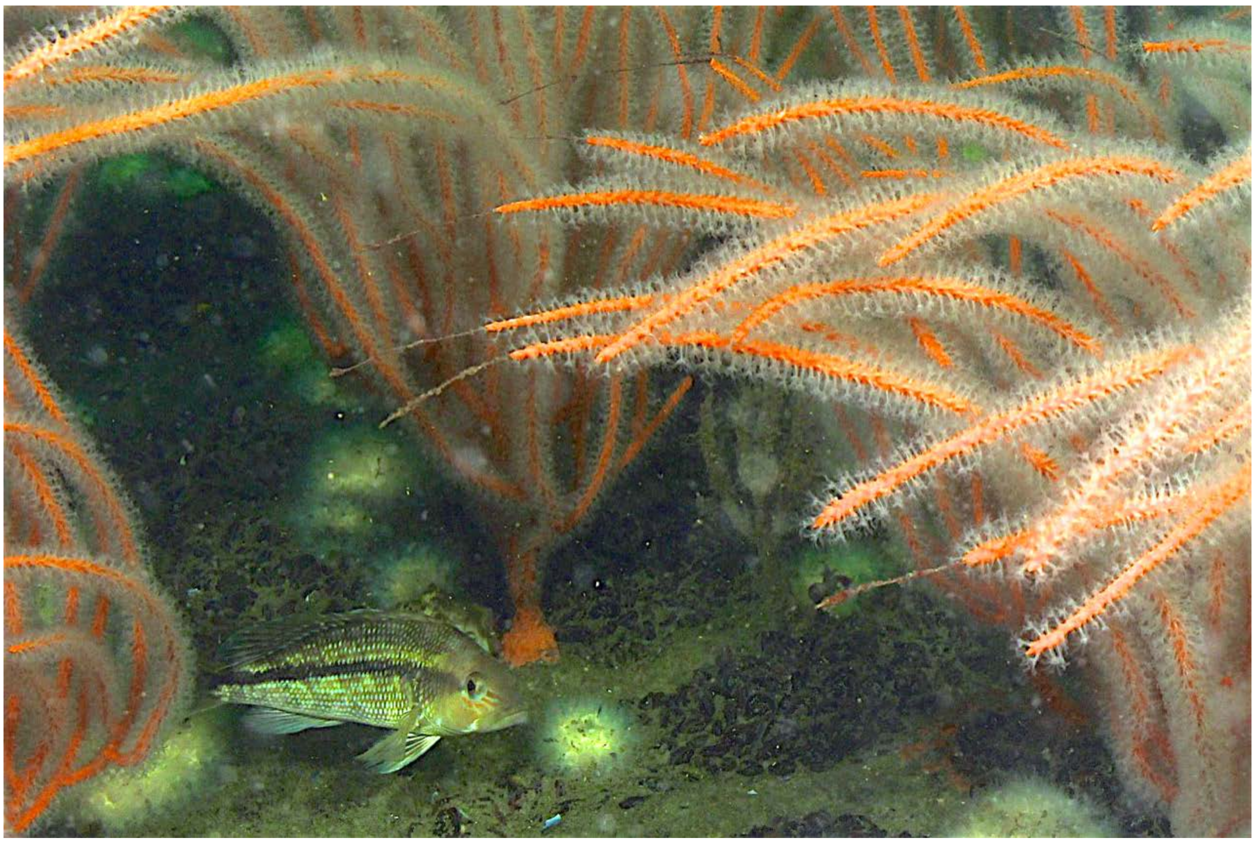
The final order of business on this agenda item will be to consider the initiation of a management document. While the Board has the prerogative to initiate such an action on August 7, my preference is to consider taking action at our joint meeting with the Mid-Atlantic Council in October. That would afford the opportunity to refine the PDT report, by adding a goal statement and making any further adjustments to the options and alternatives, and to present that report to the Council and obtain their feedback and input – still allowing for stand-alone action by the Board, but on the basis of a well-developed report that has been vetted with the Council. This process would be consistent with the discussion and recommended direction offered at the joint meeting in March 2019.

Thank you for your willingness to consider this recommended way forward. I look forward to your thoughts and comments when we convene on August 7.

Proposed Goal Statement:

Consider changes in commercial black sea bass allocation to provide fair and equitable access to the resource by better aligning allocations with updated scientific information on resource distribution and abundance while affording due consideration to the socio-economic needs and interests of coastal communities.

Hab in the MAB: Characterizing Black Sea Bass Habitat in the Mid-Atlantic Bight



Final Report to the Atlantic Coastal Fish Habitat Partnership (ACFHP)

May 2019

Bradley G. Stevens*, Cara Schweitzer**, and Andre Price***

University of Maryland Eastern Shore, Princess Anne, MD, 21853

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Acknowledgements

This study was conducted by faculty and students at the University of Maryland Eastern Shore. We would not have been able to conduct this work without the assistance of many people. We would especially like to thank Captain J. Kogon of the *OCDiveBoat*, and fellow divers B. McMahon, A. Sterling, E. Gecys, and C. Coon for assistance with diving. Scuba diving and dive training was conducted under AAUS guidelines and the supervision of L. Burke and J. Dykman, Dive Safety Officers for the University System of Maryland. Angling support was provided by Capt. C. Mizurak of the *Angler*, and fellow fisher-students I. Fenwick, N. Coit, I. Oliver, O. Scott Price, J. Rice, and N. Olsen. I. Fenwick assisted greatly with fish capture, dissection, and stomach content analysis during summer of 2017 as an intern with the National Science Foundation Research Experiences for Undergraduates program at UMES. Funding for this project was provided by the Mid-Atlantic Fisheries Management Council, via a competitive award from the Atlantic Coast Fish Habitat Partnership. Funding for graduate student support was provided by the National Oceanic and Atmospheric Administration, Office of Education Educational Partnership Program award numbers NA11SEC4810002 and NA16SEC4810007. Chapters 1 and 2 of this work were submitted in partial completion of the PhD Dissertion for Cara S. Schweitzer at UMES. Chapter 3 of this work was submitted in partial completion of the MS Degree for Andre L. Price at UMES.

The contents of this report are solely the responsibility of the award recipient and do not necessarily represent the official views of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Introduction and Summary of Results

The mid-Atlantic Bight (MAB) stretches from North Carolina to Massachusetts but is poorly studied, especially the nearshore regions of the Delaware, Maryland, and Virginia (Delmarva) peninsula. The nearshore continental shelf is composed primarily of unconsolidated sediments consisting of sand, silt, shells, and small gravels. Bedforms consist mainly of sand waves, small hills, and gullies created by ancient riverbeds, with rare outcroppings of rock, consolidated mud, and clay. There is very little hard bottom in the area. The distribution of habitats in the Delmarva MAB is poorly known, although some recent surveys have produced information on the bottom characteristics within the Maryland WEA. Seafloor sediments in the Delmarva region are characterized by large expanses of sand and shell, with widely scattered hard-bottom outcrops. These outcrops form small biological oases among a sandy seafloor desert, and are populated by sedentary invertebrate organisms that create structured habitat. Sedentary organisms are also present on anthropogenic debris (mostly shipwrecks). Numerous artificial reefs have been built in the region to enhance fishing and diving opportunities.

The nearshore continental shelf in this area is inhabited by several economically valuable species, including Tautog *Tautoga onitis*, Croaker *Micropogonias undulatus*, American Lobster *Homarus americanus*, summer flounder *Paralichthys dentatus*, and Black Sea Bass *Centropristis striata*. The most valuable inshore fishery is for black sea bass (BSB), which are considered a data poor species, due to a paucity of biological information regarding reproduction, age, growth, habitat preference, and mortality. Black sea bass are targeted by both recreational and commercial fisheries in equal measure, and the majority of commercial black sea bass landings are captured via fish traps. Commercial fish traps are often deployed on or near benthic structured habitat where economically valuable species aggregate. Recreational fishing is also mostly targeted on the many wrecks, artificial reefs, and natural bottom areas that are widely scattered throughout the region.

The MAB has become a proposed focal area for wind-power development, and wind energy areas (WEAs) have been designated offshore most of the coastal states including Maryland. Future development of wind power will affect bottom habitat in ways that are unknown, but the WEAs have been designed to avoid the most important habitats and fishing areas in the region. However, there is little information on habitat preferences of black sea bass, and how fishing or wind power development will affect the fish and their habitats. To understand the impacts of fishing or wind power development on black sea bass, we need a better understanding of the distribution and composition of benthic habitats in the MAB, and their importance to fish abundance, which is currently unknown.

Black sea bass *Centropristis striata* (BSB) are a carnivorous, primarily benthic fish that range from the Gulf of Maine to the Gulf of Mexico. Atlantic populations are separated into northern and southern stocks at Cape Hatteras, NC, and are considered a separate sub-species (*Centropristis striata striata)* from their Gulf of Mexico counterparts (*Centropristis striata melana*). Northern stock BSB perform seasonal migrations, residing in coastal waters in spring and summer months, then move to deeper waters near the continental shelf in the late fall through winter. BSB are protogynous hermaphrodites, with some individuals changing sex from female to male between 1 and 8 years of age. Common prey items for BSB include amphipods, decapods, bivalves, and small fish. Black sea bass tend to reside at sites with high rugosity at depths <28 m, that are largely associated with hard structure such as corals, mussel beds, and hard-bottom habitats or “reefs”. During the summer, fish show some site fidelity to these habitats. Currently, there are few studies that describe the habitat characteristics of BSB, or their feeding dynamics, and how these two aspects of their biology are related.

This research project, designated "Hab in the MAB", was designed to answer some of these questions. The original objectives were to:

1) Determine the preference of BSB for particular habitats by assessing their abundance, size structure, and feeding ecology within natural and artificial reefs;
2) Improve the understanding of benthic habitat structure by quantitatively assessing biodiversity, rugosity, and other habitat characteristics of natural and artificial reefs;
3) Determine if reduced fragmentation and increased connectivity of habitats increases fish recruitment, by experimentally manipulating corridors between isolated habitat patches.

During the course of the research, these goals were restructured into three specific sub-projects, and several minor ones as follows:

1. Determine the composition of biogenic structure on benthic habitat patches and the relationship to fish abundance, by
    a. Estimating relative cover of fouling organisms and fish abundance at different types of reefs, and
    b. Exploring the relationship between benthic diversity and fish abundance.
2. Investigate how seascape connectivity affects fish abundance, by
    a. Establishing a small stepping-stone corridor connecting two existing reefs, and
    b. Monitoring changes in abundance of fish on the experimental and control reefs before and after deployment;
3. Determine the dietary habits of black sea bass and their trophic relationships, by
    a. Estimating trophic position using stable isotope analysis, and
    b. Comparing food habits between fish caught at artificial and natural reefs, and during NOAA surveys.

Summary of Results

<u>Chapter 1: Habitat structure and fish preference</u>

From 2016 through 2018, we investigated the interactions between black sea bass and their habitats at over a dozen artificial and natural reefs in the Delmarva MAB using a variety of techniques. At each of these reefs, we estimated fouling community composition using quadrat sampling with a digital camera and ¼ m^2 frame along linear transects. We also estimated fish abundance using digital video cameras set on tripods, and by strip-transect censusing. Quadrat and video sampling were conducted both within the structured habitats and on nearby open-sand bottoms for comparison. Surveys of benthic habitats showed that the predominant marine biogenic structures in the Delmarva MAB are comprised of multiple species including northern stone coral *Astrangia poculata,* sponge *Cliona celata*, blue mussels *Mytilus edulis*, various hydroids (i.e. *Tubularia* sp., *Obelia* sp., *Campanularia* sp.), and gorgonian corals, putatively identified as sea whips *Leptogorgia virgulata*. Sea whips are one of the most prominent structure-forming invertebrates, and are responsible for most of the vertical structure above habitat baselines. Fish abundance at the studied sites was compared to the relative abundance of all other habitat-forming organisms present. Fish abundance was significantly correlated only with the relative abundance of sea whip corals, but not with abundance of any other species, or to total coverage of biogenic structure. Sea whips are 'autogenic engineers' (i.e. they create biogenic structure) that add complexity to benthic habitats by altering the environment with their own physical structures. Previous studies (Schweitzer et al, 2018) have shown that 50% of commercial fish traps come into contact with emergent epifauna during deployment or recovery, including sea whip corals, often resulting in damage or breaking of corals. Assessment of sea whip condition (as a damage index) at our study sites showed that sea whip corals on artificial reefs off the Delmarva coast exhibited minor levels of degradation that did not differ significantly among study sites.

Chapter 2. Seascape Connectivity and Fish Abundance

To determine if increasing seascape connectivity increases fish abundance on isolated habitat patches, we used a **Before-After-Control-Impact** (BACI) experimental design. In 2016, we constructed a stepping-stone corridor (the '**Impact'**) connecting two established sections of an artificial reef (the **Impact** site). A similar, nearby, two-section reef was designated as the **Control** site. Both the Control and Impact site consisted of two structured components (parts of shipwrecks) separated by 20 or 120 m, respectively, of unstructured, open sand bottom. Fish abundance was estimated by conducting stationary video surveys during three sampling seasons for one year **Before Impact** and one year **After Impact** at both the **Control** and **Impact** sites, and on both the structured and unstructured components. Prior to Impact, fish were more abundant at the Impact than at the Control site, both sites showed seasonal variation in abundance, and fish were completely absent from unstructured bottom at both sites. After Impact, fish abundance increased significantly only at the (previously) unstructured portion of the Impact site (where the reef was built), but did not change at any of the structured portions of either site, or at the unstructured portion of the Control site. Furthermore, fish were observed on the corridor structure during all three sampling periods. Results suggest that corridor construction increased habitat availability for fish at the Impact site, without drawing fish away from nearby sites. This small-scale study demonstrated that increasing connectivity via corridor construction may be an effective method to enhance available habitat in marine ecosystems.

Chapter 3. Feeding Ecology of Black Sea Bass at Natural and Artificial Reefs

We sampled BSB at selected natural and artificial reefs near Ocean City, MD in 2016 and 2018, using hook-and-line angling to determine if reef type influenced length frequency, sex ratios, diets, and stable isotope ratios of $\partial^{12}C/\partial^{13}C$ and $\partial^{14}N/\partial^{15}N$ in liver, muscle, and mucus. BSB caught by angling were compared to a NOAA dataset of trawl-caught BSB spanning 2000-2016. There were no significant differences in size, age, or sex composition between fish at natural and artificial habitats. The primary prey items of BSB by proportion and frequency of occurrence were crustaceans (primarily *Cancer* crabs) at both artificial and natural sites and among the NOAA samples. Values of $\partial^{15}N$ and $\partial^{13}C$ differed between habitat types in liver and muscle, but not in mucus. This study showed that natural and artificial reefs are ecologically similar for Black Sea Bass caught near Ocean City, MD, but subtle differences in diet between reef types suggest that their physical form may affect access of fish to different prey items.

Conclusions and Recommendations

Previous studies suggesting that BSB are associated with "course-grained" material are but a crude approximation of habitat. The results of this project confirm that black sea bass are tightly structure-oriented, and primarily occur within <1 m of hard bottom substrata with substantial vertical and biological structure that includes the presence of gorgonian corals, aka sea whips.

While BSB did occur near newly placed structures with little overgrowth, abundance at most sites was significantly correlated with density of sea whips, but not of any other species. Increasing the presence of structured habitat, by placement of artificial structures, resulted in an increase in abundance of BSB, without detracting from nearby structures. Diets of BSB appear to derive mostly from areas surrounding reefs, rather than among them, and differ little based on the type of reef or other source. However, the structure and extent of reefs may have a minor impact on diet due to availability of different food sources. Nonetheless, this indicates that habitat selection is probably not associated with proximity to food sources, but is more likely to be associated with actual physical structure that provides other biological benefits, such as protection from predation, optimization of reproductive opportunities, or stress reduction.

With regard to future alteration of marine habitats in the MAB, we suggest that artificial reefs should be constructed out of solid structures with appropriately scaled interstitial space, rather than concrete blocks, pipe, or steel structures that are subject to degradation, subsidence, or disintegration. We also predict that construction or installation of wind power turbines will likely provide abundant hard structure supporting invertebrate fouling communities that black sea bass and other fish prefer as habitat. Increasing the availability of such artificial habitats in the MAB, and including some in protected areas, will likely have positive benefits for the regional population of black sea bass.

Chapter 1. The Relationship Between Fish Abundance and Community Structure on Artificial Reefs in the Mid-Atlantic Bight, and the Importance of Gorgonian Sea Whip Corals (*Leptogorgia* sp.)

Adapted from: Schweitzer, C. C., and B. G. Stevens. in review. The importance of soft coral sea whips (*Leptogorgia* sp.) to fish abundance on artificial reefs in the Mid-Atlantic Bight. PeerJ.

Abstract

Autogenic engineers (i.e. biogenic structure) add to habitat complexity by altering the environment by their own physical structures. The presence of autogenic engineers is correlated with increases in species abundance and biodiversity. Biogenic structural communities off the coast of Delaware, Maryland, and Virginia (Delmarva) are comprised of multiple species including sea whips (putatively identified as *Leptogorgia virgulata),* northern stone coral *Astrangia poculata,* sponge *Cliona celata*, blue mussels *Mytilus edulis*, and various hydroids (i.e. *Tubularia* sp., *Obelia* sp., *Campanularia* sp.). Sea whips are soft corals that provide the majority of vertical height to benthic structure off the coast of the Delmarva peninsula. The mid-Atlantic bight is inhabited by several economically valuable fishes; however, data regarding habitat composition, habitat quality, and fish abundance are scarce. We collected quadrat and sea whip images from 12 artificial reef sites (i.e. shipwrecks) to determine proportional coverage of biogenic structures and to assess habitat health, respectively. Underwater video surveys were used to estimate fish abundances on the 12 study sites and determine if fish abundance was related to biogenic coverage and habitat health. Our results showed that higher fish abundance was significantly correlated with higher proportional sea whip coral coverage, but was not related to other species or total coverage of biogenic structure. Assessment of sea whip condition (as a damage index) showed that sea whip corals on artificial reefs off the Delmarva coast exhibited minor signs of degradation that did not differ significantly among study sites.

Introduction

Structurally complex habitats, such as cobble and rock reefs, and natural or artificial reefs, are profoundly important for fish and crustaceans by providing spatial refuge and feeding sites (Robertson and Sheldon 1979; Hixon and Beets 1993; Forrester and Steele 2004; Scharf *et al.* 2006; Johnson 2007; Cheminee *et al.* 2016; Gregor and Anderson 2016). Structural habitat can be essential for the settlement and proliferation of autogenic engineers (e.g. corals, sponges, bivalves, sea grasses). The presence of biogenic structure can increase the quality of habitats and can affect habitat selection, abundance of economically valuable species, and survival and settlement of fishes (Gibson 1994; Garpe and Öhman 2003; Diaz *et al.* 2004; Miller *et al.* 2012; Komyakova *et al.* 2018; Seemann *et al.* 2018; Soler-Hurtado *et al.* 2018). This is most evident when biogenic structures are damaged or undergo mortality events, which often results in regional loss of fish biomass, biodiversity, and abundance (Jones *et al.* 2004; Lotze *et al.* 2006; Thrush *et al.* 2008; Dudgeon *et al.* 2010; McCauley *et al.* 2015). The extent to which autogenic engineers influence fish abundance has been well studied in tropical marine ecosystems (Richmond 1996; Downs *et al.* 2005; Hughes *et al.* 2010; Newman *et al.* 2015), but is poorly understood within temperate rock reef systems of the mid-Atlantic.

Within the mid-Atlantic Bight, biogenic structure primarily consist of sponge *Cliona celata*, blue mussels *Mytilus edulis*, and various hydroids (i.e. *Tubularia* sp., *Obelia* sp., *Campanularia* sp.), northern stone coral *Astrangia poculata* (Steimle and Zetlin 2000), and sea whips (putatively identified), *Leptogorgia virgulata* (Gotelli 1991). Among this community, sea whip corals are the primary contributors of additional height to artificial and natural rock reefs. Previous studies conducted within coral reef ecosystems have demonstrated that rugosity and coral height are the strongest predictors of fish biomass (Harborne *et al.* 2012). The mid-Atlantic Bight is a poorly studied region and the composition of benthic biogenic structures is unknown.

Marine benthic structure within the Delaware, Maryland, Virginia peninsula (Delmarva) portion of the mid-Atlantic Bight consists of both natural rock reefs and artificial reefs. Natural reefs are composed of rock, mud, and clay outcrops, and artificial reefs, both unintentional (e.g. shipwrecks) and intentional (e.g. concrete blocks and pipes, subway cars, ships). Natural reefs are sparse, sporadically distributed and highly fragmented. Artificial reefs provide the dominant source of benthic structure either through accidental shipwrecks or constructed through artificial reef programs. Artificial reef construction has become a popular way to increase regional habitat production, biodiversity, fish abundance, and to restore biogenic structure (Bohnsack 1989; Grossman *et al.* 1997; Sherman *et al.* 2002; Granneman and Steele 2015; Scott *et al.* 2015; Smith *et al.* 2017). Artificial reef sites are constructed regularly off the coast of the Delmarva peninsula, with the goal of increasing the abundance of structure-oriented fish of economic value. Some of these species, such as black sea bass *Centropristis striata*, and tautog *Tautoga onitis,* reside directly within the structures; whereas others, such as Atlantic croaker *Micropogonias undulatus*, and summer flounder *Paralichthys dentatus*, are commonly found on sandy bottoms near benthic structures as adults (Feigenbaum *et al.* 1989; Hostetter and Munroe 1993; Scharf *et al.* 2006; Fabrizio *et al.* 2013).

Habitat quality and its relationship to species abundance has been largely been neglected in the mid-Atlantic Bight. Previous research investigating habitat association for economically important species (e.g. black sea bass) within the mid-Atlantic Bight focused on benthic hardness and did not consider biogenic composition (Fabrizio *et al.* 2013). Diaz *et al.* (2003) performed a small-scale study investigating fish abundance in relation to biogenic structure (infaunal tube densities) at Fenwick Shoals off the coast of Delaware. They found that patch size and presence of biogenic structure was significantly related to juvenile fish abundance for that site. However, there are still insufficient data to suggest that these results are representative of habitat patches throughout the mid-Atlantic Bight. To date, there is a paucity of data regarding the composition and degree of coverage of biogenic structure on reefs, and its relationship to fish abundance within the mid-Atlantic Bight

We undertook a study to determine the structure of marine biogenic communities and their relationship to fish abundance in the Delmarva portion of the mid-Atlantic Bight. Our study had four specific objectives which were: 1) to determine the species composition and coverage of biogenic structure at various artificial reefs; 2) to estimate relative fish abundance at those sites; 3) to estimate habitat quality using a damage index (DI) for sea whips, and 4) to determine the relationships between fish abundance and the quantity and quality of biogenic habitat.

Methods

Description of study sites

Twelve artificial reef study sites were selected based on site age and SCUBA accessibility (Table 1.1). Sites were located off the coast of the Delaware, Maryland, and Virginia (Delmarva) Peninsula between the latitudes of 37° N and 38.5° N ranging from 9 to 32 km off the coast (Fig. 1.1) at depths from ~10 to ~24 m. The maximum distance between sites (Site 1 and 6) was ~60.1

km and the minimum distance (between Sites 2 and 3) was ~0.52 km. The majority of the sites (n = 8) were intentionally sunk in association with the Maryland Artificial Reef Program, and the remaining four were natural wrecks. Both sites PH and RG became separated into two sections with approximately 122 m and 27 m between each section, respectively.

There have been few studies on habitats in the mid-Atlantic Bight by SCUBA or other in-situ methods due to unpredictable weather and turbid conditions. For these reasons, diving and data collection were restricted to the months of June through November during 2017 and 2018 and only conducted on days with a wave height ≤ 1 m. Fish abundance surveys were conducted June through August. If quadrat sampling could not be completed during the same sampling day, the site was resampled at a later time. During these months bottom water temperatures ranged from 9.31°C to 22.57°C and surface temperatures ranged from 13.48 to 27.23° C (CTD data). Bottom visibility in the mid-Atlantic is highly unpredictable and ranged from ~0.5 to ~18 m. Neither quadrat nor video data could be collected on days with bottom visibility < 1.5 m.

Table 1.1. Sites surveyed during this study, including name, abbreviation, approximate age, depth, month in which fish abundance surveys were completed, and category, indicating whether sites were constructed deliberately or sank unintentionally. Site names are the common name of wreck for the region, however some site names are not universal.

Site	Site Name	Abbr.	Approx. Age (y)	Approx. Depth (m)	Month Surveyed	Category
1	Fenwick Shoals	FW	120	10	July	Unintentional
2	Elizabeth Palmer	EP	104	23.5	July	Unintentional
3	EP-2	E2	100	24	July	Unintentional
4	Pharoby	PH	37	20	June	Deliberate
5	Blenny	BL	30	23.5	July	Deliberate
6	Kathleen Riggins	RG	28	16.5	June	Unintentional
7	Memorial Barge	MM	26	18	—	Deliberate
8	Sussex	SX	24	24	July	Deliberate
9	Navy Barge	NV	19	20	July	Deliberate
10	Barge	BA	2	19	August	Deliberate
11	New Hope	NH	0.5	18	August	Deliberate
12	Boiler Wreck	BW	NA	24	July	Deliberate

Data Collection

Quadrat sampling was used to estimate the proportional coverage of the dominant biogenic organisms: sea whip corals, putatively identified as *Leptogorgia virgulata*, northern stone coral, *Astrangia poculata*, blue mussels, *Mytilus edulis*, sponge, *Cliona celata,* and various hydroid species (e.g. *Tubularia sp., Obelia sp., Campanularia sp.*). Quadrat images (*n* = 11 to 60) were taken by SCUBA divers with a Canon DSLR camera in a housing attached to a 0.25 m^2 PVC frame[1]. Images were taken at 1 m intervals along the long axis of the artificial reef for 30 m, or to end of the wreck. Quadrat sampling was conducted once at each of the sites. To assess sea whip damage, a haphazardly selected subset of sea whips was photographed with GoPro® *Hero* 4 action camera[1] if abundant (e.g. > 1 m^{-2}), otherwise all sea whips present were photographed.

[1] Reference to trade names does not imply endorsement by either the University of Maryland Eastern Shore or funding sources.

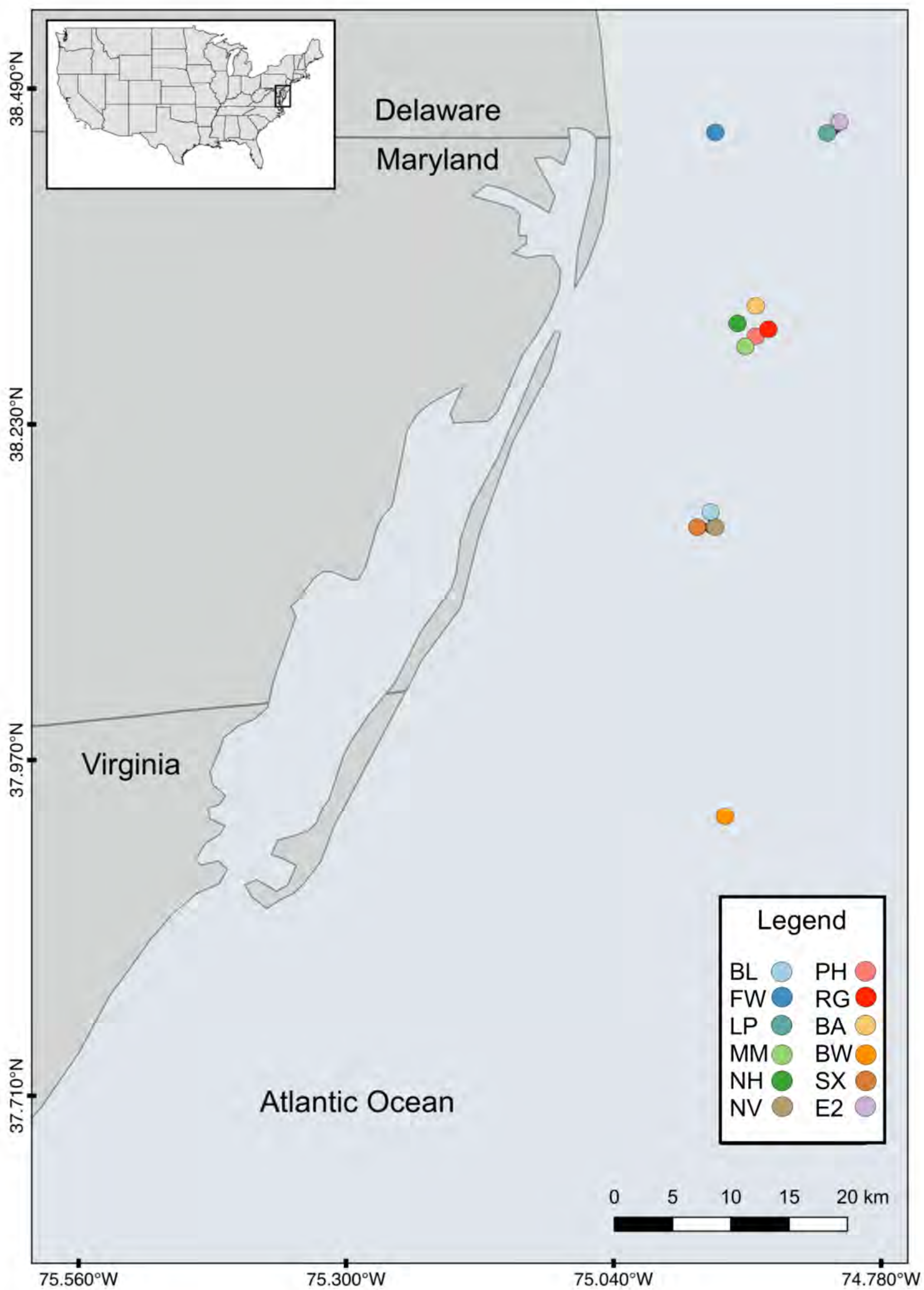

Figure 1.1. Map of study sites showing the locations of the 12 artificial reefs off the coast of the Delmarva (Delaware, Maryland, Virginia) peninsula.

Fish abundance on artificial reefs was estimated using two different types of underwater video survey: 1) line transect method, and 2) stationary cameras. Line transects were conducted at eight sites while stationary camera surveys were conducted at four of the sites. The latter method was used primarily to estimate fish abundance for an artificial reef construction project (Chapter 2 of this document) and incorporated into this analysis. Line transects were conducted for 30 m along the long axis of the site, or until the end of the wreck. Divers swam along the transect ca. 1 m above the wreck with the camera facing at a slight angle toward the wreck surface. The mean duration of line transect videos was 306 ± 102 s (mean ± SD). Stationary surveys were conducted using non-baited aluminum tripods each of which bore two GoPro® cameras placed at 90º angles. Two tripods were placed facing the wreck at a distance of approximately 1 m from where fish were observed. At Sites PH and KR, tripods were also placed in the open bottom area between each section to determine the abundance and behavior of fish at those sites. Cameras were left on tripods to record for 45 min, and then retrieved. Stationary tripod observations were repeated at least twice at each location, but line transect counts were not repeated due to hazardous weather that restricted diving frequency.

Data Analysis

Images were analyzed with image analysis software ImageJ (version 2.0.0-rc-69/1.52J, NIH) and statistical analysis was completed with R statistical software (v 3.5.2; R Core Team, 2018). Proportional cover for each of the biogenic species was estimated by outlining regions of interest (ROI) in each quadrat image. For sea whip corals, ROI were drawn over the projection of the sea whip on the surface (See Appendix Photos E-H). Analysis of similarities (ANOSIM) based on Euclidean distance was used to test for differences between biogenic structure assemblages at sampling sites. Logit transformation was applied to all proportional data before linear model (LM) analysis. Non-metric multidimensional scaling (NMDS) was used to visualize similarities and differences in biogenic composition across the research sites. Five biogenic fouling species including two corals and three non-coral organisms were included in the NMDS analysis, which represent the dominant biogenic structure organisms that inhabit the mid-Atlantic.

Due to the frequency of low bottom visibility during video survey, identification of species was substantially impaired, such that only fish relatively close to the camera could be identified. Therefore, fish abundance was estimated for all fish present and not separated by species. However, the predominant species was black sea bass, with a small amount of tautog. To estimate fish abundance on artificial reefs, we used a modified method of the MeanCount method, which is defined as the mean number of individuals observed in a series of frames throughout a viewing interval (Bacheler and Shertzer 2014). To maintain independence between frames, twelve frames were randomly selected from the line transect surveys and the number of fish within each frame was counted. The MeanCount was calculated as the mean of those twelve frame counts. For the stationary camera video surveys, fish were counted at 30 s intervals for the duration of the 30 min video, for a total of 60 counts per video. Due to the frequency of low visibility conditions, short clips of ~1.6 s length were viewed that included of 0.8 s before and after the frame selected for analysis. Frame counts were averaged over the three videos collected that year. In addition to MeanCount, the highest number of fish observed in a single frame during the video (MaxNo) was also reported, because fish were often observed aggregated near biogenic structure, specifically sea whip corals, rather than dispersed throughout the wreck. Relationships between abundance of biogenic structure and fish abundance (MeanCount or MaxNo) at each site were analyzed with a linear model. Because of the different methods used, analyses were conducted separately for line transect counts and stationary video counts.

To estimate sea whip damage, we calculated the relative area of sea whips in each image using ROIs via a line segment tool that was set at the same width as the sea whip branches. We then calculated the damaged area or region of overgrowth as a proportion of total line length.

Proportional damage of individual sea whip corals was averaged at each site, and the mean value was used to assign a damage index (DI) from 1 to 5 (Table 2) as described in Schweitzer *et al.* (2018) (See Appendix Photos O, P). The proportional data was analyzed with a linear model to determine if sea whip DI differed between sites and if DI had an effect on fish abundance.

Table 1.2. Criteria used to classify individual sea whip damage index (DI) and overall habitat DI for images captured. For individual sea whips, damage is defined as any visible tissue damage, exposed skeletal structure, or overgrowth by hydroids or bryozoans.

DI	Damage	Description
1	Minimal	< 0.05 damage or overgrowth
2	Minor	0.06-0.25 damage or overgrowth
3	Moderate	0.26-0.50 damage or overgrowth
4	Severe	0.51-0.75 damage or overgrowth
5	Critical	> 0.75 damage or overgrowth

Results

Composition of artificial reefs

Data derived from quadrat images showed a significant difference between study sites, but with some overlap in biogenic assemblages (ANOSIM $R = 0.32$; $p = 0.001$; Fig. 1.2). The mean proportional coverage of biogenic structure on artificial reefs off the Delmarva coast was 0.47 ± 0.14. Proportional coverage was lowest at Site SX (0.27), and greatest at Site NV (0.81; Fig. 1.3). Sea whip corals (*Leptogorgia* sp.) and northern stone coral (*A. poculata*) were present on 10 of the 12 sites. One of the two sites void of sea whip corals was constructed 6 mo prior to the quadrat survey and only exhibited colonization by hydroid species (Site NH; Table 1.3). Blue mussels (*M. edulis*) were found on 5 of the 12 sites. Boring sponge (*C. celata*) was observed at 8 of the 12 sites. Site BW was the only location that contained all five structure-forming species. Results from the NMDS supported the results from the ANOSIM in that some sites exhibited distinctive biogenic structure communities, while others showed considerable overlap (Fig 2).

Table 1.3. Proportional cover of biogenic structures by site. *n* is the number of quadrat images analyzed at each site; $\bar{x}$ is the mean proportional coverage for each variable: SW = sea whip coral, SC = northern stone coral, SP = boring sponge, MS = blue mussel, HY = hydroids.

Site	*n*	$\bar{x}$ SW	$\bar{x}$ SC	$\bar{x}$ SP	$\bar{x}$ MS	$\bar{x}$ HY
FW	27	0.00	0.10	0.31	0.00	0.11
LP	36	0.06	0.17	0.05	0.00	0.15
E2	11	0.11	0.18	0.04	0.00	0.15
PH	60	0.14	0.11	0.10	0.00	0.07
BL	51	0.01	0.01	<0.01	0.23	0.24
RG	41	0.08	0.26	<0.01	0.00	0.00
MM	33	0.08	0.10	0.00	0.29	0.05
SX	31	0.17	0.07	<0.01	0.00	0.03
NV	37	0.11	<0.01	0.00	0.65	0.07
BA	27	<0.01	0.00	0.00	0.54	0.01
NH	31	0.00	0.00	0.00	0.00	0.35
BW	27	0.11	0.05	0.02	0.24	0.1

Northern stone coral and blue mussels were negatively correlated. Sites NV and NH were associated with blue mussel coverage, while sites EP, E2, PH, and RG were associated with northern stone coral (Fig. 1.2). Sea whip corals and hydroids were negatively correlated, suggesting a chronological succession of the fouling community. Sites PH, RG, MM, SX, NV, and BW were associated with sea whips, whereas sites BL and BA were associated with hydroids. Sites FW and PH were associated with boring sponge (Fig. 1.2).

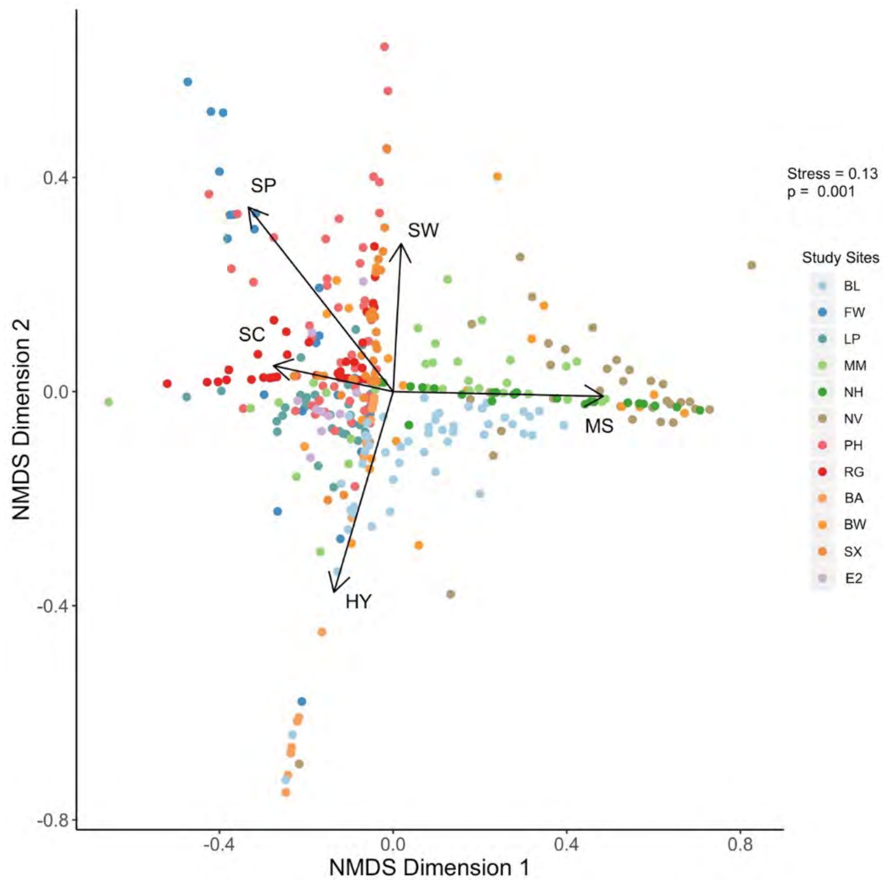

Figure 1.2. Nonmetric multidimensional scaling analysis of biogenic structure assemblages at the 12 artificial reef sites off the Delmarva coast. P value is from the ANOSIM analysis. Variables: SW = sea whip corals; SC = northern stone coral; SP = boring sponge; MS = blue mussel; HY = hydroids.

MeanCounts of fish were obtained from 11 of the 12 sites. Visibility was too poor for a video survey to be conducted at Site MM, and hazardous weather prevented additional outings. MeanCounts of fish were highest at Sites E2 and PH, and lowest at Sites FW and NH, whereas MaxNo was highest at Sites E2 and SX (Fig. 1.3, Table 1.4). No fish were observed swimming on open sandy bottom. MeanCounts and MaxNo were highly correlated (r^2 = 0.94). A linear model using fish MeanCounts as the response variable and total proportional coverage as the predictor variable was not significant (ANOVA, F = 0.14; p = 0.72; r^2 = 0.02), indicating that abundance of fish was not related to total proportional coverage of biogenic structure. MeanCounts were significantly related to proportional coverage of sea whip corals at sites with stationary tripods (p = 0.036; r^2 = 0.48; Table 1.5; Fig. 1.5) as well as at sites where line transect video surveys were conducted (p = 0.014; r^2 = 0.69).

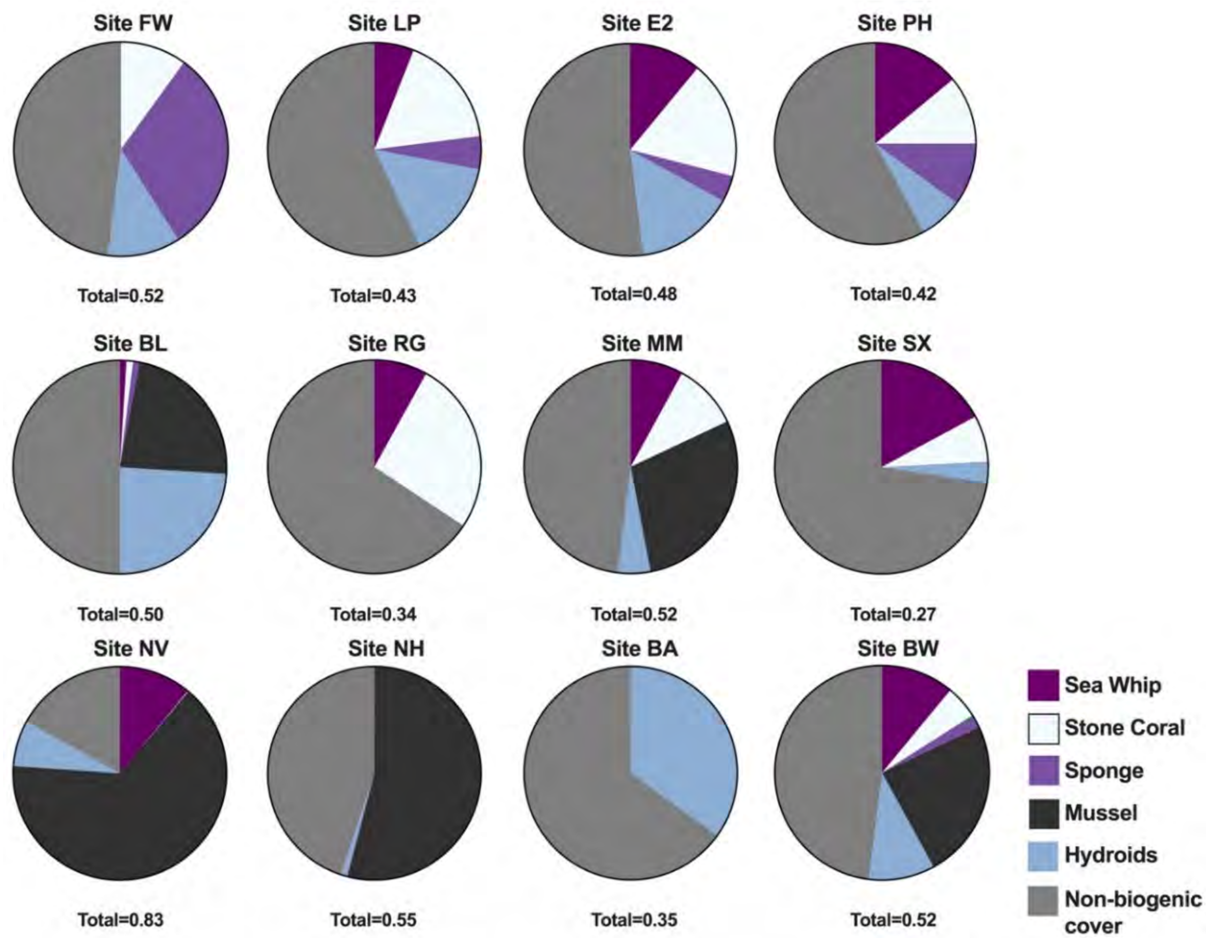

Figure 1.3. Proportional cover of five structure-forming species at 12 study sites. Total = Cumulative total coverage of all five biogenic species groups from quadrat images.

Table 1.4. Summary of fish MeanCount and MaxNo for underwater video census surveys.

Site	MeanCount	SD	MaxNO
FW	0.50	0.76	2
LP	5.25	2.18	14
E2	14.4	5.67	35
PH	7.49	3.07	24
BL	3.93	5.44	18
RG	5.05	2.66	18
MM	—	—	—
SX	6.64	7.56	27
NV	4.36	4.86	15
NH	0.64	2.41	3
BA	1.57	0.84	7
BW	7.07	4.92	19

Table 1.5. ANOVA results from the linear model analysis for 11 of the 12 sites. Fish MeanCount is the response variable and biogenic structural species are the predictor variables.

Variable	**Sum Sq**	**F value**	**df**	***P* value**
Sea whips	73.87	9.31	10	0.028
Stone Coral	20.01	2.52	10	0.173
Sponge	0.13	0.17	10	0.904
Blue mussel	7.87	0.99	10	0.365
Hydroids	11.21	1.41	10	0.288

Evidence of habitat disturbance due to fishing (e.g. lures, fishing line, abandoned traps) was observed at 10 of the 12 sites (all but Sites E2 and BA). Observations of tangled fishing line were common at edges of shipwrecks. Fishing gear was observed in direct contact with sea whip corals at 9 of the 10 sites where sea whips occurred (Fig. 1.6). To determine if cumulative sea whip damage was related to reduced habitat quality and fish abundance we analyzed a total of 193 sea whip images from 10 of the 12 study sites, excluding Sites FW and NH, where sea whip corals were absent. Sea whips at most sites exhibited various levels of degradation (Fig. 1.7). However, despite evidence of fishing disturbance at all sites, with the exception of Site E2, the mean damage index (DI) was 0.15 ± 0.19 SD for all sites, which is indicative of minor levels of degradation (Table 1.6). Site LP showed the highest DI with a mean of 0.26 ± 0.19 indicating a moderate level of degradation, however this was not significantly different from the other sites ($p = 0.061$).

Table 1.6. Summary of the mean proportional damage for sea whips and the habitat DI by site. *n* is the number of sea whips analyzed at each site. $\bar{x}$ is the mean proportional damage for the measured sea whips. SD is the standard deviation. Max is the highest proportional damage observed. Min is the lowest proportional damage observed. D.I. is the damage index assigned to the site.

Site	***n***	$\bar{x}$	**SD**	**Max**	**Min**	**D.I.**	**Degradation Category**
1	0	–	–	–	–	–	–
2	31	0.26	0.19	0.77	0.05	3	Moderate
3	11	0.02	0.02	0.02	0.00	1	Minimal
4	19	0.15	0.24	1.00	0.00	2	Minor
5	17	0.15	0.24	1.00	0.00	2	Minor
6	19	0.07	0.05	0.18	0.02	2	Minor
7	24	0.15	0.15	0.47	0.00	2	Minor
8	21	0.12	0.11	0.40	0.00	2	Minor
9	26	0.11	0.15	0.66	0.00	2	Minor
10	7	0.15	0.30	0.82	0.00	2	Minor
11	0	–	–	–	–	–	–
12	28	0.15	0.21	0.78	0.00	2	Minor

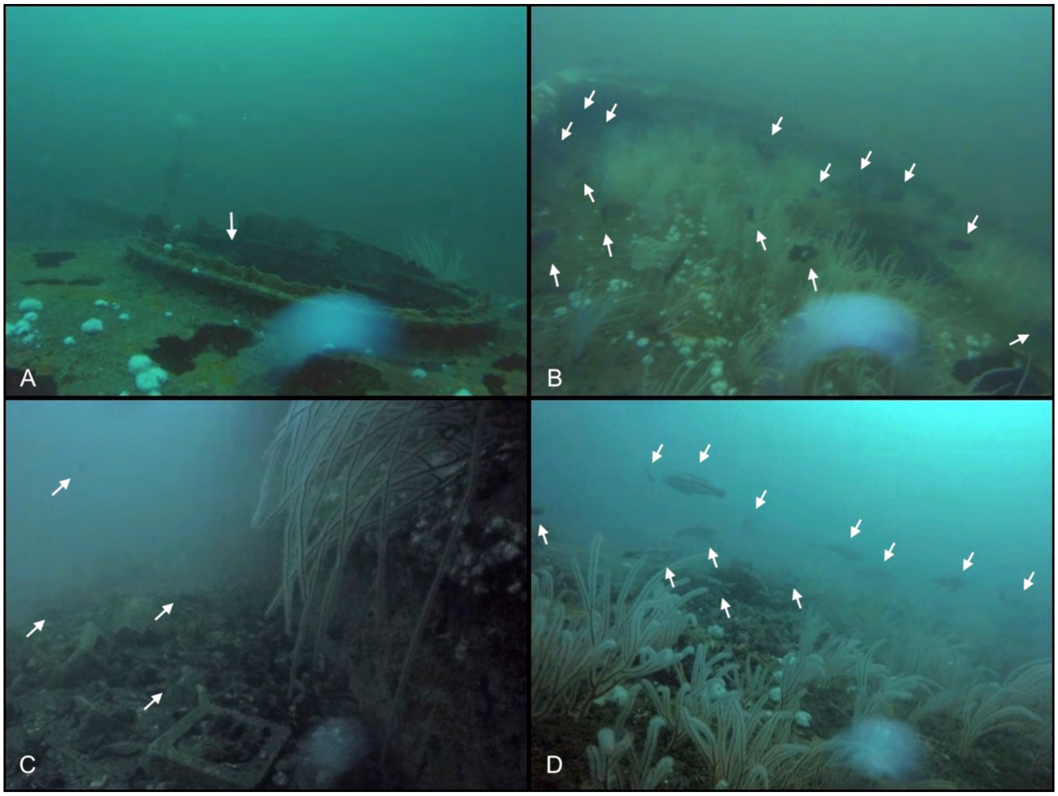

Figure 1.4. Photos illustrating fish and sea whip density at two locations (Sites SX and NV). A) Region of Site SX with minimal biostructure. White arrow highlights the single fish located within this frame. B) Region of Site SX with higher sea whip coverage, on same dive as 4A. White arrows show the location of the 14 fish observed. C) An area of Site NV that is mostly composed of rock, broken shells and concrete blocks with a single sea whip coral and some colonies of northern stone coral on the wall of the wreck. White arrows show the locations of four fish. D) Region of Site NV with increased sea whip coverage during same dive as 4C. White arrows show the location of 12 fish.

Discussion

The presence of autogenic engineers often increases habitat quality resulting in increases in species abundance and biodiversity across terrestrial, freshwater, and marine ecosystems (Jones *et al.* 1994; Hastings *et al*. 2007). However, not all types of structures are equivalent, or have positive correlations with species biodiversity and abundance (Jones *et al.* 1997). Therefore, it is important to understand the relationships between composition of biogenic structure and its effect on community structure. The mid-Atlantic Bight is a poorly studied region inhabited by multiple economically important species (Hostetter and Munroe 1993; Shepherd *et al.* 2002) that are exploited both recreationally and commercially. Many of these species (e.g. black sea bass and tautog) are considered structure oriented, but it remains unclear if biogenic structure affects their habitat selection. Insights into the relationships between biogenic structure and fish abundance will be useful for developing ecosystem-based fisheries management (EBFM).

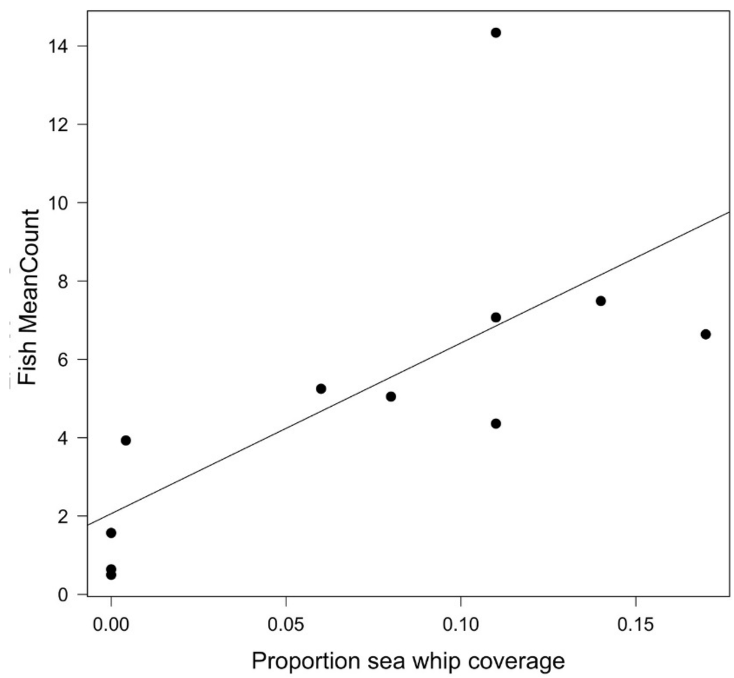

Figure 1.5. Relationship of MeanCount and proportional sea whip coverage for 11 of the 12 study sites. There is a significant positive correlation (p = 0.018; r^2 = 0.48).

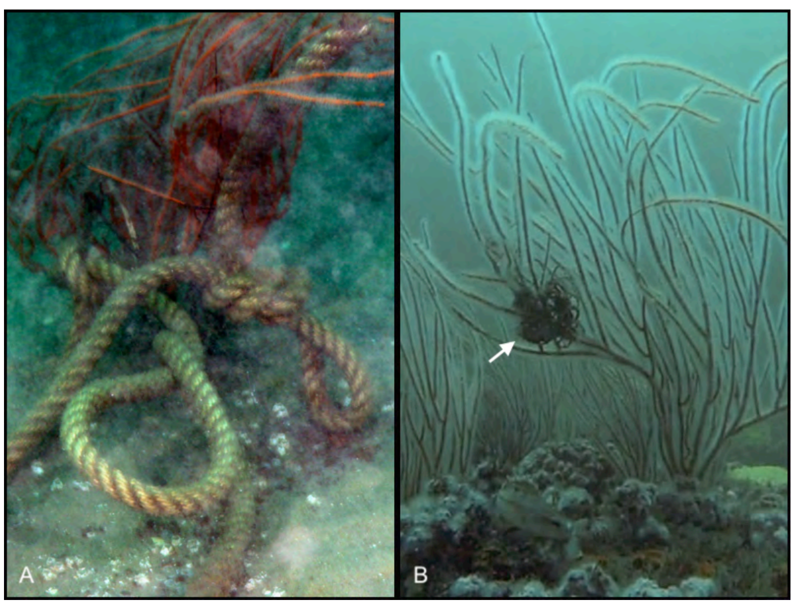

Figure 1.6. Two photographs showing representative examples of anthropogenic disturbance observed at the research sites. A) Sea whip coral from Site PH entangled in rope. B) Sea whip from Site NV with fish line entangled around a portion of branches.

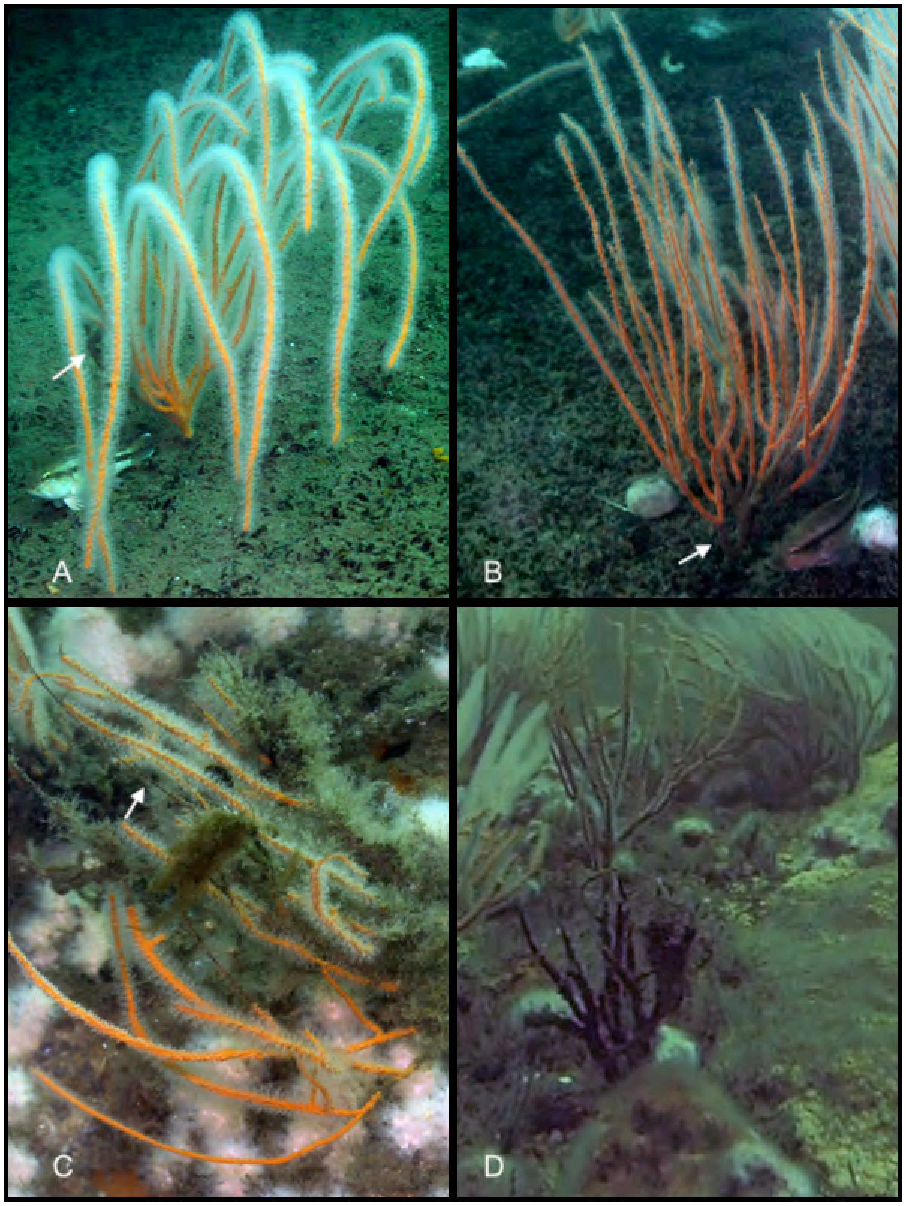

Figure 1.7. Photographs showing sea whip corals with four different degrees of damage. A) Sea whip coral exhibiting a minimal proportional damage index of 0.02. White arrow highlights the region of damage. B) Sea whip coral exhibiting minor proportional damage index of 0.13, localized at the base of the coral. C) Sea whip coral exhibiting a severe proportional damage index of 0.51. The white arrow is showing a region where the tissue has completely decayed, exposing the skeletal structure. This coral also exhibits colonization by hydroids. D) Sea whip coral exhibiting critical proportional damage index of 1.00 with no live tissue remaining.

In this study we measured habitat composition and relative abundance of fish on 12 artificial reef sites to determine if relationships existed between biogenic structure and habitat use by fish. We concluded that abundance of fish was significantly correlated with abundance of sea whip coral and that fish were often aggregated near sea whips. In fact, sites without sea whips, or having a proportional abundance <0.01, exhibited low values for both fish MeanCounts and MaxNo. Within the mid-Atlantic Bight, sea whip corals are the primary autogenic engineer that increases the relative height of benthic structure, increasing the structural complexity of such habitats. In previous studies, coral height has been found to be a significant predictor of fish abundance and biodiversity within coral reef systems (Hoyle and Harborne 2005). Due to their height, sea whip corals can be susceptible to disturbance (e.g. fishing) that may result in damage and degradation (Schweitzer *et al.*, 2018), which could lead to reduced fish abundance.

Habitat degradation is commonly correlated with a reduction in biodiversity and abundance of associated species (Wilson *et al*. 2006). We observed sea whips entangled in fishing line and rope, along with various levels of damage to colonies throughout the study sites. However, our study sites did not differ significantly from each other; therefore, we could not determine the effect of sea whip damage on fish abundance. This result is not surprising because, despite receiving recreational fishing pressure, these 12 sites are seldom fished by commercial fishers. Previous studies have shown that commercial traps drag along the ocean bottom upon retrieval, running over and breaking sea whips (Schweitzer *et al.* 2018), which may accelerate degradation. In order to test the hypothesis that sea whip coral health affects fish abundance on patch reefs, data are needed on sites with wider distribution of impact levels, ranging from moderate to severe degradation, to compare with less-impacted sites.

In this study we did not investigate natural reef sites due to their inaccessibility to SCUBA. Natural reefs off the coast of the Delmarva Peninsula are highly fragmented and sparse, occurring at depths ≥ 27 m. Attempts to locate these by SCUBA diving along commercial trap lines demonstrated that greater amounts of time were needed to locate and sample patch reefs than could be accommodated by no-decompression diving on air or EAN32 gas mix. Natural reefs are commonly targeted by both recreational and commercial fishers; therefore, it is important for future studies to incorporate surveys of natural reefs. Schweitzer et al. (2018) surveyed three naturally occurring patch reefs with a remotely operated vehicle in an area targeted by commercial fishers. The stratified DI for those sites was 0.37, substantially greater than 0.15 for the study sites in this survey. However, biogenic structure composition and relative fish abundance for those sites or other natural reef sites is unknown. Schweitzer et al. (2018) also determined that 50% of commercial fish traps encountered biological organisms including sea whips during recovery, often resulting in running over, damaging, or breakage of structures. However, further research is needed to determine whether the higher damage index observed at those sites is due to fishing impacts or natural disturbance.

Our research showed a significant difference in the composition of biogenic structure between sites. Blue mussels were the dominant epifauna at five sites (i.e. ≥ 22% cover), however they were not observed at the other seven sites. Northern stone coral was observed at ten sites and was dominant (≥17%) at three. Only two sites were not inhabited by sea whips, one of which was an artificial reef constructed ~6 mo prior to quadrat sampling. Site NH, constructed 2 y prior to being surveyed exhibited <0.01 proportional sea whip coverage, indicating that it takes a minimum of 2 y for sea whips to begin to grow on concrete and metal substrata. However, settlement and growth rates for sea whips (*L, virgulata*) are currently unknown. In contrast, sites BA and NH, both of which were constructed <3 y before surveying, were occupied exclusively by hydroids and mussels, respectively, indicating that those species settle quickly, and are probably replaced over time by longer-lived species such as sea whips and stone corals. We conducted quadrat surveys only once at each site. Repeated quadrat surveys, especially after severe weather events, would give insight on rates of succession and sea whip colonization rates on newer artificial reefs.

Fish abundance was estimated via two underwater video survey methods: line transects and non-baited stationary cameras, conducted over the course of two years, which is a limitation to this study. Ideally, abundance censuses would be conducted in a synoptic fashion; however, weather and water conditions in the mid-Atlantic Bight are unpredictable, and were often deemed too hazardous for SCUBA surveys, making it difficult to collect data within specific time blocks. The video surveys acquired from the stationary cameras at four sites (Sites LP, E2, PH, & RG) could result in an upward bias of the MeanCount; nevertheless, fish MeanCount still showed a significant correlation with sea whip abundance at the remaining seven sites. Additional surveys are needed to understand how fish abundance at sites can vary throughout and over years since many of the prominent fish species (e.g. black sea bass and tautog) are seasonal migrators.

Our study is the first to quantify the composition of biogenic structure on artificial reefs off the coast of Delmarva Peninsula and to show that fish abundance is significantly correlated with the presence and abundance of sea whip corals. Construction of artificial reefs off the coast of Delmarva occurs on an annual basis to increase the local abundance of economically valuable species. Creating artificial reefs near regions with established sea whip coral populations may help facilitate sea whip settlement and colonization of new structures. Future studies to determine variations in fish abundance over time, and to determine the succession of biogenic structure would be useful. In addition, future surveys of naturally occurring patch reefs should be conducted, in order to gain a more detailed assessment of habitat quality in the mesophotic regions of the Mid-Atlantic Bight.

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Chapter 2. Effects of Habitat Enhancement on Local Fish Abundance: A Before-After/Control-Impact (BACI) Design Study on Artificial reefs in the Mid-Atlantic Bight

Cara C. Schweitzer and Bradley G. Stevens

Adapted from: Schweitzer, C.C. and B. G. Stevens (MS in preparation). Response of fish abundance to increased seascape connectivity using a mosaic corridor connecting artificial reefs in the Mid-Atlantic Bight.

Abstract

Seascape connectivity, the arrangement and proximity of nearby habitats, which can facilitate or impede animal movements, has been a well-studied research topic in terrestrial systems and is becoming a topic of interest in marine systems. Despite this, there are few studies that actively increase seascape connectivity to existing reefs. To determine if increasing seascape connectivity increases fish abundance on habitat patches, we constructed a stepping-stone corridor connecting two established sections of an artificial reef based on a Before-After-Control-Impact (BACI) experimental design. Fish abundance was estimated by conducting stationary video surveys during three sampling seasons for one year before corridor placement (the impact) and one year after impact at the study site and control site. We observed a significant increase in fish abundance at the corridor (impact) site and no significant change at the control site. Furthermore, fish were observed on the corridor during all three sampling series. This study tests the terrestrial concept of corridor functional connectivity of patches to facilitate animal movement and abundance. This small-scale study demonstrates that increasing corridor connectivity may be an effective method for enhancing habitats in marine as well as terrestrial ecosystems.

Introduction

Landscape connectivity of terrestrial systems and the effect of increasing and decreasing connectivity have been well studied over the decades (Fahrig and Merriam 1985; Fahrig 2001; Fahrig 2002; Kindlmann and Burel 2008; Ayram *et al.* 2016). Within terrestrial ecosystems enhancing landscape connectivity has been shown to increase species abundance, biodiversity, and viability (Schooley and Branch 2011; Ayram *et al.* 2016). A popular mechanism for increasing habitat patch connectivity is the implementation of corridors (Beier and Noss 1998; Bennett 2003; Hilty 2012). Although there has been some debate on the success rate of corridors, some studies show that corridors help facilitate the movement of birds, insects, reptiles, and mammals, and have also been shown to increase plant richness (Beier and Noss 1998; Schooley and Branch 2011). In marine ecosystems, seascape connectivity has only more recently been studied. However, there have been few experimental studies that have investigated the effects of connectivity through manipulation of artificial reefs or corridor construction.

Within marine ecosystems, increasing seascape connectivity results in positive effects on marine reserve performance, accelerated recovery of community composition after disturbance, and increased facilitation of fish movement (Mumby and Hastings 2008; McCook *et al.* 2009; Olds *et al.* 2012; Engelhard *et al.* 2017). These studies, however, did not manipulate connectivity through artificial reef construction. There are few studies of the effects of patch connectivity on fish aggregation and abundance on those sites.

Within the mid-Atlantic Bight, benthic structure is predominantly provided by artificial reefs, which are frequently constructed, often in isolation. Isolated reefs exhibit slower settlement rates of spores and larvae (Svane and Petersen 2001; Connell and Slatyer 1977) and reduced fish settlement (Overholtzer-McLeod 2006; Turgeon *et al.* 2010) compared to artificial reefs constructed in closer proximity to other reef systems. As shown in Chapter 1, abundance of fish on Delmarva reefs was significantly associated with relative abundance of sea whip corals, and recently constructed artificial reefs exhibited lower relative coral and fish abundance compared to established artificial reefs (Chapter 1, Schweitzer and Stevens in review).

In this study we explore the terrestrial corridor model by increasing seascape connectivity between two sections of established artificial reefs. We use a Before-After-Control-Impact (BACI; Smith 2014) experimental design to statistically assess whether a mosaic stepping-stone style corridor connecting two established sections of an artificial reef increases fish abundance at that site compared to a control site.

Methods

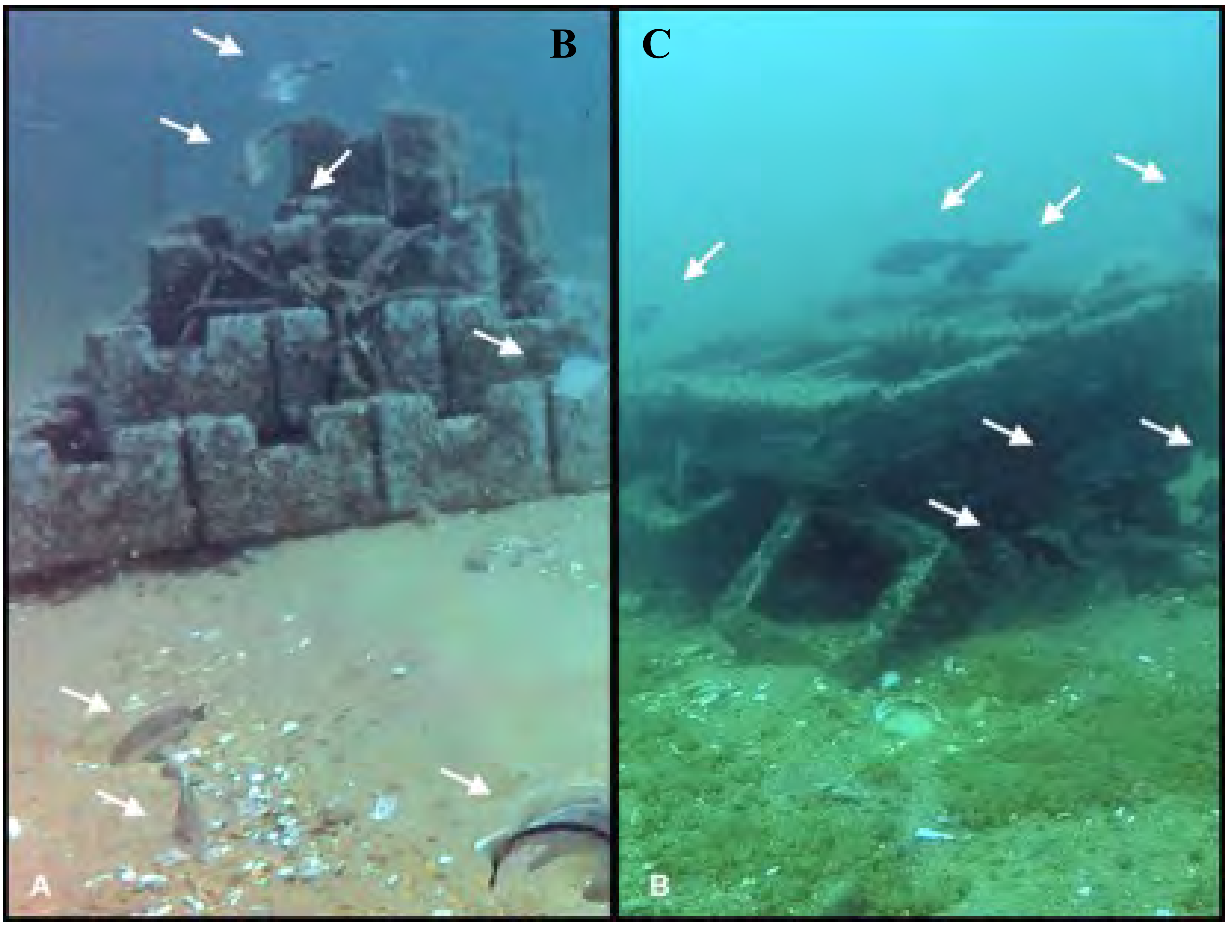
We used a simple two year before-after-control-impact (BACI) design to measure the change in fish abundance after increasing connectivity between an established artificial reef. Two artificial sites (PH and RG in Table 1.1) located ~ 14.5 km off the coast of Maryland, USA were selected based on SCUBA accessibility and spatial pattern. Both sites had broken into two distinct sections of established structure, separated by open sandy bottom. The control site (RG in Table 1.1) is designated as Site C, or CS for the two structured portions. It is a natural shipwreck that sank accidentally in 1991 and is still largely intact; its two sections are separated by ~24 m and lie at a depth of 16.7 m. The impact site (Site PH in Table 1.1), designated as site I (or IS for the structured portions) was a wooden vessel sunk intentionally in 1980; its two sections are separated by ~120 m at a depth of 19.8 m. The open bottom areas between the structured sections at sites C and I were designated CO and IO, respectively. Sites C and I are separated by a distance of 1.3 km, and both sites are subject to recreational fishing pressure. Site C is primarily colonized with sea whip *Leptogorgia virgulata* and northern stone corals *Astrangia poculata*. In addition to sea whip and northern stone corals, Site I is colonized by the boring sponge *Cliona celata*, and various hydroid species (i.e. *Tubularia* sp., *Obelia* sp., *Campanularia* sp; see Chapter 1 for detailed descriptions of the sites and biogenic structure).

At the impact site, a mosaic stepping-stone style corridor was constructed on the open bottom between the two structured sections. The corridor was constructed with concrete oyster castles stacked to form pyramid-like structures of various heights (See Appendix Photos K, L). Three size categories of pyramids were placed: large = 4 tiers; medium = 3 tiers; small = 2 tiers (Table 2.1). A total of 29 pyramids were deployed via a utility vessel December 21, 2016 (Fig. 2.1), spaced at intervals of ca. 6 m. Construction occurred during winter because most fish had undergone a seasonal migration to deeper offshore waters at that time. Site C did not receive any pyramids or other modifications.

Table 2.1. Specifications of the pyramids that comprise the stepping stone corridor. Tier refers to the layers of oyster castle blocks in each pyramid. *n* Blocks are the number of blocks used to build each pyramid size. *n* pyramids are the number of pyramids of each tier size.

Tier	n Blocks	n Pyramids
2	5	15
3	14	14
4	30	4

Figure 2.1. Pyramids made of oyster-castle blocks that were used to create the corridor. A) Image of 3-tier and 4-tier pyramids. B) A 4-tier pyramid with white arrows highlighting fish. C) A 3-tier pyramid that landed upside down.



To estimate fish abundance at the research sites, two GoPro® cameras were fastened on non-baited aluminum tripods and set facing outward at 90º angles (See Appendix Photos A, B, I). Cameras were set to record at a rate of 60 frames s^{-1} and at a resolution of 1080 x 720 pixels, with an approximate field of view of 90º. Tripods were placed by divers approximately 1 m from each structure (CS or IS) in areas where fish were observed. Tripods were also placed in the stretch of open bottom between the separated sections of both the study sites (CO and IO), at a distance of ~10.5 m and ~18 m away from the structure for Sites C and I, respectively. Cameras were left to record for 45 to 50 min in order to obtain at least 30 min of video that was void of diver interruptions. Tripods were then retrieved and placed on the second structured section of the wreck. Both sections of a site were recorded within a single sampling day. Video surveys were conducted approximately six months before (B) augmentation (2016), and 6–8 months after (A) augmentation (2017). Video surveys were conducted during three time periods in each year: early summer, mid-summer, and fall. Weather in the mid-Atlantic Bight is highly variable, unpredictable, and causes frequent turbid conditions, which can impede scuba accessibility and video surveys due to poor visibility. Bottom visibility < 1.5 m was deemed too poor for video surveys. Due to weather restrictions, our sampling series occurred during 2-week windows with a minimum of 4 weeks between each survey (Table 2.2).

Table 2.2. Dates of video surveys at the research sites before and after corridor implementation.

	Before			**After**		
Site	Series 1	Series 2	Series 3	Series 1	Series 2	Series 3
Control	06/15/16	9/09/16	10/30/16	7/19/17	9/16/17	11/12/17
Impact	06/16/16	9/18/16	10/19/16	7/11/17	9/04/17	11/12/17

Video and data analysis were conducted using Final Cut Pro X© 10.4 (Apple Inc., Cupertino, California USA) and GraphPad Prism Software 7.0c (GraphPad Software Inc., La Jolla California USA). Videos were trimmed to 31 min and edited with color corrections to enhance the clarity of the video. Fish abundance was estimated using a modification of the MeanCount method described in Bacheler and Shertzer (2014). Fish were counted at 30 s intervals for the duration of the 30 min video, for a total of 60 counts per video. Due to the frequency of low visibility conditions, counting fish in still frames was unreliable, therefore short clips of ~1.6 s length were viewed that included of 0.8 s before and after the frame selected for analysis. Fish movement within that interval permitted a more precise count. The total number of fish observed during the clip was recorded for the count. Furthermore, low visibility conditions substantially impaired species identification, such that only fish relatively close to the camera could be identified. Therefore, fish abundance was counted in aggregate, and not separated by species. Values of fish abundance are expressed as mean fish-per-frame (fpf) ± standard error (SE)

We used a BACI design to analyze the video count data, in which surveys were designated as belonging to Before (2016) or After (2017) groups at each of the sections of the control and impact site. Linear mixed effects modeling (LME) was used to determine the effects of various factors. Multiple models were tested that included different factors: Time (i.e. Before vs. After), Site (C vs I), Sub-sites (CS, CO, IS, IO), and the interaction between Time and Site. Since multiple cameras were used to determine fish counts, videos analyzed during a sampling series were treated as pseudo-replicates. In all models, the two cameras on each tripod were treated as random effects. A null model containing only the intercept was also tested. The Akaike Information Criterion (AIC) was used to select the best fit model. The Δ_i values were used to rank the different models (m_i) against the null model. Additionally, a multiple-comparisons 2-way ANOVA was conducted to look at annual changes of fish abundance between sites. We corrected for multiple comparisons with the Bonferroni correction and report the adjusted p values. The BACI interaction effect estimate (differential change) was calculated using the equation: $\widehat{BACI} = \mu_{CA} - \mu_{CB} - (\mu_{IA} - \mu_{IB})$.

Results

Despite our best efforts, some of the pyramids landed upside down, and others fell apart during winter storms. To estimate fish abundance on the research sites, six recordings were attempted with a goal of 360 frame counts for each site per sampling series: four recordings of the artificial reef sections and two recordings of the open bottom separating the sections. However, due to poor weather conditions, poor visibility, and strong currents knocking over tripods, the goal of 360 frame counts was met only once (Table 2.3). Fish were observed on pyramids at Site I during all three series, and schools of fish were observed swimming between pyramids (Fig. 2.1).

Table 2.3. Mean of fish counts during three sampling series in two years for the Control and Impact sites. Control (CS) = established structure at the control site; Control (CO) = open sand between the two structures at the control site; Impact (IS) = established structure at the impact site; Impact (IO) = open sand between the structure (Before) and site of corridor construction (After). All values displayed as mean fish-per-frame (fpf) from all survey videos, plus/minus standard error ($\bar{x}$ ± SE).

Time	Site	Section	Code	Series 1	Series 2	Series 3	Annual
Before	Control	Structured	CS	7.17 ± 0.24	1.23 ± 0.10	7.06 ± 0.29	5.15 ± 0.19
		Open	CO	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	Impact	Structured	IS	8.53 ± 0.27	11.75 ± 0.39	3.55 ± 0.30	8.23 ± 0.24
		Open	IO	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
After	Control	Structured	CS	7.68 ± 0.29	1.07 ± 0.13	5.82 ± 0.56	5.61 ± 0.27
		Open	CO	0.02 ± 0.02	0.00 ± 0.00	0.00 ± 0.00	0.01 ± 0.01
	Impact	Structured	IS	6.23 ± 0.28	13.93 ± 0.71	5.24 ± 0.25	8.14 ± 0.30
		Open	IO	6.55 ± 0.28	4.78 ± 0.16	8.50 ± 0.27	6.35 ± 0.34

Fish abundance at site C was higher on the structured portions (mean >5.0 fpf) than on the open bottom (CO; mean 0.0 fpf), but differed little between years (t test; p = 0.82; Fig. 2.2). Only one fish was observed on the open sand in 2017. Abundance varied seasonally, with abundance during survey series 2 being lower than either series 1 or 3, and this pattern was similar in both years (F = 6.4; p = 0.12).

Fish abundance at site I in 2016 was also higher on the structured portions (mean ~ 8.2 fpf) than on the open bottom (mean 0.0 fpf, Fig. 2.3). However, in 2017, after corridor construction, mean abundance on the structured portions was similar to 2016, but the mean on open bottom increased significantly to ~6.4 fpf (t test, p = 0.001). Abundance at site I also varied seasonally, but in the opposite direction from site C, with abundance during survey series 2 being significantly greater (p < 0.001), than either series 1 or 3, which did not differ (p = 0.29), and this pattern was similar in both years (F = 6.4; p = 0.12).

When averaged across all series, fish abundance increased only at the impacted, open bottom portion of site I, and there were no changes at the structured portions of either site, or at the non-impacted open-bottom portion of site C (Fig. 2.4). The BACI interaction effect estimate was: $\widehat{BACI}$ = 2.98 ± 0.27 (Fig. 2.4). The best mixed effects model was model m_5, which included Time, Series, Subsites, and Time x Site interactions (Table 2.4). Therefore we concluded that the increase in observed fish abundance was due to the corridor implementation.

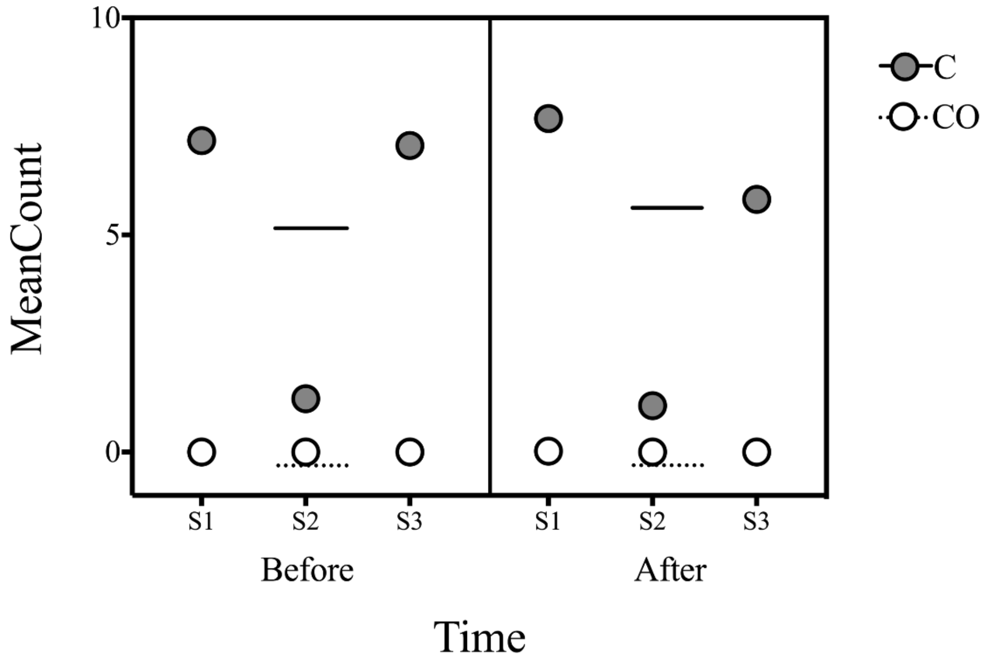


Figure 2.2. Fish abundance at the Control site. C = established structure; CO = open sand between the control sections. Horizontal bars are the annual means of fish counts before and after the corridor construction (Table 2.3).

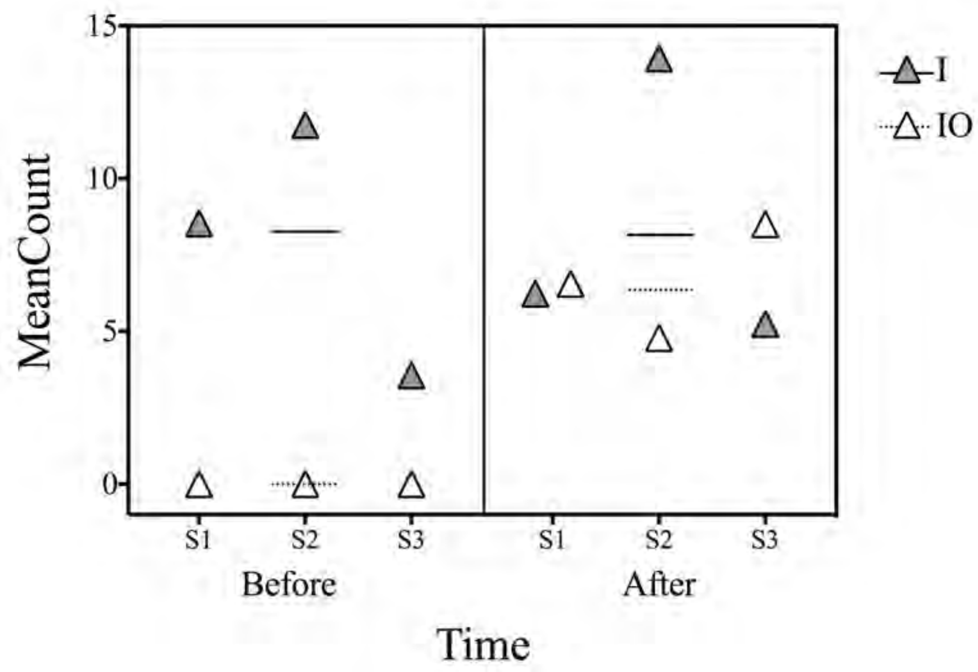


Figure 2.3. Fish abundance at the Impact site. I = established structure; IO = open sand before impact; corridor after placement. Horizontal bars are the annual means of fish counts before and after the corridor construction (Table 2.3).

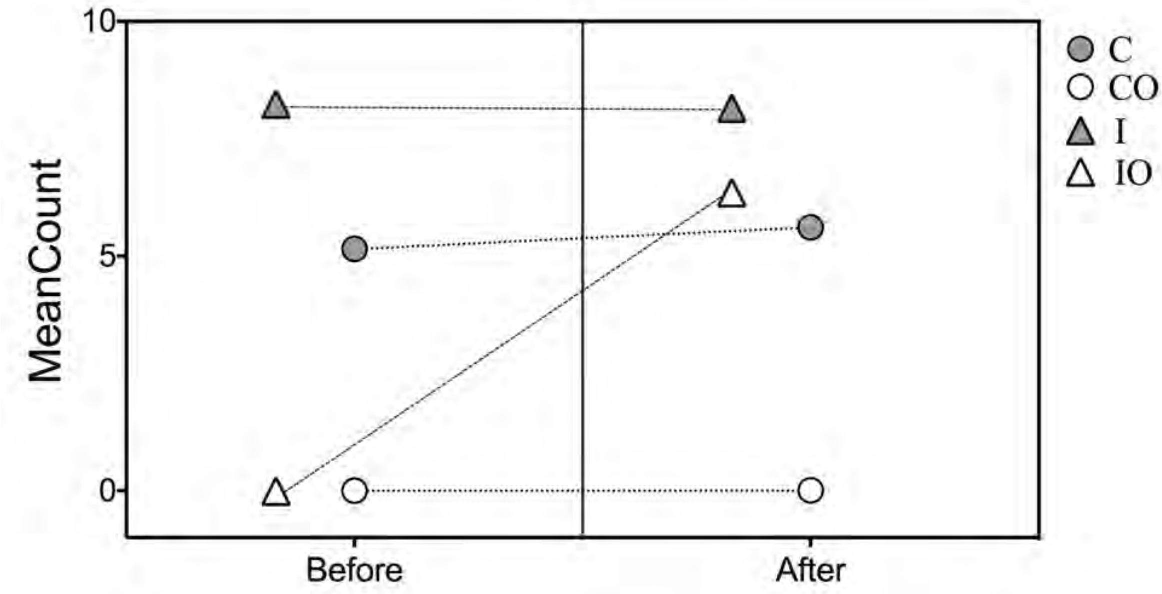


Figure 2.4. Annual mean fish abundance observed at structured and open portions of each site. C = established structure at the Control site; CO = open sand between the structure sections; I = established structure at the Impact site; IO = the modified section of the Impact site.

Table 2.4. Comparisons of mixed effects models m_0 – m_5, where m_0 is the null model; all models included cameras as a random effect. Time = before (2016) vs after (2017) corridor construction; Series = three sampling series of early summer, mid-summer, and fall; Site = control vs impact sites as two categories (including structured/unstructured subsites); TxS = interaction of Site (control/impact) and Time (before/after); Subsites = control and impact site separated into established structure and open space; TxSS = interaction of Time and Subsites; df = degrees of freedom; Loglik = log likelihood; AIC = Akaike information criterion value; Δ_i = increase in AIC value from the selected model (bolded); w_i = model probability. Model m_5 was selected as the best fit model.

Model	Variables	df	Loglik	AIC	Δ_i	w_i
m_5	**Time, TxS, Series, Subsites**	**12**	**-6966.43**	**13957.0**	**—**	**0.992**
m_4	Time, TxS, Subsites	10	-6973.24	13966.6	9.58	0.008
m_3	Time, Site, Series, TxS	8	-7156.83	14329.7	372.72	0.000
m_2	Time, Site, TxSS	6	-7193.89	14399.8	442.83	0.000
m_1	Time	4	-7258.38	14524.8	567.79	0.000
m_0	Intercept only	3	-7287.24	14580.5	623.50	0.000

Discussion

This study tested a common terrestrial method to increase seascape connectivity in an attempt to increase fish abundance on an artificial reef off the coast of Ocean City, Maryland. Connectivity was increased by constructing a stepping stone style corridor connecting two established patches of an artificial reef. This experimental design was based on the Before-After-Control-Impact (BACI) designs (Smith 2014).

Our results showed that fish abundance increased significantly on the corridor within a few months of construction, but did not change at the unmodified portions of either site. After corridor implementation, the impact site showed a significant increase in fish abundance not only from the previous year, but also when compared to the control site. Fish abundance recorded on the established sections did not change significantly between years at either site indicating that the observed increase in fish abundance was a result of the corridor implementation. We also observed a significant change in abundance between sampling series at both sites, which occurred both before and after the corridor. Interestingly, the seasonal variation at each site was identical between years, but exhibited opposite patterns between sites, and persisted after corridor construction. During both 2016 and 2017, the control site showed a reduced abundance during Series 2 before increasing to numbers similar to what was observed during Series 1. At the impact site during both 2016 and 2017, fish abundance increased in Series 2 and then decreased in Series 3. However, after corridor implementation the reduction in fish abundance during Series 3 was not as pronounced.

These results demonstrate that corridor connectivity can be an effective method to increase fish abundance on isolated habitat patches. Our observations support previous research that investigated relationships in seascape connectivity. Turgeon *et al.* (2010) showed evidence that open sand acted as a barrier for structure-oriented fish, significantly reducing attempts to cross large gaps of open sand. Our observations before the corridor implementation support those findings. No fish were observed swimming on open sand during the video surveys in 2016 (before), and only a single fish was observed on open sand at the control site in 2017 (after). When the distance of open sand was reduced at the impact site, fish were seen not only on the pyramids, but swimming between them.

This study was a simple, small-scale, one-year before/after study with one control and one impact site, and therefore has limitations. Since this study was focused on testing corridors in a marine environment, study site specifications were highly specific: easily accessible to scuba, separated into two sections, and established (i.e. >10% of the structure colonized by biogenic structure). This limited the number of sites available, resulting in a single impact and single control. A second control site would have given more insight into the seasonal fluctuations at the study sites and annual abundance. Another limitation is monitoring for only 1 year after modification, which was not the original plan. In addition to frequent poor visibility in 2018, which severely impeded consistent data collection, hurricanes and bomb cyclones destroyed much of the pyramid corridor. In addition, dive time was limited by the need to complete other study requirements for estimating fish abundance and fouling community structure at other sites.

Our first year observations, however, indicate that increasing connectivity via stepping stone corridor may increase fish abundance more effectively than building artificial reefs in isolation. Fish abundance was 1.57 ± 0.84 fpf at an artificial reef constructed 6 mo prior to the video survey (Table 1.4, site NH), whereas fish were observed on all the surveyed pyramids during all three series despite being void of biogenic structure. Additional surveys at the impact site and the incorporation of additional sites are needed.

Our experience with corridor construction lead us to recommended that corridors be constructed using more durable materials, and a structure designed to withstand severe weather events. Stacked concrete oyster castles did not stay in place during storms, and became scattered and partially buried. We have also observed that concrete pipes (Site MM in Table 1) also became buried over time, leaving little of the structure exposed. Structures should include a wide enough base to prevent rapid burial, and should include a variety of spaces that are scaled appropriately for body sizes of both juvenile and adult fish.

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Chapter 3. Trophic Ecology of Black Sea Bass Elucidated Using Gut Contents and Stable Isotopes: Comparisons between Natural and Artificial Reefs, and Offshore Surveys in the Mid-Atlantic Bight

Andre Price and Bradley G. Stevens

Abstract

Diets of Black Sea Bass (BSB, *Centropristis striata*) have been studied in the Mid-Atlantic Bight, but no studies have compared differences in dietary composition of BSB between natural and artificial reefs. We sampled 407 BSB at selected natural and artificial reefs near Ocean City, MD in 2016 and 2018, using hook-and-line angling to determine if reef type influenced length and age relationships, sex ratios, diets, and stable isotope ratios of $\partial^{12}C/\partial^{13}C$ and $\partial^{14}N/\partial^{15}N$ from three tissue types: liver, muscle, and mucus. BSB caught in 2016 and 2018 were compared to a NOAA dataset (n=1304) of trawl-caught BSB spanning 2000-2016 in proximity to the reef sites where angling occurred. There were no significant differences in age composition between fish at natural and artificial habitats, indicating that the sorting of age by location type did not occur. Stomach content analyses indicate that crustaceans (primarily *Cancer* crabs) dominated diets of BSB at artificial and natural sites by proportion and by frequency of occurrence; crabs were also the dominant dietary item in the NOAA samples. However, this may be overestimated due to the long gut residence time of crustacean tissues. ANOVA determined that location type had a significant effect on stable isotope values in all tissues except for $\partial^{15}N$ in mucus. This study showed that natural and artificial reefs are ecologically similar for Black Sea Bass caught near Ocean City, MD, however, subtle differences in diet between reef types suggest that their physical form may affect access of fish to different prey items.

Introduction

An important requirement of Ecosystem Based Fisheries Management is to determine the trophic relationships between fish, their prey, and their predators. Consequently, studies of fish diets are of primary importance in understanding their ecological relationships. Many such studies catch fish over wide temporal or spatial ranges and attempt to make large-scale conclusions, but diets may vary over temporal and spatial scales that are much smaller than the scales at which most sampling occurs.

NOAA conducts annual spring and fall bottom trawl surveys on the Northeast Atlantic Shelf. A small number of black sea bass (BSB) are caught during these surveys, and gut contents of those BSB have been analyzed over the scale of the surveys (Bowman et al. 2000). Byron and Link (2010) showed that BSB sustained ontogenetic shifts in diet from mostly polychaetes and arthropods to fish, particularly between sizes of 9 and 14 cm total length. Other studies have analyzed differences in diet between fish caught at widely varying locations, from New York to North Carolina (La Rosa, 2018). However, few studies have exclusively focused on determining differences in food choices between specific locations or habitats in the Mid-Atlantic Bight.

Traditional studies of fish diets have used stomach content analysis, which offers only a "snapshot" of what the animal has consumed in the past few hours to days (Hurst and Conover 2001; Araújo et al. 2007), but is insufficient to make long term inferences about dietary activity (Hurst and Conover 2001; Araújo et al. 2007). In contrast, stable isotopes can be used as "time capsules," to infer what the animal has eaten over time, with the ability to reflect changes in ecological and dietary patterns in different tissues over varying temporal scales (West et al. 2006; Buchheister and Latour 2011). However, stable isotope analyses should be paired with stomach analysis, and multi-tissue sampling for validation purposes and to avoid misrepresentation of stable isotope readings (Post 2002). Furthermore, the time required for isotopic turnover in different tissues is associated with growth, tissue type, and other metabolic processes (Herzka 2005; Carleton et al. 2008; Buchheister and Latour 2011).

Stable isotope analyses of $\partial^{13}C$ and $\partial^{15}N$ have been utilized in a variety of organisms with different tissue fractions in order to infer trophic position and how ∂ values are affected by diet (Becker et al. 2007; Bauchinger and McWilliams 2009). Within fish species, stable isotopes have traditionally been examined from muscle and liver tissues, which have turnover rates of months or weeks, respectively. Church et al. (2009) indicated the utility of using external mucus to determine short-term (30-36 days) turnover in $\partial\ ^{13}C$ and $\partial\ ^{15}N$ in juvenile Steelhead Trout *Oncorhynchus mykiss,* and Maruyama et al. (2017) indicated a much longer turnover (200 days) in the mucus of 5-year old Amur catfish (*Silurus asotus*). Winter et al. (2019) suggested that epidermal mucus collected from live Common Carp (*Cyprinus carpio*) can replace the use of dorsal muscle for isotope readings, but cautioned that differences in tissue turnover rates are dependent on diet. Sampling of epidermal mucus can be used as a non-lethal method to obtain stable isotope samples, but few studies have verified its reliability in wild fish, and none have tested this method in BSB.

Stable Isotopes: ^{13}C, ^{15}N, and delta (∂) notation

Isotopes are variants of a particular element that differ by the number of neutrons in that element's nucleus; stable isotopes are the non-radioactive isotopes of an element (Fry 2006). Isotopes can be defined as "light", or "heavy", based on the sum of the protons and neutrons in the isotope's nucleus. For example, ^{13}C is heavier than ^{12}C. For most elements, the lighter isotope is naturally more abundant than the heavier isotope (Fry 2006; West et al. 2006). The difference in the ratio of heavy to light isotopes is commonly expressed in ∂ notation, which can be expressed in the following equation (cited in Hayes 2004), originally introduced by McKinney et al. (1950), where ∂ is the abundance of isotope A of element X in a sample relative to the abundance of that same isotope in a standard (Hayes 2004):

$$\partial^{A}X_{STD}=({}^{A}R_{Sample}/{}^{A}R_{STD})-1$$

Carbon and nitrogen are among the most abundant elements in living organisms, and are used in many ecological studies to infer environmental and trophic data, respectively (West et al. 2006). Differences in isotopic abundance are important because the accumulation of $\partial^{15}N$ is strongly related to trophic level. Additionally, $\partial^{13}C$ signatures can provide additional information about whether dietary items originate from benthic or pelagic sources (Post 2002; Carabel et al. 2006; Fry 2006; Glibert et al. 2018). Generally, higher ∂ values in $^{13}C/^{12}C$ and $^{15}N/^{14}N$ ratios represent higher tropic levels. The accumulation and excretion of these isotopes due to feeding, growth, and metabolic processes can provide us with "ecological timelines" that allow inference of dietary activity that surpasses the capability of inferences solely made by stomach content analysis (MacNeil et al. 2006; Heady and Moore 2013).

The goal of this study was to obtain a greater understanding of the trophic relationships between BSB and their prey items, and differences in feeding behavior between fish occupying natural and artificial reefs in the Mid-Atlantic Bight. This was done by the examination of gut contents, and isotope signatures in BSB tissues. Specific objectives were to:

1. Determine the primary prey items for BSB near Ocean City, MD.
2. Determine if differences in length, age distribution, or diet exist between BSB caught at artificial and natural reef sites; and
3. Estimate ontogenetic shifts in feeding dynamics of BSB near Ocean City, MD using gut contents and stable isotope analyses of $\delta\,^{13}C$ and $\delta\,^{15}N$ in liver and muscle tissue

Methods and Materials

Sample Collection of BSB and Prey

Black sea bass were collected using hook and line angling from natural and artificial reef sites from spring through fall of 2016, and from spring through summer of 2018. (We also sampled >400 fish in 2017, but those were all lost when electric power loss at our laboratory caused a freezer to thaw). All angling occurred during daylight hours, and squid was used as bait. Sampling sites consisted of a mix of natural bottoms (mostly cobble and shell with a few gorgonian corals) and artificial reefs (mostly shipwrecks and metal structures, Table 3.1). Some of these sites overlapped with those sampled for fish and invertebrate community structure in Chapters 1 and 2. In 2016 we sampled at sites 1 through 6, but due to low catches, in 2018, we sampled different sites that produced a higher CPUE and were more clearly defined by unique substrates (sites 7-12). All sites were classified as either natural or artificial based on the substrate type. Additional data on stomach analysis of BSB for comparison to fish caught in this study were obtained from the NOAA NEFSC seasonal bottom trawl surveys. Comparisons to the angling dataset were made with a subset of NOAA's data that only included BSB obtained in the Spring and Summer months, from 2000 through 2016, and were caught between 36 and 40 ºN degrees latitude. On 10 August 2018, beam trawl tows were conducted near sites 8 and 10 to obtain samples of prey items for isotopic baselines. The trawl used consisted of a net with 2.0 cm (0.75-inch) mesh hung on a 1.0 m wide frame. The net was towed at an average speed between 2.5 and 3.0 knots.

Fish and Stomach Analysis

Stomach contents and stable isotope analyses were conducted on each fish caught by angling. Upon retrieval, fish were immediately placed in individual plastic freezer bags to prevent mucus contamination, and dispatched by placement in super-cooled ice, which slowed digestive processes. Preservation by freezing was chosen because it has a minimal effect on isotope values in contrast to other methods (Bosley and Wainright 1999; Kaehler and Pakhomov 2001). Carcasses remained in plastic bags and were frozen at -80 ºC for mucus removal later. In the laboratory, total length (TL) of fish was measured to the nearest cm, and fish were weighed to the nearest 1.0 g, macroscopically sexed, and dissected to remove stomachs, muscle, and liver samples (See Appendix Photos M, N). Fish that were not clearly identifiable as male (M) or female (F) after dissection were considered to be in transitional, but some were classified as unknown (U). All stomachs were initially placed in 10% formaldehyde for a minimum of 2 weeks and transferred to 70% ethanol for preservation until further sorting of prey items. Liver and muscle samples were prepared for stable isotope analysis of $\partial^{13}C$ and $\partial^{15}N$. Livers were removed and white muscle tissue was excised from an area directly above the pectoral fin and immediately frozen at -80 °F. In 2018 a subsample of fish were selected to test mucus for stable isotope analysis of $\partial\,^{13}C$ and $\partial\,^{15}N$.

Table 3.1. Sites where Black Sea Bass were captured for this study, and number captured in 2016 (Fish16) and 2018 (Fish18). ND= no data. Site type is defined as artificial (A) or natural (N).

Site	Location	Lat	Long	Type	Fish16	Fish18	Description
1	Pharoby North	38.556666	-74.903611	A	25	ND	Scalloper boat, sunk 1980, section 1 of 2
2	Pharoby South	38.543888	-74.902222	A	45	ND	Scalloper boat, sunk 1980, section 2 of 2
3	Kathleen Riggins Main	38.543888	-74.985833	A	30	ND	Clammer boat; sank in 1991
4	Kathleen Riggins Debris	38.383055	-74892777	A	3	ND	Rubble field from shipwreck
5	Elizabeth Palmer	38.636944	-74.876388	A	1	ND	Wooden schooner wrecked in 1915
6	Unknown Wreck #2 (Palmer East)	38.599722	-75.154444	N	3	ND	Highly deteriorated wooden wreck of unknown origin
7	Natural Bottom Site 1	38.410833	-75.080277	N	ND	102	Mostly shell & cobble covering mud and sand bottom
8	Natural Bottom Site 2	38.447777	-74.969444	N	ND	108	Mostly shell & cobble atop mud and sand bottom
9	Jimmy Jackson	38.331111	-75.033888	A	ND	2	Concrete and metal structures; constructed circa 2011
10	Blenny	38.153333	-79.91666	A	ND	24	Submarine; scuttled 1989. Mussel and gorgonian coral growth on site
11	Cable cars	38.540555	-74.991944	A	ND	51	Staggered subway cars; mussel growth on substrate
12	Navy Barges	38.168333	-75.154444	A	ND	13	Sunken cargo barges

Prey items were removed, weighed to the nearest 0.01 g, and identified to the lowest possible taxonomic level. Stomach content data were analyzed using percent number (%N), percent weight (%W), percent frequency of occurrence (%FO), and prey specific index of relative importance (PSIRI), as expressed in Varela et al. (2017) and Brown et al. (2012) as:

%PSIRI= [%FO *(%PN + %PW)] / 2 where

$\%N_i$=number of prey item i*100/ total number of prey items

$\%W_i$ = weight of prey item i *100 / total weight of all prey items

$\%FO_i$ = number of stomachs with prey item i *100/ total number of non-empty stomachs

Preparation for stable isotope analysis

All samples for stable isotope analysis were prepared in accordance to UC Davis' ^{13}C and ^{15}N Analysis of Solids by EA-IRMS protocol[2]. Samples of muscle and liver tissue were dried for 48 h in an oven at 65 °C, homogenized with a mortar and pestle, enclosed in tin capsules, and stored in a desiccator until shipment. Mucus samples were treated in accordance to methods adapted from Church et al. (2009). Fish were removed from the freezer in their respective bags and thawed for 5 minutes, or until mucus appeared on the dermis of the fish. Mucus was gently scraped from the dorsal side of the fish and placed into a glass scintillation vial. The mucus received three consecutive 5 ml rinses of reverse osmosis (RO) water, shaken between each addition, after which the mucus-water filtrate was passed through a 5 μm polycarbonate filter. One final 5 ml rinse of RO water was passed through the filter, and the filtrate was decanted into a 50 ml plastic test tube. Subsequently, the filtrate was frozen for at least 24 h in a freezer at 0ºC, then cryodesiccated for 48 h in a lyophilizer, mixed by spatula, weighed, and enclosed in tin capsules. All samples were shipped to UC Davis' Stable Isotope Facility in Davis, CA, where they were analyzed with an elemental analyzer interfaced to a continuous flow isotope ratio mass spectrometer (IRMS).

Data analysis

Diet composition was expressed as a proportion of total contents, by frequency of occurrence (FO), and gravimetric weight. Weight, number and FO were used for the calculation of PSIRI. Chi-square tests of independence were used to determine if significant differences in fish diets existed between site types (artificial vs natural), size groups, or sex. PSIRI was used to compare prey composition between fish collected by this project and those collected by NOAA. The base code for plotting PSIRI was created by Simon Brown.

Diet data were also analyzed using non-metric multidimensional scaling (NMDS). This method uses rank order of prey weights to calculate positions of each prey item and groups of data within a multi-dimensional space. Weights of seven prey groups were included: Annelids, Worms (non-annelids), Arthropods, Molluscs, Fish, Animal Remains (AR), and Miscellaneous. Data were analyzed for differences between sexes (Male, Female, Transitional), and by capture locations. Cluster analysis was also used to analyze the data by location, using Euclidean distances calculated on a matrix that was centered (i.e. as residuals from the mean) and scaled (in standard deviation units).

[2] https://stableisotopefacility.ucdavis.edu/13cand15nsamplepreparation.html

Stable isotope data were compared using two-way analyses of variance (ANOVA) to determine whether significant differences existed by site type, fish size, or the interaction of site and size. The linear model tested by the ANOVA was:

$$D_T \sim L_i{*}S_i{+}\varepsilon$$

Where D is either $\partial^{15}N$ or $\partial^{13}C$, T is tissue type, L is location type, S is size, and ε is experimental error. Because multiple similar tests were conducted, a Bonferroni correction was applied to prevent error-rate inflation, and results were compared to a critical value of p=0.01. Scatterplots with ellipses were used to display overlap of $\partial^{15}N$ and $\partial^{13}C$ data, where ellipses represent the 95% confidence interval. Ellipses were created using the R function "stat_ellipse" with ggplot2 (R Core Development Team, 2011). Fish were categorized as "small", "medium", or "large", with ranges of 0-25 cm, 25-50 cm, and >50 cm TL, respectively. Differences in mean size between sexes were tested using a student's t-test, whereas differences in size distribution between site types were tested with at Komogorov-Smirnov non-parametric ANOVA (K-S test).

Results

A total of 407 fish were caught by angling for this study; 197 at artificial sites and 210 at natural sites (Table 3.1). In 2018, sampling locations were changed due to low CPUE with our sampling gear at many of the 2016 locations. There was considerable variation in sample size for most locations sampled, particularly in 2016 (Table 3.1). Sampling did occur in 2017, but the 400 fish sampled from that year were destroyed during an electrical outage and were excluded from this study.

Female BSB were caught more often than males in the samples obtained by angling as well as in the NOAA data (Fig. 3.1). Sex ratios were 235:165:6:1 (F:M:T:U) in our samples and 874:323:2:105 in the NOAA samples. Female fish were the most abundant sex across habitat types by proportion (Fig. 3.2), but males grew to a larger total length (Fig. 3.1). Mean size of male BSB caught in this study (27.2 cm TL) was greater than mean size of females (23.921 cm TL, t=6.83 ,p=4.82e-11). There were no significant differences in mean size of fish between artificial and natural sites (K-S test, p=0.49, D=0.82). Mean size of males in the NOAA data (26.7 cm TL) was also greater than mean size of females (23.7 cm TL) (t=5.8947, p=6.88e-09).

<u>Stomach Content Analysis</u>

Arthropods comprised the highest proportion of organic stomach contents at nearly 60% of total consumed biomass (Figure 3.3). The majority of arthropods in our data and in the NOAA data were composed of decapod crabs and hermit crabs. The majority of identifiable decapod crabs were rock crabs, *Cancer irroratus*. Over 50% of the 205 fish caught at natural sites had empty stomachs, while only 13% of 193 fish stomachs from artificial sites were empty. The top four prey items at both natural and artificial sites were arthropods, annelids, fish, and worms (Figure 3.4). A chi square test of independence showed no significant differences in prey consumption between artificial and natural sites for prey count by fish size (p=0.29), or sex (p=0.18) between site types. PSIRI values for top prey items consumed by BSB caught with our gear at artificial and natural sites, and between our data and NOAA, are shown in Table 3.2. Graphic analysis of diet PSIRI for Black sea bass collected in this study show that arthropods dominated the diets of BSB at artificial sites in percent number, weight, and FO (Fig. 3.5).

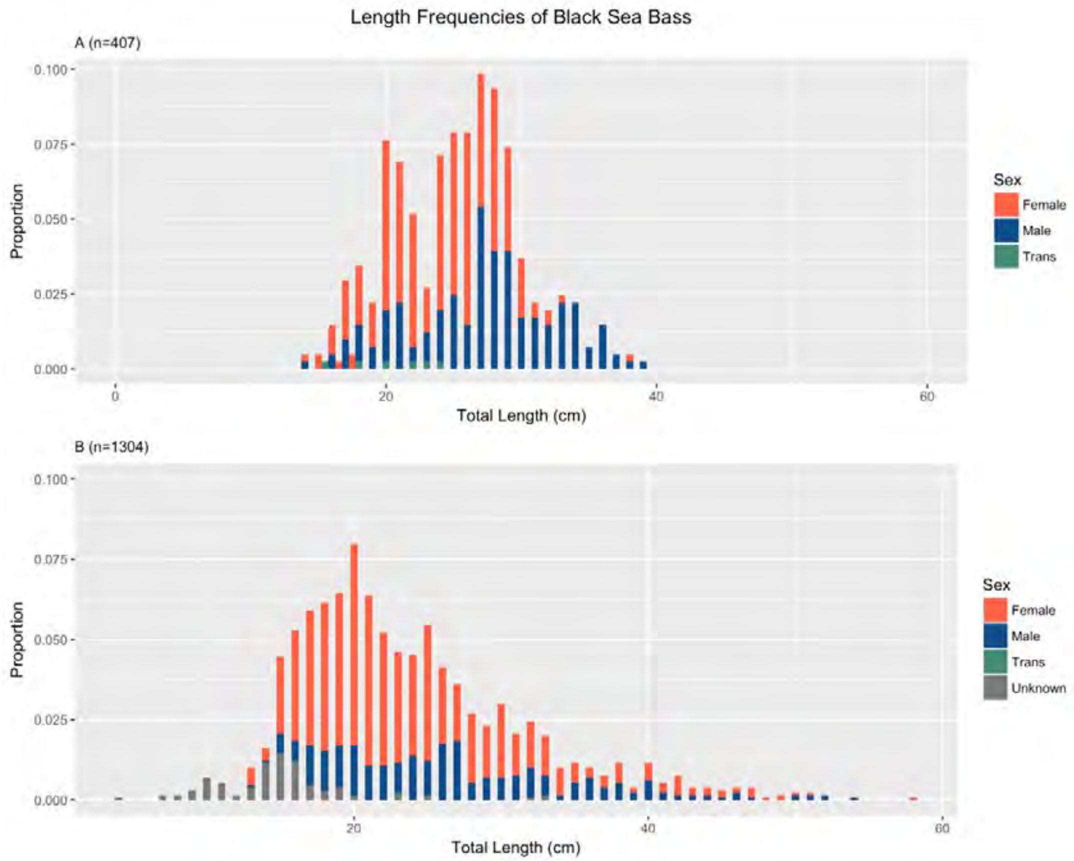

Figure 3.1. Length frequencies of Black sea bass. A, Fish sampled by hook and line in 2016 and 2018; B, Data from NOAA seasonal trawl surveys. Females were more abundant in both data sets, while mean size of males was greater than that of females.

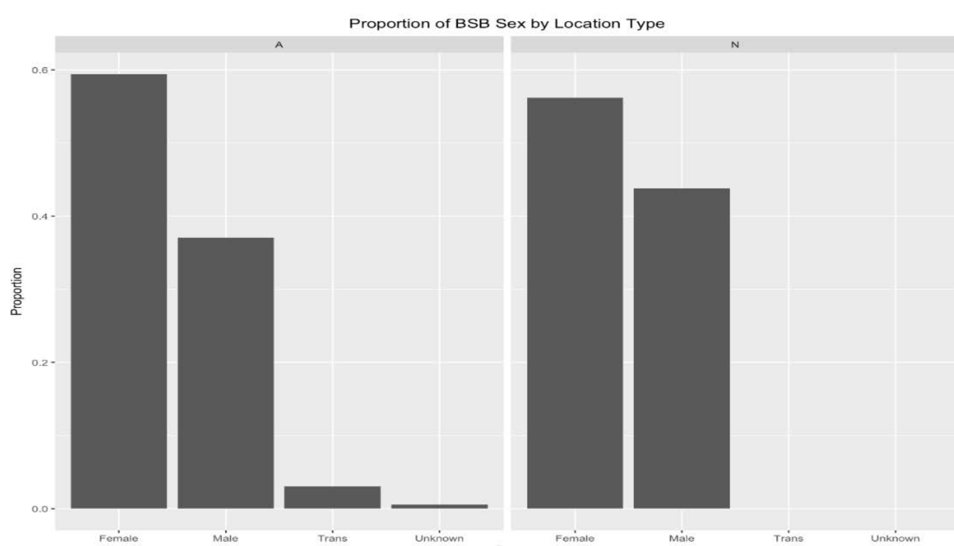

Figure 3.2. Proportions of Black sea bass of different sex caught by angling at artificial (left) and natural (right) sites in 2016 and 2018.

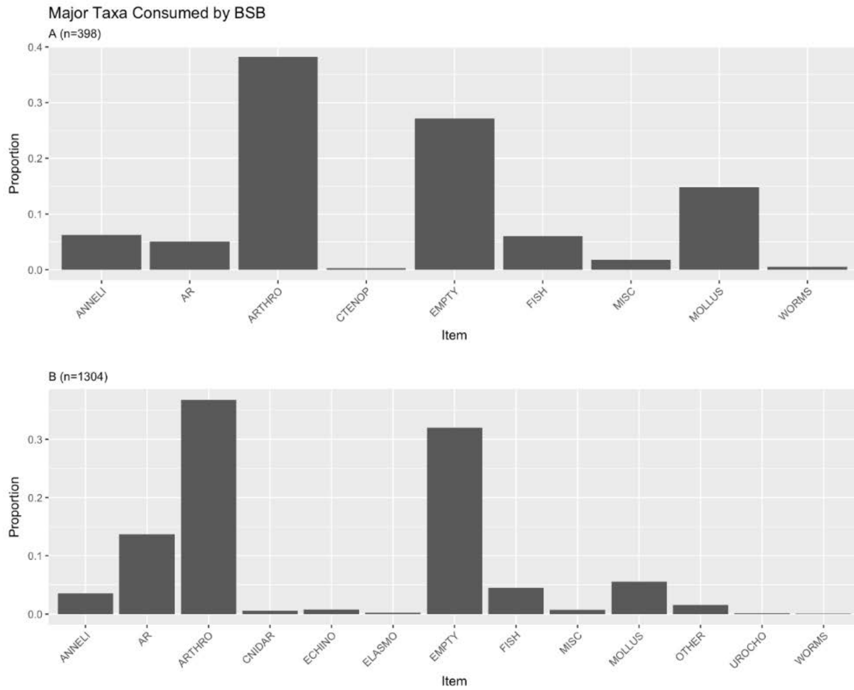

Figure 3.3. Proportion of major prey taxa consumed by Black sea bass. A) Fish caught by hook and line in 2016 and 2018; B) Fish captured during NOAA trawl surveys from 2000-2016.

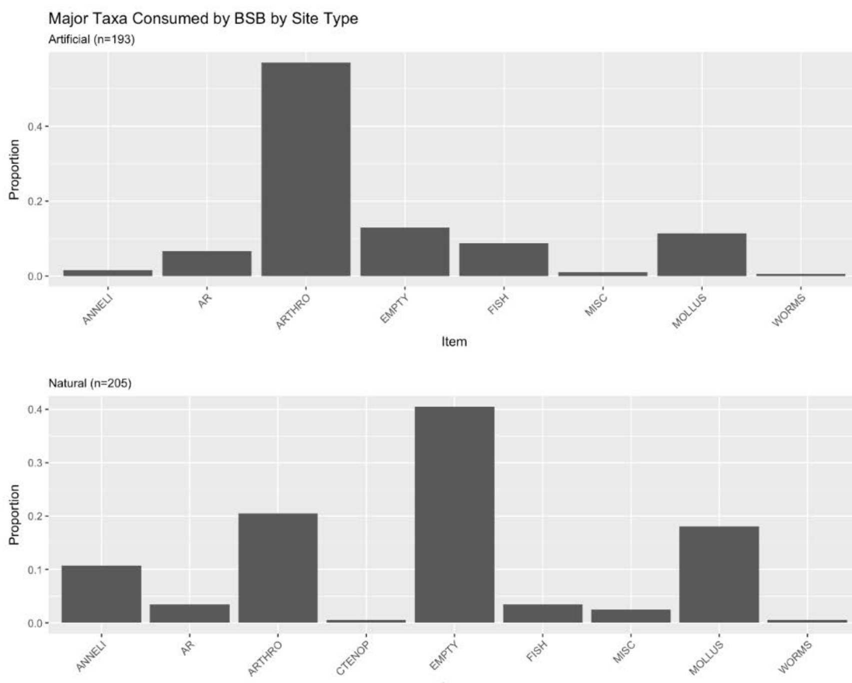

Figure 3.4. Proportion of major prey taxa consumed by Black sea bass caught by hook and line at artificial and natural sites in 2016 and 2018. The top four prey items (arthropods, fish, molluscs, annelids) were the same at natural and artificial sites, and empty stomachs occurred more frequently among fish at natural bottom sites.

Table 3.2. %PSIRI values for the top four prey items by habitat type (artificial or Natural) and source, i.e. caught with hook and line by UMES researchers (2016 and 2018), or from NOAA trawl surveys (1980-2016).

	Habitat type		Source	
Prey Item	Artificial	Natural	UMES	NOAA
Annelids	0.100	10.61	0.72	1.44
Arthropods	28.87	17.36	32.08	48.5
Fish	1.067	0.53	1.00	10.70
Molluscs	2.317	11.09	6.01	1.705

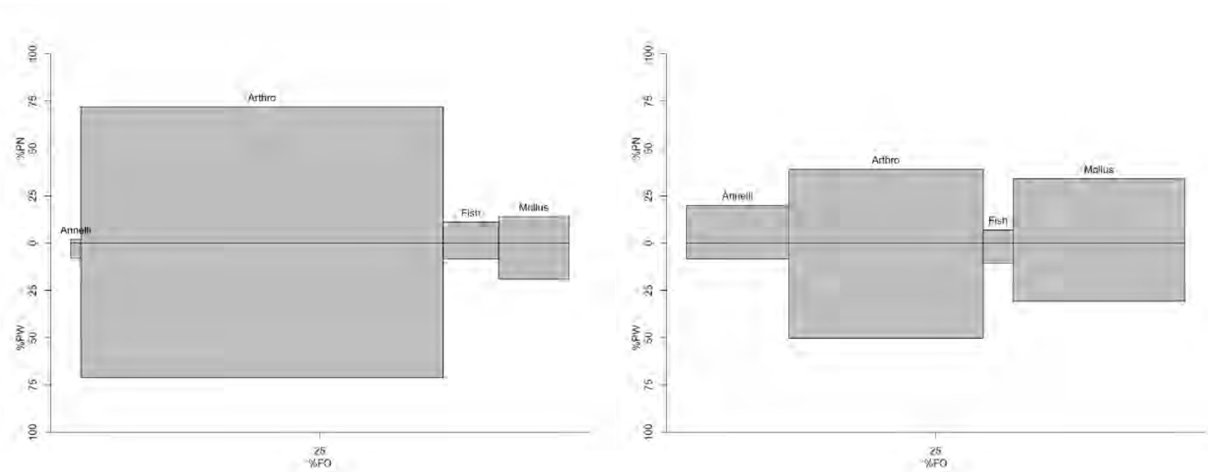

Figure 3.5. PSIRI for the main food items in diets of Black sea bass caught in 2016 and 2018 by angling at A) artificial sites and B) natural sites.

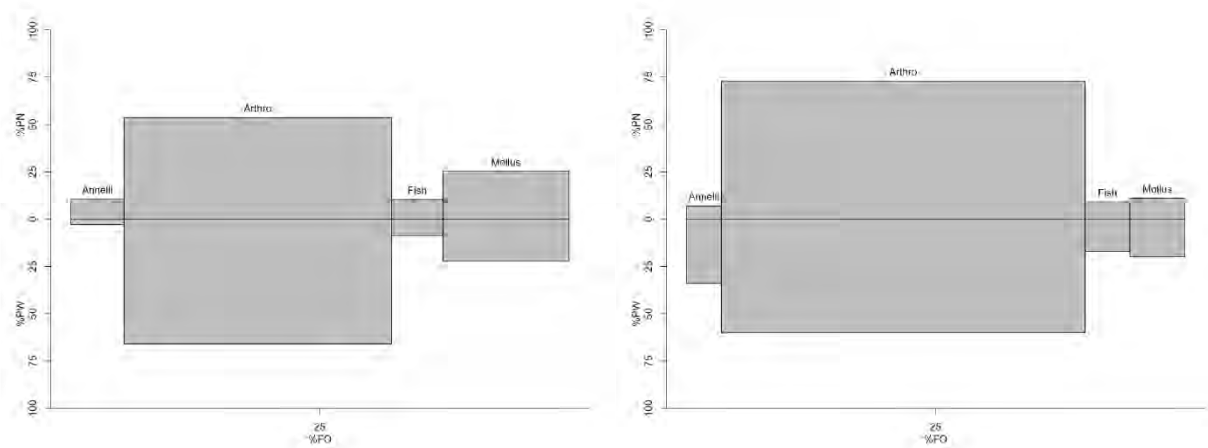

Figure 3.6: PSIRI for the main food items in diet of Black sea bass caught by: A) angling in 2016 and 2018 (our study), and B) during NOAA trawl surveys from 2000-2016.

At natural sites, arthropods were still the dominant prey item, but annelids had a higher FO and greater PSIRI compared to artificial sites. Graphic analysis of PSIRI for BSB collected in our study and by NOAA (Fig. 3.6) showed similar results. In the NOAA data, annelids composed a higher percent weight, but a lower FO than in BSB caught by angling.

Stable Isotope Analysis

There was considerable overlap in values for $\partial^{13}C$ and $\partial^{15}N$ of all tissue types between site types (artificial vs natural) and fish size (large vs small) (liver, muscle, and mucus are shown in Figures 3.7, 3.8, and 3.9, respectively). Although ellipses show a high degree of overlap and very little defined independence, ANOVA tests showed statistical differences ($p<0.05$) due to both site type and size (Table 3.3).

Table 3.3. Summary of comparisons between stable isotope ratios by tissue, site, and size group. Significant p-values for ANOVA tests are designated as: **=0.05; **=0.01; ***=0.001.

Test	$\partial^{15}N$	$\partial^{15}N$	$\partial^{15}N$	$\partial^{13}C$	$\partial^{13}C$	$\partial^{13}C$
Source	Liver	Muscle	Mucus	Liver	Muscle	Mucus
Site	4.38e-07***	7.249e-09***	0.0678 ns	<2e-16***	<2.2e-16***	0.6887e-6***
Size	0.0105*	0.9892 ns	0.0316 *	0.7445 ns	0.0004***	6.209e-05***
Interaction	0.8837 ns	0.7877 ns	0.8059 ns	0.9222 ns	0.0007***	0.5387ns

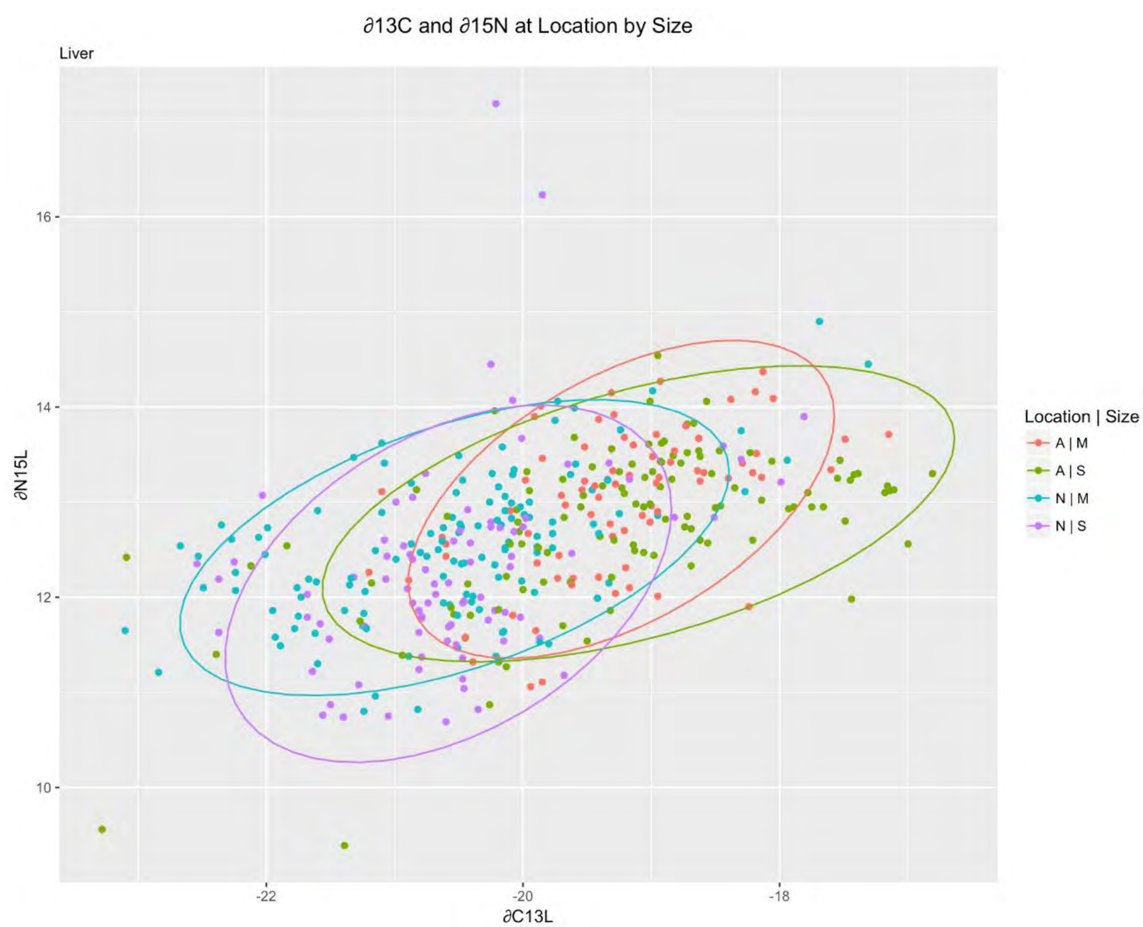

Figure 3.7. Stable isotope ratios for $\partial^{13}C$ and $\partial^{15}N$ in liver of Black sea bass, categorized by size (M=medium, S=small) and location (A=Artificial, N=Natural). Significant differences occurred in both isotopes between artificial and natural sites.

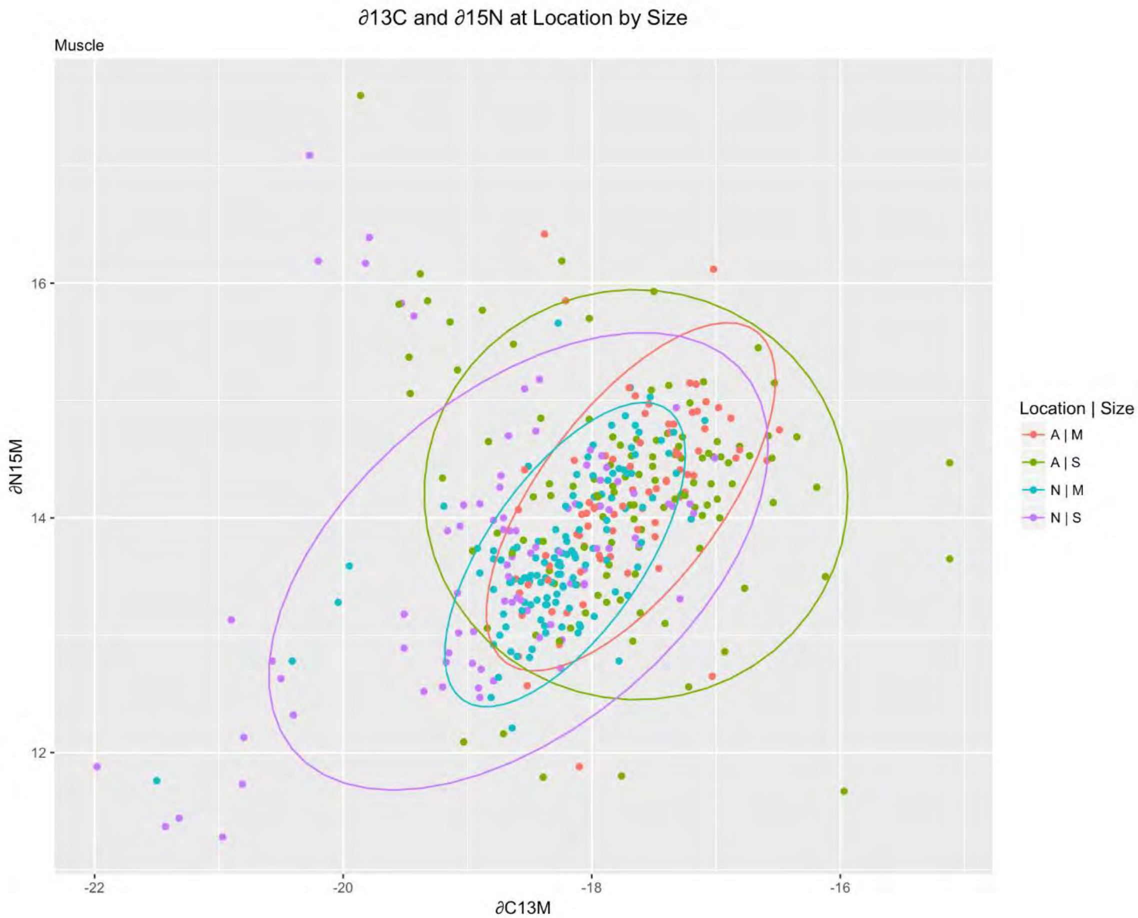

Figure 3.8. Stable isotope ratios for ∂^{13}C and ∂^{15}N in muscle of Black sea bass, categorized by size (M=medium, S=small) and location (A=Artificial, N=Natural). Significant differences occurred between size, location, and their interaction in ∂^{13}C, but only between location types in ∂^{15}N.

Significant differences in ∂^{13}C and ∂^{15}N were more commonly due to site, and less often to size (Table 3.3). Significant differences were found between location types for all tissues, and both isotopes, with the exception of ∂^{15}N in mucus (p=0.67). Mean values of ∂^{15}N were higher at artificial sites than at natural sites in both liver (12.86 vs 12.43, respectively) and muscle (14.20 vs 13.70), indicating that fish on artificial reefs were feeding at slightly higher trophic levels. Similarly, ∂^{13}C values were higher at artificial sites than at natural sites in liver (-19.24 vs -20.54, respectively) and muscle (-17.71 vs -18.48), indicating that fish on artificial reefs were consuming slightly more prey from littoral sources, vs benthic sources. These results demonstrate that our sample sizes were large enough to detect differences as small as 0.4 units of ∂^{15}N, or about 10% of a trophic level, though such small differences may not have great biological significance. Significant differences were found between size groups for ∂^{15}N in liver and mucus, and for ∂^{13}C in muscle (p=0.0004) and mucus (p=0.03). The interaction between site and size was significant only for ∂13C in muscle (p=0.0007).

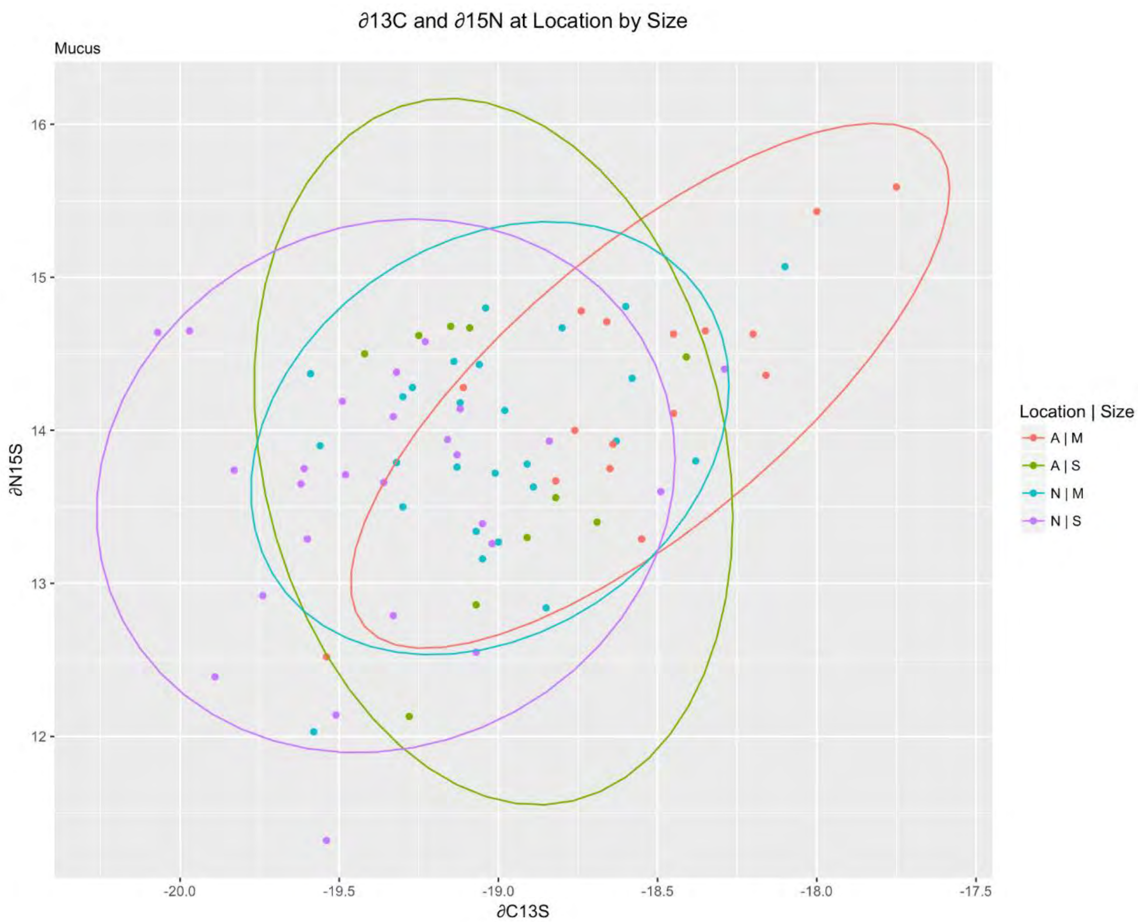

Figure 3.9. Stable isotope ratios for $\partial^{13}C$ and $\partial^{15}N$ in mucus, by size (M=medium, S=small) and location (A=Artificial, N=Natural). Significant differences occurred by location type and by size in $\partial^{13}C$ only.

Multivariate Analysis

NMDS analysis by sex shows that males and females are slightly separated along a diagonal axis and that transitional fish have a very restricted diet, but this may be an artifact of small sample size (Fig. 3.10). Analysis of diet by location shows that fish diets at the natural sites (NB_ONE and NB_TWO) were similar, as were sites PS & PN (the South and North sections of the Pharoby shipwreck), but the two sections of site KR (KR and KRM) were widely separated (Fig. 3.10). The dendrogram produced by cluster analysis of the locations showed that site CARS forms a unique group, sites KRM and NB_TWO form a second group, and the remaining sites form a third group (Fig. 3.11). It also shows sites AV and JJ as being closest together, which doesn't occur in the NMDS plot. Both analyses show that PN and PS are highly similar; that JJ and BLEN are similar but far to the right end of the scale, that KRM is at the opposite end of the scale, and that KR and KRM are much more different than would be expected. However, it is surprising that the cluster analysis showed large distances between sites NB_ONE and NB_TWO. The differences between these two methods are due to the fact that NMDS uses ranks, so is "non-metric" as well as multi-dimensional, whereas cluster analysis uses Euclidean distances along one dimension between each pair of samples. Both are different ways of looking at a complex data set in a reduced set of dimensions, and both provide useful information.

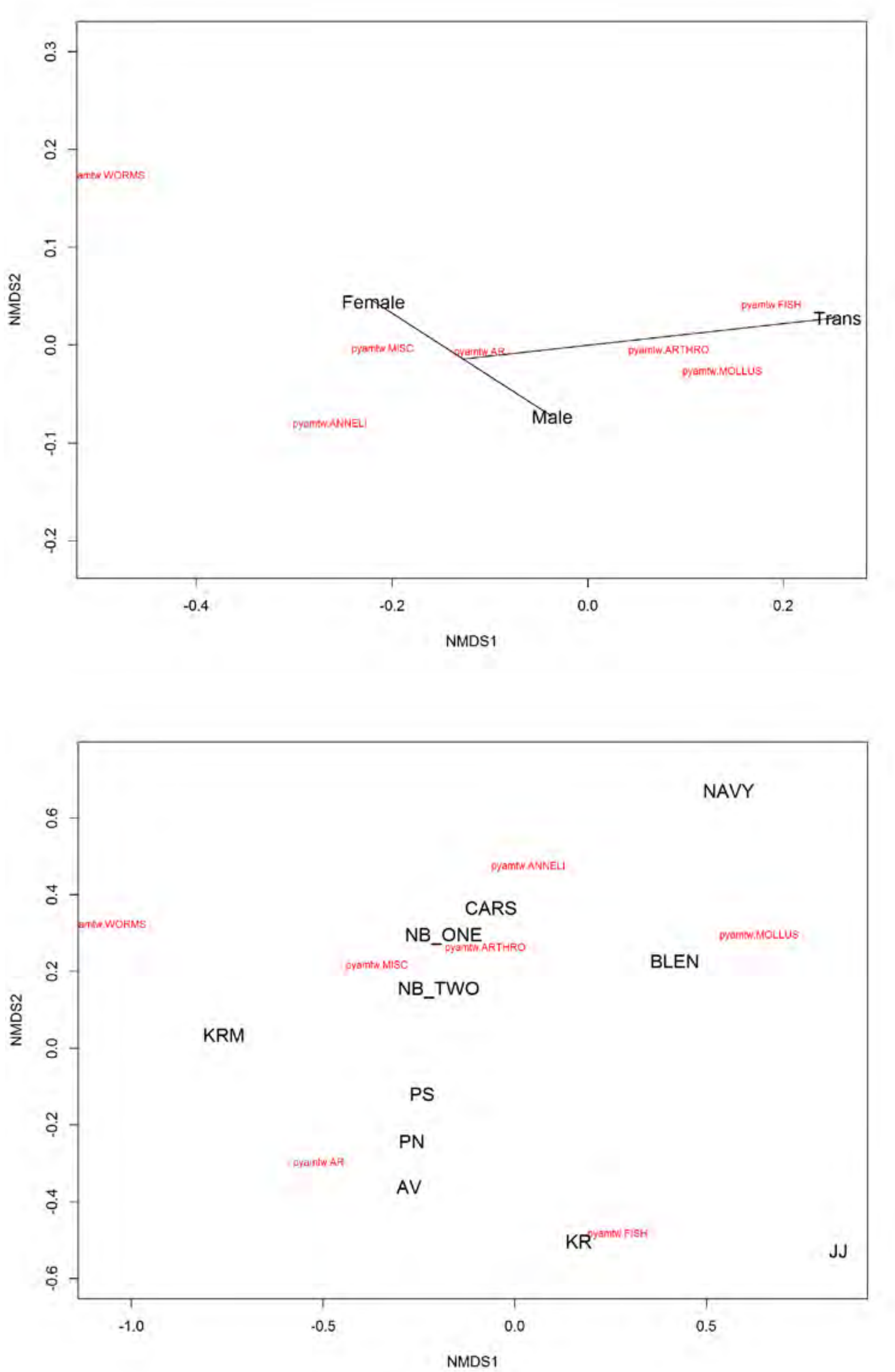

Figure 3.10. Non-metric multidimensional scaling plot of fish diets, using weights of seven prey groups: Annelids, Worms (non-annelids), Arthropods, Molluscs, Fish, Animal Remains (AR), and Miscellaneous. Top: Data overlaid by Sex groupings; Bottom: Data overlaid by Location groupings.

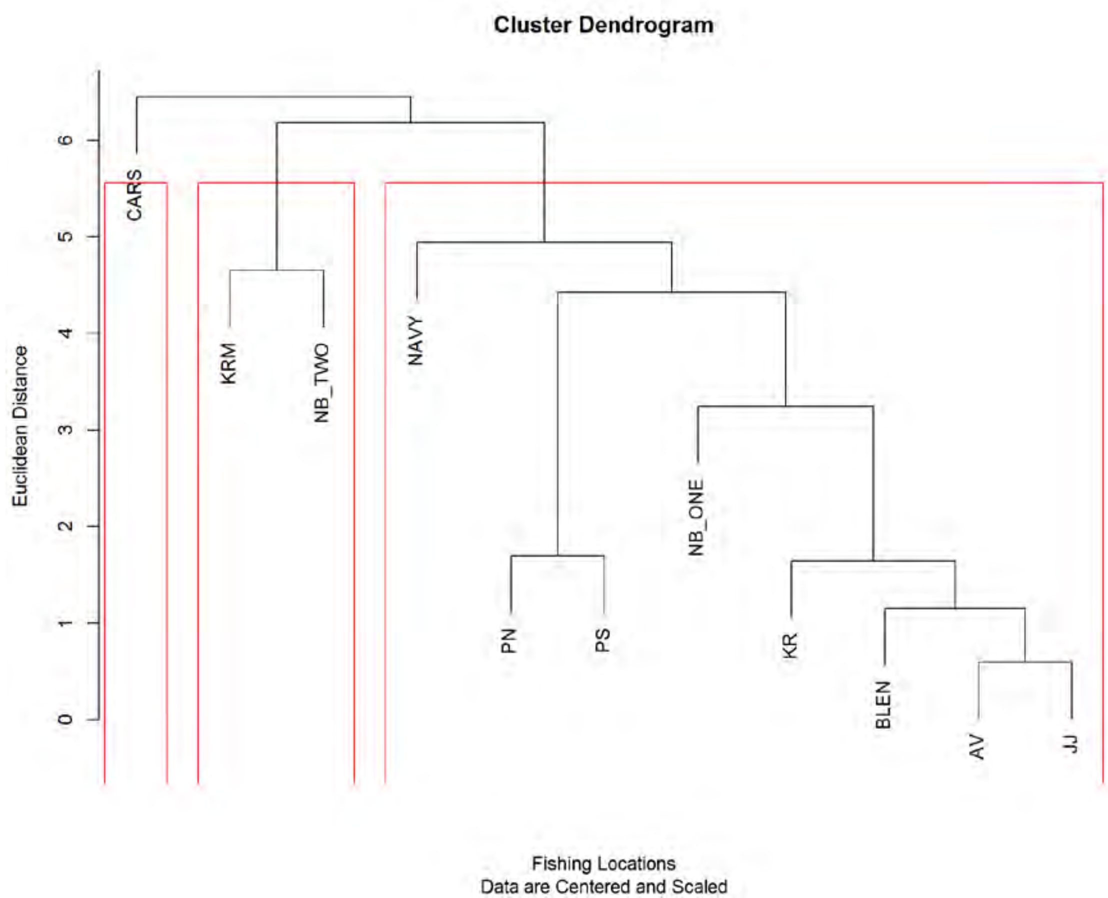

Figure 3.11. Cluster analysis dendrogram of prey weights by sampling location. Three groups of sites are separated at a distance of 5.5.

Discussion

Our results show that the ecological functionality of artificial reefs is similar to that of natural reef habitats for Black sea bass in the Mid-Atlantic Bight, based on several traits examined including size, sex, gut contents, and trophic position. Diet composition did not differ significantly between fish captured at natural or artificial sites, despite the fact that benthic organisms caught by beam trawl sampling differed between the two site types (Fig. 3.12). However, trawls only sampled the sandy seafloor near the reefs and wrecks, and not the actual structured habitat, so only indicate what prey items were present in the nearby area. We used trawl sampling only to collect specimens for comparative isotope ratios, and did not try to assess abundance. However, recent studies using small mesh trawls in the nearby Maryland wind energy area showed that the most common epifaunal organisms were sand dollars *Echinarachnius parma*, hermit crabs *Pagurus* sp., auger snails *Terebra dislocata*, and sand lance *Ammodytes americanus* (Cruz-Marrero et al. 2019). Of these four species, probably only sand lance were consumed by black sea bass. Astarte clams *Astarte castanea* and rock crabs *Cancer irroratus* were #6 and #8 in order of abundance, but were prominent among BSB stomach contents. Compared to BSB muscle, the isotopic signatures of $\partial^{13}C$ and $\partial^{15}N$ in epifaunal organisms were distinct and lower in mussels, scallops, clams, rock crabs, snails, shrimp, and sand dollars, although there was some overlap with flounder (probably gulfstream flounder *Citharichtys arctifrons*) (Fig. 3.13). These results suggest that BSB probably forage in the sandy seafloor adjacent to structured habitats, rather than among the reefs and wrecks, as crabs, worms, and clams are not common on the wrecks. The higher proportion of empty stomachs at natural sites may indicate less frequent feeding at those sites, or that fish may have regurgitated stomach contents during retrieval, as those sites were relatively deeper than the artificial sites. Alternatively, feeding may have been impacted by recreational fishing effort, since several of the artificial sites that we sampled are popular fishing destinations.

Figure 3.12. Organisms caught in beam trawls near natural (top) and artificial (bottom) sites for this study. Catch at the natural site consisted mostly of large shells and cobble, with some sea robin and squid egg mops. Catches at the artificial sites mostly consisted of Crangonid shrimp and smaller shells.

Analysis of stomach contents did not show evidence of a shift in diet with ontogeny for fish caught in our study. Few black sea bass >50 cm TL were caught at the sites that we sampled; this was likely due to commercial and recreational fishing pressure at those sites, as well as a much smaller sample area and sample size obtained in this study compared to the NOAA data and Byron and Link (2010). Despite the lack of major differences, subtle differences may provide insight about the habitat types.

Stable isotope ratios varied most significantly by location type. Significant differences between locations for a given tissue type or size category cannot be definitively correlated to prey type consumption. Significant differences in both ∂^{15}N and ∂^{13}C occurred between artificial and natural sites, but not between size groups of fish, indicating that fish at the different site types may be feeding at slightly different trophic levels. Even differences that were significant may not have great biological significance. Differences in ∂^{13}C in liver between location types may indicate that fish at particular sites frequently prey on items with a higher ∂^{13}C values. Prey items with higher ∂^{13}C values would be characteristic of items from more littoral sources, yet this was not reflected in diet analyses. Isotopic values in mucus were not drastically different for ∂ ^{15}N or ∂ ^{13}C, so it may be possible to use mucus as a non-lethal sampling method for Black sea bass in future studies.

Figure 3.13. Stable isotope ratios for $\partial^{13}C$ and $\partial^{15}N$ in muscle of black sea bass (red dots and ellipse), compared to items caught in trawl on August 10, 2018.

If the small differences in either prey or isotope levels between site types were to be considered ecologically significant, it could be argued that they are due to structural differences between reef types. Most of the artificial reefs consisted of relatively intact masses of vertical structure, with heights ranging from 1 to 5 m above bottom. Fish on those sites would have to move meters away from the center of the site to access sandy seafloor on which to feed, but would have easy access to the water column above the wreck. In contrast, natural sites are broken into many irregular small patches and fish would not have to move far to find natural seafloor. Previous studies (Cullen and Stevens, 2017) have shown that fish hide among cracks and crevices, and beneath the canopy of sea whips, where they have close access to sandy seafloor, but would have to move multiple meters up into the water column to feed there. Thus it is possible that artificial reefs restrict access to lower trophic level seafloor resources but improve access to higher trophic level pelagic resources by some small amount.

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Chapter 4. Conclusions and Recommendations

This study has provided a preliminary look at the relationships between black sea bass (BSB) and their habitats. These interactions are mediated both by diet and behavior. Previous studies suggesting that BSB are associated with "course-grained" material (Fabrizio et al, 2013) gave only a crude approximation of their habitat. The results of this project confirm that black sea bass are tightly structure-oriented, and primarily occur within a few meters of hard bottom substrata with substantial vertical and biological structure that includes the presence of gorgonian corals, aka sea whips *Leptogorgia virgulata*. Sea whips are responsible for most of the vertical structure above habitat baselines, and are the primary biological indicator for abundance of BSB. Visual observations indicate that sea whips provide structure that BSB like to occupy. We have documented a continuum of proportional damage to sea whip colonies across a spectrum of fishing intensity, ranging from very low (0.02) at small, rarely fished sites, to minor (0.15) at sites fished primarily by recreational fishers, to moderate (0.37) at those targeted by commercial fishers. However, this relationship is circumstantial, since we do not have a quantitative measure of fishing intensity. In this study we observed many sea whips that had evidence of damage by recreational fishing line. Previous studies (Schweitzer et al. 2018) have shown that 50% of commercial fish traps come into contact with emergent epifauna during deployment or recovery, including sea whip corals, often resulting in damage or breaking of corals. Additional studies conducted at some of these same sites (as part of a separate study) found that sea whips ranged in size from 15 to <100 cm, and in age from 2 to 15 years, with 50% of corals in the age range of 6-8 years (Wenker 2019). These results indicate that recruitment of sea whips is episodic, possibly occurring only at decadal intervals. Episodic recruitment may be facilitated by the action of major storms or hurricanes that remove other competing epifauna (e.g. mussels) from hard-bottom seafloor habitats, releasing habitat for recruits to settle and attach. Thus sea whips damaged by natural or artificial causes, including fishing activity (whether recreational or commercial), may require decades to recover.

We found only minor differences in diets of black sea bass between natural and artificial reefs. Likewise, stable isotope ratios of $\partial^{12}C/\partial^{13}C$ and $\partial^{14}N/\partial^{15}N$ from liver, muscle, and mucus showed minor differences between reef types. Crustaceans (primarily *Cancer* crabs) were the major prey item in both our study and comparative data from NOAA, but may be overestimated due to the low digestibility crustacean shells. Diet studies indicate that black sea bass probably derive the majority of their prey by foraging over the sandy seafloor away from structured reef sites. However, we did not observe such foraging activity during daytime video surveys, suggesting that it is a nighttime or crepuscular activity. This study showed that natural and artificial reefs are ecologically similar for black sea bass caught near Ocean City, MD, although subtle differences in diet between reef types suggest that their physical form may affect access of fish to different prey items. Nonetheless, this indicates that habitat selection is probably not associated with proximity to food sources, but is more likely to be associated with actual physical structure that provides other biological benefits, such as protection from predation, optimization of reproductive opportunities, or stress reduction.

Construction of a stepping-stone corridor connecting established sections of an artificial reef resulted in an increase in fish abundance at the corridor site, compared to nearby sites that showed no change in abundance. This demonstrates that corridor construction increased habitat availability for fish at the Impact site, without drawing fish away from nearby sites. Our results suggest that increasing connectivity between patch reefs may be an effective method to enhance available habitat in marine ecosystems. The structures that we built, however, did not turn out to be the best choice. Stacks of concrete “oyster castles” did provide a variety of interstitial space that was attractive to fish. However, the stacks did not remain intact, but were scattered and partially buried by storms. We also observed that concrete pipes placed near one site were also mostly buried in the sand. Future construction of artificial reefs should utilize structural designs that will not easily come apart, or be buried, and will provide a variety of interstitial spaces that are scaled to the size of both juvenile and adult fish.

There is currently much public discussion about development of wind power infrastructure in the MAB in the near future, particularly off of the Maryland coastline. Evidence from other wind power sites suggests that the hard substrata introduced by construction or installation of turbines, whether composed of rock or steel, will support invertebrate fouling communities that black sea bass and other fish prefer as habitat (Andersson and Ohman 2010). Video surveys of the Maryland wind energy development area have shown that this portion of the coastal zone has little in the way of hard-bottom habitats (Cruz-Marrero et al., 2019). Likewise, searches of thousands of seafloor images collected during the NOAA Habcam surveys in the Maryland WEA produced only a few images containing sea whips or black sea bass (Wenker 2019). Consequently, it seems highly likely that construction of such artificial habitats in the MAB will increase the availability of preferred habitats for black sea bass, and possibly lead to increased local population abundance.

While there is circumstantial evidence that sea whips are damaged by both recreational and commercial fishing activities, there is not yet enough evidence to indicate that such activity has caused declines in sea whip populations, and natural disturbances (e.g. by storms or pathogens) may have a greater impact on populations over small time scales. At the same time, global climate change, including ocean warming and acidification, is known to have detrimental impacts on corals worldwide, and may also be a source of stress or disease among sea whips. Gorgonians in the Caribbean, including *Leptogorgia* sp., have shown increased incidence of infection by *Aspergillus sydowii*, a soil-borne fungus that causes tissue erosion and death of some coral colonies, possibly associated with disturbance of the normal microbiome community (Smith et al. 1996, Rosenberg et al. 2007). These outbreaks are associated with terrestrial runoff and dust storms that may be a consequence of climate change (Harvell et al. 1999, Hallegraef et al. 2014, Soler-Hurtado et al. 2016). Whether the observed condition of sea whip communities in the MAB is the result of repeated acute disturbance from fishing, or of persistent stress from long-term climate change is currently unknown. However, both acute and repetitive stressors probably have an impact on coral populations, and consequently fish abundance.

Regardless of future development, protection and/or conservation of habitats dominated by sea whips would probably have positive benefits for black sea bass. Prior studies have shown that protecting portions of the habitat of a fished stock within a marine protected area (MPA) leads to an increase in density, biomass, and size of individuals, which subsequently leads to increased reproduction and recruitment (Botsford 2005, Pitchford et al. 2007). However, it would be inappropriate to institute conservation measures that restrict commercial or recreational fishing at existing reef sites. However, as new reefs are built, or wind power turbines constructed, it would be worthwhile to consider setting some areas aside as marine protected areas where black sea bass fishing would be prohibited. Since most of these new sites will be developed in areas where there is currently little available habitat or fish, such measures should not create conflict with existing fishing practices.

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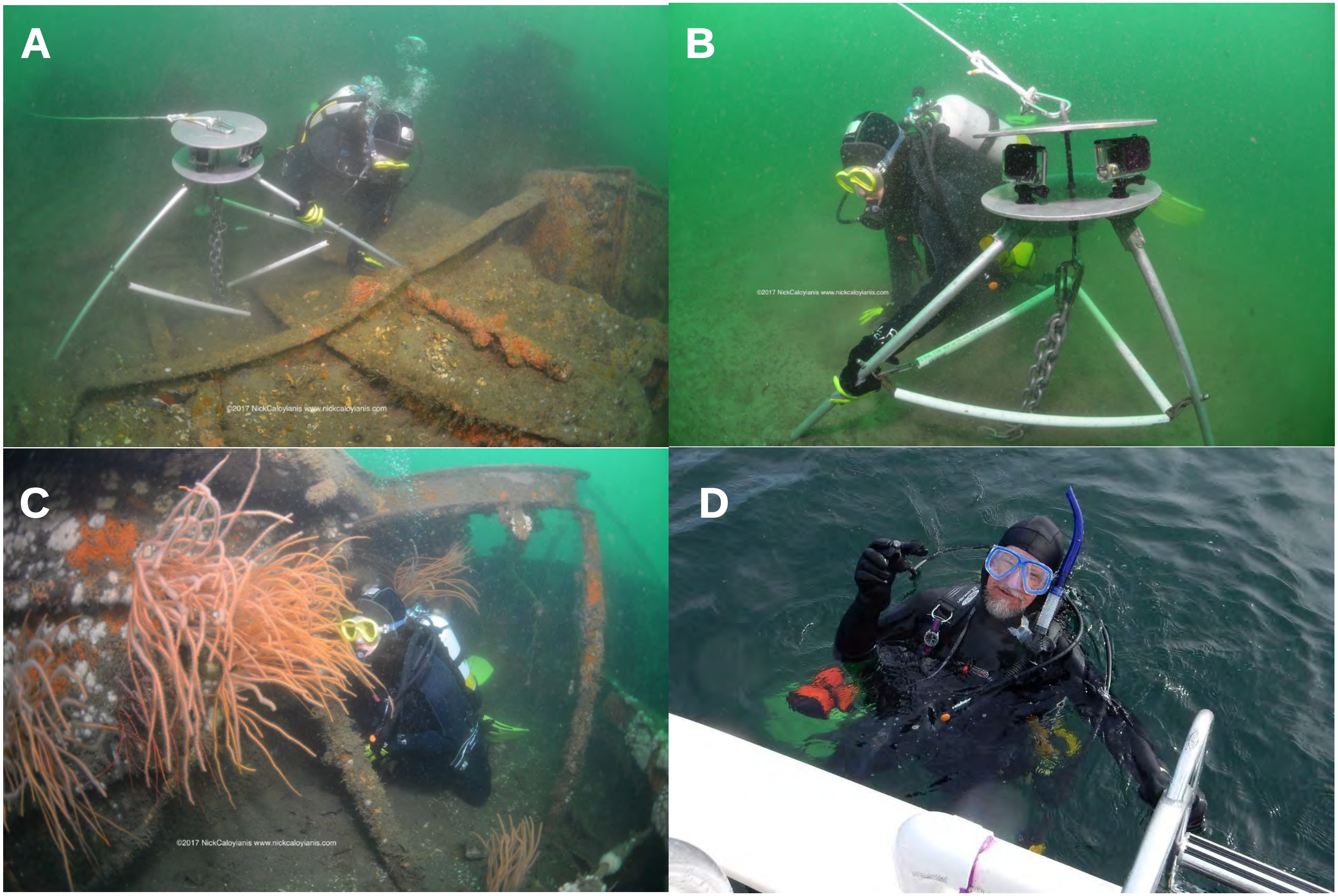
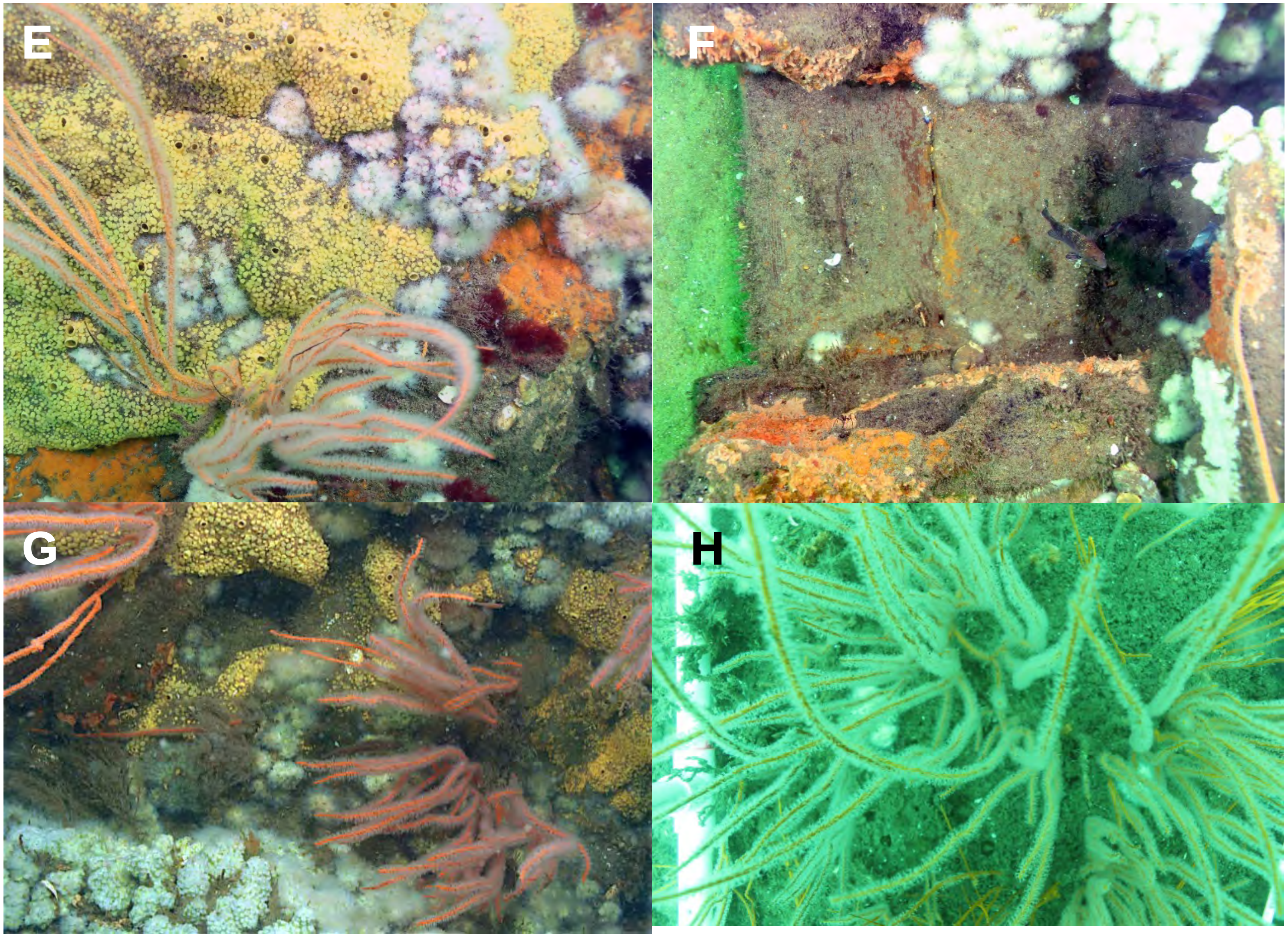
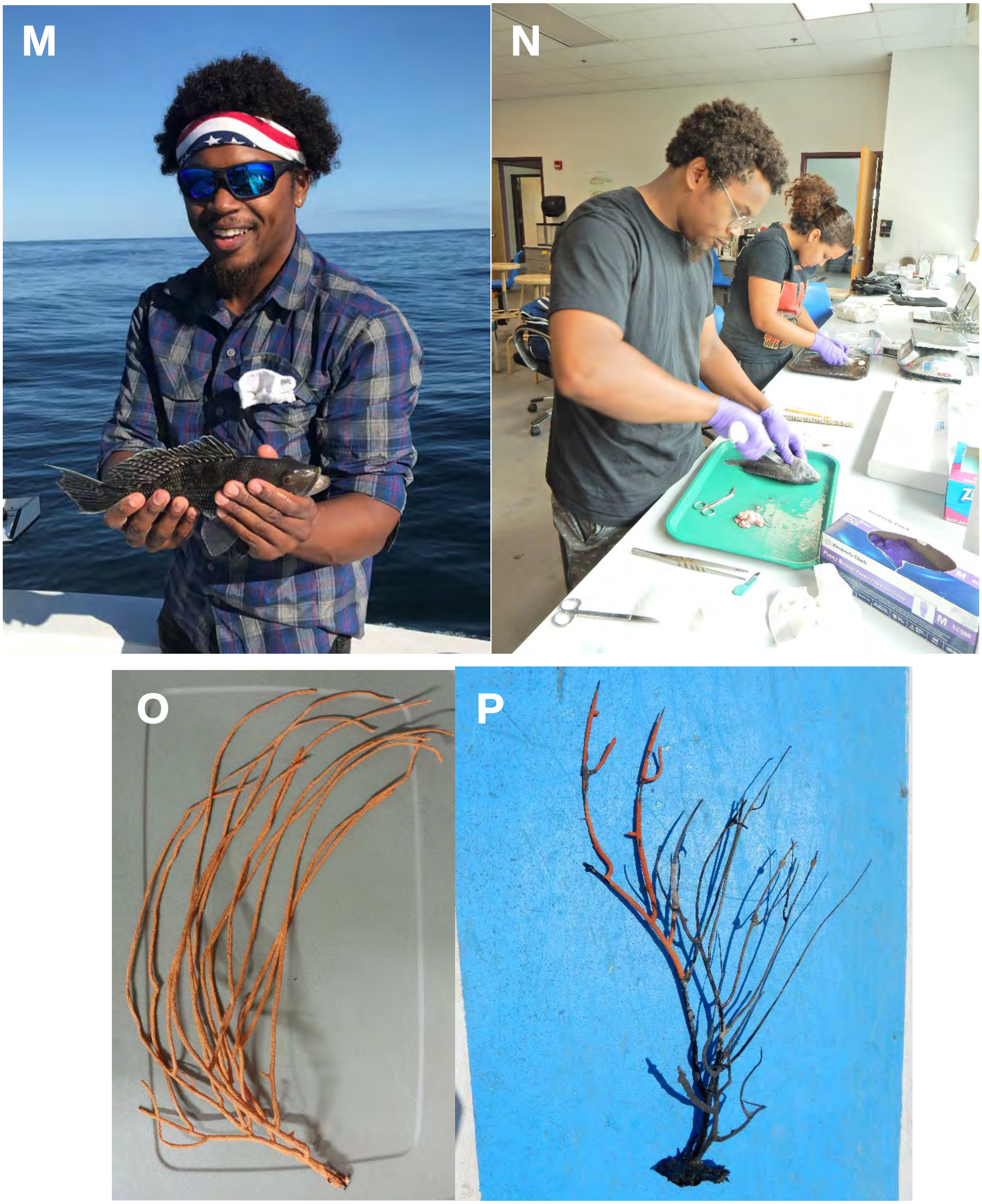


Appendix Photographs. Diving activities during the project: A-C, Cara Schweitzer setting up video tripods (Nick Caloyianis); D, Brad Stevens preparing to dive (Jeremiah Kogon).



Quadrat photos taken at sites PH-S and PH-N. E) Quadrat with high abundance of boring sponge *Cliona celata* (yellow dots); F) Photo of wood wreck with black sea bass near center; G) Quadrat with moderate abundance of boring sponge and northern stone coral *Astrangia poculata* (white patches); H) Quadrat with high abundance of sea whips *Leptogorgia virgulata*.

Tools of the Trade. I) Cara Schweitzer with video tripod; J) Digital camera on quadrat frame; K) Brad Stevens with “oyster castle” pyramids of 4-tiers each; L) A 2-tier pyramid with Cobia *Rachycentron canadum* in foreground.



Species studied: M) Andre Price with black sea bass *Centropristis striata;* N) Andre Price and Ileana Fenwick dissect stomachs from black sea bass. O) Healthy sea whip *Leptogorgia virgulata* with Damage Index DI=1; P) Sea whip with extensive damage and tissue loss (DI =5). All photos by B. Stevens.

The Authors

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Dr. Stevens is a tenured Professor of Marine Science in the Department of Natural Sciences at the University of Maryland Eastern Shore, and Distinguished Research Scientist with the NOAA Living Marine Resources Cooperative Science Center. He received his PhD from the University of Washington in 1982. He previously worked for the National Marine Fisheries Service of NOAA for 22 years in Kodiak, Alaska, where he was Task Leader for Bering Sea Crab Stock Assessment, managed the Seawater Laboratory at the Kodiak Fisheries Research Center, and was Acting Director of the NMFS Kodiak Laboratory in 2006. He has authored or co-authored over 65 peer-reviewed publications and conference proceedings, and is the Editor and principal author of "King Crabs of the World", CRC Press, 2014. Dr. Stevens' research program focuses on ecology and reproductive biology of invertebrates (primarily crabs), and impacts of fishing on fish and invertebrate populations and their habitats. In 2003, he discovered the wreck of the Russian barque Kad'yak, the oldest known shipwreck site in Alaska, and the first shipwreck from the Russian Colonial Period ever found, and recently published an account of that discovery: "The Ship, the Saint, and the Sailor: The Long Search for the Legendary Kad'yak" (Ingram Press, 2018). In 2015, he initiated the AAUS Diving program at UMES, and currently serves on the University System of Maryland Diving Control Board.

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Dr. Cara Schweitzer received her PhD in Marine, Estuarine and Environmental Science from the University of Maryland Eastern Shore in May, 2019. The title of her PhD Dissertation was "The Effects of Commercial Trap Fishing on Benthic Structural Habitat and Fish Abundance in the Mid-Atlantic: Case Study of Black Sea Bass *Centropristis striata*". She is currently weighing offers for postdoctoral employment.

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Mr. Andre Price received his MS Degree in Marine, Estuarine and Environmental Science from the University of Maryland Eastern Shore in May, 2019. The title of his Thesis was "Comparing Localized Feeding Ecology of Black Sea Bass (*Centropristis striata*) at Natural and Artificial Reefs Using Gut Content and Stable Isotope Analyses". He currently works for the National Marine Fisheries Service, Northeast Fishery Science Center, in Woods Hole, MA.

The relationship between fish abundance and benthic community structure on artificial reefs in the Mid-Atlantic Bight, and the importance of sea whip corals *Leptogorgia virgulata*

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ABSTRACT

Autogenic engineers (i.e., biogenic structure) add to habitat complexity by altering the environment by their own physical structures. The presence of autogenic engineers is correlated with increases in species abundance and biodiversity. Biogenic structural communities off the coast of Delaware, Maryland, and Virginia (Delmarva) are comprised of multiple species including boring sponge *Cliona celata*, various hydroids (i.e., *Tubularia* sp., *Obelia* sp., *Campanular* sp.), northern stone coral *Astrangia poculata*, sea whips *Leptogorgia virgulata*, and blue mussels *Mytilus edulis.* Sea whips are soft corals that provide the majority of vertical height to benthic structure off the coast of the Delmarva peninsula. The mid-Atlantic bight is inhabited by several economically valuable fishes; however, data regarding habitat composition, habitat quality, and fish abundance are scarce. We collected quadrat and sea whip images from 12 artificial reef sites (i.e., shipwrecks) ranging from 10 to 24 m depth to determine proportional coverage of biogenic structures and to assess habitat health, respectively. Underwater video surveys were used to estimate fish abundances on the 12 study sites and determine if fish abundance was related to biogenic coverage and habitat health. Our results showed that higher fish abundance was significantly correlated with higher proportional sea whip coral coverage, but showed no significant relationship to other biogenic structure. Assessment of sea whip condition (as a damage index) showed that sea whip corals on artificial reefs off the Delmarva coast exhibited minor signs of degradation that did not differ significantly among study sites.

Subjects Fisheries and Fish Science, Ecology, Marine Biology

Keywords Sea whip, Black sea bass, Biogenic structure, Mid-atlantic bight, Coral, Fish abundance, Temperate reef, Artificial reef

INTRODUCTION

Structurally complex habitats, such as cobble and rock reefs, and natural or artificial reefs, are profoundly important for fish and crustaceans by providing spatial refuge and feeding sites (*Robertson & Sheldon, 1979*; *Hixon & Beets, 1993*; *Forrester & Steele, 2004*; *Scharf, Manderson & Fabrizio, 2006*; *Johnson, 2007*; *Cheminee et al., 2016*; *Gregor & Anderson, 2016*). Structural habitat can be essential for the settlement and proliferation of autogenic

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engineers (e.g., corals, sponges, bivalves, sea grasses). The presence of biogenic structure can increase the quality of habitats and can affect habitat selection, abundance of economically valuable species, and survival and settlement of fishes (*Gibson, 1994*; *Garpe & Öhman, 2003*; *Diaz, Solan & Valente, 2004*; *Miller et al., 2012*; *Komyakova, Jones & Munday, 2018*; *Seemann et al., 2018*; *Soler-Hurtado, Megina & López-González, 2018*). This is most evident when biogenic structures are damaged or undergo mortality events, which often results in regional loss of fish biomass, biodiversity, and abundance (*Jones et al., 2004*; *Lotze et al., 2006*; *Thrush et al., 2008*; *Dudgeon et al., 2010*; *McCauley et al., 2015*). The extent to which autogenic engineers influence fish abundance has been well studied in tropical marine ecosystems (*Richmond, 1996*; *Downs et al., 2005*; *Hughes et al., 2010*; *Newman et al., 2006*), but is poorly understood within temperate rock reef systems of the Mid-Atlantic.

Within the Mid-Atlantic Bight, biogenic structure primarily consists of boring sponge *Cliona celata*, various hydroids (i.e., *Tubularia* sp., *Obelia* sp., *Campanular* sp.), northern stone coral *Astrangia poculata,* sea whip corals *Leptogorgia virgulata* (*Gotelli, 1991*; *Guida et al., 2017*), and blue mussels *Mytilus edulis* (*Steimle & Zetlin, 2000*; *Cullen & Stevens, 2017*). Among this community, sea whip corals are the primary contributors of additional height to artificial and natural rock reefs. Previous studies conducted within coral reef ecosystems have demonstrated that rugosity and coral height are the strongest predictors of fish biomass (*Harborne, Mumby & Ferrari, 2012*). Benthic rock reefs and artificial reefs within the Mid-Atlantic Bight are poorly studied and the composition of benthic biogenic structures is unknown.

Marine benthic structure within the Delaware, Maryland, Virginia peninsula (Delmarva) portion of the Mid-Atlantic Bight consists of both natural rock reefs and artificial reefs. Natural rock reefs are composed of rock, mud, and clay outcrops, and artificial reefs, both unintentional (e.g., shipwrecks) and intentional (e.g., concrete blocks and pipes, subway cars, ships). Natural rock reefs are sparse, sporadically distributed and highly fragmented. Artificial reefs provide the dominant source of benthic structure either through accidental shipwrecks or constructed through artificial reef programs. Artificial reef construction has become a popular way to increase regional habitat production, biodiversity, fish abundance, and to restore biogenic structure (*Bohnsack, 1989*; *Grossman, Jones & Seaman, 1997*; *Sherman, Gilliam & Spieler, 2002*; *Granneman & Steele, 2015*; *Scott et al., 2015*; *Smith et al., 2017*). Artificial reef sites are constructed regularly off the coast of the Delmarva peninsula, with the goal of increasing the abundance of structure-oriented fish of economic value. Some of these species, such as black sea bass *Centropristis striata*, and tautog *Tautoga onitis,* reside directly within the structures; whereas others, such as Atlantic croaker *Micropogonias undulatus*, and summer flounder *Paralichthys dentatus*, are commonly found on sandy bottoms near benthic structures as adults (*Feigenbaum et al., 1989*; *Hostetter & Munroe, 1993*; *Scharf, Manderson & Fabrizio, 2006*; *Fabrizio, Manderson & Pessutti, 2013*).

Habitat quality on benthic rock reefs and its relationship to species abundance has been largely neglected in the Mid-Atlantic Bight. Previous research investigating habitat association for economically important species (e.g., black sea bass) within the Mid-Atlantic Bight focused on benthic hardness and did not consider biogenic composition (*Fabrizio,* *Manderson & Pessutti, 2013*). *Diaz, Solan & Valente (2004)* performed a small-scale study investigating fish abundance in relation to biogenic structure in relation to density of patches of infaunal tubes at Fenwick Shoals off the coast of Delaware. They found that patch size and presence of biogenic structure was significantly related to juvenile fish abundance for that site. However, there are still insufficient data to suggest that these results are representative of habitat patches throughout the Mid-Atlantic Bight. To date, there is a paucity of data regarding the composition variability and degree of coverage of biogenic structure on natural or artificial reefs, and its relationship to fish abundance within the Mid-Atlantic Bight.

It is important to understand how sensitive, stable, or resilient complex habitats are in order to preserve the sustainability of economically valuable species. An improved understanding in the relationship between benthic habitat quality and fish abundance in the Mid-Atlantic Bight can lead to improvements in management policies. Assessments in habitat quality is commonly achieved by monitoring indicator species that are selected based on their sensitivity to habitat disturbances, and can be effective in the evaluation of an ecosystems response to stressors (*Andersen, 1986*; *Simberloff, 1998*; *Siddig et al., 2016*). Since sea whip corals primarily contribute to additional vertical relief, they may be more susceptible to fishing disturbances, and external damage and over-colonization can be easily quantified, we hypothesize that sea whip corals may be an indicator species for benthic habitats in the Mid-Atlantic Bight.

We undertook a study to determine the structure of marine biogenic communities and their relationship to fish abundance in the Delmarva portion of the Mid-Atlantic Bight. Our study had four specific objectives which were: (1) to determine the species composition and proportional coverage of biogenic structure at various artificial reefs; (2) to estimate relative fish abundance at those sites; (3) to estimate habitat quality using a damage index (DI) for sea whips; and (4) to determine the relationships between fish abundance and the quantity and quality of biogenic habitat.

METHODS

Description of study sites

Twelve artificial reef study sites were selected based on site age and SCUBA accessibility (Table 1). Sites were located off the cost of the Delaware, Maryland, and Virginia (Delmarva) peninsula between the latitudes of 37°N and 38.5°N ranging from 9 to 32 km off the coast (Fig. 1) at depths from ~10 to ~24 m. The maximum distance between sites (Site FW and RG) was ~60.1 km and the minimum separation distance (between Sites EP and E2) was ~0.52 km. The majority of the sites ($n = 8$) were intentionally sunk in association with the Maryland Artificial Reef Program, and the remaining four were natural wrecks. Both sites PH and RG became separated into two sections with approximately 122 m and 27 m between each section, respectively.

There have been few studies on habitats in the Mid-Atlantic Bight by SCUBA or other in-situ methods due to unpredictable weather and turbid conditions. For these reasons, diving and data collection were restricted to the months of June through November during

Table 1 Table showing approximate age, name abbreviations, and depth of the study sites. Month surveyed is the month fish abundance surveys were completed. Survey method states whether the fish abundance survey was conducted via line transect method (Line) or via stationary camera method (Stationary). Category states whether sites were constructed or naturally sank. Site names are common names of the wreck or region; however; some site names are not universal.

Site	Site name	Abbr.	Approx. age (y)	Approx. depth (m)	Month surveyed	Survey method	Category
1	Fenwick Shoals	FW	120	10	July	Line	Unintentional
2	Elizabeth Palmer	EP	104	23.5	July	Stationary	Unintentional
3	EP2	E2	100	24	July	Stationary	Unintentional
4	Pharoby	PH	37	20	June	Stationary	Deliberate
5	Blenny	BL	30	23.5	July	Line	Deliberate
6	Kathleen Riggins	RG	28	16.5	June	Stationary	Unintentional
7	Memorial Barge	MM	26	18	—	—	Deliberate
8	Sussex	SX	24	24	July	Line	Deliberate
9	Navy Barge	NV	19	20	July	Line	Deliberate
10	New Hope	NH	2	19	August	Line	Deliberate
11	Barge	BA	0.5	18	August	Line	Deliberate
12	Boiler Wreck	BW	NA	24	July	Line	Deliberate

2017 and 2018 and only conducted on days with a wave height ≤ one m. Fish abundance surveys were conducted June through August. If quadrat sampling could not be completed during the same sampling day, the site was resampled at a later time. Bottom temperatures were collected via a Castaway® CTD (Sontek Inc., San Diego, CA, USA) once daily. During these months bottom water temperatures ranged from 9.31 °C to 22.57 °C and surface temperatures ranged from 13.48 °C to 27.23 °C. Bottom visibility ranged from ~0.5 to ~18 m. Neither quadrat nor video data could be collected on days with bottom visibility <1.5 m.

Data collection

Quadrat sampling was used to estimate the proportional coverage of the dominant biogenic organisms: boring sponge, *C. celata,* various hydroid species (e.g., *Tubularia sp., Obelia sp., Campanularia sp.*), northern stone coral *A. poculata,* sea whip corals *L. virgulata,* and blue mussels *M. edulis*. Quadrat images ($n = 11$ to 60) were taken by SCUBA divers with a Canon DSLR camera in a housing attached to a 0.25 m^2 PVC frame.[1] Images were taken at one m intervals along the long axis of the artificial reef for 30 m, or to end of the wreck. Quadrat sampling was conducted once at each of the sites.

To assess sea whip damage, images of sea whips were taken with GoPro® *Hero* 4 action camera.[1] If sea whips were abundant (e.g., >1 m^{-2}), a subset of sea whips was haphazardly selected and photographed. However, if sea whip abundance was low, then all sea whips present were photographed.

To estimate fish abundance on artificial reefs, an underwater video survey was conducted via two methods: (1) line transect method, and (2) stationary cameras (Table 1). Line transects were conducted at eight sites while stationary camera surveys were conducted at four of sites. The latter method was used primarily to estimate fish abundance for an artificial reef building project and incorporated into this analysis. Line transects were

[1] Reference to trade names does not imply endorsement by either the University of Maryland Eastern Shore or funding sources.

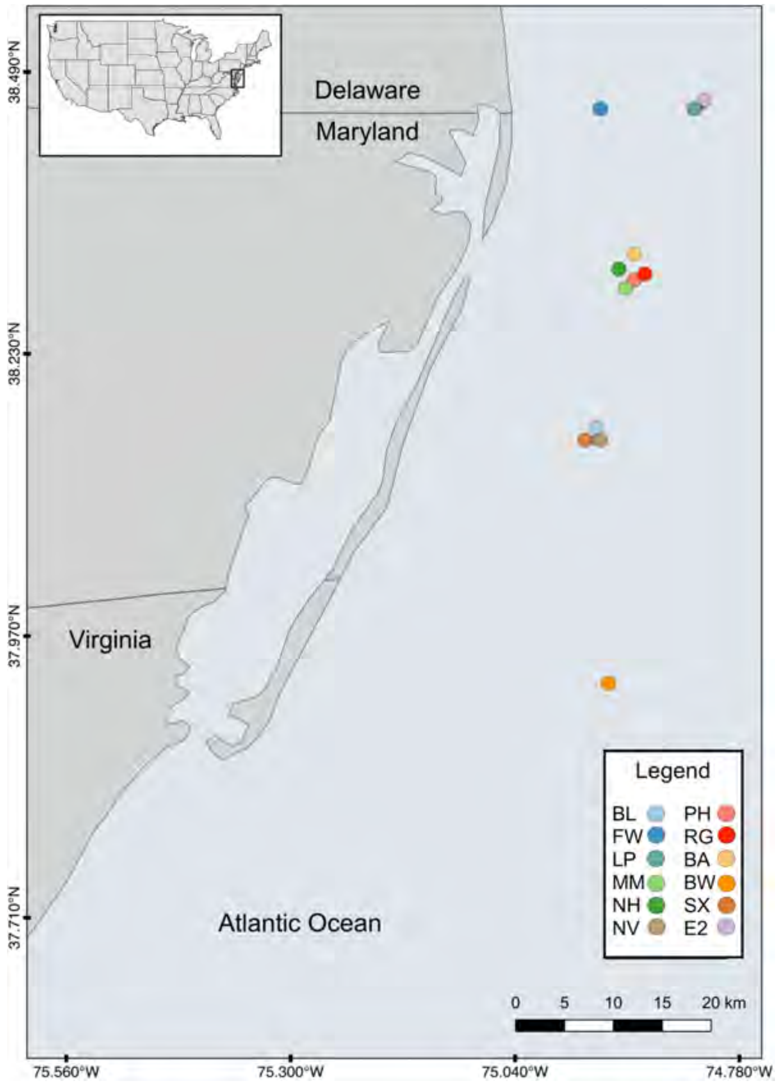

Figure 1 Map of study sites. Map of the study area showing the locations of the 12 artificial reefs off the coast of the Delmarva (Delaware, Maryland, Virginia) peninsula.

Full-size DOI: 10.7717/peerj.7277/fig-1

conducted for 30 m along the long axis of the site, or until the end of the wreck. Divers swam along the transect approximately one m above the wreck with the camera facing at a slight angle toward the wreck surface. The mean duration of line transect videos was 306 s ± 102 s SD. Stationary surveys were conducted by placing non-baited aluminum tripods, each of which bore two GoPro® camera placed at 90° angles. Two tripods were placed facing the wreck at a distance of approximately one m from where fish were observed. At Sites 3 and 4, tripods were also placed in the open bottom area between each section to determine the abundance and behavior of fish at those sites. Cameras were left on tripods to record for 45 min, and then retrieved. Stationary camera observations were repeated at least twice at each location, but line transect counts were not repeated due to hazardous weather that restricted diving frequency.

Data analysis

Images were analyzed with image analysis software ImageJ (version 2.0.0-rc-69/1.52J, NIH) and statistical analysis was completed with R statistical software (v 3.5.2; *R Core Team, 2018*). Proportional cover for each of the biogenic species was estimated by outlining regions of interest (ROI) in each quadrat image. For sea whip corals, ROI were drawn over the projection of the sea whip on the surface. Analysis of similarities (ANOSIM) based on the Euclidean distance metric was used to test for differences between biogenic structure assemblages at sampling sites. A non-metric multidimensional scaling (NMDS) was used to visualize similarities and differences in biogenic composition throughout the research sites. Five biogenic species composed of two corals and three non-coral organisms were included in the NMDS analysis, which represent the dominant structural organisms that inhabit the Mid-Atlantic.

Due to the frequency of low bottom visibility during video surveys, identification of species was substantially impaired, such that only fish relatively close to the camera could be identified. Therefore, fish abundance was estimated for all fish present and not separated by species. To estimate fish abundance on artificial reefs, we used a modified method of the fish MeanCount method, which is defined as the mean number of individuals observed in a series of frames throughout a viewing interval (*Bacheler & Shertzer, 2014*). To maintain independence between frames and statistical independence, 12 frames were randomly selected from the line transect surveys and the number of fish within each frame were counted. The MeanCount was calculated as the mean of those 12 frame counts. Since the stationary camera surveys produced two videos, the 12 randomly selected frame counts for each video were averaged per site. In addition to MeanCount, the highest number of fish observed in a single frame during the video (MaxNo) was also reported. Relationships between fish abundance (MeanCount) and coverage of biogenic structure and at each site were analyzed with a linear model (LM) with fish abundance (i.e., MeanCount) as the response variable and biogenic structure species as the predictors. A logit transformation was applied to all proportional data before LM analysis.

To estimate sea whip damage, we initially calculated the relative area of sea whips in using each image using ROIs via a line segment tool that was set at the same width as the sea whip branches. We then calculated the damaged area or region of overgrowth as a proportion of total line length. Proportional damage of individual sea whip corals was averaged at each site, and the mean value was used to assign a damage index (DI) from 1 to 5 (Table 2) as described in *Schweitzer, Lipcius & Stevens (2018)*. The proportional data was analyzed with a LM to determine if there was a was a difference in sea whip DI between sites and if DI had an effect on fish abundance.

RESULTS

Composition of artificial reefs

Data derived from quadrat images showed a significant difference, but with some overlap in biogenic assemblages between study sites (ANOSIM $R = 0.32$; $p = 0.001$; Fig. 2). The mean proportional coverage of biogenic structure on artificial reefs off the Delmarva coast

Table 2 **Damage index classifications.** Criteria used to classify individual sea whip damage index (DI) and overall habitat DI for images captured. For individual sea whips, damage is defined as any visible tissue damage, exposed skeletal structure, or overgrowth by hydroids or bryozoans.

DI	Damage	Description
1	Minimal	<0.05 damage or overgrowth
2	Minor	0.06–0.25 damage or overgrowth
3	Moderate	0.26–0.50 damage or overgrowth
4	Severe	0.51–0.75 damage or overgrowth
5	Critical	>0.75 damage or overgrowth

was 0.47 ± 0.14 (mean ± SD). Proportional coverage was lowest at Site SX (0.27), and greatest at Site NV (0.83; Fig. 3). Sea whip corals *L. virgulata* and northern stone coral *A. poculata* were present on 10 of the 12 sites. One of the two sites void of sea whip corals was constructed 6 mo prior to the quadrat survey and only exhibited colonization by hydroid species (Site BA; Table 3). Blue mussel *M. edulis* beds were found on 5 of the 12 sites. Boring sponge *C. celata* was observed at eight of the 12 sites. Site BW was the only location that contained all five structure-forming species.

Results from the NMDS supported the results from the ANOSIM such that some sites showed distinction in biogenic structure communities, while some sites showed considerable overlap (Fig. 2). Northern stone coral and blue mussels were negatively correlated. Sites NV and NH were associated with blue mussel coverage, while sites EP, E2, PH, and RG were associated with northern stone coral (Fig. 2). Sea whip corals and hydroids were negatively correlated. Sites PH, RG, MM, SX, NV, and BW were associated with sea whips. Sites BL and BA were associated with hydroids. Sites FW, and PH were associated with the boring sponge (Fig. 2).

Fish MeanCounts were obtained from 11 of the 12 sites. Visibility was too poor for a video survey to be conducted at Site MM, and hazardous weather prevented additional outings. The highest fish count observed (MaxNo; Table 4) in the video survey was also reported because fish were often observed aggregated near biogenic structure, specifically sea whip corals, rather than dispersed throughout the wreck (Fig. 4). The two highest MeanCounts were at Sites E2 and PH, while the lowest were at Sites FW and NH, whereas the Sites E2 and SX had the highest MaxNo (Table 4). No fish were observed swimming on open sandy bottom. Since MeanCounts and MaxNo were highly correlated ($r^2 = 0.94$) results are reported in MeanCounts. A LM analysis of all 12 sites showed that total proportional coverage of biogenic structure was not significant predictor to fish abundance (ANOVA, $F = 0.14$; $p = 0.72$; $r^2 = 0.02$). Proportional sea whip coverage, however, was the only significant predictor to fish MeanCounts ($p = 0.028$; $r^2 = 0.48$; Table 5; Fig. 5). An additional analysis was conducted for sites where video surveys were conducted via line transect method to determine if stationary cameras created an upward bias. Similarly, line transects showed a significant relationship between MeanCount and proportional sea whip coral coverage ($p = 0.014$; $r^2 = 0.69$).

Evidence of habitat disturbance due to fishing (e.g., lures, fishing line, abandoned traps) was observed at 10 of the 12 sites (all but Sites E2 and BA). Observations of tangled fishing

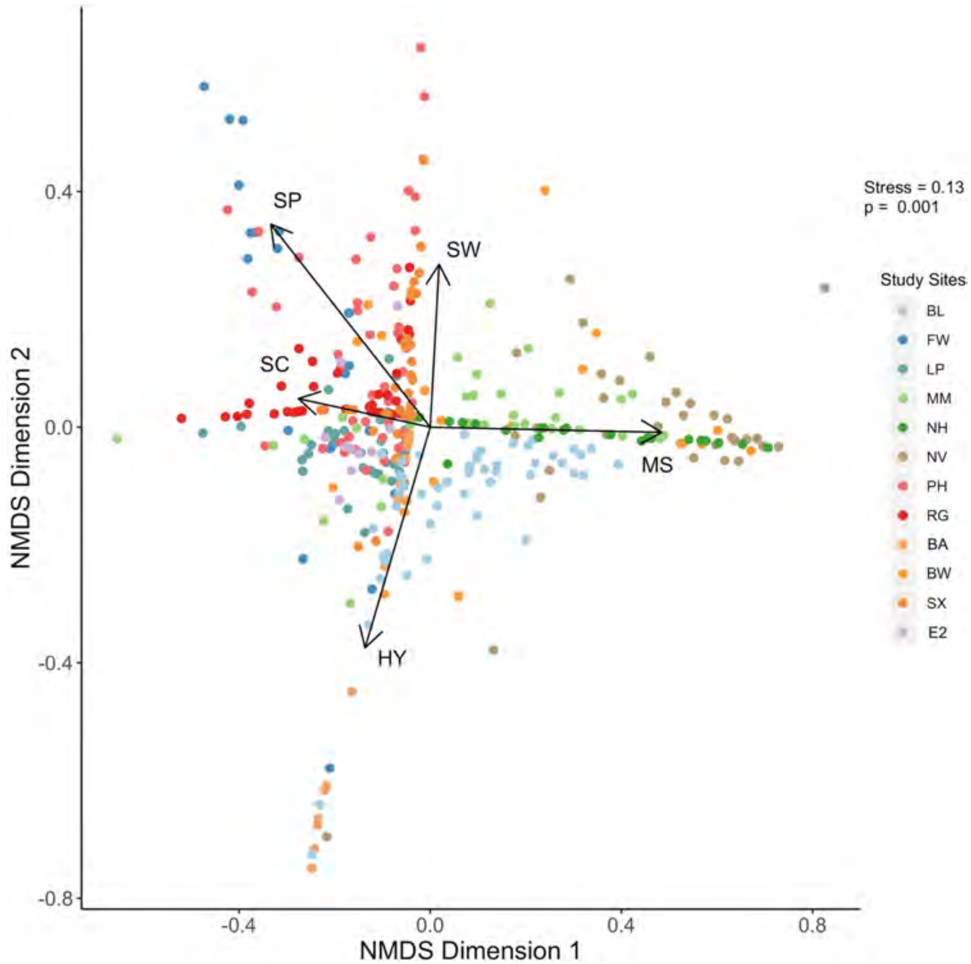

Figure 2 **NMDS plot.** Results of the nonmetric multidimensional scaling analysis depicting biogenic structure assemblages on the 12 artificial reef sites off the Delmarva coast. *P* value is from the ANOSIM analysis. Variables: SW, sea whip corals; SC, northern stone coral; SP, boring sponge; MS, blue mussel; HY, hydroids.

Full-size DOI: 10.7717/peerj.7277/fig-2

line were common at edges of shipwrecks. Fishing gear was observed in direct contact with sea whips corals at nine of the 10 sites where sea whips occurred (Fig. 6). To determine if cumulative sea whip damage was related to reduced fish abundance we analyzed a total of 193 sea whip images from 10 of the 12 study sites, excluding Sites FW and BA, where sea whip corals were absent. Sea whips at most sites exhibited various levels of degradation (Fig. 7). However, despite evidence of fishing disturbance at all sites, with the exception of Site E2, the mean damage index (DI) was 0.15 ± 0.19 SD for all sites, which is indicative of minor levels of degradation (Table 6). Site LP showed the highest DI with a mean of 0.26 ± 0.19 indicating a moderate level of degradation, however this was not significantly different from the other sites (ANOVA; $p = 0.061$) therefore no further analysis was conducted. Consequently, we could not determine if sea whip corals could serve as an indicator species for habitat quality.

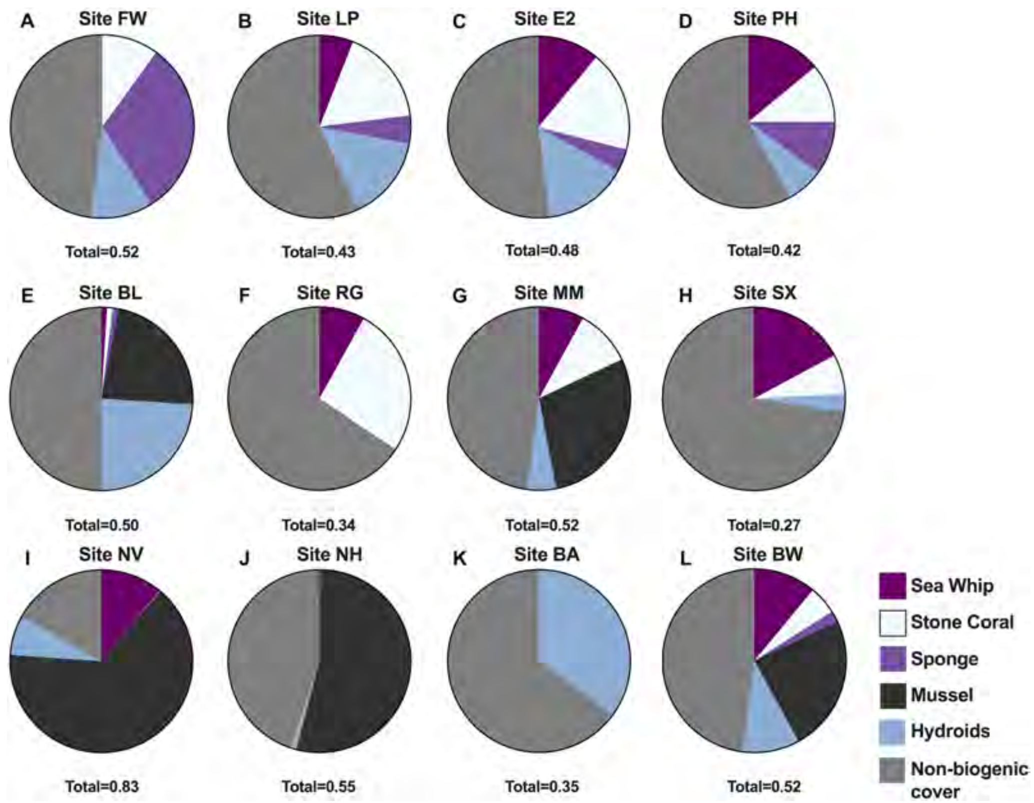

Figure 3 Proportional cover of five structure-forming species groups at the 12 study sites. Pie charts showing the proportions of the five biogenic structures at the 12 study sites (A) Site FW, (B) Site LP, (C) Site E2, (D) Site PH, (E) Site BL, (F) Site RG, (G) Site MM, (H) Site SX, (I) Site NV, (J) Site NH, (K) Site BA, (L) Site BW. Total, Cumulative total coverage of all five biogenic species groups from quadrat images.
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Table 3 Summary table of quadrats. Summary table of proportional cover of biogenic structures by site. *n* quadrats are the number of images taken and analyzed at each site. $\bar{x}$ is the mean proportional coverage for each variable: SW, sea whip coral; SC, northern stone coral; SP, boring sponge; MS, blue mussel; HY, hydroids.

Site	*n* quadrats	$\bar{x}$ SW	$\bar{x}$SC	$\bar{x}$ SP	$\bar{x}$MS	$\bar{x}$ HY
FW	27	0.00	0.10	0.31	0.00	0.11
LP	36	0.06	0.17	0.05	0.00	0.15
E2	11	0.11	0.18	0.04	0.00	0.15
PH	60	0.14	0.11	0.10	0.00	0.07
BL	51	0.01	0.01	<0.01	0.23	0.24
RG	41	0.08	0.26	<0.01	0.00	0.00
MM	33	0.08	0.10	0.00	0.29	0.05
SX	31	0.17	0.07	<0.01	0.00	0.03
NV	37	0.11	<0.01	0.00	0.65	0.07
NH	27	<0.01	0.00	0.00	0.54	0.01
BA	31	0.00	0.00	0.00	0.00	0.35
BW	27	0.11	0.05	0.02	0.24	0.1

Table 4 Table showing fish MeanCount and MaxNo. Summary of fish MeanCount and MaxNo for underwater video census surveys.

Site	MeanCount	SD	MaxNO
FW	0.50	0.76	2
EP	5.25	2.18	14
E2	14.4	5.67	35
PH	7.49	3.07	24
BL	3.93	5.44	18
RG	5.05	2.66	18
MM	–	–	–
SX	6.64	7.56	27
NV	4.36	4.86	15
NH	0.64	2.41	3
BA	1.57	0.84	7
BW	7.07	4.92	19

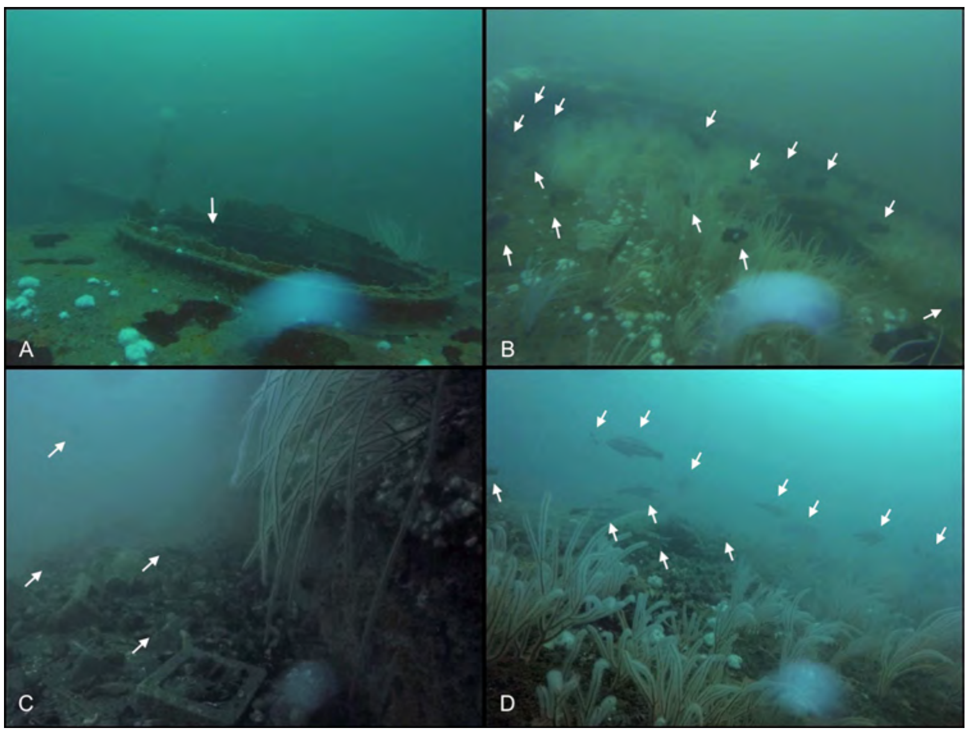

Figure 4 Comparisons of fish aggregations on sites. Photos taken at two locations at Sites SX and NV. (A) Region of Site SX with minimal biostructure. White arrow highlights the single fish located within this frame. (B) Photo taken during the same dive survey as 4A. Region of Site SX with increased sea whip coverage. White arrows show the location of the 14 fish seen within this frame. (C) An area of Site NV that is mostly composed of rock, broken shells and concrete blocks with a single sea whip coral and some colonies of northern stone coral on the wall of the wreck. White arrows show the locations of the 4 fish in the frame. (D) Photo taken during the same dive survey as 4C showing an area with increased sea whip colonies. White arrows show the location of the 12 fish within the frame. Photo credit: Cara C. Schweitzer.

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Table 5 **Results from linear model of fish MeanCount vs proportional cover.** ANOVA results from the linear model analysis for 11 of the 12 sites. Fish MeanCount is the response variable and biogenic structural species are the predictor variables.

Variable	Sum Sq	*F* value	*df*	*P* value
Sea whips	73.87	9.31	10	0.028
Stone Coral	20.01	2.52	10	0.173
Sponge	0.13	0.17	10	0.904
Blue mussel	7.87	0.99	10	0.365
Hydroids	11.21	1.41	10	0.288

DISCUSSION

The presence of autogenic engineers often increases habitat quality resulting in increases in species abundance and biodiversity across terrestrial, freshwater, and marine ecosystems (*Jones, Lawton & Shachak, 1994*; *Hastings et al., 2007*), however, not all can be considered equivalent having positive correlations with species biodiversity and abundance (*Jones, Lawton & Shachak, 1997*; *Daleo et al., 2004*). Therefore, it is important to understand the relationships between composition of biogenic structure and fish abundance. Benthic rock reefs and artificial reefs within the Mid-Atlantic Bight are poorly studied and inhabited by multiple economically important species (*Hostetter & Munroe, 1993*; *Shepherd, Moore & Seagraves, 2002*) that are exploited both recreationally and commercially. Many of these species (e.g., black sea bass and tautog) are considered structure oriented, but it remains unclear if biogenic structure affects their habitat selection. Insights into the relationships between biogenic structure and fish abundance will be useful for developing ecosystem-based fisheries management (EBFM).

In this study we measured habitat composition and relative fish abundance on 12 artificial reef sites to determine if relationships existed between biogenic structure and habitat use by fish. We concluded that fish abundance was significantly correlated with sea whip coral as a proportion of total cover and that fish were often aggregated near sea whips. In fact, sites without sea whips, or having a proportional abundance of <0.01, had low values for both fish MeanCounts and MaxNo. Within the Mid-Atlantic Bight, sea whip corals are the primary autogenic engineer that contributes to height of benthic structure, increasing the structural complexity of such habitats. In previous studies, coral height has been found to be a significant predictor of fish abundance and biodiversity within coral reef systems (*Hoyle & Harborne, 2005*). Due to their height, sea whip corals can be susceptible to disturbance (e.g., fishing) that may result in damage and degradation (*Schweitzer, Lipcius & Stevens, 2018*), which could lead to reduced fish abundance.

Habitat degradation is commonly correlated with a reduction in biodiversity and abundance of associated species (*Wilson et al., 2006*). We observed sea whips entangled in fishing line and rope, along with various levels of damage to colonies throughout the study sites. However, our study sites did not differ significantly from each other; therefore, we could not determine the effect of sea whip damage on fish abundance. This result is not surprising because, these sites are exposed to seasonal recreational fishing pressure, and are seldom fished by commercial fishers. Seasonal fishing pressure (i.e., June through

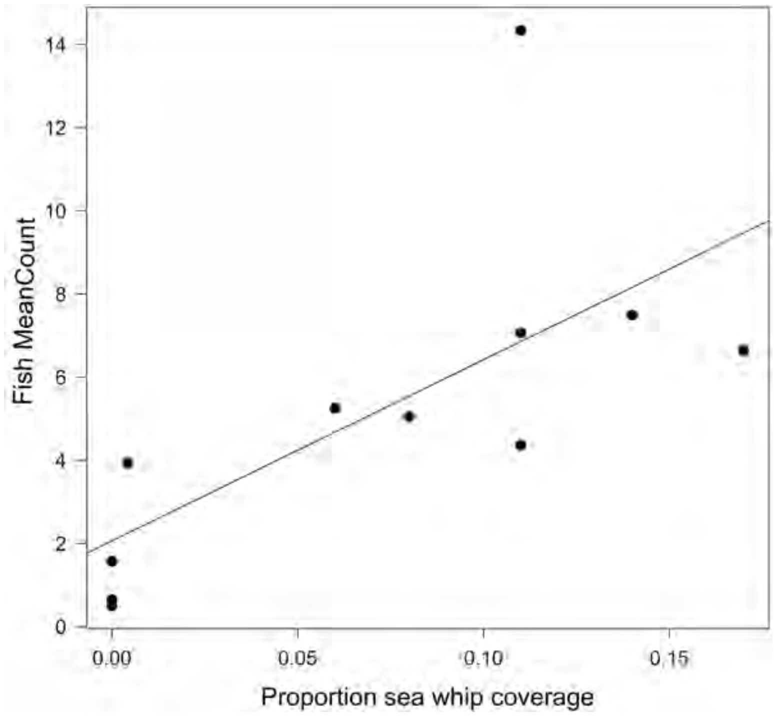

Figure 5 Relationship between fish MeanCount and proportional sea whip coverage. Linear model showing the relationship between fish MeanCount and proportional sea whip coral coverage for 11 of the 12 study sites. There is a significant positive correlation ($p = 0.018$; $r^2 = 0.48$).

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September) may allow for some recovery from disturbance, however sea whip recovery rate from tissue damage is poorly understood. Previous studies have shown that commercial traps drag along the ocean bottom upon retrieval, running over and breaking sea whips (*Schweitzer, Lipcius & Stevens, 2018*), which may accelerate degradation. In order to test the hypothesis that sea whip coral health affects fish abundance on patch reefs, data are needed on sites with wider distribution of impact levels, ranging from moderate to severe degradation, to compare with less-impacted sites.

In this study we did not investigate natural reef sites due to their inaccessibility to SCUBA. Natural reefs off the coast of the Delmarva peninsula are highly fragmented and sparse, occurring at depths $\geq$ 27 m. Attempts to locate these by SCUBA diving along commercial trap lines demonstrated that greater amounts of time were needed to locate and sample patch reefs than could be accommodated by no-decompression diving on air or EAN32 gas mix. Natural reefs are commonly targeted by both recreational and commercial fishers; therefore, it is important for future studies to incorporate surveys of natural reefs. *Schweitzer, Lipcius & Stevens (2018)* surveyed three naturally occurring patch reefs with a remotely operated vehicle in an area targeted by commercial fishers. The mean DI for those sites was 0.37, substantially greater than 0.15 for the study sites in this survey. However, biogenic structure composition and relative fish abundance for those sites or other natural reef sites is unknown.

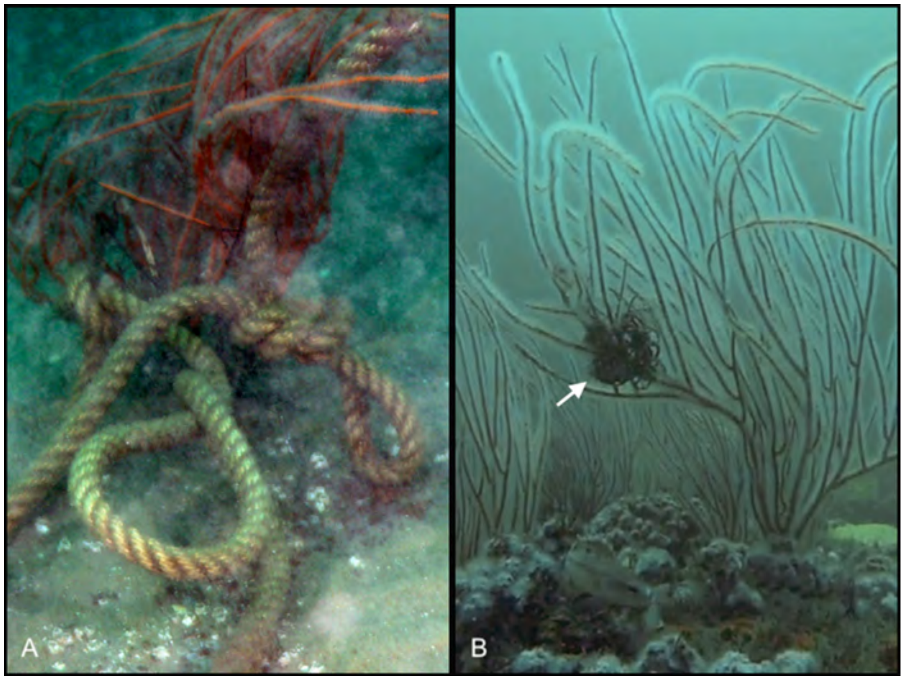

Figure 6 Anthropogenic disturbance effecting sea whip corals. Two photographs showing representative examples of anthropogenic disturbance observed at the research sites. (A) Sea whip coral from Site PH entangled in rope. (B) Sea whip from Site NV with fish line entangled around a portion of branches. Photo credit: Cara C. Schweitzer.

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Our research showed a significant difference in the composition of biogenic structure between sites. Blue mussels were the dominant epifauna at five sites (i.e., $\geq$22% cover), however they were not observed at the other seven sites. Northern stone coral was observed at ten sites and was dominant ($\geq$17%) at three. Only two sites were not inhabited by sea whips, one of which was an artificial reef constructed ~6 mo prior to quadrat sampling. Site NH, constructed 2 y prior to being surveyed exhibited <0.01 proportional sea whip coverage, indicating that it takes a minimum of 2 y for sea whips to begin to grow on concrete and metal substrata. However, settlement and growth rates for sea whips (*L, virgulata*) are currently unknown. In contrast, sites BA and NH, both of which were constructed <3 y before surveying, were occupied exclusively by hydroids and mussels, respectively, indicating that those species settle quickly, and are probably replaced over time by longer-lived species such as sea whips and stone corals. We conducted quadrat surveys only once at each site. Repeated quadrat surveys, especially after severe weather events, would give insight on rates of succession, changes in sea whip DI, and sea whip colonization rates on newer artificial reefs.

One limitation of our study is that fish abundance was estimated via two different underwater video survey methods: line transects and non-baited stationary cameras, that were conducted over the course of two years. Ideally, abundance censuses would be conducted in a synoptic fashion; however, weather and water conditions in the Mid-Atlantic Bight were often deemed too hazardous for SCUBA surveys, making it difficult

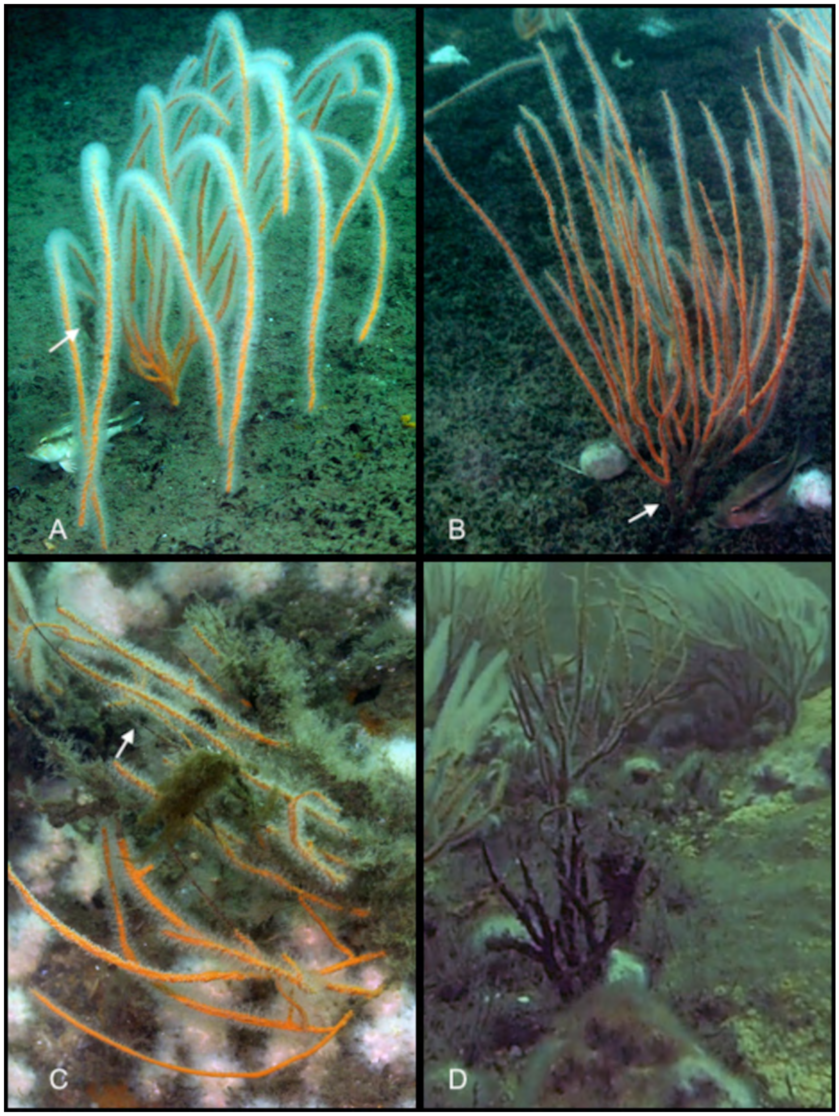

Figure 7 Sea whip corals at various levels of damage. Photographs showing sea whip corals with four different degrees of damage. (A) Sea whip coral exhibiting a minimal proportional damage index of 0.02. White arrow highlights the region of damage. (B) Sea whip coral exhibiting minor proportional damage index of 0.13, localized at the base of the coral. (C) Sea whip coral exhibiting a severe proportional damage index of 0.51. The white arrow is showing a region where the tissue has completely decayed, exposing the skeletal structure. This coral also exhibits colonization of hydroids. (D) Sea whip coral exhibiting critical proportional damage index of 1.00 with no live tissue remaining. Photo credit: Cara C. Schweitzer.

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to collect data within specific time blocks. The video surveys acquired from the stationary cameras at four sites (Sites LP, E2, PH, & RG) could result in an upward bias of the MeanCount; nevertheless, fish MeanCount still showed a significant correlation with sea whip abundance at the remaining seven sites. Additional surveys are needed to understand how fish abundance at sites varies seasonally and annually since many of the prominent fish species (e.g., black sea bass and tautog) are seasonal migrators.

Table 6 **Damage indices for the research sites.** Summary of the mean proportional damage for sea whips and the habitat DI by site. n is the number of sea whips analyzed at each site. $\bar{x}$ is the mean proportional damage for the measured sea whips. SD is the standard deviation. Max is the highest proportional damage observed. Min is the lowest proportional damage observed. D.I. is the damage index assigned to the site.

Site	n	$\bar{x}$	SD	Max	Min	D.I.	Degradation Category
FW	0	–	–	–	–	–	–
EP	31	0.26	0.19	0.77	0.05	3	Moderate
E2	11	0.02	0.02	0.02	0.00	1	Minimal
PH	19	0.15	0.24	1.00	0.00	2	Minor
BL	17	0.15	0.24	1.00	0.00	2	Minor
RG	19	0.07	0.05	0.18	0.02	2	Minor
MM	24	0.15	0.15	0.47	0.00	2	Minor
SX	21	0.12	0.11	0.40	0.00	2	Minor
NV	26	0.11	0.15	0.66	0.00	2	Minor
NH	7	0.15	0.30	0.82	0.00	2	Minor
BA	0	–	–	–	–	–	–
SW	28	0.15	0.21	0.78	0.00	2	Minor

Our study is the first to quantify the composition of biogenic structure on artificial reefs off the coast of Delmarva peninsula and to show that fish abundance is significantly correlated with the presence and abundance of sea whip corals. Construction of artificial reefs off the coast of Delmarva occurs on an annual basis to increase the local abundance of economically valuable species. Creating artificial reefs near regions with established sea whip coral populations may help facilitate sea whip settlement and colonization of new structures. Future studies to determine variations in fish abundance over time, and to determine the succession of biogenic structure would be useful. In addition, future surveys of naturally occurring patch reefs should be conducted, in order to gain a more detailed assessment of habitat quality in the mesophotic regions of the Mid-Atlantic Bight.

CONCLUSION

These results show that there is significant variation in biogenic structure assemblages between artificial reef sites off the coast of the Delmarva peninsula. Fish aggregations and abundance on these artificial reefs are significantly correlated to the abundance of the sea whip coral *L. virgulata*. Sites voided or containing low abundance of *L. virgulata* exhibited the lowest fish abundance. Currently, these artificial reef sites show only minor signs of degradation with no significant difference between sites. It would be important to further these surveys to natural rock reefs and sites that undergo both commercial and recreational fishing pressure to determine if such sites exhibit different levels of sea whip damage, and if higher levels of sea whip degradation effect fish abundance and aggregations. This study could be used as a baseline for current conditions of artificial reef sites off the Delmarva peninsula. Similar surveys should be conducted in the future to monitor succession rates of biogenic structure assemblages. Furthermore, continuing surveys that monitor sea whip settlement rate on new constructed artificial reefs, changes sea whip abundance, and the progression or recovery of damaged sea whips could be valuable to understanding habitat selection and fidelity for economically valuable species in the Mid-Atlantic Bight.

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ADDITIONAL INFORMATION AND DECLARATIONS

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Competing Interests

The authors declare there are no competing interests.

Author Contributions

- Cara C. Schweitzer conceived and designed the experiments, performed the experiments, analyzed the data, contributed reagents/materials/analysis tools, prepared figures and/or tables, authored or reviewed drafts of the paper, approved the final draft.
- Bradley G. Stevens conceived and designed the experiments, authored or reviewed drafts of the paper, approved the final draft.

Data Availability

The following information was supplied regarding data availability:

Schweitzer, Cara (2019): SW data_FS.xlsx. figshare. Dataset. https://doi.org/10.6084/m9.figshare.7772951.v1.

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1. Title Page

Project Title: Estimating and mitigating the discard mortality rate of black sea bass in offshore recreational rod-and-reel fisheries

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2. Executive Summary

In late fall and winter, black sea bass migrate offshore towards the edge of the continental shelf and overwinter at deep shipwrecks and reefs (45-80+ m). The recreational fishery catches black sea bass offshore during the winter both as the target species and as bycatch while targeting other species (e.g., scup, pollock, hakes, cod, tilefish). Black sea bass are often discarded by recreational anglers during these offshore winter fisheries due to factors such as size restrictions, daily possession limits, "high-grading", or closed seasons. The discard mortality rate of black sea bass has been previously investigated for inshore fisheries conducted in relatively shallow water and warmer seasons (i.e., spring through fall), but the discard mortality rate of black sea bass in the winter offshore recreational fishery has not been previously investigated. As a result, this project focused on providing a robust discard mortality rate estimate for the offshore black sea bass recreational fishery in the Mid-Atlantic to inform stock assessments and fishery management, and provide best-practice recommendations for anglers to reduce discard mortality.

We conducted an extensive tagging study involving collaboration among recreational fishing industry stakeholders, volunteer anglers, commercial fishermen, and scientists. Fieldwork was conducted from November 2016 through March 2017, and included eight research tagging charters aboard recreational headboats. Our primary study site was the Ice Cream Cone shipwreck, which is situated in 45 m depth and ~85 km southeast of Sea Isle City, NJ. A total of five research tagging charters were completed to the Ice Cream Cone shipwreck from early December 2016 through early February 2017. Two additional tagging trips were completed to the Baltimore Rocks (67 m depth) in February 2017 and one trip to the Indian Arrow shipwreck (58 m depth) in late March 2017. On all tagging trips, volunteer anglers were provided with standardized terminal tackle rigs, whose configuration was established based on a survey of 282 recreational black sea bass anglers. The use of this standardized terminal tackle ensured that black sea bass were captured under authentic scenarios that are representative of the Mid-Atlantic offshore recreational fishery. For each captured black sea bass, a series of technical (e.g., capture depth, angler experience level, fight time, unhooking time, handling time, hooking location, hook removal method), biological (e.g., total length [TL], release behavior, injury, barotrauma symptoms), and environmental (air temperature, sea surface and bottom water temperature) variables were recorded to investigate which factors significantly influenced discard mortality.

Since black sea bass captured in deep water often experience barotrauma, we also examined the effect of swim bladder venting (when done properly) on fish submergence (i.e., the ability to swim back down to the bottom after release) and discard mortality. To accomplish this, fish were released at the sea surface either with no intervening measures (i.e., unvented) or following swim bladder venting with a hollow needle by a trained scientist. At the Ice Cream Cone shipwreck, we tagged a subsample of fish with pressure sensing Vemco acoustic transmitters and monitored their movements post-release using an array of 30 acoustic receivers maintained in collaboration with commercial fishermen. Almost all other sampled fish were tagged with conventional t-bar anchor tags and released to investigate migration patterns and confirm survival if recaptured.

A total of 1,823 black sea bass (136 - 612 mm TL) were sampled throughout the three study sites. Of all sampled fish, 1,713 were released (i.e., some were retained for ageing), including 957 that were vented and 756 unvented. A total of 1,467 fish were tagged with conventional t-bar anchor tags. At our main study site, the Ice Cream Cone shipwreck, 566 fish were sampled, and a subset of 96 fish (278 - 546 mm TL) tagged with acoustic transmitters, 48 of which were vented (278 - 546 mm TL) and 48 were not vented (279 - 485 mm TL). Fight times for captured fish ranged from 12 - 251 (Mean ± SD: 78 ± 32) seconds for the full sample. Capture of larger fish at deeper depths by low speed reels, or capture as part of a double header increased fight time. The majority of fish were hooked in the mouth. Released black sea bass exhibited four release behaviors including erratic swimming, sinking, floating, and swimming down, with the vast majority exhibiting the latter two behaviors. Results of a logistic regression indicated that fish total length, capture depth, venting, and the presence of exopthalmia influenced release behavior, with larger fish, that were not vented, caught at deeper depths, and experienced exopthalmia had a lower probability of swimming down.

A total of 304 (17%) black sea bass incurred injuries (i.e., wounds > 2 cm), mostly as a result of hooking trauma and/or the hook removal process. Twelve individuals (0.4%) were dead upon landing, with most having been bitten in half by predators or experienced ripped gills from hooking. The majority (82%) of captured individuals exhibited no injury. The vast majority (95%) of captured black sea bass exhibited symptoms of barotrauma. Stomach eversion was the predominant barotrauma symptom, with stomach eversion score 2 (i.e., stomach protruding from the mouth cavity) being present in 68% of all captured fish. Exopthalmia was present in ~10% of all captured fish. Barotrauma symptoms were generally more prevalent at deeper depths, particularly exopthalmia, which was most prevalent at the deepest capture depth of 67 m.

Acoustic detection data were obtained for 94 of the 96 black sea bass tagged with acoustic transmitters. The two undetected fish exhibited floating behavior and both possibly experienced avian predation. Survivorship of individual black sea bass tagged with acoustic transmitters was objectively determined by a multi-step process that compared their vertical and horizontal movements to those of 'known alive' (positive controls, n=7) and 'known dead' (negative controls, n=2) fish. Of the 94 black sea bass that were detected within the receiver array, 61 survived the capture and handling process and were considered to be alive and 33 died after release. Of the 33 mortalities, nine were attributed to predation following re-submergence. All predation events occurred within 1.8 - 18.4 (7.2 ± 4.5) hours of release. All of the remaining 24 mortalities were assumed to have occurred due to the fishing event, and occurred from 5.0 - 128.0 (17.1 ± 26.7) hours post-release. Of these, 19 (79.2%) mortalities occurred within 24 hours of release, four from 24 - 72 hours post-release (16.7%), and one (4.2%) >72 hours post-release (95.8% of mortality occurred within 72 hours).

Final black sea bass survivorship data were analyzed with the non-parametric Kaplan-Meier estimator and the semi-parametric Cox proportional hazards model to evaluate the suitability of capture-related variables (i.e., covariates) for predicting survival and to identify a parsimonious subset of covariates that best predict survival. Once the subset of influential covariates was identified, a parametric survival analysis modeling approach was used to assess potential models that can describe survivorship over time and estimate overall discard mortality. The results of our survival analyses suggested that swim bladder venting was the most significant predictor of mortality in released black sea bass. Based on the model results, the mean total fishing-related (i.e., discard) mortality rate at the Ice Cream Cone shipwreck in 45 m depth was 0.21 (95% CI: 0.12, 0.37) for vented black sea bass and 0.52 (95% CI: 0.38, 0.67) for unvented black sea bass. When looking only at unvented fish, fight time was the most significant predictor of mortality, with increased fight time (>54 seconds) resulting in a markedly higher discard mortality rate. Based on these findings, discard mortality for both vented and unvented fish may have been elevated at the deeper locations due to the higher mean fight times of 80 seconds at the Indian Arrow shipwreck (58 m) and 94 seconds at the Baltimore Rocks (67 m).

Given that swim bladder venting (when done correctly) was the most influential factor on discard mortality and increased submergence success over all depths, we recommend that anglers vent all black sea bass that are captured during the offshore winter fishery before they are released, particularly those that experience barotrauma symptoms. However, full realization of the benefits of venting will require continued education and outreach on proper venting techniques and recommended venting tools. Based on this study, swim bladder venting would be the best practice for reducing discard mortality, but given that longer fight times significantly increased discard mortality of unvented fish, we recommend the following practices as additional options for reducing fight time and therefore also discard mortality: target black sea bass in as shallow of water as possible, reel in fish at a moderate to fast pace, use appropriate strength tackle that can easily land black sea bass in deep water, and consider using single hook rigs given that double header catches had longer fight times. In addition, the impacts of dead discards could be reduced by avoiding the targeting of other species in fishing locations and seasons when black sea bass retention is prohibited, or avoiding locations and seasons when undersized black sea bass that have to be released are the primary catch.

In conclusion, our study estimated mean discard mortality rates of 21% for vented and 52% for unvented black sea bass following capture and release in 45 m depth. Given that venting is not commonly practiced in the fishery, the 52% estimate for unvented fish is most representative of the current discard mortality rate when the fishery operates at (or near) this depth. However, due to increased fight times, the discard mortality rate is expected to be higher at greater depths. Current black sea bass stock assessments and fishery management plans assume a 15% discard mortality rate for the coastwide, year-round black sea bass recreational fishery. Based on our results, we recommend further evaluation of the appropriateness of this assumption in terms of being able to provide the best possible estimate of total fishery removals and for developing management plans. Because swim bladder venting was the single greatest factor that reduced the discard mortality rate and increased submergence success, fishery managers might consider encouraging, or even mandating, the venting of black sea bass released in offshore and deep water winter recreational fisheries. Yet, as previously stated, this would require extensive education of fishery participants on proper venting technique and tools. Additionally, given that predation events by other fishes primarily occurred early in our field season and that deeper depths had to be fished to catch black sea bass later in the winter, it may be most advantageous to open the fishery in our study areas off southern New Jersey from the period of mid- or late-December through January, which is when fish are more likely to be accessible at 'shallower' depths (i.e., <~55 m) and predation risk is lower. The results of our study are also applicable to other deep water regional fisheries in which black sea bass experience barotrauma, and therefore should assist with the development of regulations that would reduce the number of discards and discard mortality of black sea bass.

3. Introduction

Recreational rod-and-reel fishing is a popular activity that produces significant socioeconomic benefits to coastal communities (Lovell et al., 2013). Each year, a substantial portion of the total recreational catch is discarded due to management measures (e.g., minimum landing sizes, possession limits, closed seasons) or personal conservation ethics (Tufts et al., 2015). However, reliable discard mortality rate estimates are often difficult to obtain, despite being vital for estimating total fishing mortality in stock assessments and for developing fishery management plans. Previous studies on recreational fisheries have indicated that discard mortality rates are species-specific and often influenced by various capture-related variables, including tackle type, fish handling method, air/water temperature, capture depth, and degree of physical injury (e.g., Diodati and Richards, 1996; Hochhalter and Reed, 2011; Curtis et al., 2015). Increased research related to discard mortality in recreational fisheries and associated outreach efforts to educate anglers have also recently been identified as key strategies for addressing challenges in managing recreational fisheries (FishSmart, 2014; NOAA, 2014).

Black sea bass (*Centropristis striata*) are commonly captured along the east coast of the United States by recreational anglers (Shepherd and Nieland, 2010). Throughout their range, the species is caught as part of numerous seasonal recreational fisheries that utilize multiple different gear and tackle types, and occur over a range of water depths, water temperatures, and air temperatures. Accordingly, published black sea bass discard mortality rates vary considerably by region (e.g., 4.7% to 39%), with an increase in mortality rate evident in deeper capture depths (Bugley and Shepherd, 1991; Collins et al., 1999; Rudershausen et al., 2014). Currently, black sea bass stock assessments and fishery management plans assume a 15% discard mortality rate for the coast-wide recreational fishery (NEFSC, 2017), but the wide range of published estimates indicate that this rate may not be representative of all regional fisheries.

In late fall and winter, black sea bass migrate offshore towards the edge of the continental shelf (Moser and Shepherd, 2009) and overwinter on deep shipwrecks and reefs (45-80+ m). Within this time and area, large numbers of fish can be discarded by recreational anglers during directed and non-directed (e.g., scup, cod, tilefish) trips due to size restrictions, daily possession limits, "high-grading", or closed seasons. The discard mortality rate of black sea bass in this offshore fishery is uncertain. Collins et al. (1999) reported black sea bass discard mortality rates up to 39% following rod-and-reel capture in a similar depth range (43-54 m) off South Carolina, but it is unclear the extent to which this estimate is applicable to the Mid-Atlantic offshore recreational fishery that occurs in colder water and air temperatures, sometimes at deeper depths, and in different ecosystem conditions (i.e., predator species and abundance). In addition, the estimates derived by Collins et al. (1999) for the 43-54 m depth range were based on low sample sizes (n=25) and by monitoring fish in cages for 24 h post-release, which is a technique that can bias mortality estimates and potentially serve as under- (i.e., shielding from predation) or over-estimates (i.e., impacts on feeding) of discard mortality (Davis, 2002). Consequently, further research was needed to provide a more robust discard mortality rate estimate for the offshore black sea bass recreational fishery in the Mid-Atlantic to inform stock assessments and fishery management.

This project addressed the Mid-Atlantic Fishery Management Council 2016–2017 Collaborative Fisheries Research Program Priority #4 by determining the discard mortality rate of black sea bass captured by recreational anglers using rod-and-reel fishing gear in the fall/winter Mid-Atlantic offshore fishery. In addition, this project established best practices guidelines to reduce the discard mortality rate of black sea bass in both the offshore and inshore fisheries. These goals were achieved by meeting the following originally proposed research objectives:

(1) Estimate the discard mortality rate of black sea bass following capture with rod-and-reel fishing gear at a deepwater offshore shipwreck in the Mid-Atlantic using passive acoustic telemetry and a longitudinal survival analysis.

(2) Identify the capture-related factors that influence black sea bass discard mortality.

(3) Utilize the results from (2) to establish "best practice" guidelines for reducing the mortality of discarded black sea bass.

(4) Conduct a broad outreach effort to disseminate project results from (1) and (3) to invested stakeholder groups (e.g., fishery managers and scientists, recreational fishing community).

(5) Describe the residency, behavior, and habitat use of black sea bass at an offshore shipwreck in the Mid-Atlantic.

4. Methods

<u>Study Timeline</u>: Fieldwork was conducted from November 2016 through March 2017, which covers the winter period of highest offshore recreational fishing effort for black sea bass in the Mid-Atlantic.

<u>Study Sites</u>:

Ice Cream Cone Wreck (main study site): This study utilized input from a range of industry collaborators to ensure selection of a suitable study site that provided an accurate representation of the winter offshore recreational black sea bass fishery in the Mid-Atlantic, and was in a location conducive for maintaining an acoustic telemetry receiver array. Following extensive conversation with industry collaborators, including those who are part of the Starfish Fleet in Sea Isle City, NJ (e.g., Captain Bob Rush, Capt. Mike Weigel), captains from the United Boatmen of New Jersey, and industry stakeholders from the Partnership for Mid-Atlantic Fisheries Science, it was decided to have the main study site be the "Ice Cream Cone Wreck", which is located ~85 km southeast of Sea Isle City, NJ in 45 m depth (Figure 1). This location is an area with consistently high black sea bass catch rates and a depth range that is representative of common offshore fishing grounds for black sea bass.

Baltimore Rocks and Indian Arrow Wreck: Black sea bass catch rates at the Ice Cream Cone Wreck slowed considerably beginning in the middle of January 2017. In fact, only 14 fish were captured during the last tagging trip to the site on February 3, 2017. In an effort to achieve our target number of observations (i.e., ~1,200 fish) and to investigate how our observations and discard mortality might vary by depth, the decision was made to conduct future trips at alternative, deeper fishing locations that were further from port and are locations where black sea bass have historically been captured later in the winter fishing season. Three additional trips were made, including two trips to the Baltimore Rocks (67 m in depth) and one trip to the Indian Arrow wreck (58 m), during February and March, respectively (Table 1; Figure 1A). Not only did the execution of these trips allow us to reach our target sample size, but they also permitted the observation of fish captured at deeper depths, and the investigation of potential effects of capture depth on barotrauma and fish survival (see Findings section below).

Tagging Methods:

Our team collaborated with the Vemco staff (Halifax, Canada) in order to select the most appropriate pressuring-sensing acoustic transmitters (model V9P-2H; Vemco AMIRIX Systems, Inc., Nova Scotia) and optimal transmitter programming configurations (e.g., tag power, battery life, depth sensor resolution, and transmission schedule; Table 2) to match the study site depth and study objectives. Similarly, our team worked with the Floy tag manufacturing company (Seattle, WA) to design and purchase the conventional t-bar anchor tags most appropriate for black sea bass tagging, including Pedersen discs used to attach the acoustic transmitters (see below).

Transmitter attachment and retention study: Prior to any tagging trips, a holding tank study was conducted in order to test multiple transmitter attachment methods, and evaluate the minimum acceptable fish tagging size, transmitter retention rate, and tagging-induced mortality rate for each method. In collaboration with Bill Hoffman from the Massachusetts (MA) Division of Marine Fisheries, 35 live black sea bass (Total lengths: 27 – 42 cm) were collected while fishing with rod-and-reel aboard the *R/V Mya* in Buzzards Bay, MA on 9/12/2016. Following capture, fish were kept in onboard holding tanks during transport to the Seawater Laboratory at the University of Massachusetts Dartmouth School for Marine Science and Technology in New Bedford, MA. All methods related to the holding tank experiment were performed under approval by the Institutional Animal Care and Use Committees (IACUC) at both Rutgers University and the University of Massachusetts Dartmouth (Appendix 1).

Two methods for externally attaching acoustic transmitters were tested beginning on 9/20/2016. Method 1 involved the use of Floy spaghetti tag material, which was passed through the dorsal musculature of the fish with a hollow needle and tied around the transmitter end cap to secure it in place (n=10 fish; Figure 2A). Method 2 involved the use of 22.7 kg test monofilament line, 0.25 – 0.75" Pedersen discs, and copper crimps (n=5 fish; Figure 2B). For this method, a 20 cm length of monofilament line was first tied to the transmitter end cap. Next, a small baffle and Pedersen disc were threaded onto the line and pushed flush against the transmitter. Using a hollow needle, the monofilament line was threaded through the dorsal musculature of the fish, and a Pedersen disc and baffle were threaded onto the tag end of the line. Finally, Pedersen discs were snugged in place on either side of the fish's body and a small, single sleeve, copper crimp was threaded onto the tag end, positioned flush against the baffle/disc assembly, and secured in place by a crimping tool. The monofilament line tag end was then cut.

After 62 days of observation following tagging with each method, there was zero tag shedding or mortality at the termination of the study on 11/21/2016. Given this, (1) any mortality observed in the field could be assumed to be due to the capture, handling, and release processes, rather than the tagging process, and (2) tag shedding is unlikely to occur during this time window. Although both attachment methods were successful, Method 1 resulted in a high prevalence of skin lesions and tissue irritation. Thus, Method 2 was chosen as the preferred attachment method, because it did not cause as much harm to the fish (i.e., fewer and less severe tag-induced lesions were observed) and was generally thought to provide a more solid attachment of acoustic transmitters to black sea bass. The minimum acceptable fish size for tagging was also established at 27 cm, which is consistent with the size of the smallest fish monitored in this holding study and permitted the tagging of black sea bass that are under the current federal minimum size limit (12.5" or 31.75 cm).

<u>Field protocol, tagging strategy, and data collection</u>:

Determining standardized terminal tackle: Prior to any sampling, we conducted an extensive survey of recreational black sea bass anglers and captains to determine the reel type (e.g., conventional, spinning, or electric), tackle (e.g., line type and strength, hook type and size, etc.), and rigging techniques (e.g., use of monofilament topshot, topshot length, etc.) that are most commonly used in the Mid-Atlantic recreational offshore black sea bass fishery. This survey was hosted on SurveyMonkey during October and November 2016, and was distributed primarily via online message boards for recreational anglers (e.g., www.thebassbarn.com, www.noreast.com, and www.njfishing.com). A total of 282 anglers responded to the survey. This survey was originally intended to designate standardized rod-and-reel setups and terminal tackle rigging for use by all volunteer anglers during all research tagging charters. However, it was ultimately only used to select standardized terminal tackle rigging, because the volunteer anglers wanted to use their personal rods and reels while fishing. Our research team permitted this, because rod choice is not expected to impact discard mortality and it gave us the opportunity to investigate how other factors such as reel speed/retrieve ratio might impact discard mortality while still keeping the terminal tackle rigging standardized. Based on the results of the online tackle survey (Table 3), our standardized terminal tackle rigging was a High-Low rig made with 50 lb. (22.7 kg) monofilament leader material and two 5/0 Octopus J-hooks (Mustad Ref. # 92553-BN) (Figure 3). All terminal tackle rigs were tied by co-PI D. Zemeckis. Anglers were provided the appropriately sized lead sinkers for the current sea conditions that day to keep the baits on the bottom to catch black sea bass (i.e., 10 - 20 ounces, 284 - 567 grams).

Tagging trips: Eight for-hire charter trips were conducted from December 2016 – March 2017 (Table 1). Research tagging charters to deploy acoustic transmitters at the Ice Cream Cone wreck were conducted aboard the *F/V Susan Hudson* from Sea Isle City, NJ, from December 2016 – February 2017 (n=4 trips), and one charter aboard the *F/V Porgy IV* sailing from Cape May, NJ, in January 2017. The final three tagging trips were all completed aboard the *F/V Susan Hudson*, with two trips fishing the Baltimore Rocks and the final trip fishing the Indian Arrow shipwreck. Each tagging trip had 6 - 14 volunteer anglers of varying experience levels (as quantified by questionnaire) and up to four scientific personnel. Prior to the commencement of fishing activity on each trip, each volunteer angler was required to complete an angler questionnaire that quantified their experience level (Appendix 2). For all fishing activities, volunteer anglers were given the option to fish with their own fishing rod-and-reel setup as long as their terminal tackle rig was the standardized design as described above. If the angler did not have their own rod and reel setup they were provided one that was rigged accordingly by scientific staff. All anglers were provided the same bait (chopped sea clam or squid, provided by the chartered vessel) and allowed to determine how best to fish, handle, and unhook their catch to promote authentic scenarios. Each volunteer angler was provided a stopwatch in order to record the following times for each fish: fight time, unhooking time, and handling time.

For each captured black sea bass, a series of technical variables that describe the capture event were recorded, including: capture depth, angler experience level, fight time, unhooking time, handling time, hook location (Figure 4), and hook removal method. Biological variables including total length (TL), air and water temperature, and release behavior were also recorded. Each fish was also assigned a physical injury score (i.e., present or absent), as well as exopthalmia and stomach eversion scores, which assessed the impacts of the capture process and barotrauma, respectively. See Table 4 for a description of all recorded variables. To monitor post-release fate, a subset of 96 black sea bass were tagged with Vemco acoustic transmitters. Captured fish not tagged with acoustic transmitters were tagged with conventional t-bar anchor tags (Floy FD-94; n=1,467) to confirm survival or identify movement patterns if recaptured, or otherwise retained for biological sampling (i.e., ageing: n = 74). The remaining 282 captured fish were not tagged due to logistical issues (e.g., too many fish that needed processing during a very short period of time) or after our conventional t-bar tag supply was exhausted.

Previous research on black sea bass indicated that swim bladder venting may decrease discard mortality (Collins et al., 1999), and anecdotal reports from the industry suggest that the inability to submerge (due to barotrauma) is a major contributor to discard mortality (Gary Shepherd, pers. comm.). To examine the true extent to which swim bladder venting impacts submergence success and discard mortality rate, a subset of captured black sea bass were vented using a Ventafish VF-1 Fish Venting Tool following techniques outlined at www.catchandrelease.org. This tool included a 16 gauge replaceable needle with a 45 degree front end. To minimize risk of internal injury to the fish from improper technique, all fish were vented by a single trained scientist (co-PI D. Zemeckis) by placing the fish flat on the measuring board and inserting the needle into the swim bladder behind the pectoral fin while using the spring-loaded button on the tool to insert the needle and let the gas release out of the vent holes on the needle. Having one trained scientist perform all of the venting of the fish ensured that we were able to test the influence of proper venting technique on black sea bass discard mortality. An equal number of vented and non-vented fish were tagged with acoustic transmitters (n=48 fish per treatment), and efforts were made to vent fish over all observed lengths and in an equal ratio for all other capture observations.

Tag recaptures and lottery: A toll free phone number was maintained through Rutgers University to retrieve fishery-dependent recapture information. That number was printed on all conventional t-bar anchor tags and Pedersen discs used for attaching acoustic transmitters so that whenever a tagged fish was recaptured it would hopefully be reported to our research team. A database of all reported recaptures was maintained and a lottery reward system was used to randomly award three anglers (who reported tag recaptures) a $500 reward on three separate occasions during the project (i.e., June, September, and December of 2017).

<u>Acoustic receiver array design, deployment, and monitoring</u>: To monitor the fate of fish tagged with acoustic transmitters, an array of 30 acoustic receivers (Vemco model VR2W) was strategically deployed based upon extensive communication among the project team and fishing industry collaborators in order to maximize the coverage of the Ice Cream Cone shipwreck and surrounding areas and to minimize the risk of losing equipment (Figure 1). All receivers were deployed using an established mooring system based on that depicted in Figure 5A. Twenty five receivers (Stations: SB1 - SB25) were deployed on November 28, 2016 in cooperation with Captain Eric Burcaw aboard the *F/V Rachel Marie* from Sea Isle City, NJ and an additional five receivers (Stations: SB26 - SB30) were deployed on January 17, 2017 in cooperation with the *F/V Porgy IV* (Figure 5B). These five additional receivers were deployed based on preliminary data that showed a high degree of movement towards the southern portion of the acoustic array and our desire to increase our ability to monitor movements in this direction. HOBO Pendant temperature

loggers (Onset Computer Company, Onset, MA) were placed at the surface and bottom of receiver mooring lines at stations SB1, SB8, SB21, and SB23 and were programmed to record water temperature every 5 minutes (Figure 1B). Three trips (12/20/2016; 1/21/2017; 2/21/2017) were conducted aboard the *F/V Rachel Marie* to download, clean, and maintain acoustic receivers, with most receivers being permanently hauled and downloaded on 3/27/2017. Three acoustic receivers were lost over the period of November 28 to March 27 (SB3, SB10, SB24). All downloaded acoustic telemetry detection data were backed-up on external drives and quality controlled for data analysis.

Three acoustic receivers (SB12, 13, and 15: Figure 5B) positioned in close proximity to the shipwreck were left in place after 3/27/2017 to continue monitoring the study site in case tagged black sea bass visited this location during their inshore spring migration. Unfortunately, all three acoustic receivers and mooring systems were lost when they were attempted to be retrieved by Captain Burcaw during one of his commercial fishing trips on 6/4/2017. Efforts were made to grapple at the location at which each receiver was set, but Captain Burcaw was unable to recover any of the gear. Although these receivers were positioned around the shipwreck and were not previously disturbed or lost, it's possible that there was a negative interaction with another trap or scallop dredge fisherman in the spring, or perhaps a passing cargo ship or tugboat. Despite these losses, the loss of only six total receivers was viewed as being relatively minor given the distance of the receiver array from shore, the rough winter weather, and the regular presence of passing cargo ships in the study site, as well as the presence of commercial sea scallop fishing vessels near and inside the array in March 2017. Further, the loss of only three receivers during the main study period, including no losses around the wreck, permitted excellent data recovery to meet study objectives.

Given the importance of 'known alive' (i.e., positive control, see below) fish to the analysis, a last attempt to monitor for any acoustically-tagged black sea bass that may have remained at or returned to the Ice Cream Cone wreck was made in December 2017. To accomplish this, we provided the *F/V Susan Hudson* with a single acoustic receiver to deploy during one of their charter fishing trips to the wreck. This receiver was deployed as planned, however, no acoustic detections were obtained.

<u>Statistical analysis:</u> All statistical analyses were performed with the statistical computing software R (R Foundation for Statistical Computing, 2018). Significance was accepted at a level of $p < 0.05$. To investigate the relationship between fight time and fish TL, capture depth, capture as part of a 'double header' (i.e., two fish captured simultaneously, one on each hook), and reel ratio (i.e., high or low speed reels) a generalized additive mixed effect model with an inverse link function was performed using the 'mgcv' package (Wood, 2011) in R. To account for variation resulting from angler behavior, 'Angler' was included as a random effect. All model variants were compared using the Akaike Information Criterion (AIC; Akaike, 1973) to examine the effect of each factor on fight time, with the model variant with the lowest AIC score being chosen as the best fitting model.

A fixed-effects logistic regression was also employed to evaluate the relationship between release behavior and several capture-related variables, including depth, fish TL, physical injury, presence of exopthalmia, presence of stomach eversion, and venting. A parsimonious set of these variables were selected with a stepwise forward model selection process using AIC following Benoit et al. (2010). In brief, variables were added incrementally to an intercept-only model and retained only if the AIC score was reduced by at least three units. If final models had an equal number yet different composition of variables and an AIC score ≤ 3 units, both were kept and considered equally plausible.

Survivorship assessment: Survivorship of individual black sea bass tagged with acoustic transmitters was objectively determined by comparing vertical and horizontal movement against black sea bass with known statuses (see below). Following procedures detailed by Capizzano et al. (2016), prior to analysis all transmitter data were initially vetted for false detections using the FDA Analyzer tool in VEMCO's User Environment (version 2.2.2) and irrational detection data that coincided with transmitter failures.

Dead controls (known dead fish): Accurate identification of the post-release fate of black sea bass is predicated upon a thorough understanding of the horizontal and vertical movements that are exhibited by a dead fish. For example, surface currents can move dead fish as it sinks to the bottom and bottom currents can cause a carcass to drift along the bottom, providing the perception of directed movement (i.e., a living fish). To identify behaviors that were indicative of a dead fish, five dead fish were tagged with acoustic transmitters and released at the study site. Preliminary data from dead controls released early in the study suggested that carcasses tended to drift out of the array, thus, to obtain a representation of a stationary fish (i.e., a dead fish that was resting in one place), an additional transmitter was deployed on a stationary mooring line within the acoustic array (Figure 1B). Resulting dead control data were used as standards by which to determine the fate of all other acoustically-tagged fish. Reliable data were obtained from two of the fish dead control fish released within the receiver array; data from the three other dead controls were determined to be insufficient due to the extreme brevity of their monitoring period (i.e., hours).

Positive controls (known alive fish): Throughout the study period, seven acoustically-tagged black sea bass were confirmed to be alive either by acoustic detection (n=4), or fishery-dependent recapture (n=3). Acoustic detections were obtained for these fish in collaboration with the Atlantic Cooperative Telemetry (ACT) Network (Table 5). Since the fate of these fish was known (i.e., 'alive'), they were treated as positive controls and used as standards by which to determine the fate of all other acoustically-tagged fish.

Given the impact of misclassifying mortality events on subsequent longitudinal survival results (see below), we employed a three-step approach to determine individual fish fate. Step (1) of our approach involved the use of a discriminant function analysis, which creates a function capable of classifying individuals of unknown origin into groups based on metrics from individuals of known origin (White and Ruttenberg, 2007) using solely acoustic detection data. A discriminant function was created using gross movement metrics from positive and negative controls, specifically maximum depth variance, minimum depth, and the proportion of total depth observations that were shallower than an individual's mean overall observed depth minus the mean depth variance of dead control fish, using the R package "MASS" (version 7.3-45; Venables and Ripley, 2002). Discriminant function results included a fate assignment (alive or dead) for each fish.

Step (2) included the application of a depth variance test applied to depth observations recorded at defined intervals throughout the detection history of each acoustically-tagged fish. Because transmitters were programmed to emit transmissions on a phased schedule, acoustic detection data were binned into specific time intervals post-release to maintain a consistent number of expected detections per interval (Capizzano et al., 2016). Only bins with at least 10 observations were included in the analysis. To account for the effect of tide height on individual depth observations, the study site's tidal cycle was estimated and subsequently removed from each transmitter's depth record using the R package "oce" (version 09-21; Kelley and Richards, 2017). The variance of tide corrected depth observations in each time bin were compared to that of the negative controls for each fish using a one-tailed t-test of the absolute difference from the median (modified Browne–Forsythe–Levene test for homogeneity of population variance; Lyman Ott and Longnecker, 2010); from now on referred to as the depth-variance survival test. Tide-adjusted depth data of negative controls were assumed to be representative of dead black sea bass in the study area since they interacted with the area's bathymetric features over time. Due to the infrequency of off-bottom movement exhibited by black sea bass, when a tagged black sea bass's depth-variance was significantly different ($p < 0.05$) from the negative controls during one or more time intervals, the fish was classified as being alive.

Following Steps 1 and 2, all fish that were detected for >2 days whose fate was predicted to be the same by both the discriminant analysis and depth variance test (n=50 fish) were assigned the appropriate fate (e.g., Discriminant analysis result = ALIVE, Depth variance test result = ALIVE, Final fate = ALIVE). For the remaining 44 detected fish, due to the brevity of their monitoring period (i.e., the lack of critical movement data) and the discrepancy between the discriminant analysis and depth variance results, each fish was subsequently subjected to a semi-quantitative analysis that used multiple metrics to objectively infer their final fate. This analysis included: (1) a semi-qualitative assessment of the horizontal and vertical movement patterns of each fish that placed particular emphasis on the comparison of their movements to those evident in both positive and negative controls; and (2) the analysis of the trajectory of horizontal movements in relation to surface and bottom currents predicted at the study site by the Regional Ocean Modeling System (ROMS) (data available at https://www.myroms.org/).

For (1), individual horizontal and vertical movement plots (see Appendix 3 for example plots) were first examined to determine if the general pattern of movement was consistent with either positive (characterized by bottom-oriented behavior with some vertical movements up to ~20 m and more extensive horizontal movements, including non-linear emigration from the receiver array) or negative control fish (characterized by small vertical movements on the order of the depth range evident in the study site and no or limited horizontal movement restricted to straight line emigration from the array). In nine instances, vertical movements, represented by repeated, extensive movements from the bottom to 15 - 20 m that commenced at the onset of darkness (night), that were not observed in either positive or negative control fish were evident (Fish #'s: 3358, 3359, 3365, 3367, 3370, 3372, 3374, 3376, 3379; Appendix 3). Based on the observation of numerous predation events (e.g., the capture of fish that were bitten while being brought to the surface) that occurred during each of the research trips on which these nine fish were tagged, each fish was considered to have been predated upon following release. Based on conversations with vessel captains and crews, there is strong evidence that predation events such as these commonly occur during the early part of the offshore black sea bass fishing season (e.g., November and December when dogfish and bluefish abundance are highest at these locations), thus, all predation events were included in the survival analysis as 'dead' fish (see below).

For (2), the trajectory of horizontal movements exhibited by each fish during periods when they were floating at the surface (i.e., depth = 0 m) or moving along the bottom in a manner that resulted in their emigration from the receiver array was compared with ROMS current predictions at the study site (at the time of detection) to determine if movements were indicative of active swimming or drifting behavior. In brief, examination of directional movement data from both positive and negative controls indicated that while positive controls (i.e., known alive fish) often moved in opposition or tangential to the direction of the prevailing current (i.e., into the current), dead control fish (i.e., known dead fish) almost always drifted in the direction of the prevailing current (i.e., with the current). Furthermore, positive control fish also generally exhibited straight line movement out of the array over a much shorter period (<10,000 seconds) than dead controls (>10,000 seconds), thereby providing evidence of active movement. Given these observations, the fate of all remaining fish (n=35) was determined by comparing the duration and trajectory of their movement in relation to the bottom current direction, with fish that slowly moved along the bottom (i.e., with only small differences in depth evident) in the direction of the current being classified as 'dead' and those that moved more rapidly against or tangential to the direction of the bottom current being classified as 'alive'.

Analysis of survival data: Final black sea bass survivorship data were analyzed to address the following objectives: (1) to evaluate the suitability of capture-related variables (i.e., covariates) for predicting survival and to identify a parsimonious subset of these that best predict survival; and (2) to use this subset of covariates to assess potential models that can describe survival over time and estimate overall discard survival. Event times for both dead (i.e., time of death) and surviving (i.e., time of last observation) black sea bass, along with the values for a suite of capture-related variables that may affect survival (i.e., covariates) were compiled following methods described by Benoît et al. (2015) and Capizzano et al. (2016). Such event times were categorized as one of three types of data censoring: (1) fish that were inferred to have died within the acoustic receiver array (i.e., uncensored), (2) fish that died during capture and handling or release (i.e., left-censored), and (3) fish released alive whose death was not inferred/observed during the experiment (i.e., right-censored).

A combination of non-parametric and semi-parametric longitudinal survival analyses were used to address objective (1) following procedures outlined by Knotek at al. (2018). First, the empirical Kaplan-Meier (KM) estimator was used to visually assess the influence of biological, technical, and environmental covariates on the survival function (cumulative probability of survivorship over time; Cox and Oakes 1984). Because the KM estimator is non-parametric, it follows the proportion of individuals alive as a function of time in the absence of censored observations. Log-rank tests, specifically the Peto & Peto modification of the Gehan-Wilcoxon test, were performed to accept or reject the null hypothesis that there was no statistical difference between survival functions for categorical covariates. The median for covariates with continuous data were used to establish broad categories for the KM estimator and log-rank tests.

A mixed-effects Cox proportional hazards model (CPHM) was then used following Knotek et al. (2018) to objectively evaluate the suitability of covariates as predictors of survival given the model's ability to simultaneously evaluate the additive effect of multiple covariates (Cox 1972; Therneau and Grambsch, 2000). The model is expressed as:

$$h(t) = h0(t)\exp(X'+Z'b) \qquad \textbf{(Eq. 1)}$$

where h(t)is the instantaneous probability of mortality at time *t* conditional on having survived to time *t* (i.e., the estimated hazard function), which is a function of a non-parametric baseline hazard function h0(t), a vector of covariates X' and a Gaussian random effect *Z'*. Because this class of survival analysis is semi-parametric, it makes no assumption about the shape of h0(t) but assumes that the ratio of hazards for two individuals is constant over time and is a function of both the covariates and random effects (Cox, 1972). To identify a parsimonious subset of covariates, the stepwise forward selection process using Akaike's Information Criterion corrected for small sample sizes (AICc; Burnham and Anderson 2002) was used as per Benoit et al. (2010). The random effect ('sampling trip') was considered to incorporate any within-trip correlations (e.g., Benoît et al. 2010) as outlined by Knotek et al. (2018). Seven sensible covariates were identified *a priori* and with KM estimators as potentially influencing discard mortality in black sea bass and were included in the model selection procedure: fight time, handling time, TL, physical injury, air temperature, sea surface temperature, season (fall and winter), and venting. The release behavior covariate was dropped due to insufficient sample size of fish that floated after release (n=10). Covariates that produced the best fit model were used in the subsequent modeling as the predictors for survival.

Despite their ability to fit the data, non-parametric and semi-parametric models cannot be used to parse out different mortality sources (e.g., capture-handling, post-release) or provide mechanistic interpretations of survivorship patterns over time (Benoit et al. 2015). Therefore, the parametric survival modeling approach developed by Benoît et al. (2015) was used due to its ability to explicitly account for these types of mortality and provide estimates for each. Specifically, this model assumes that there are two general groups of fish (i.e., fish that have been adversely affected by the fishing event and will die vs. fish unaffected by the fishing event and will not die). The KM estimator of the survival function suggested the presence of two types of mortality over time when viewing survival across all observations: capture and handling mortality that occurred prior to release, and capture-related post-release mortality which occurred within days of release (Figure 6; Benoît et al. 2012, 2015). The survival function for this model (S(t); probability of surviving to time t) is expressed as:

$$S(t) =(\exp[-(t)]+(1-)) \qquad \textbf{(Eq. 2)}$$

where τ is the probability of surviving capture and handling, π controls the probability that an individual was adversely affected by the fishing event, and α and γ are respectively the scale and shape parameters of an underlying Weibull distribution that determines the mortality patterns over time for the adversely affected individuals. From Equation (2), it is clear that at t = 0, $S(t) = \tau$. Therefore, as $t \rightarrow \infty$, the term $exp[-(t)] \rightarrow 0$ (i.e., all affected fish die) and S(t) (1-)(i.e., only unaffected individuals remain alive). Thus, is the conditional post-release mortality rate (i.e., the mortality rate for individuals that were alive when released but subsequently died as a direct result of discard mortality), and 1-+ is the total discard mortality probability.

After determining the basic model and appropriate terms to include, model variants of Equation (2) were developed and fit with the parsimonious subset of covariates. The influence of capture-related variables that may affect survival can be included in the model via the α, γ, τ, and π terms but the effects are most often and strongly observed on the two latter terms (e.g., Benoît et al. 2012, 2015; Capizzano et al. 2016). Three model variants of Equation (2) were considered for model selection procedures (Table 6). Model variants were fit with selected covariates from the CPHM using maximum likelihood and constructed with the same forward selection procedure using AICc.

Because venting may be difficult to implement, the non-parametric KM estimator and semi-parametric CPHM survival analyses were performed on unvented fish to examine the suitability of covariates for predicting survival. Eight sensible covariates determined *a priori* and with KM estimators were included in CPHM model selection with the forward selection procedure using AICc: fight time, handling time, TL, physical injury, sea surface temperature, temperature differential between bottom water and air, season (fall and winter), and release behavior. Since no parametric survival analysis was applied to these data, only general trends are provided.

5. **Problems Encountered**

Some unanticipated problems were encountered during the project, but these problems did not prevent us from addressing our core objectives. With regard to fieldwork (tagging trips and receiver deployment and maintenance), we experienced some difficulty completing offshore tagging trips due to the rough weather conditions, particularly during January 2017. There were also some mechanical and logistical issues that arose with the primary tagging vessel, the *F/V Susan Hudson*, which was unavailable for approximately three weeks in January 2017, because of repairs that needed to be performed following an inspection by the United States Coast Guard. However, the recruitment of a backup vessel (*F/V Porgy IV,* Cape May, NJ) allowed us to quickly capitalize on a nice weather window and not only deploy all of our acoustic transmitters on schedule, but also exceed our target number of black sea bass capture observations by almost 50%. We were also able to spread the acoustic transmitter releases over a variety of weather conditions, and collect observations at multiple locations.

As communicated above, the acoustic receiver array was expanded on January 17, 2017 to provide increased monitoring at the southern extent of the array. This helped to counter the problems observed in data from the first acoustic telemetry receiver download on 12/20/2017, which indicated that the majority of the fish that emigrated from the array did so in a south/southwest direction. In addition to the six acoustic receiver mooring systems that were completely lost during this study (see above), there were three mooring systems that had their surface buoys destroyed by ship strikes. This became evident after they were recovered off the seafloor using a grappling system that couldn't have been employed without the expertise of the collaborating commercial fishermen. Recovery of this equipment not only salvaged the expensive research gear, but also permitted downloading of the valuable data stored on the acoustic receivers. Therefore, strategically rigging our mooring systems and collaborating with commercial fishermen helped to minimize the amount of lost equipment and data.

Due to the complex and diverse nature of the black sea bass movements and behavior in the study site, the need to allow the maximum amount of time for tag recaptures and detections (i.e., the establishment of positive controls), and the complexity of the final survival analysis, the final estimation of discard mortality rate and the identification of the capture-related factors that were predictors of mortality were slightly delayed until later in the project timeline than expected. However, this thoroughness resulted in the most robust results as possible for inclusion in this final report, but it did delay our ability to conduct broad outreach efforts to disseminate out results and educated anglers on recommended best practices for reducing discard mortality (i.e., Objective 3). But, due to the overwhelming importance of the positive control fish to both the accurate identification of individual fish fate and the estimation of the discard mortality rate, it was necessary to obtain as many positive control fish as possible in an effort to maximize the validity of our results. As outlined below, we did begin to disseminate our results to the scientific community and recreational fishing community, and have outlined a detailed plan for completing those efforts with the finalization of our results for this final project report.

6. Findings

Summary of capture events: During the eight research tagging charters conducted from December 2016 to March 2017, a total of 1,823 black sea bass ranging in size from 136 - 612 mm TL were captured over three depths (45, 58, and 67 meters; Figure 7). Due to the sometimes high volume nature of the fishery (i.e., many fish being captured over a short time), a complete set of data for all quantified variables was not available for all captured fish, hence the discrepancies in sample size presented throughout this report. All fishing activities were performed with the standardized High-Low, two-hook terminal tackle setup that was chosen as the most representative gear configuration used in the offshore black sea bass fishery. A total of 50 volunteer anglers of all experience levels participated in tagging trips, however, there were markedly more experienced (scores 5 - 9; n=43 anglers, n=1,663 capture events) than inexperienced (scores 0 - 4; n=7 anglers, n=155 capture events) anglers. However, we feel as though this relationship is representative of true conditions, given that more experienced (i.e., 'die hard') fishermen tend to participate in this fishery given its offshore nature and occurrence during characteristically cold and rough winter months.

Anglers used a fairly wide range of conventional fishing reels, with retrieve gear ratios from 2.5:1 to 7.1:1. For analysis, these reel retrieve ratios were broadly classified as 'low' (reel retrieve ratio <5.0:1; n=891 capture events) and 'high' (reel retrieve ratio >5.0:1; n=927 capture events) speed. All captured black sea bass were lifted onboard while still attached to the hook, no fish were netted or gaffed. A total of 321 capture events were classified as 'double headers', with two fish captured simultaneously (one on each hook). Of the 1,823 captured fish, 1,713 were released including 957 that were vented and 756 that were not vented (Table 7). A total of 1,467 fish were tagged with conventional Floy tags, 766 of which were double tagged (to estimate tag shedding rate). A subset of 96 fish (278 - 546 mm TL) were tagged with Vemco acoustic transmitters, 48 of which were vented (278 - 546 mm TL) and 48 of which were not vented (279 - 485 mm TL).

Technical variables: Fight times ranged from 12 - 251 (Mean SD: 78 ± 32) seconds for the overall sample, with transmitter-tagged fish being fought for 17 - 225 (56 ± 24) seconds (Table 8). Results of a generalized additive mixed effect model indicated that fight time was influenced by fish TL, capture depth, capture as part of a double header, and reel ratio (Table 9). Comparison of delta AIC scores suggested that depth was the most influential factor impacting fight time, with fish captured at the deepest depth (67 m) experiencing the longest fight times (Figure 8). There was a positive relationship between fight time and TL, with larger fish being fought for longer periods (Figure 9). At each depth, interpolation of mean fight time suggested that fish >491 mm TL were fought for longer than average durations. Capture as part of a double header and by low gear (speed) reels also increased fight time (Figures 10 and 11).

Unhooking times and handling times for all observations and transmitter-tagged fish are presented in Table 8. The majority of fish were unhooked by the capturing angler (Figure 12), however, there was no apparent difference in unhooking time between anglers and fishing vessel mates/deckhands or between experienced and inexperienced anglers (Table 8). The majority of fish were hooked in the mouth (shallow or medium mouth), but fish were hooked in various locations of the body throughout the study (Table 10).

Biological variables: Released black sea bass exhibited four behaviors including erratic swimming, sinking, floating, and swimming down, with the vast majority of fish exhibiting the latter two behaviors (Table 11; Figure 13). Results of a logistic regression indicated that fish TL, capture depth, venting, and the presence of exopthalmia influenced release behavior, with larger fish, that were not vented, caught at deeper depths, and experienced exopthalmia had a lower probability of swimming down (Tables 12&13; Figure 14). Air, sea surface water, bottom water, and deltaT (the difference between surface and bottom temperature) temperatures experienced by fish are presented in Table 8. Bottom and surface water temperature at the Ice Cream Cone study site ranged from 6.1 - 14.5 C from the first to last day of monitoring (Figure 15).

Injury score: A total of 304 (17%) black sea bass incurred injuries (i.e., wounds > 2 cm), mostly as a result of hooking trauma and/or the hook removal process. Twelve individuals (0.4%) were dead upon landing, with most having been bitten in half (n=8) or experienced ripped gills (n=2). The majority (82%) of captured individuals exhibited no injury.

Barotrauma: The vast majority (95%) of captured black sea bass exhibited symptoms of barotrauma. Stomach eversion was the predominant barotrauma symptom, with stomach eversion score 2 (i.e., stomach protruding from the mouth cavity) being present in 68% of all captured fish (Figure 16). All four stomach eversion scores were observed in fish tagged with acoustic transmitters, with the relative distribution of scores being comparable to the broader sample (Table 14). Exopthalmia was present in ~10% (n=172) of all captured fish, and in ~6% of fish tagged with acoustic transmitters (Table 14). Barotrauma symptoms were generally more prevalent at deeper depths, particularly exopthalmia, which was most prevalent at the deepest capture depth (67m; Figures 16 & 17).

<u>Survivorship assessment (Objectives 1 & 2)</u>: Acoustic detection data were obtained for 94 of the 96 black sea bass that were tagged with acoustic transmitters. The two fish that were not detected after release (Transmitters 3360 and 3375), were both captured during December (5 & 13th) sampling trips, exhibited ‘floating’ release behavior, and were among the smallest individuals that were acoustically-tagged (286 - 287 mm TL). Given that several other acoustically-tagged fish were detected for extended periods (i.e., minutes to hours) while they floated at the surface (e.g., Fish 3418, 3419; Appendix 3) and these weren’t, it is highly possible that these two undetected fish experienced avian predation shortly after release. Avian predators, primarily herring and black-backed seagulls, were present in abundance during each of these sampling trips, and were observed to actively predate upon other released fish at distances of 15 m or more from the anchored vessel. Regardless, due to the lack of acoustic detection, these individuals were not included in the survival analysis, because avian predation events could not have been visually confirmed for these fish despite our research team observing acoustically-tagged fish floating at the sea surface for as long as possible.

Of the 94 black sea bass that were detected within the receiver array, 61 survived the capture and handling process and were considered to be alive and 33 died after release. Of the black sea bass determined to be alive, 60 emigrated from the receiver array during the monitoring period. The single fish that was detected within the acoustic array on the last day of monitoring (3/27/2017) was later detected by a receiver array off Maryland, thereby confirming its survival. Of the 33 mortalities, nine were attributed to predation following re-submergence (i.e., as the animal swam or sank towards the bottom or after it reached the bottom). All predation events occurred within 1.8 - 18.4 (7.2 ± 4.5) hours of release. The remaining 24 mortalities were assumed to have occurred due to the capture and handling process or natural mortality, and occurred from

5.0 - 128.0 (17.1 ± 26.7) hours post-release. Of these, 19 (79.2%) mortalities occurred within 24 hours of release, four from 24 - 72 hours post-release (16.7%), and one (4.2%) >72 hours post-release (95.8% of mortality occurred within 72 hours).

Analysis of survival data (Objectives 1 & 2):

A fixed-effects CPHM was selected because the inclusion of a random effect did not reduce the AICc by more than three units (-0.651). The best-fit CPHM for black sea bass survival data retained only the effect of venting (Table 15). Results of individual KM estimator survival functions by covariate are reported in Appendix 4. Of note, KM plots suggested that release behavior was a significant predictor of mortality with floating fish exhibiting higher discard mortality than those that swam down (Figure A3; Appendix 4). However, because release behavior was highly correlated with venting and the low sample size for fish that floated, only venting was included in the CPHM model selection.

An effect of venting on only the probability that a fish was adversely affected by discard mortality (π) reduced the AICc by 5.21 units and produced the best model fit (Table 16; model variant 2). The inclusion of venting in model variants 1 (effect on both the capture and handling mortality [τ] and the probability that a fish was adversely affected by discard mortality post-release [π]) and 3 (effect only on the probability that a fish was adversely affected by discard mortality post-release [π]) did not lower the AICc by three units. Consequently, these variants were not considered further. The selected model produced estimates that matched well with those from the empirical KM estimator (Figure 18). Most of the black sea bass mortality is estimated to have occurred post-release (Table 17; Figure 18). Mean post-release mortality rates for non-vented fish were nearly two and a half times greater than vented fish. The mean total fishing-related (i.e., discard) mortality rate was 0.21 (95% CI: 0.12, 0.37) for vented black sea bass and 0.52 (95% CI: 0.38, 0.67) for non-vented black sea bass.

With respect to the unvented black sea bass in the acoustic subsample, a fixed-effects model was selected because the random effect failed to reduce the AICc by more than three units (-3.11). Only fight time was found to predict survival for unvented fish using the CPHM (Table 18; Figure 19). The hazard ratio from the CPHM model summary results suggest that fight time is positively associated with the event probability (i.e., increased fight times increase the chance of mortality; Table 19). Results of individual KM survival function tests by parameter are reported in Appendix 4.

Best-practice capture and handling guidelines (Objective 3): The successful identification of factors that influenced mortality, and therefore the discard mortality rate, of black sea bass in the winter offshore Mid-Atlantic recreational fishery (Objective 2) permitted the formulation of best-practice capture and handling guidelines for reducing discard mortality. Based on the findings that swim bladder venting (when done correctly) was the most influential factor impacting discard mortality and increased submergence success over all depths (i.e., reduced the incidence of floating), we recommend that anglers vent all black fish that are captured during the offshore winter fishery before they are released, particularly those that experience barotrauma symptoms (e.g., exopthalmia or stomach eversion). Given previous documentation of the negative impacts from improper venting technique (e.g., increased injury and mortality: Wilde, 2009), full realization of the benefit of venting will require a broad education and outreach campaign to educate anglers on proper venting techniques and recommended venting tools (see Project Outreach section below).

In light of the extent of the Mid-Atlantic deepwater black sea bass fishery and the large number of anglers who participate in it, educating the majority of participants on proper venting technique may be difficult. As an alternative, particularly if a mandatory venting policy is considered for this fishery, one option would be to focus on educating for-hire (e.g., charter and headboat) vessel captains and crews (e.g., mates/deckhands) about proper venting technique and recommend that anglers who are unfamiliar or uncomfortable with venting protocols to have their catch unhooked and vented by these personnel. This approach would be advantageous since it would focus on properly educating a smaller population, and likely work to reduce the occurrence of improper venting by maximizing the number of ventings that are performed by trained individuals. In addition, these trained individuals will be able to educate other anglers, which, in combination with our team's education and outreach efforts, will help to create a larger population of anglers who are educated on how to properly vent black sea bass. This will be important given the frequently high catch rates in this fishery and the fact that crew members are unlikely to be able to vent all black sea bass that are to be released.

Based on the finding that longer fight time (i.e., >54 seconds) increased mortality in the acoustic subsample, another logical best-practice guideline is to explore methods to minimize the time black sea bass spend on the line while being reeled to the surface. Examination of the GAMM model results indicated that depth of capture had the greatest influence on fight time, thus, we recommend that anglers target black sea bass in as shallow of water as possible (see Management recommendations below). Regarding reel retrieve ratio, although lower speed reels yielded longer fight times (on average), the effect of individual angler had a seemingly large impact on the apparent relationship. In other words, angler behavior (i.e., whether they may have turned the reel handle faster or slower than average) seemed to influence the impact that reel gear had on fight time more than the reel gear ratio itself. Given this, it seems more logical (and practical) to recommend that anglers reel their catch to the surface at a moderate to fast pace, rather than implement restrictions on reel speeds/retrieve ratios. It should be noted, however, that we do not recommend that anglers reel fish to the surface as quickly as possible, because it is possible that this could lead to greater injury to the fish and possible more severe barotrauma-related injury such as swim bladder or stomach rupture.

Capture as part of a double header also resulted in increased fight time. Given this, discard mortality may be reduced if anglers fish with only one hook (as this will eliminate the chance of catching a double header). However, given the deepwater nature of the fishery and the clear indication that the vast majority of anglers use a two-hook high-low rig (as determined by our tackle survey), it is likely that a one-hook recommendation or restriction would be met with strong opposition. Instead, we recommend that anglers use fishing gear (i.e., rod and reel, line) of appropriate strength for the area in which they are fishing (i.e., water depth, size of fish being caught, potential for double headers, etc.) to avoid unnecessary increases in fight time.

Lastly, due to the aforementioned logistical issues with swim bladder venting, reducing fight time may be a more practical recommendation to provide anglers. However, it should be noted that the restriction of fight time will likely not result in the same reduction in mortality that is evident with swim bladder venting.

Anglers can reduce the overall number of black sea bass that are discarded when targeting other species (e.g., cod, pollock, scup, tilefish) by avoiding fishing locations and seasons when black sea bass retention is prohibited, or by avoiding locations and seasons when primarily undersized fish are caught. Also, it is recommended that anglers avoid the practice of "high-grading" (i.e., discarding keeper-sized fish in search of larger fish) to reduce the number of black sea bass that are discarded.

Movements, habitat use, and residency (Objective 5): Movement patterns, habitat use, and residency times at the shipwreck were examined for the 61 fish that were considered to be alive. Detection periods for these fish ranged from 0.07 - 52.07 (12.39 ± 11.70) days. The majority of fish remained at or in close proximity to the shipwreck during their residency within the receiver array, being detected at or directly adjacent to the wreck for continuous periods of 0.00 - 52.06 (12.33 ± 11.73) days (Appendix 3). Excluding fish that emigrated from the wreck within one day of tagging (n=6), 23 fish (41.8%) remained resident at the wreck for periods of 1-7 days, 13 (23.6%) for 7-14 days, 6 (10.9%) for 14-21 days, and 13 (23.6%) for >21 days. By month of tagging, residency times at the wreck were as follows: December: 0.00 - 44.26 (12.12 ± 11.74) days; January: 3.41 - 6.4 (5.87 ± 0.89); and February: 1.83 - 52.07 (13.74 ± 21.48) days. This pattern suggests that cohorts of fish may have been migrating through the study site during their offshore migration, with some individuals remaining at the wreck for longer periods and others spending only brief periods (i.e., <3 days) at the wreck before continuing offshore. The majority of fish emigrated from the array to the southeast (n=35) or south (n=17), with the remaining moving out to the southwest (n=5), east (n=2), and west (n=1). Some additional preliminary habitat use results are presented in Appendix 5 (Winton et al., *In review*), and expanded investigation into black sea bass spatial ecology is planned once those advanced methods are published.

A total of 37 fisheries-dependent recaptures were recorded as of the composition of this report. In general, these recaptures primarily occurred in the Mid-Atlantic region, however, a single fish was recaptured south of Cape Cod, MA (Figure 20). Minimum linear displacements for recaptures ranged from 0 - 464 (89 ± 75) km, and times at liberty from 56 - 365 (160 ± 70) days. Of the recaptured fish, 24 were vented (13 not vented), and 28 swam down at release while 7 floated. A single fish was recaptured at the Ice Cream Cone wreck exactly one year after tagging (12/21/2016 - 12/21/2017).

Project Outreach (Objective 4): An oral presentation was given at the monthly meeting of the Sunrise Rod and Gun Club in Red Bank, NJ on June 2, 2017, entitled "Estimating and mitigating discard mortality in recreational fisheries". Approximately 40 recreational anglers were in attendance and the presentation communicated preliminary results from our project and recommended best practices for reducing discard mortality based on the findings of other published studies. On February 4, 2017, a booth was manned at the Raritan Bay Anglers Club fishing tackle flea market in New Brunswick, NJ. The booth included project materials and plots of preliminary acoustic telemetry results to communicate to anglers the importance of adopting recommended best practices in catch-and-release to reduce discard mortality. Most anglers who visited the booth were very interested in the research and excited to see this type of work being completed to improve the sustainability of the recreational black sea bass fishery. Furthermore, each offshore tagging trip conducted for this project included up to 14 volunteer anglers. Communications with these anglers, which included emails, online message board posts, and phone conversations, also contributed to the outreach component of this project and helped to spread the word about the research objectives and early findings. In addition, when recovered tags were reported it was an excellent opportunity to convey information on the project objectives, as well as preliminary findings and best-practice recommendations. Co-PI D. Zemeckis also recently appeared on a one hour session of Mike Shepherd's fishing talk radio show, "Shep of Fishing" on

News Talk 1400 AM WOND on January 20, 2018. Black sea bass discard mortality was discussed during this radio show and results from the study were shared with listeners.

Given that the project has been completed and recommended best-practices have been developed for reducing black sea bass discard mortality in recreational fisheries, we will continue our outreach efforts to educate recreational anglers and fishery managers on these recommended best practices. Although these efforts have been delayed while completing the data collection and analysis for the project, our project team is actually now better prepared to perform outreach given that co-PI D. Zemeckis recently became an Extension Professor of Fisheries and Aquaculture at Rutgers University. Therefore, in addition to the outreach outlets of other project partners (e.g., the New England Aquarium and MA Division of Marine Fisheries), we will now be able to capitalize on the wide reach of Rutgers Cooperative Extension. In fact, co-PI D. Zemeckis already has the following presentations scheduled in order to educate recreational anglers on project results and recommended best practices for reducing discard mortality:

- Saltwater Anglers of Bergen County (SWABC), monthly meeting, February 20, 2018, Rochelle Park, NJ
- Saltwater Fishing Expo, March 16-18, 2018, Edison, NJ (http://www.sportshows.com/saltwater/)
- Sunrise Rod and Gun Club, monthly meeting, April 4, 2018, Red Bank, NJ
- New Jersey Federation of Sportsmen's Clubs, annual banquet, April 21, 2018, Ocean City, NJ

In addition to these already scheduled presentations, our project team will seek more opportunities to speak at meetings involving recreational anglers. We will also prepare appropriate educational materials (e.g., flyers, infographics) for dissemination on recreational fishing message boards, websites of our collaborating institutions (e.g., Rutgers University, New England Aquarium, MA Division of Marine Fisheries) and other regional partners (e.g., NJ Department of Environmental Protection, Cape Cod Charterboat Association), at booths at saltwater and outdoorsmen shows, and other opportunities that arise for connecting with the recreational fishing industry. Therefore, these ongoing efforts, during which Mid-Atlantic Fishery Management Council funding will be acknowledged, will allow for widespread dissemination of our results and recommended best-practices for reducing the discard mortality of black sea bass.

Dissemination of preliminary project results to the scientific community and fishery managers was accomplished at the 2017 annual meeting of the American Fisheries Society in Tampa, FL when co-PI D. Zemeckis delivered a presentation entitled "Estimating and mitigating discard mortality in recreational fisheries: Case Studies from the northeast U.S." in a symposium focused on bycatch reduction in fisheries. Co-PI D. Zemeckis also delivered a presentation including preliminary results on this project at the 2017 annual meeting of the Mid-Atlantic Chapter of the American Fisheries Society in October 2017 in Dover, DE, entitled "Utilizing collaborative scientist-industry partnerships to estimate and reduce discard mortality in recreational fisheries". Preliminary results were also shared by co-PI D. Zemeckis in a seminar presentation delivered at the NOAA NEFSC James J. Howard Laboratory in Sandy Hook, NJ in December 2017, as part of a talk entitled "Applying previous experiences in marine sciences to expand Rutgers' marine extension program". Co-PIs D. Zemeckis and J. Kneebone are also co-Organizers of a relevant symposium at the 2018 annual meeting of the American Fisheries Society and this project will be the focus of a presentation at that meeting.

After submission of this final report, copies will be disseminated to members of the scientific community who have interest in topics such as black sea bass, discard mortality, fisheries management, electronic tagging, and recreational fisheries. This final report will also be reformatted for publication in a peer-reviewed scientific journal, such as *Fisheries Research* or *Transactions of the American Fisheries Society*, which will allow for expanded and wide dissemination of our results to the scientific community and fishery managers. In addition, a scientific manuscript that seeks to publish new analytical approaches of acoustic telemetry data, with inclusion of data from this black sea bass discard mortality study, is presently in review with the journal of *Methods in Ecology and Evolution* (see submitted draft in Appendix 5). This paper includes co-authorship by co-PIs J. Kneebone and D. Zemeckis:

M.V. Winton, J. Kneebone, D.R. Zemeckis, and G. Fay. *In Review*. A spatial point process model to estimate individual centers of activity from passive acoustic telemetry data. *Methods in Ecology and Evolution* (draft was submitted for publication on December 31, 2017).

7. Discussion

This project represented a collaborative research effort involving recreational fishing industry stakeholders, volunteer anglers, commercial fishermen, and scientists to address an important data gap in our understanding of black sea bass discard mortality in the winter, deepwater, offshore Mid-Atlantic recreational rod-and-reel fishery. Meaningfully involving industry stakeholders in this project helped to ensure that our methods provided an accurate representation of actual fishery conditions, thereby maximizing the applicability of our results for consideration in stock assessments and fishery management plans. Additionally, findings from this project have improved our general understanding of black sea bass biology, discard mortality in recreational fisheries, methods to reduce discard mortality, and the impacts of bycatch in recreational and commercial fisheries.

Our study estimated mean total fishing-related discard mortality rates of 21% for vented and 52% for unvented black sea bass following capture and release in 45 m depth. Acknowledging that venting is not commonly practiced in the fishery, the 52% estimate (for unvented fish) is therefore representative of the current discard mortality rate that is evident when the fishery operates at (or near) this depth. This discard mortality rate is higher than previous estimates generated for a similar depth range (43-54 m) by Collins et al. (1999), who reported discard mortality rates of up to 39% after monitoring fish in cages for 24 hrs. However, this difference could be due in part to the methods in which fish were monitored after release in both studies. For example, while Collins et al. (1999) briefly monitored post-release fate in cages where animals were shielded from predation, while our electronic tagging approach was able to account for predation and monitor mortality over a longer monitoring period. In contrast, Rudershausen et al. (2014) estimated a 19% mean discard mortality rate for non-vented black sea bass following capture at depths of 20-35 m, which is less than half of our estimate for 45 m depth. This discrepancy may be due differences in fight times that were evident between the two capture depths (i.e., 20-35 m vs. 45 m), given our finding that longer fight times (which were evident at deeper depths) resulted in reduced submergence success and higher mortality.

Current black sea bass stock assessments and fishery management plans assume a 15% discard mortality rate for the coastwide, year-round black sea bass recreational fishery (NEFSC, 2017). Our results, as well as those reported in Collins et al. (1999), suggest that this rate is not representative of the discard mortality rate that is evident in the offshore, deepwater, winter recreational fishery. Given this, it is recommended that stock assessment scientists and fishery managers re-evaluate the validity of the currently assumed 15% estimate and consider whether a single mean discard mortality rate is still appropriate for accurately estimating total recreational fishery removals for the diverse, coastwide recreational fishery. This could be particularly important moving forward, because according to accounts from multiple stakeholder groups, the winter offshore fishery may not be well monitored and there have been many options presented in recent years with respect to opening certain months to black sea bass fishing during the winter period.

Venting the swim bladder of black sea bass significantly reduced discard mortality, with vented fish being more than two times as likely to survive than unvented fish. This finding is at odds with a previous review by Wilde (2009) who concluded that venting fish should not only be discouraged by fishery management agencies, but be prohibited rather than required by regulation given the possibility that venting may adversely affect survival of fish captured from deep water. However, a more recent meta-analysis by Eberts and Somers (2017) found that swim bladder venting, along with the use of descending devices, had positive effects on reducing discard mortality. As a result, Eberts and Somers (2017) recommended that fishery managers consider barotrauma relief options carefully on a case-by-case basis. This study provides robust results indicating that swim bladder venting can reduce the discard mortality rate of black sea bass in the offshore recreational fishery in the Mid-Atlantic. However, as communicated in other papers (e.g., Scyphers et al., 2013; Brownscombe et al., 2016), it is imperative that anglers are educated on proper venting technique to maximize the benefits of this practice and minimize the risk of potentially increasing discard mortality from improper technique. Therefore, as outlined above, our project team will continue our outreach and education efforts in order to share our project findings, including recommended best practices for reducing discard mortality and proper swim bladder venting techniques for black sea bass.

Avian predation is another potential source of mortality in the Mid-Atlantic offshore black sea bass fishery that was not well accounted for by our study. Due to the high catch rates on many of the tagging trips it was difficult or impossible to monitor the disposition of floating fish for more than a few minutes post-release as they drifted away from the anchored vessel. Despite this, there is strong evidence that two acoustically-tagged fish that were floating were consumed by avian predators due to the lack of any acoustic detections for these fish (see Findings). Regardless, although the frequency of avian predation could not be estimated by our study, swim bladder venting will reduce its occurrence given that vented fish will experience higher submergence success and therefore be able to escape avian predators.

Tackle recommendations, such as the use of different hook types (e.g., circle hooks), are often offered as methods to reduce injury and discard mortality in both recreational and commercial fisheries. However, in the Mid-Atlantic offshore black sea bass fishery, hooking location and injury were not found to be significant predictors of mortality, and there was a low incidence of 'deep' or 'internal' hooking (i.e., in the gills or internal organs). This low incidence of deep mouth hooking may be due in large part to the fact that the most common terminal tackle setup is a High-Low rig with short leaders from the main line to each hook (i.e., dropper loops of 3-5", or 7.6 - 12.7 cm). As suggested by Capizzano et al. (2016), this configuration does not leave much opportunity for the fish to swallow the hook, and therefore results in a high incidence of mouth hooking. Given this, circle hooks, which have been demonstrated to increase the incidence of mouth hooking in other fisheries, may not offer an added conservation benefit for black sea bass in the offshore Mid-Atlantic fishery.

Future work

Although our results convincingly demonstrate that swim bladder venting (when done properly) can reduce discard mortality rate, future research should investigate the relative benefit of descending devices as an additional option for reducing the discard mortality rate of black sea bass in deep water fisheries. Previous research has shown that the descending devices can increase the submergence success of black sea bass (Musick et al., 2015), but no studies have been conducted to quantify the relative benefits of descending devices for reducing black sea bass discard mortality. In this study, our project team opted to test swim bladder venting as a method to mitigate barotrauma-related mortality because it is a relatively quick process that is already adopted by some recreational anglers, and therefore was considered more likely to be adopted by anglers in a fishery with high catch rates (such as the offshore black sea bass fishery). However, it would be valuable to evaluate the relative benefits of swim bladder venting and descending devices for reducing discard mortality, and, depending on the differences, educate anglers on the best practices that would provide maximum benefit for reducing discard mortality.

The movement patterns and population structure of black sea bass in offshore Mid-Atlantic waters is another issue that requires additional research. Many of our volunteer anglers and fishing industry partners hypothesized that the large black sea bass that are caught at some of these offshore locations in the Mid-Atlantic would migrate seasonally from southern New England (e.g., Rhode Island and Massachusetts), which is supported by some previous tagging research (Moser and Shepherd, 2009). However, we only had one tag recapture from a fish migrating to the area off Cape Cod (Figure 20) despite tagging hundreds of large fish. Nonetheless, the stock structure of black sea bass remains a largely unresolved issue (NEFSC, 2017). Based on the previous research and our limited observations of movement patterns, we recommend that additional research on black sea bass stock structure be conducted in the future. Our findings of relatively low discard mortality in vented black sea bass at these offshore depths presents the opportunity to expand future tagging efforts to these offshore locations.

Management implications

The results of our study have direct and significant implications for the management of the offshore recreational black sea bass fishery in the Mid-Atlantic, and likely beyond. Given our findings that swim bladder venting was the single greatest factor that reduced the discard mortality rate and increased submergence success, there is strong evidence that total mortality would be greatly reduced if anglers were encouraged, or possibly even required, to vent all black sea bass that are released in the Mid-Atlantic offshore fishery. Furthermore, our results provide strong support that venting will increase the post-release survival of black sea bass that experience barotrauma in any other fishery that occurs along the coast. However, as previously mentioned, such reductions in mortality are predicated upon the widespread education of recreational anglers about and adoption of proper venting technique. Therefore, substantial and continued outreach would be necessary to maximize the benefits of venting.

Observations of the timing of post-release predation events, the negative impact of extended fight times on survival, and the relationship between fight time and capture depth also hold strong management implications for the fishery. Based on our survivorship assessment, predation (at-depth both during capture and post-release) by other fishes was evident in the acoustically-tagged subsample only during early December, primarily on the first research trip on December 5, 2016. Based on previous experiences of our research team and discussions with the captain and crew of the *F/V Susan Hudson*, predation events such as those observed are common in the early part of the offshore fishing season before predators such as bluefish and spiny dogfish migrate further offshore or south as waters cool with the onset of winter. Interestingly, subsequent sampling trips to the Ice Cream Cone wreck on December 21st and January 17th experienced one or no predation events by other fishes, respectively, and there were no predation events by other fishes observed during the trips to deeper fishing spots in mid-February through late-March.

Although predation by other fishes was absent during the latter tagging trips to the Indian Arrow wreck (58 m depth) and Baltimore Rocks (67 m depth), discard mortality may have actually been elevated at these locations due to the increased fight times that were evident. Results of our survival analysis on unvented fish suggest that longer fight times (>54 seconds) resulted in markedly higher mortality. Thus, since mean fight times for the 58 and 67 m capture depths were 80 and 94 seconds, respectively, it is likely that the discard mortality rate of both vented and unvented fish captured at these deeper depths was higher than those estimated for 45 m depth at the Ice Cream Cone wreck. In addition, based on the data collected during this study, the overall mortality resulting from discarding of fish would be expected to be higher at the Baltimore Rocks (i.e., the deepest fishing location) due to the fact that nearly half of the black sea bass captured at this location were less than the 12.5" (318 mm) federal and New Jersey minimum size limit, and would have been mandated to be released (Figure 7). Taken together, the occurrence of predation events by other fishes primarily at the beginning of the season and the need to fish at deeper depths during the latter part of the season (due to the continued offshore migration of black sea bass during the winter), our results suggest that in order to reduce the impacts of discards it may be most advantageous to open the fishery from the period of mid- or late-December through January, which is when fish are more likely to still be accessible at 'shallower' depths (i.e., <~55 m) and predation risk is lower. However, these observations are based on the 2016-2017 fishery off southern New Jersey and there could be variation inter-annually and along the coast. Therefore, it is recommended that fishery managers consider and apply these findings for each local and regional fishery.

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10. Tables

Table 1 – Summary of tagging trips by location and tagging vessel. The depth fished during each trip as well as the number of volunteer anglers, number of acoustic transmitters deployed, number of convention t-bar tags deployed, and total capture observations are reported.

Date	Vessel	Fishing Location	Depth (m)	Number of anglers	Transmitters	t-bar tags	Total observations
Dec 5, 2016	F/V Susan Hudson	Ice Cream Cone	45	7	20	172	197
Dec 13, 2016	F/V Susan Hudson	Ice Cream Cone	45	7	24	168	202
Dec 21, 2016	F/V Susan Hudson	Ice Cream Cone	45	7	24	73	98
Jan 17, 2017	F/V Porgy IV	Ice Cream Cone	45	10	18	37	55
Feb 3, 2017	F/V Susan Hudson	Ice Cream Cone	45	7	10	4	14
Feb 18, 2017	F/V Susan Hudson	Baltimore Rocks	67	14	0	316	362
Feb 24, 2017	F/V Susan Hudson	Baltimore Rocks	67	14	0	427	440
Mar 21, 2017	F/V Susan Hudson	Indian Arrow	58	13	0	270	455
			Total	**50**	**96**	**1467**	**1823**

Table 2 – Programming specification for the Vemco acoustic transmitters used in this study.

Tag Model	Est tag life (days)	Step 1			Step 2			Step 3		
		End Time (dy hr:min:sec)	Min Delay (sec)	Max Delay (sec)	End Time (dy hr:min:sec)	Min Delay (sec)	Max Delay (sec)	End Time (dy hr:min:sec)	Min Delay (sec)	Max Delay (sec)
V13-2H	673	15 00:00:00	60	180	15 00:00:00	220	340	660 00:00:00	360	480

Table 3 – Results from online tackle survey (n=282 respondents) to select standardized terminal tackle rigging.

Type of Reel	No. Respondents	Proportion
Conventional	**268**	**0.95**
Electric	3	0.01
Spinning	11	0.04
Total	282	

Type of Main Line	No. Respondents	Proportion
Braided	**262**	**0.93**
Monofilment	20	0.07
Total	282	

Topshot	No. Respondents	Proportion
Yes	**209**	**0.8**
No	53	0.2
Total	262	

Rigging Setup	No. Respondents	Proportion
Bait	**252**	**0.9**
Jig	27	0.1
Total	279	

Bait Hook Type	No. Respondents	Proportion
J-Hook	**220**	**0.89**
Circle	24	0.1
Total	244	

High-Low Bait Rig	No. Respondents	Proportion
Yes	**234**	**0.96**
No	10	0.04
Total	244	

J-Hook Type	No. Respondents	Proportion
Octopus	**58**	**0.5**
Baitholder	54	0.47
Virginia	2	0.02
O'Shaughnessy	1	0.01
Total	115	

Hooks/rig	No. Respondents	Proportion
One	7	0.04
Two	**163**	**0.85**
Three	21	0.11
Four	0	0
Five	1	0.01
Total	192	

Hook Size	No. Respondents	Proportion
1/0	3	0.01
2/0	19	0.09
3/0	41	0.2
4/0	48	0.23
5/0	**69**	**0.33**
6/0	19	0.09
7/0	9	0.04
8/0	2	0.01
Total	210	

Topshot	Average	Mode
lb test	40	40
length (ft)	15	20

Main Line	Average	Mode
lb. test	43	50

Bait J-Hook	Average	Mode
Size	4.25	5

Table 4 – Description of all of the technical and biological capture-related variables and the injury and barotrauma scores that were recorded for each captured black sea bass.

Variable	Description
Technical	
Capture depth	Water depth at the location of capture
Angler experience	Angler experience score as quantified by questionnaire
Fight time	Elapsed time from when a fish was hooked to when it reached the surface
Unhooking time	Elapsed time from surfacing until the fish was unhooked
Handling time	Elapsed time from surfacing until fish was released (time out of water)
Hook location	Location where the fish was hooked on the body
Hook removal method	Manner in which the fish was unhooked
Angler hand	Fish was unhooked by hand by the capturing angler
Mate hand	Fish was unhooked by hand by a fishing vessel mate/deckhand
Biological	
Total length	Length from the tip of the snout to the tip of the center of the tail
Air temperature	On deck temperature at the time of capture
Surface temperature	Water temperature at the surface
Bottom temperature	Water temperature at the bottom/wreck
Delta temperature	Difference between surface and bottom water temperatures
Release behavior	Observed behavior exhibited by a fish immediately upon release
Floating	Fish floated on surface
Swam down	Fish swam down towards bottom
Erratic swimming	Fish swam erratically and appeared disoriented
Sinking	Fish sank without swimming
Injury score	
Present (1)	Hook or other wound present >2 cm in length
Absent (0)	Injury limited to hook entry/exit
Barotrauma score	
Exopthalmia	
Present (1)	Eyes bulging from orbitals, bubbles may be present in eyes
Absent (0)	Eyes not bulging from orbitals
Stomach eversion	
0	Stomach not everted
1	Stomach everted but remains within mouth cavity
2	Stomach everted but is protruding from the mouth
3	Stomach everted and ruptured

Table 5 – Summary of acoustic detections received for four transmitters in collaboration with the Atlantic Cooperative Telemetry Network. Note: these four fish were used as positive controls.

Transmitter	Date released	Date detected	Latitude	Longitude	Detections	Detecting institution
3356	12/21/2016	9/9/2017	38.37	-74.54	1	University of Maryland
3357	12/21/2016	6/8/2017	40.38	-73.59	2	Stony Brook University
3385	12/13/2016	6/20 – 6/26/2017	38.73	-74.61	42	University of Delaware
3441	2/3/2017	9/22/2017	38.37	-74.54	4	University of Maryland

Table 6 - Assumptions for the capture and handling (CH; τ) and the probability of being adversely affected by the fishing event post-release (π) parameters of Equation (2) used to define the three competing model variants for analyzing black sea bass survival data.

Variant	Parameters	Description
1	$\tau = [1 + \exp(-X'\beta_1)]^{-1}$ $\pi = [1 + \exp(-X'B_2)]^{-1}$	Covariate effects on the CH mortality and the probability of being adversely affected by the fishing event post-release
2	$\pi = [1 + \exp(-X'B_3)]^{-1}$	Covariate effect on the probability of being adversely affected by the fishing event post-release only
3	$\tau = [1 + \exp(-X'\beta_4)]^{-1}$	Covariate effect on the CH mortality only

Footnote: *X* is the design matrix for the covariate(s) and *β* is the vector of parameters for the effect of the covariates.

Table 7 – Summary of capture variables for all vented and non-vented black sea bass (‘All observations’), including the 96 fish that were tagged with acoustic transmitters (‘Transmitters’). Values in parentheses represent the mean ± standard deviation.

Category	Number of fish	Length range (mm)	Range of time (seconds)		
			Fight	Unhooking	Handling
All observations					
Vented	957	136-612 (349±66)	12-251 (80±32)	2-215 (17±18)	16-420 (141±77)
Non-vented	756	194-548 (323±69)	18-240 (75±69)	3-189 (18±19)	13-575 (142±81)
Total	**1713**	**136-612 (339±70)**	**12-251 (78±32)**	**2-215 (17±19)**	**13-575 (142±81)**
Transmitters					
Vented	48	278-546 (351±61)	17-225 (57±31)	2-42 (12±10)	80-326 (158±50)
Non-vented	48	279-485 (357±52)	29-90 (55±13)	3-52 (17±12)	91-310 (171±51)
Total	**96**	**278-546 (354±57)**	**17-225 (56±24)**	**0-52 (15±11)**	**80-326 (164±51)**

Table 8 – Summary of capture variables recorded for all captured black sea bass ('All observations') and the subset of 96 fish that were tagged with acoustic transmitters ('Transmitters'). Values in parentheses represent the mean ± standard deviation.

Variable	Transmitters	All observations
Capture depth (m)	45	45, 58, 67
Total length (mm)	278 – 546 (354 ± 57)	136 – 612 (339 ± 70)
Fight time (s)	17 – 225 (56 ± 24)	12 – 251 (78 ± 32)
45 m	17 – 225 (56 ± 24)	12 – 225 (55 ± 22)
58 m	-	32 – 240 (80 ± 27)
67 m	-	35 – 251 (94 ± 30)
Unhooking time (s)	2 – 52 (15 ± 11)	10 – 215 (17 ± 19)
Angler hand	2 – 49 (15 ± 11)	1 – 215 (18 ± 20)
Mate hand	3 – 52 (15 ± 12)	2 – 173 (17 ± 17)
Experienced anglers	2 – 52 (14 ± 11)	1 – 189 (17 ± 19)
Inexperienced anglers	13 – 36 (29 ± 9)	2 – 215 (19 ± 21)
Handling time (s)	80 – 326 (164 ± 51)	13 – 575 (142 ± 81)
Air temperature (°C)	5.9 – 15.1 (10.7 ± 2.3)	4.7 – 17.4 (13.9 ± 2.4)
Sea surface temperature (°C)	7.4 – 13.8 (11.4 ± 2.1)	7.2 – 13.9 (12.4 ± 1.7)*
Bottom temperature (°C)	7.4 – 13.8 (11.3 ± 2.0)	7.5 – 13.4 (12.2 ± 1.4)*
Delta temperature (°C)	-0.6 – 0.4 (0.1 ± 0.3)	-0.3 – 0.5 (0.3 ± 0.3)*

* Data only available for trips to the Ice Cream Cone wreck

Table 9 – Model selection results for the generalized additive mixed effect model examining the relationship of each variable on fight time. The model with the lowest Akaike Information Criterion (AIC) value is in bold. TL=total length; DH=double header

Model	Estimated degrees of freedom	Deviance explained	AIC	ΔAIC
Fight time ~ s(TL) + Depth + DH+Reel_gear	**51.52**	**64.3%**	**15088**	**0**
Fight time ~ s(TL) + Depth + DH	50.64	64.0%	15102	14
Fight time ~s(TL) + DH + Reel_gear	50.22	55.5%	15480	392
Fight time ~ s(TL) + Depth+ Reel_gear	50.37	63.4%	15132	43
Fight time ~s(TL) + DH	49.29	55.5%	15479	391
Fight time ~ s(TL) + Depth	49.46	63.1%	15147	58
Fight time ~s(TL) + Reel_gear	49.23	54.2%	15530	441
Fight time ~s(TL)	48.29	54.2%	15528	440
Fight time ~ 1	47.32	49.9%	15685	597

Table 10 – Summary of hooking locations for all captured black sea bass (‘All observations’) and the 96 fish that were tagged with acoustic transmitters (‘Transmitters’). Percentages represent the percent of total observations in each group.

	Transmitters		All Observations	
Hook Location	**Observations**	**%**	**Observations**	**%**
Shallow mouth	47	49.5%	955	54.0%
Medium mouth	38	40.0%	675	38.2%
Deep mouth			9	0.5%
Eye	1	1.1%	5	0.3%
Gills			6	0.3%
Head	1	1.1%	8	0.5%
Isthmus	7	7.4%	96	5.4%
Operculum			5	0.3%
Dorsal surface			5	0.3%
Ventral surface	1	1.1%	4	0.2%
Total	95		1768	

Table 11 – Summary of the number of black sea bass that exhibited each release behavior in the full set of observations (‘All observations’) and the subset of 96 fish that were tagged with acoustic transmitters (‘Transmitters’). ES=Erratic swimming; F=Floating; S=Sinking; SD=Swam down

Category	Release behavior			
	ES	F	S	SD
All observations				
Vented	3	190	6	724
Non-vented	4	234	4	465
Total	**7**	**427**	**10**	**1190**
Transmitters				
Vented		1		47
Non-vented		11		37
Total		**12**		**84**

Table 12 - Forward selection process for the logistic regression model that evaluated release behavior against a set of sensible covariates for all released black sea bass (*n*=1594). Covariates that produced a conservative corrected Akaike Information Criterion (AICc) reduction of three or more units from the previous model were retained (see ΔAICc). An asterisk (*) denotes the final model.

Run	Covariates	AICc	ΔAICc
1	~1	1832.163	
2	~depth	1783.034	49.129
3	~depth + venting	1747.244	35.79
4	~depth + venting + total length	1740.044	7.2
5*	~depth + venting + total length + exopthalmia	1736.882	3.162
6	~depth + venting + total length + exopthalmia + injury	1738.367	-1.485

Table 13 - Regression output coefficient table of the logistic regression model used to analyze the impact of covariates on release behavior for all black sea bass (*n*=1594). Parameter estimates for covariates are listed and include estimates for the regression coefficient, standard error of the regression coefficient (Std. error), the exponentiated coefficient called the odds ratio, the Wald statistics value (*z*-value), and overall statistical significance (*p*-value).

Coefficients:	*Estimate*	*Std. error*	*Odds ratio*	*z-value*	*p-value*
(Intercept)	2.190271	0.308884	8.937631	7.091	1.33E-12
Exopthalmia					
Presence	-0.42472	0.184109	0.653956	-2.307	0.02106
Depth					
57.912 m	-0.252	0.185813	0.777247	-1.356	0.17504
67.056 m	-0.92272	0.149485	0.397439	-6.173	6.72E-10
Venting technique					
Vented	0.800121	0.122604	2.225811	6.526	6.75E-11
Total length	-0.02957	0.009175	0.970866	-3.223	0.00127

Table 14 – Summary of the number of black sea bass that exhibited exopthalmia and each stomach eversion score in the full set of observations ('All observations') and the subset of 96 fish that were tagged with acoustic transmitters ('Transmitters').

Category	Exopthalmia		Stomach Eversion Score			
	Present	Absent	0	1	2	3
All observations						
Vented	92	863	30	193	714	18
Non-vented	80	670	65	207	442	36
Total	172	1533	95	400	1156	54
Transmitters						
Vented	1	47	2	8	35	3
Non-vented	5	43	4	13	29	2
Total	6	90	6	21	64	5

Table 15 - Forward selection process for the Cox Proportional Hazards Model that evaluated the survival function for black sea bass in the acoustic transmitter subsample over a set of sensible covariates determined from Figures A1 – A3 and Table A1 (Appendix 4). Covariates that produced a conservative AICc reduction of three or more units from the previous model were retained (see ΔAICc). An asterisk (*) denotes the final model and parsimonious set of covariates to be considered in the parametric survival analysis. Note: model variants 2 and 3 were indistinguishable by AICc, thus, the most parsimonious model (run 2) was selected as the final model.

Run	Covariates	AICc	ΔAICc
1	~1	285.175	
2*	~ venting	278.2613	6.913218
3	~ venting + total length	277.8582	0.403035

Table 16 - Summary of model variant and covariate selection results using maximum likelihood and a forward selection procedure for black sea bass in the acoustic transmitter subsample. An asterisk denotes the strongest evidence was for variant 2 of the model with the effect of venting covariate on the mixture model component only.

Run	Covariates	Variant	AICc	ΔAICc
1	~1		134.9005	
2*	~venting	2	129.4044	5.4961
2	~venting	1	132.5241	2.3764
2	~venting	3	146.05	-11.1495

Table 17 - Sample sizes and estimates of key parameters for the analysis of survival data for vented black sea bass. The number of fish that died upon release (dead), that died during capture and handling or immediately after release (left-censored), and that were last seen alive (right-censored) are presented. Estimates (95% confidence intervals) of the capture and handling mortality rate ($1-\tau$), the conditional post-release mortality rate ($\tau \cdot \pi$) and the total mortality rate associated with the fishing event (i.e., discard mortality; $1-\tau+\tau \cdot \pi$) are presented by treatment group.

	Numbers				Fishing mortality rates		
Season	Total	Dead	Left	Right	Capture-Handling	Post-Release	Total
Vented	48	9	1	38	0.017 (0.001, 0.158)	0.203 (0.107, 0.351)	0.219 (0.131, 0.406)
Not vented	46	18	5	23	0.017 (0.001, 0.158)	0.487 (0.319, 0.633)	0.504 (0.362, 0.662)

Table 18 - Forward selection process for the Cox proportional hazards regression model that evaluated the survival function for only unvented black sea bass in the acoustic subsample over a set of sensible covariates determined from Figures A4 – A6 and Table A2 (Appendix 4). Covariates that produced a conservative AICc reduction of three or more units from the previous model were retained (see ΔAICc). An asterisk (*) denotes the final model

Run	Covariates	AICc	ΔAICc
1	~1	162.0427	
2*	~ fight time	154.6790	7.3637
3	~ fight time + handling time	155.7066	-1.0276

Table 19 - Regression output coefficient table of the Cox proportional hazards regression model used to analyze the impact of fight time on the overall survival of unvented black sea bass in the acoustic subsample (n=46). Parameter estimates for fight time are listed and include estimates for the regression coefficient, standard error of the regression coefficient (Std. error), the exponentiated coefficient called the hazard ratio, 95% confidence intervals (CI) for the hazard ratio, the Wald statistics value (z-value), and overall statistical significance (p-value).

Coefficients:	*Estimate*	*Std. error*	*Hazard ratio*	*Lower CI*	*Upper CI*	*z-value*	*p-value*
Fight time	0.05284	0.0169	1.05426	1.02	1.09	3.126	0.00177

11. Figures

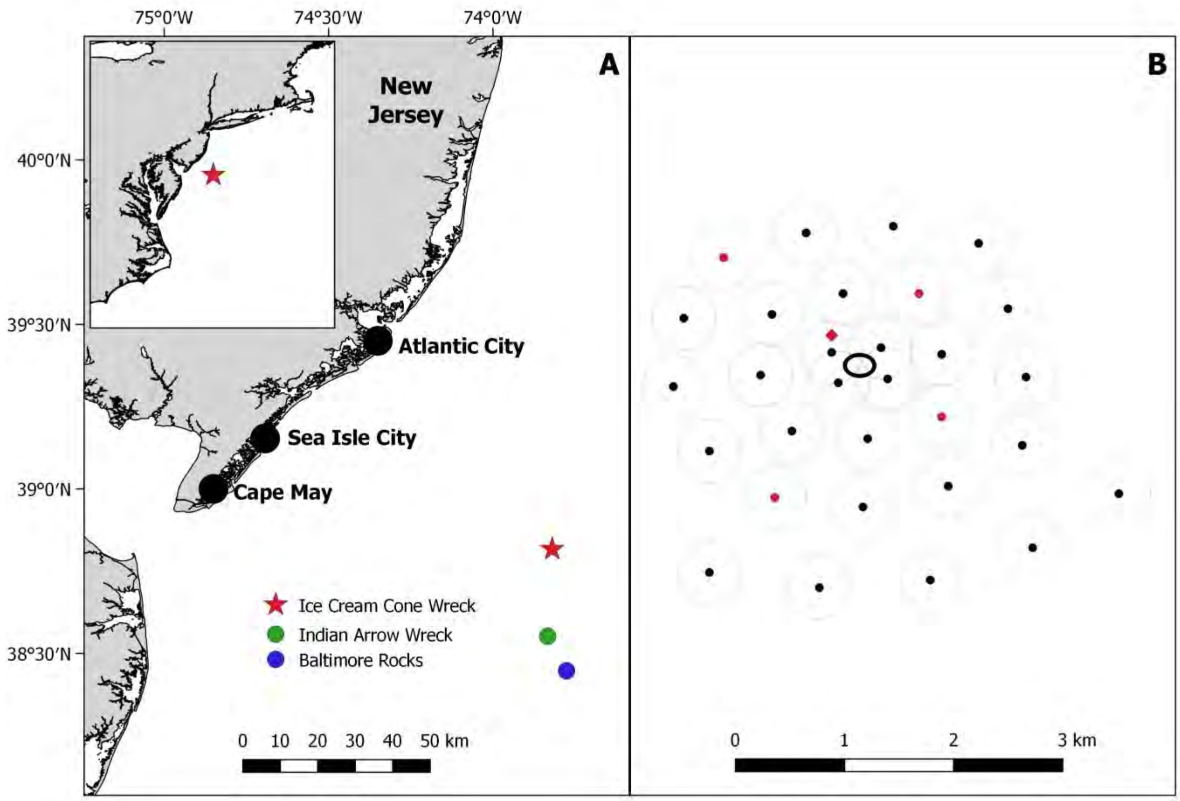

Figure 1 - Map of the approximate location of the "Ice Cream Cone" shipwreck (A: red star and B: black oval), which was the primary study site for this project, as well as the two secondary tagging locations (Baltimore Rocks, Indian Arrow Wreck) (A), and the acoustic receiver array that was deployed to monitor the post-release fate of tagged black sea bass around the wreck (B). Individual acoustic receiver locations (small circles) with (red) and without (black) temperature loggers deployed on their mooring lines are presented. Estimated individual receiver detection range (dotted circles) are presented around each receiver location. The location of the stationary (dead) negative control tag (red diamond, B) is also presented.

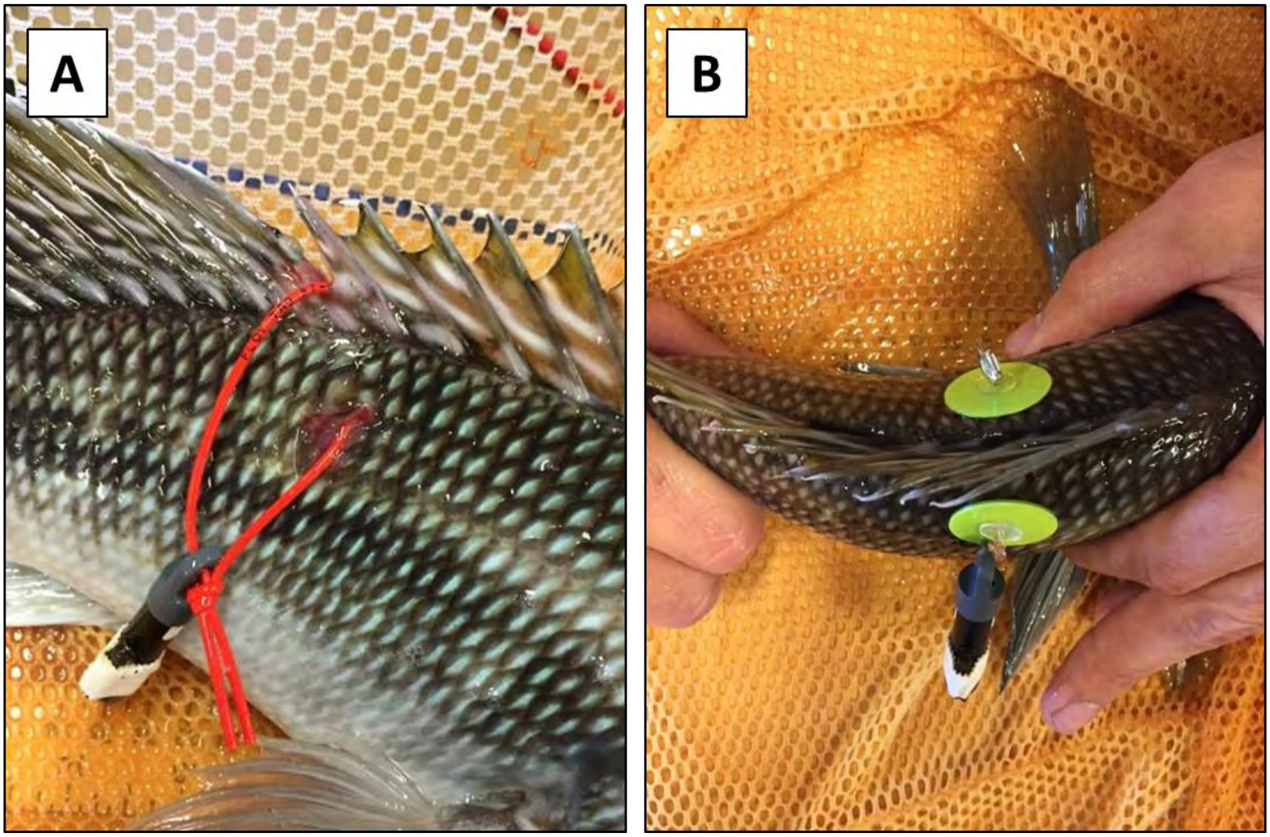

Figure 2 – Example of acoustic transmitter attachment method 1 (A) and method 2 (B) used in the experimental holding tank study. Lesions that were evident with method 1 are visible in A. Note: smaller Pedersen discs were used when tagging black sea bass in the discard mortality component of the study.

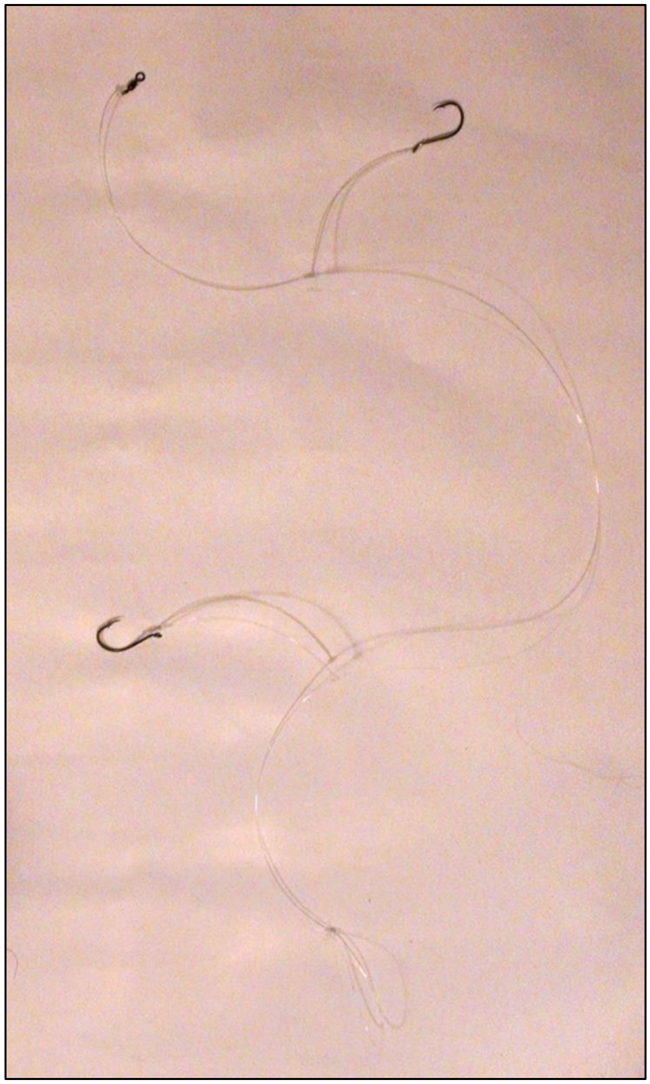

Figure 3 – Example of the standardized ‘high-low’ terminal tackle setup that was used during all sampling trips. This setup was determined to be most representative of the deep water Mid-Atlantic black sea bass fishery based on results of an extensive survey of 282 recreational anglers.

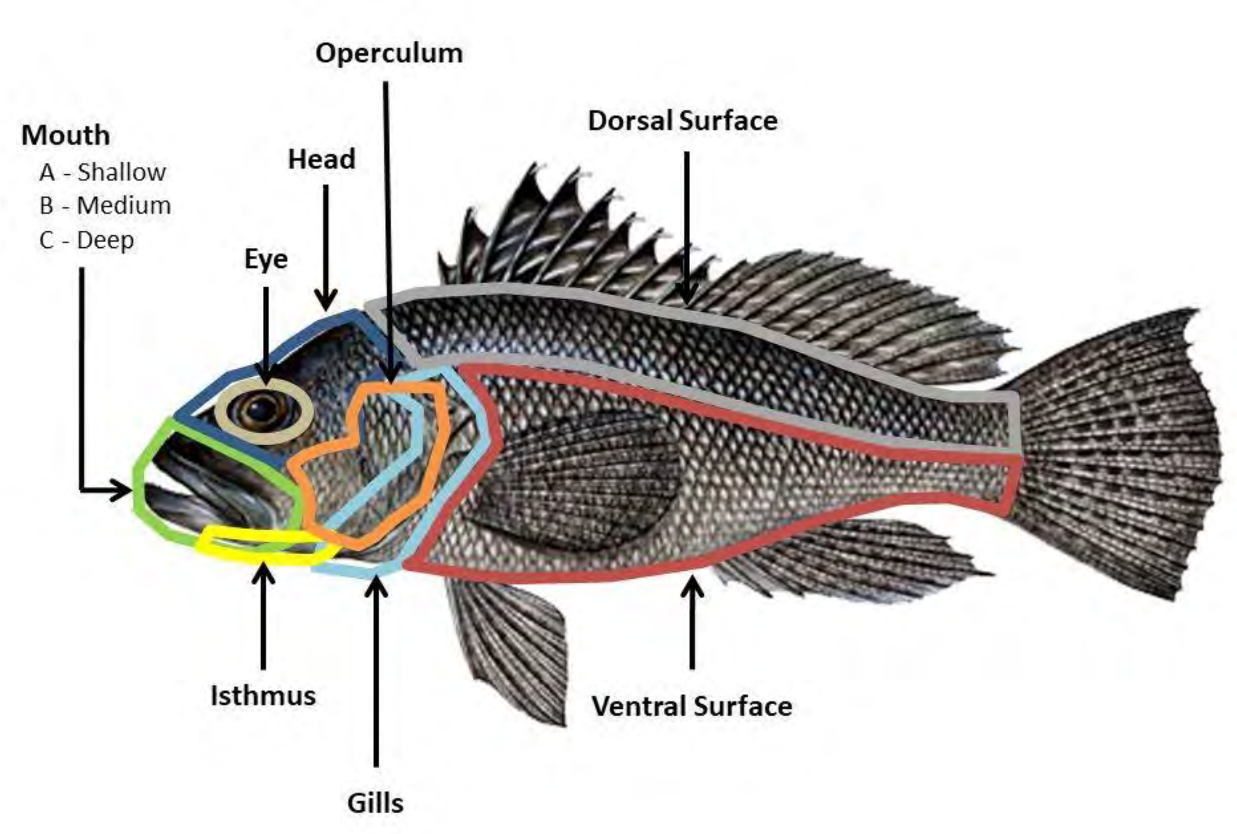

Figure 4 - Designations for hooking locations of black sea bass. Note: ‘Gills’ denotes the internal hooking location.

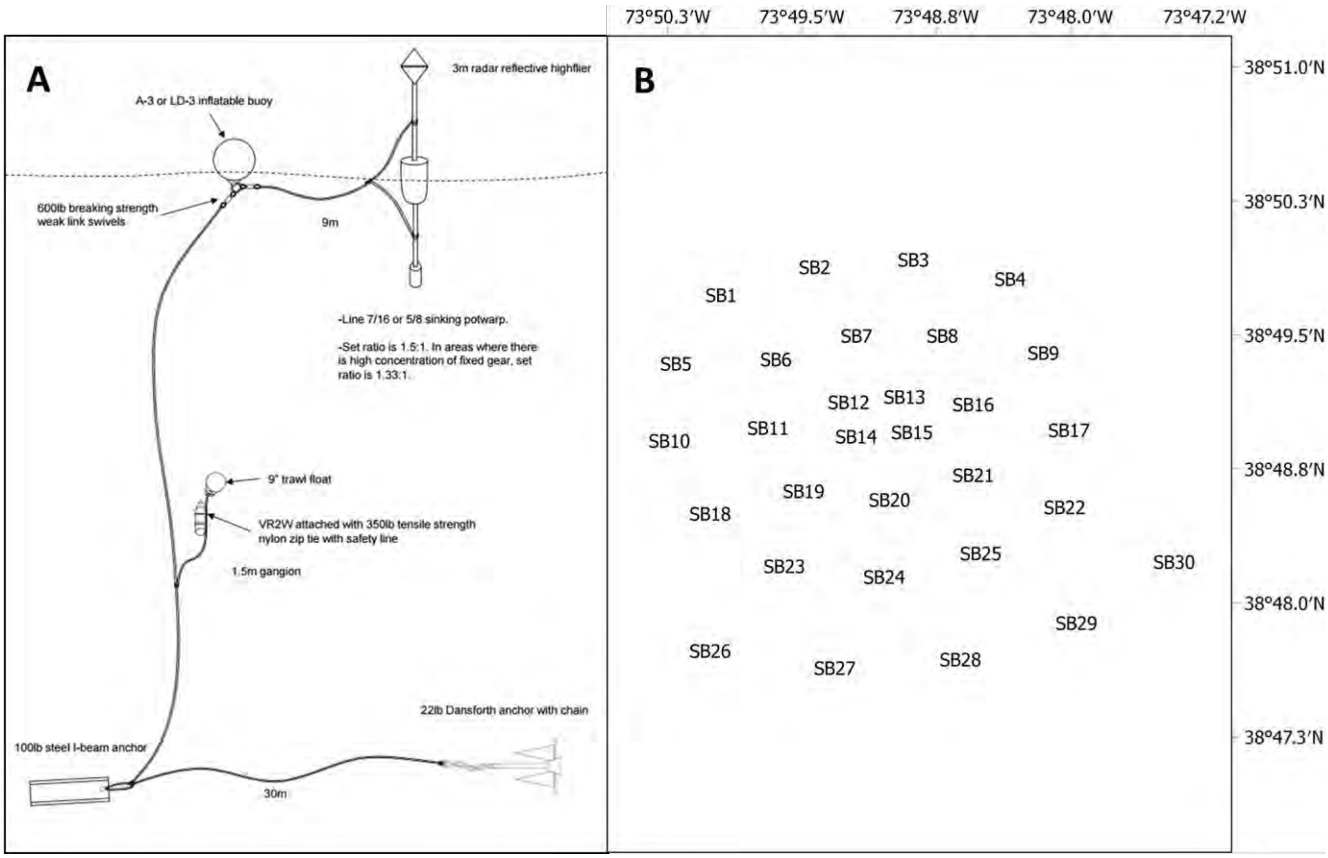

Figure 5 – Schematic of acoustic receiver mooring system (A) and the station identification labels for each receiver that was deployed in the array (B). Note that pot-style buoys with sticks were used as surface floats instead of highfliers with radar reflectors.

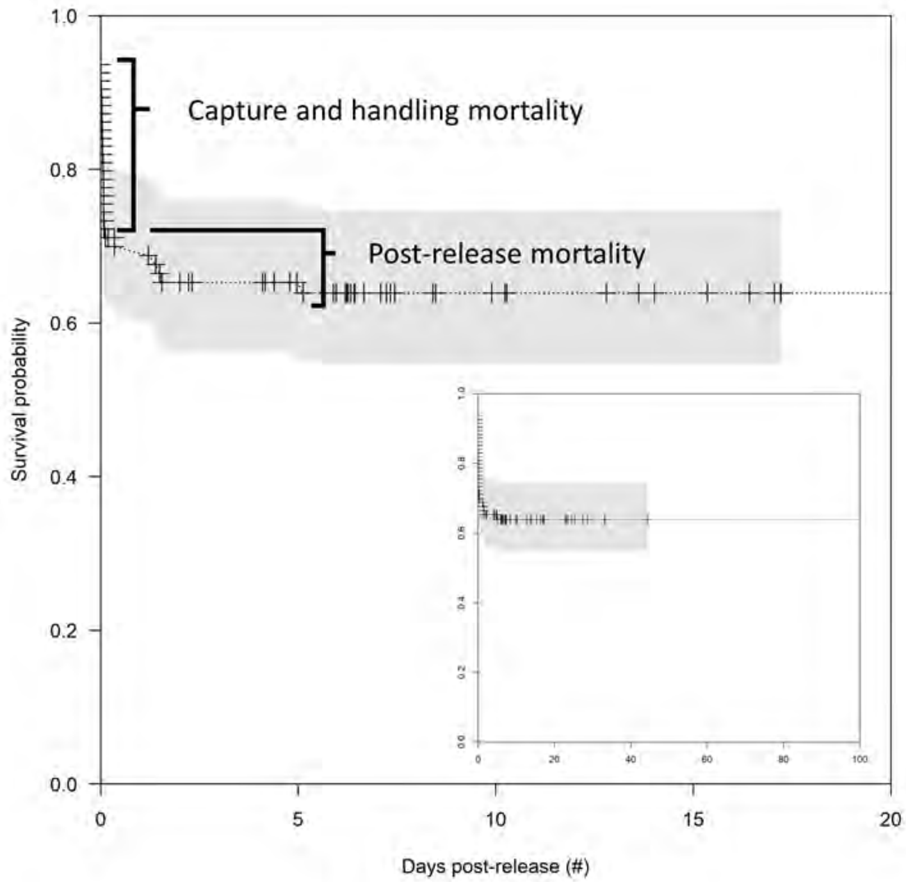

Figure 6 - Plot of the Kaplan-Meier estimator of the overall survival function for all tagged and released black sea bass over the first 20 days, with the 95% confidence interval indicated by shaded areas, and times of right censoring indicated with plus (+) signs. Time zero is the time of release back into the water. The plot is annotated to indicate the presence of two types of mortality over time for black sea bass that were captured and released (no evidence of natural mortality). The inset plot displays the Kaplan-Meier estimator of the overall survival function for these fish over 100 days.

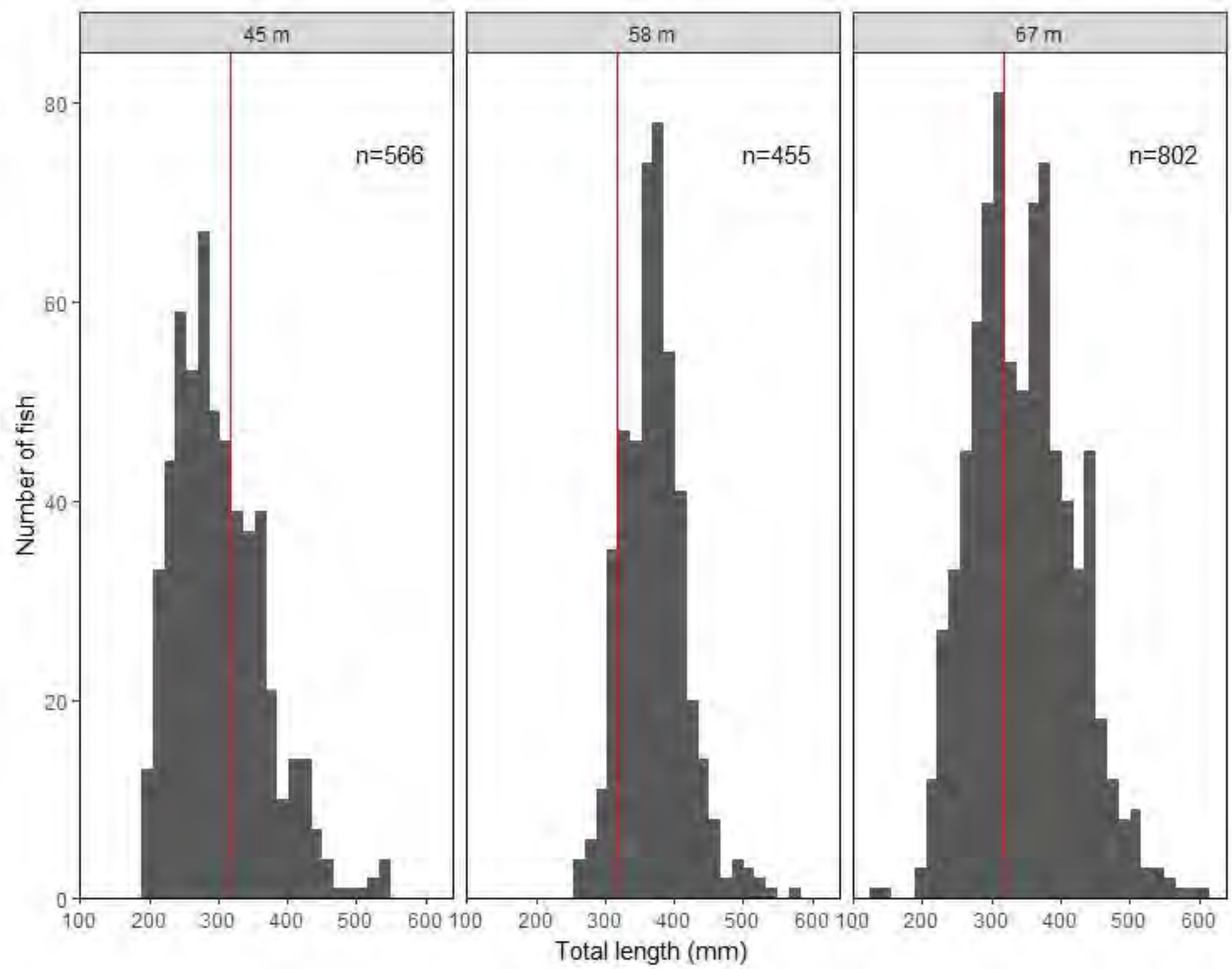

Figure 7 – Length frequency histograms of black sea bass captured at each depth. Sample sizes are presented for each depth. Red lines represent the federal minimum black sea bass size limit (12.5”, 318 mm).

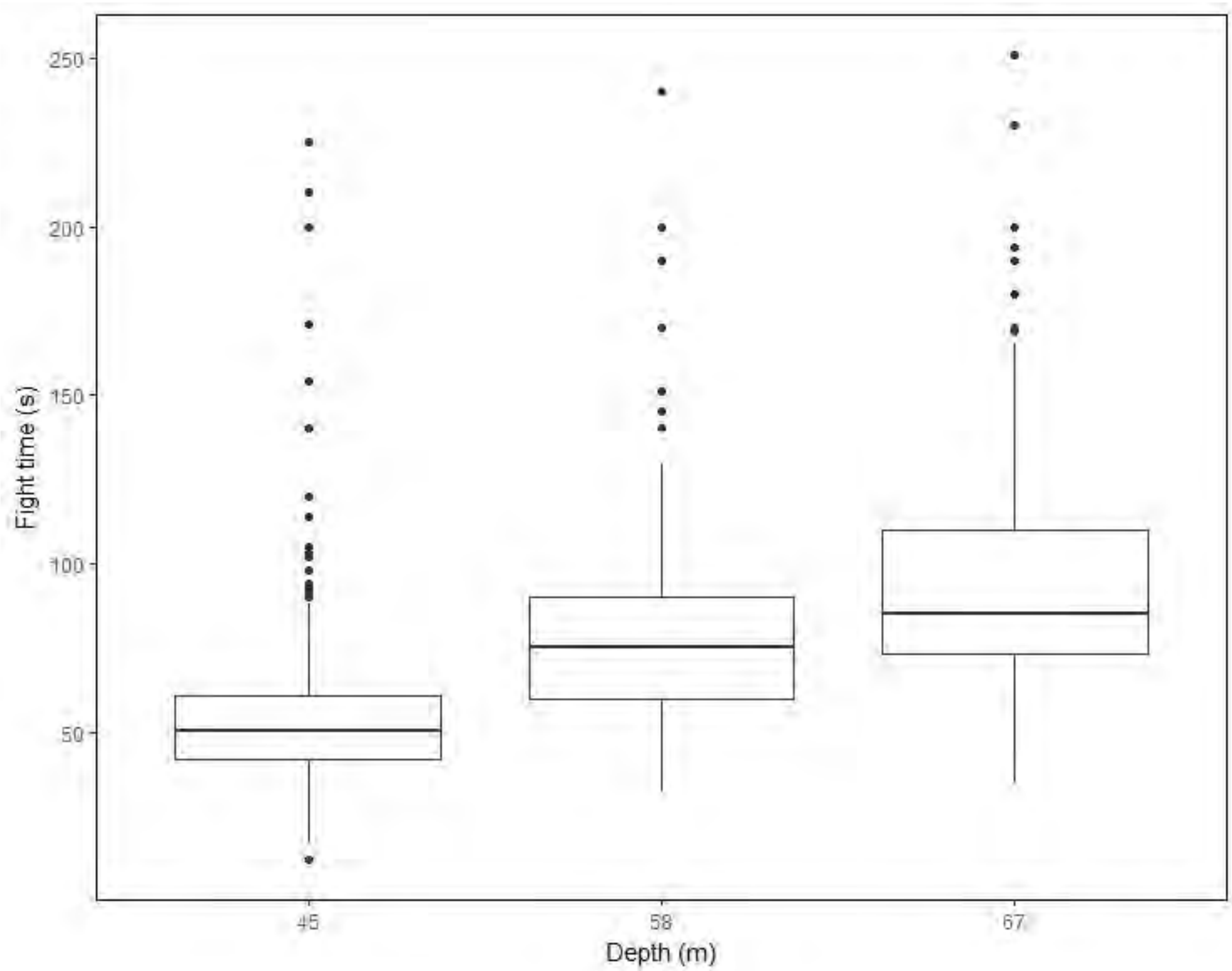

Figure 8 – Boxplot demonstrating the relationship between fight time (seconds) and capture depth (meters). Whiskers represent upper (75%) and lower (25%) quantiles and the black line represents the median value.

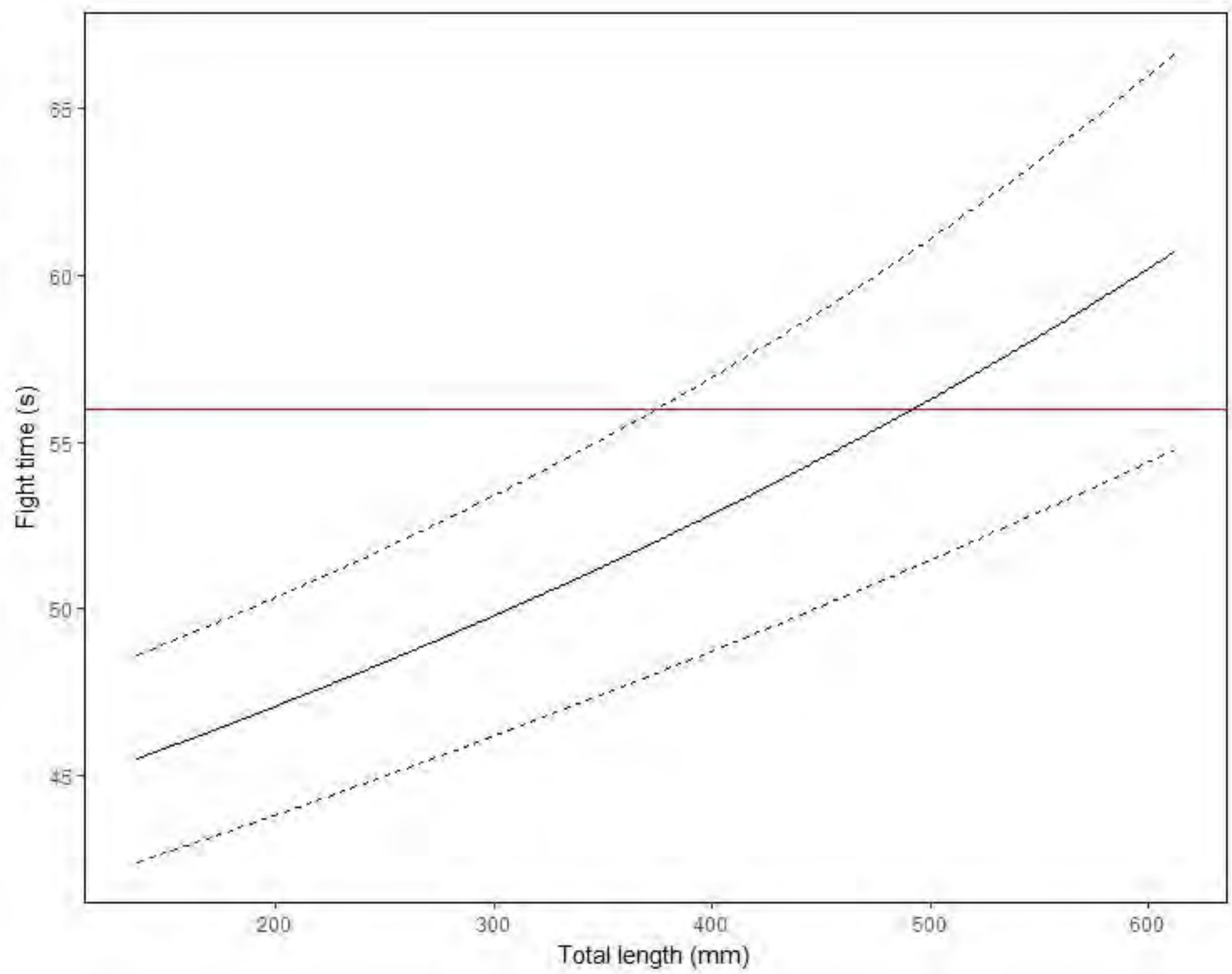

Figure 9 – Relationship between fight time and total length as predicted by the best-fitting generalized additive mixed effect model (solid black line). Upper and lower 95% confidence intervals (dotted lines) are also presented. Red horizontal line demonstrates the mean fight time for the model intercept depth (45 m), and suggests that fish >491 mm total length were generally fought longer than average.

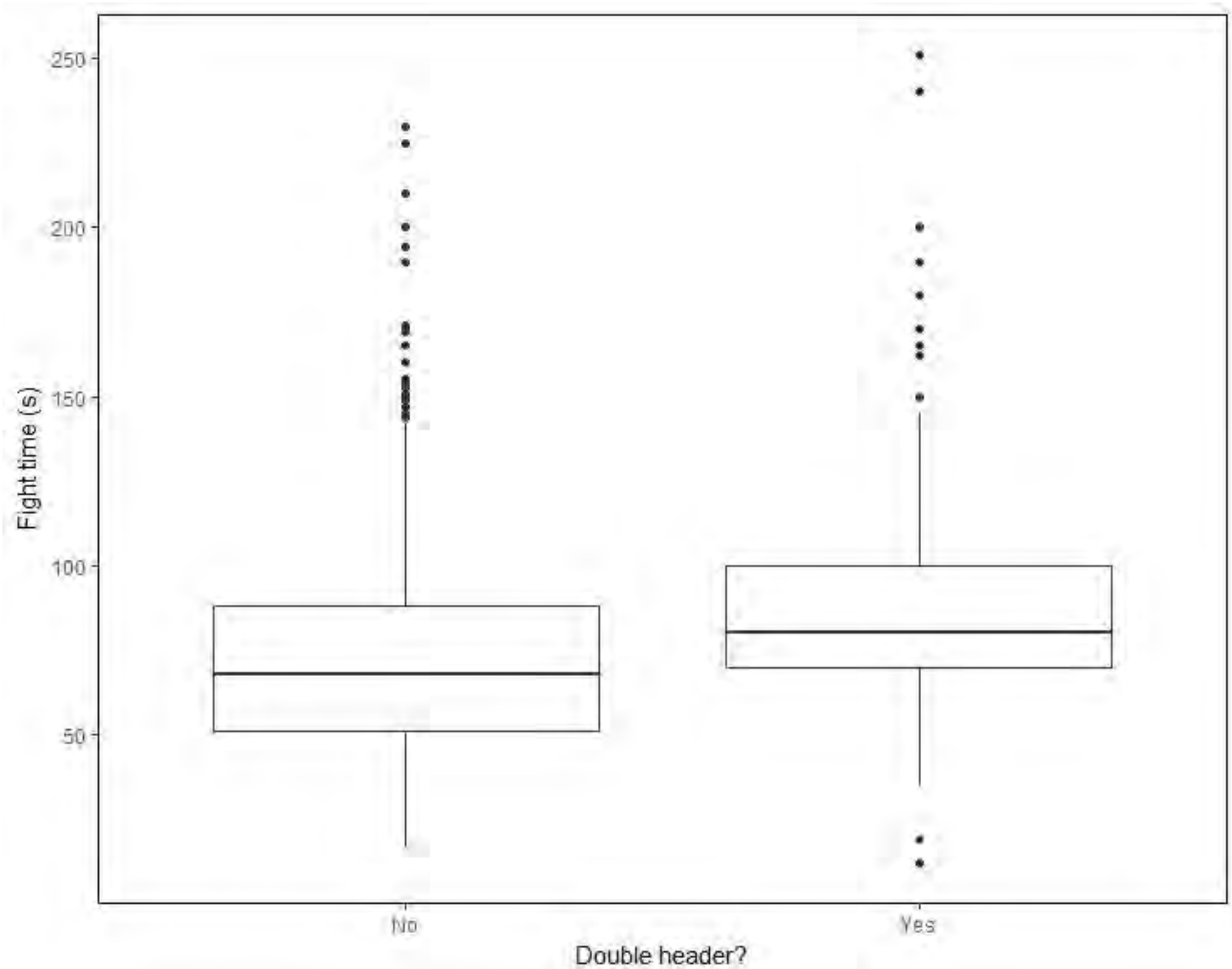

Figure 10 – Boxplot demonstrating the relationship between fight time and capture of fish as part of a double header (i.e., two fish captured simultaneously, one on each hook). Whiskers represent upper (75%) and lower (25%) quantiles and the black line represents the median value.

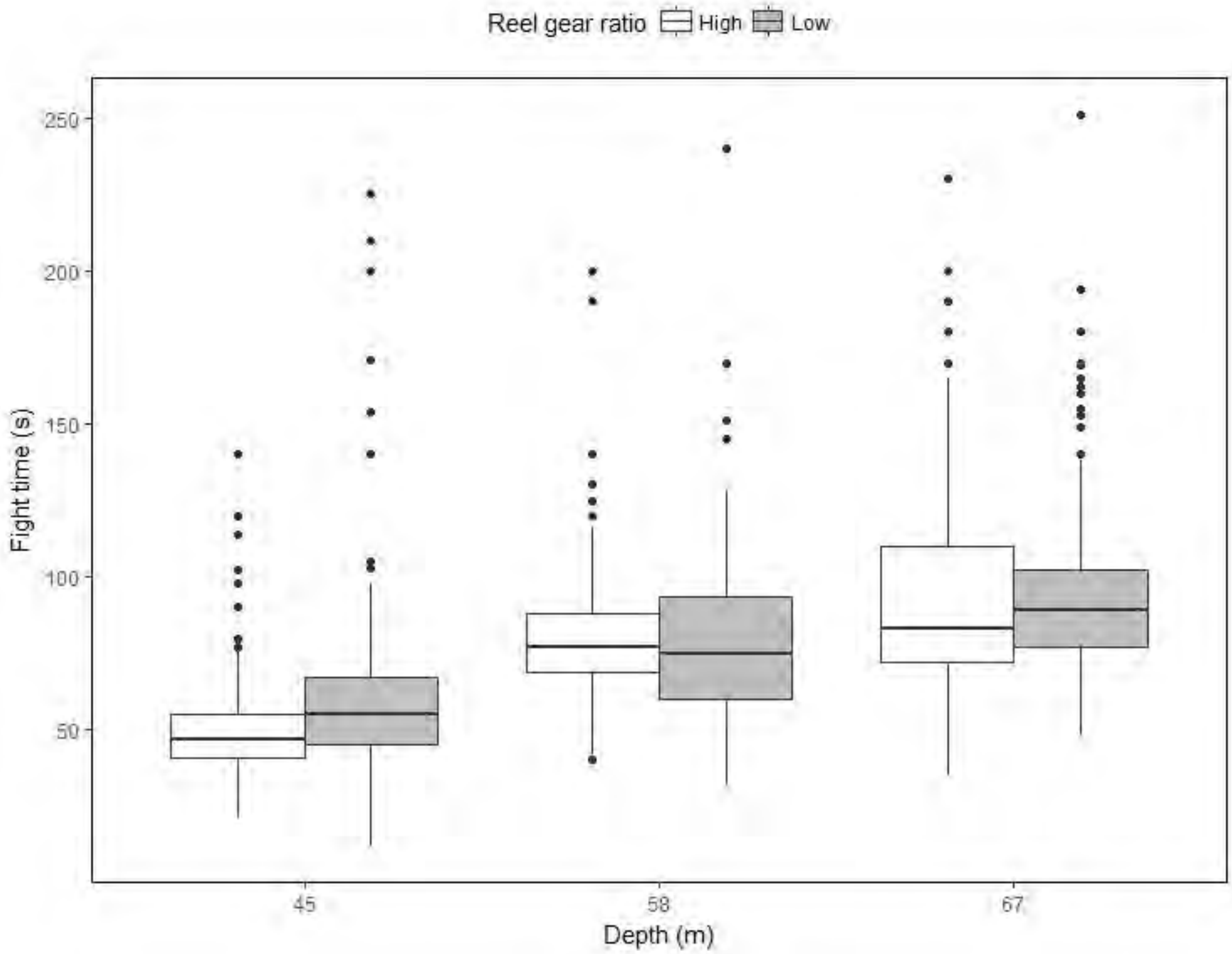

Figure 11 – Boxplot demonstrating the relationship between fight time and capture depth for each reel gear retrieve ratio ('reel gear'). Whiskers represent upper (75%) and lower (25%) quantiles and the black line represents the median value.

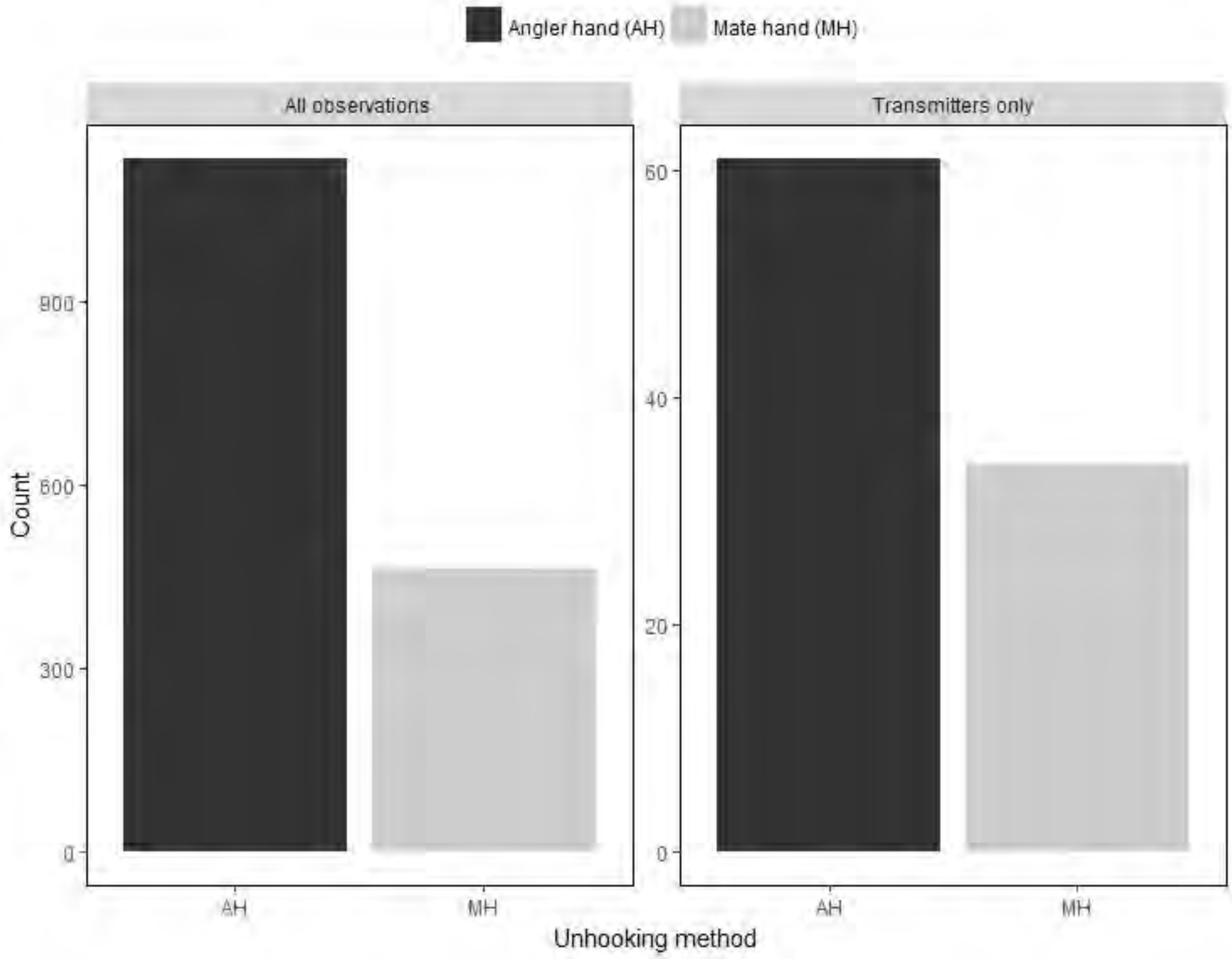

Figure 12 – Histogram of the number of black sea bass that were unhooked by hand by the capturing angler ('Angler hand') or by fishing vessel crew/mate ('Mate hand') for all capture observations and the 96 fish that were tagged with acoustic transmitters.

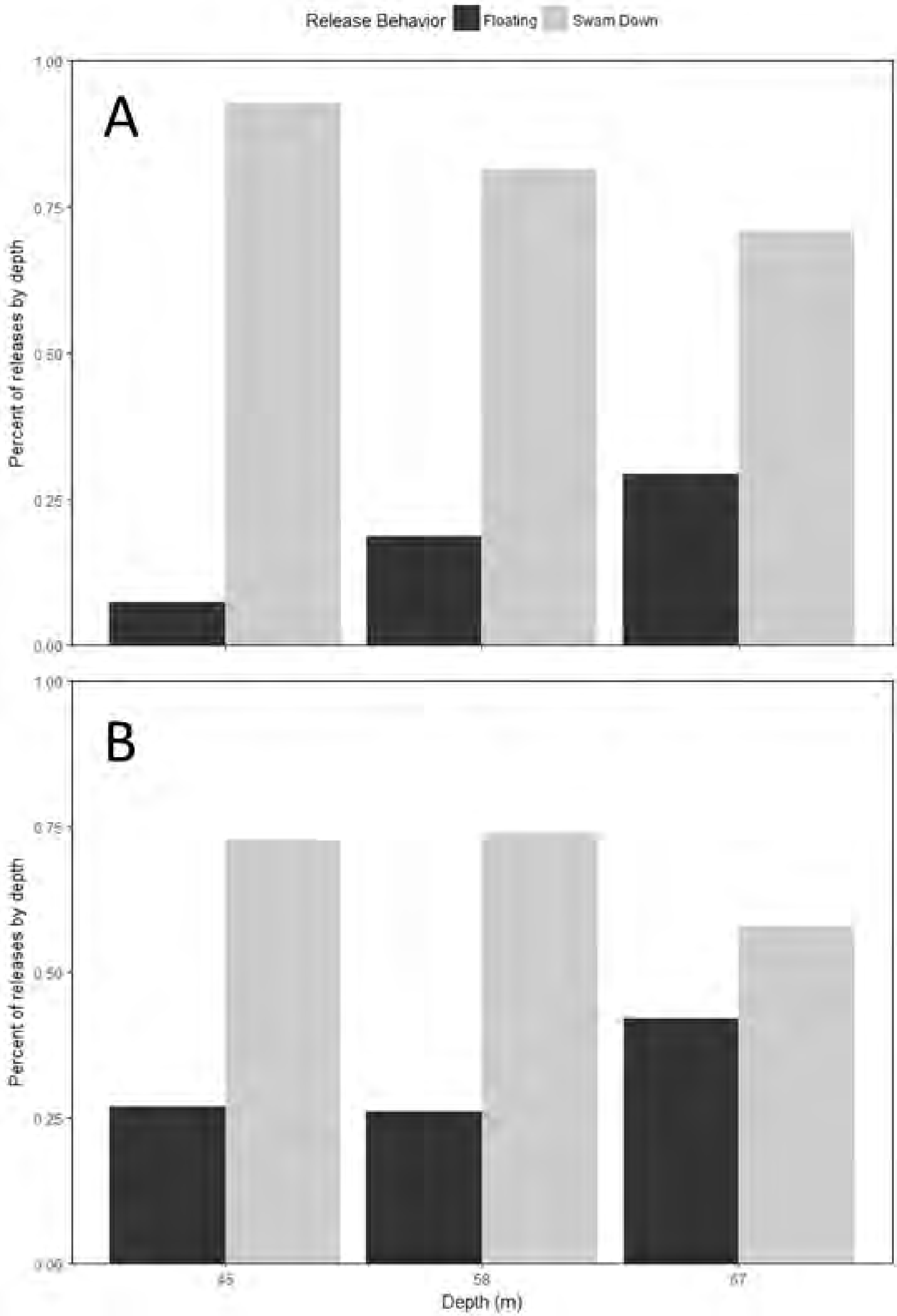

Figure 13 – Histogram of the prevalence of 'floating' and 'swam down' release behaviors by depth for vented (A) and non-vented (B) fish.

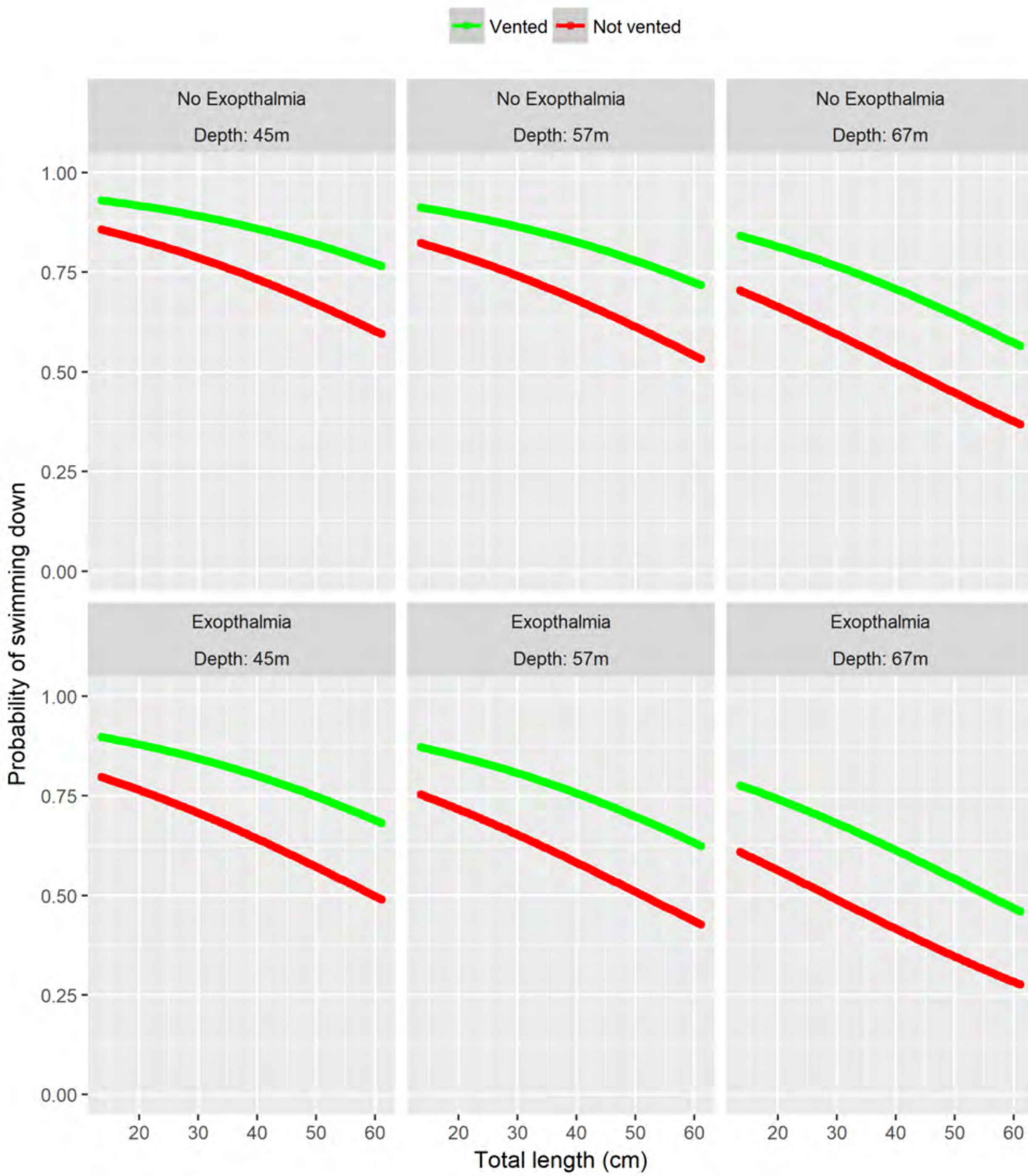

Figure 14 - Probability that a released black sea bass will actively swim down as a function of venting as well as total length, capture depth, and presence of exopthalmia. Larger fish, that were not vented, caught at deeper depths, and experienced exopthalmia had a lower probability of swimming down (i.e., higher probability of floating upon release).

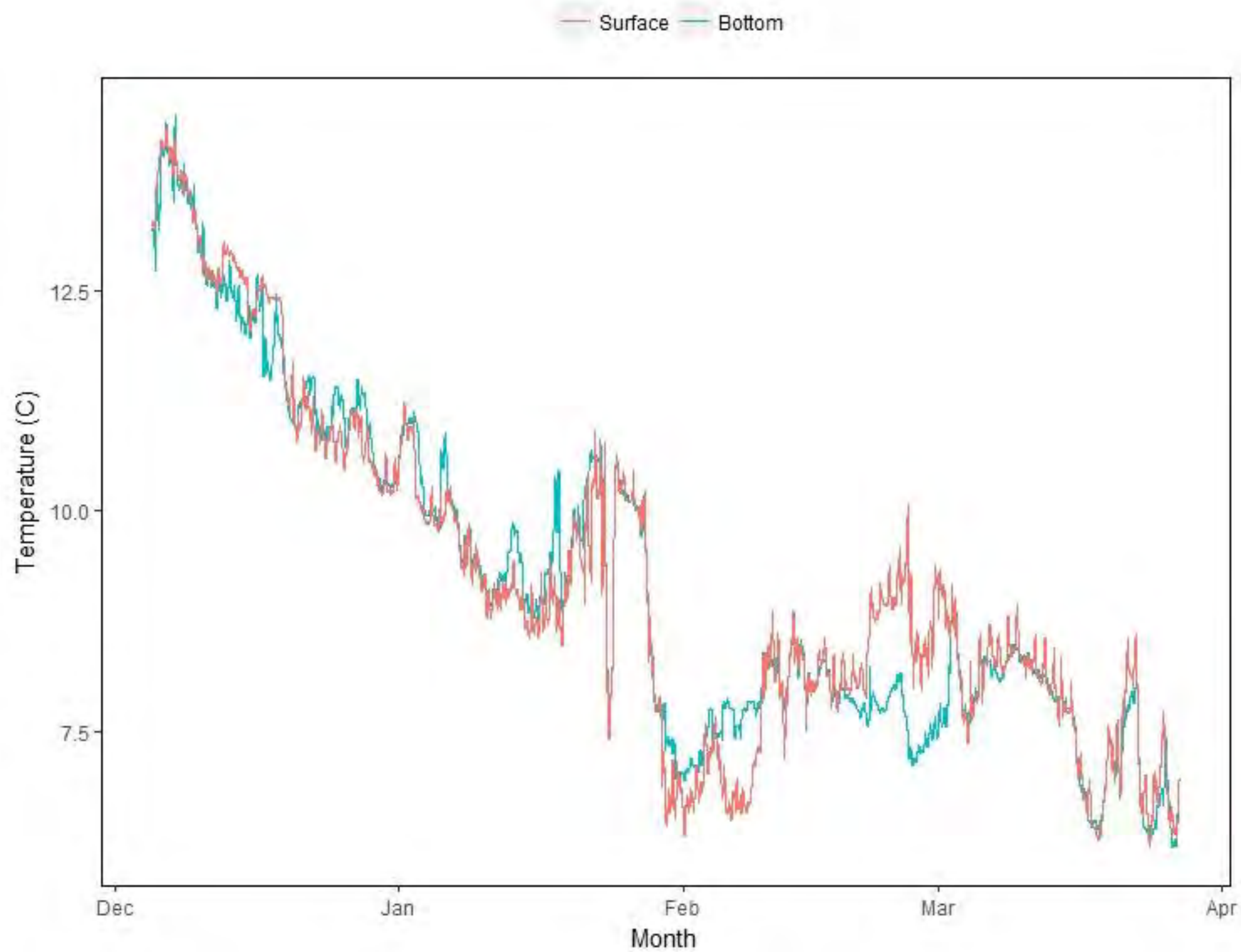

Figure 15 – Surface and bottom water temperatures measured by HOBO Pendant temperature loggers placed on the station SB8 receiver mooring from December 5, 2016 to March 27, 2017. All acoustically tagged black sea bass were monitored between these dates. Note that fishing slowed dramatically at the wreck on February 3, 2017, shortly after a significant drop in surface and bottom temperature.

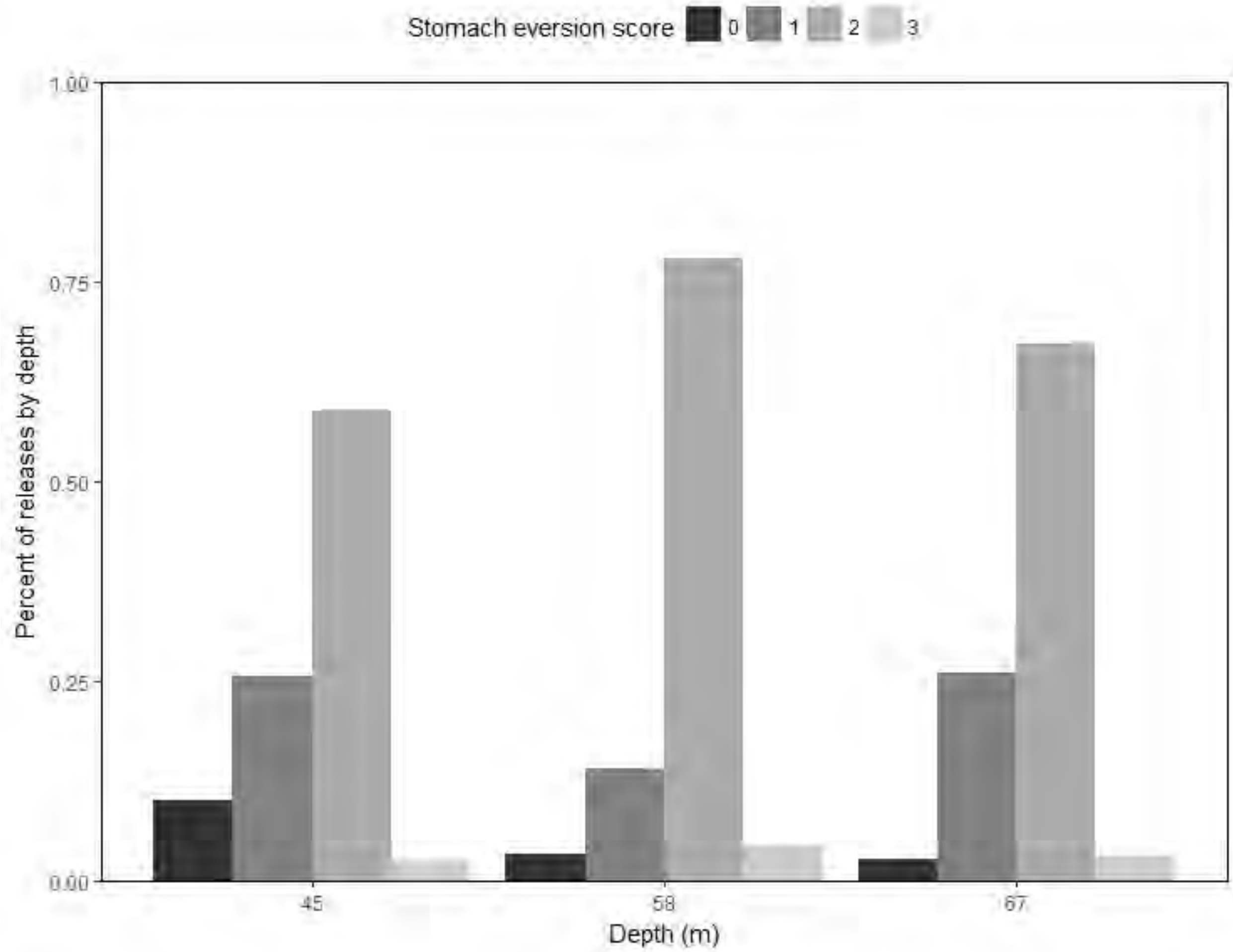

Figure 16 – Histogram of the percent of total fish releases that experienced stomach eversion scores 0, 1, 2, and 3 for each capture depth. Score 0: Stomach not everted; Score 1: Stomach everted but remains within mouth cavity; Score 2: Stomach everted but is protruding from the mouth; Score 3: Stomach everted and ruptured.

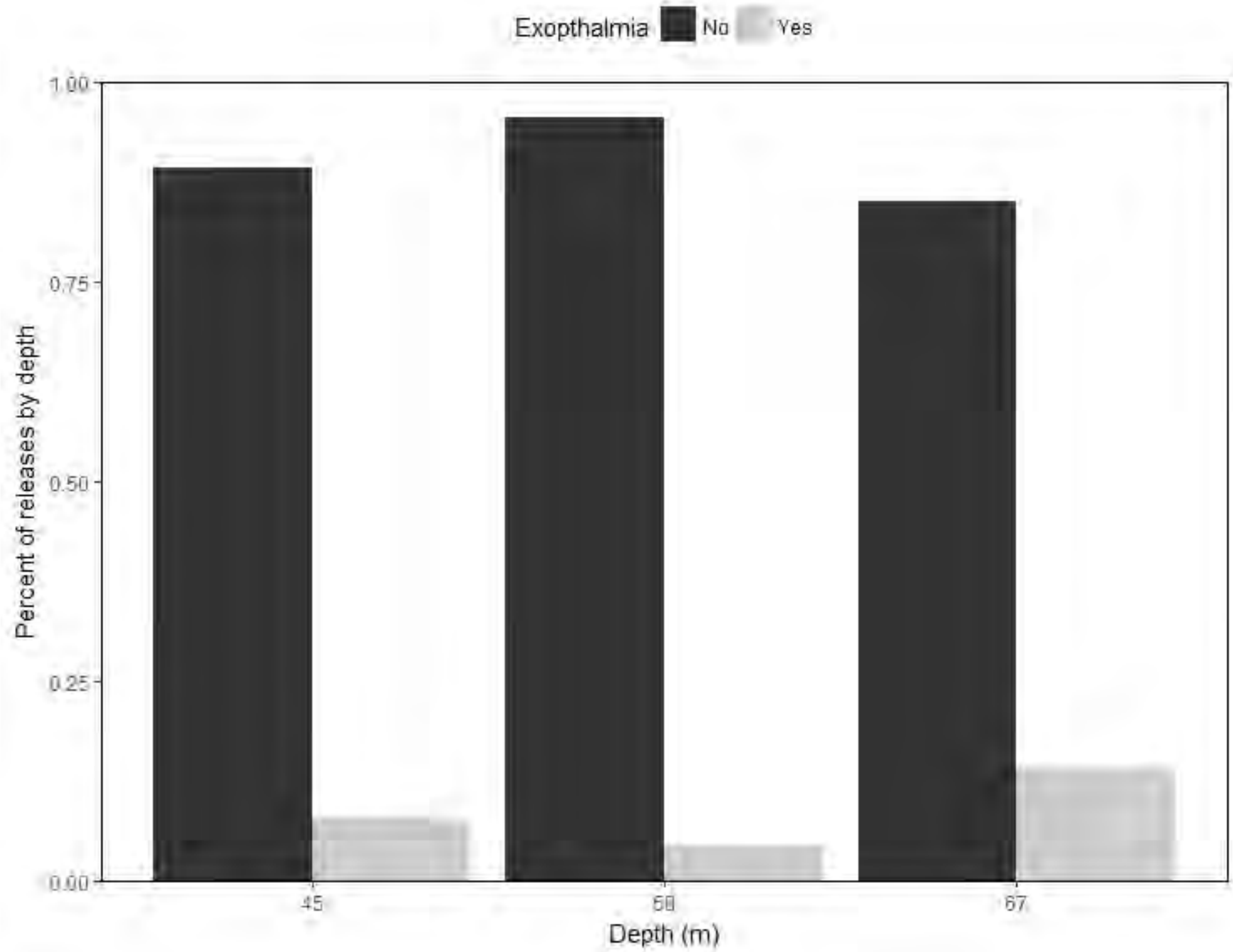

Figure 17 – Histogram of the percent of total fish released by depth that experienced exopthalmia.

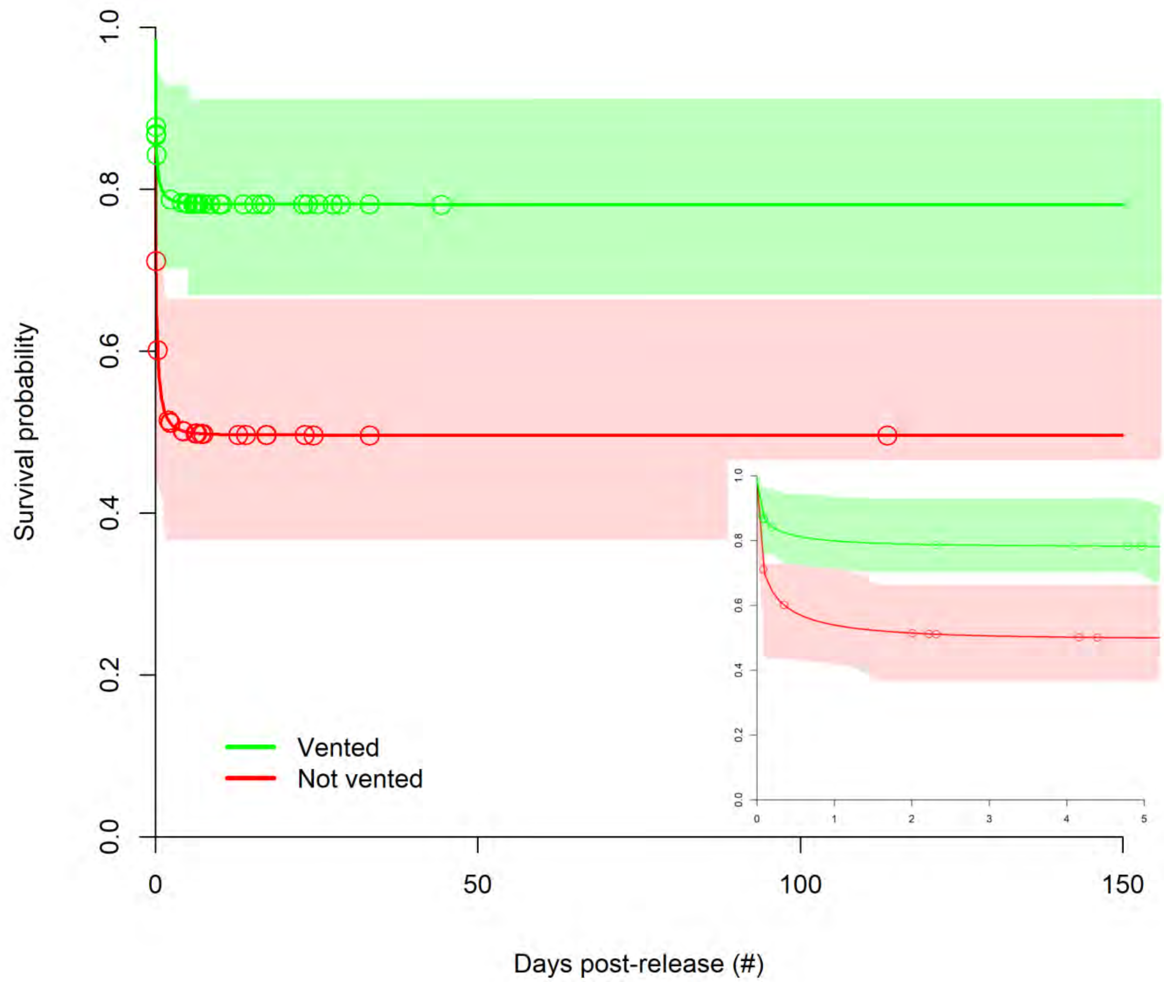

Figure 18 - Nonparametric and model-based estimates of survival functions for black sea bass that were either vented (green) or not vented (red) prior to release, where time zero is the time of release back into the water. Shaded areas indicate the 95% confidence band for the Kaplan-Meier survivor function estimates, the solid lines are estimates from the preferred survival model, and the circle location and size indicate the occurrence and relative number of right-censored observations. The inset plots in each panel show the finer scale survival functions during the first five days after release, when all of the discard-related mortality is estimated to have occurred.

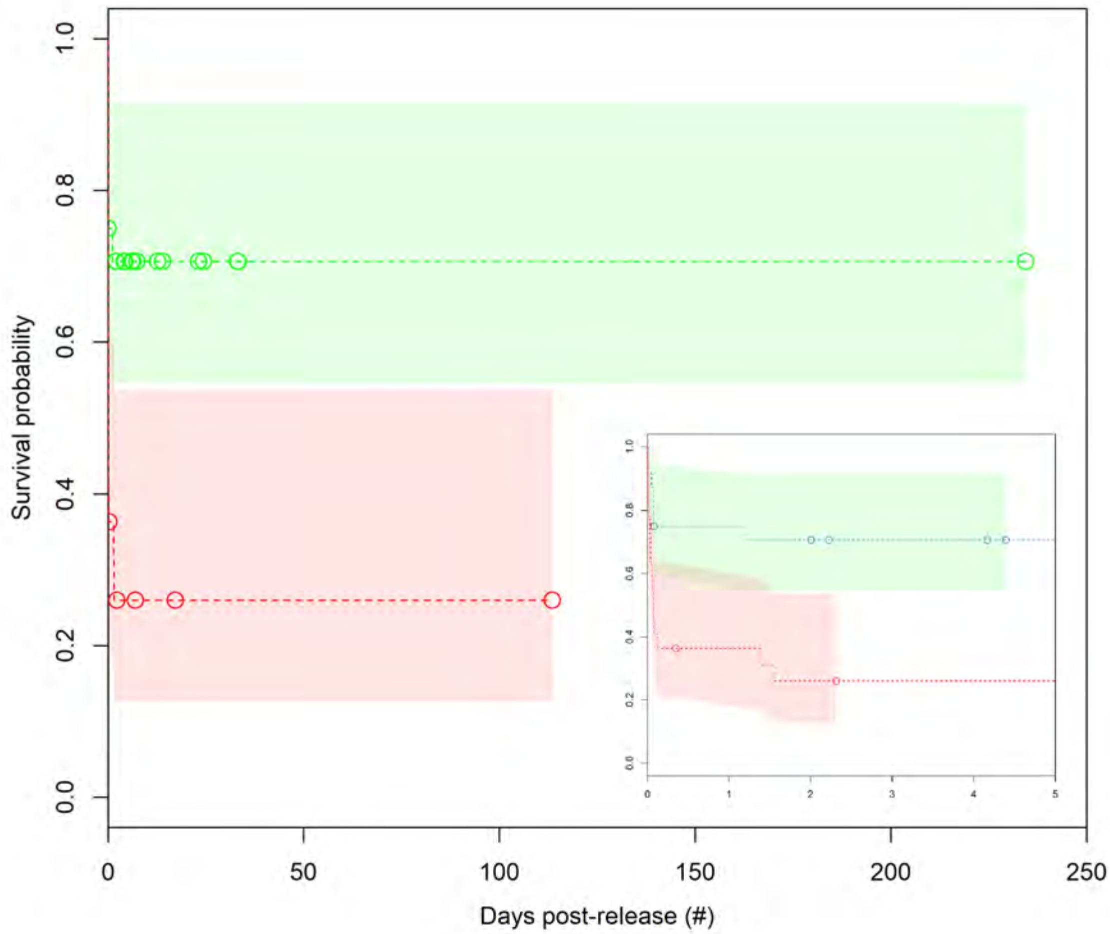

Figure 19 - Plot of the Kaplan-Meier survival function estimate for only unvented black sea bass in the acoustic subsample by low (≤54 s) and high (>54 s) fight times. Shaded areas indicate the 95% confidence interval and circles indicate the time when an individual was last observed alive (i.e., right-censored). Time zero is the time of release back into the water. The inset plot shows the finer scale survival functions during the first five days after release.

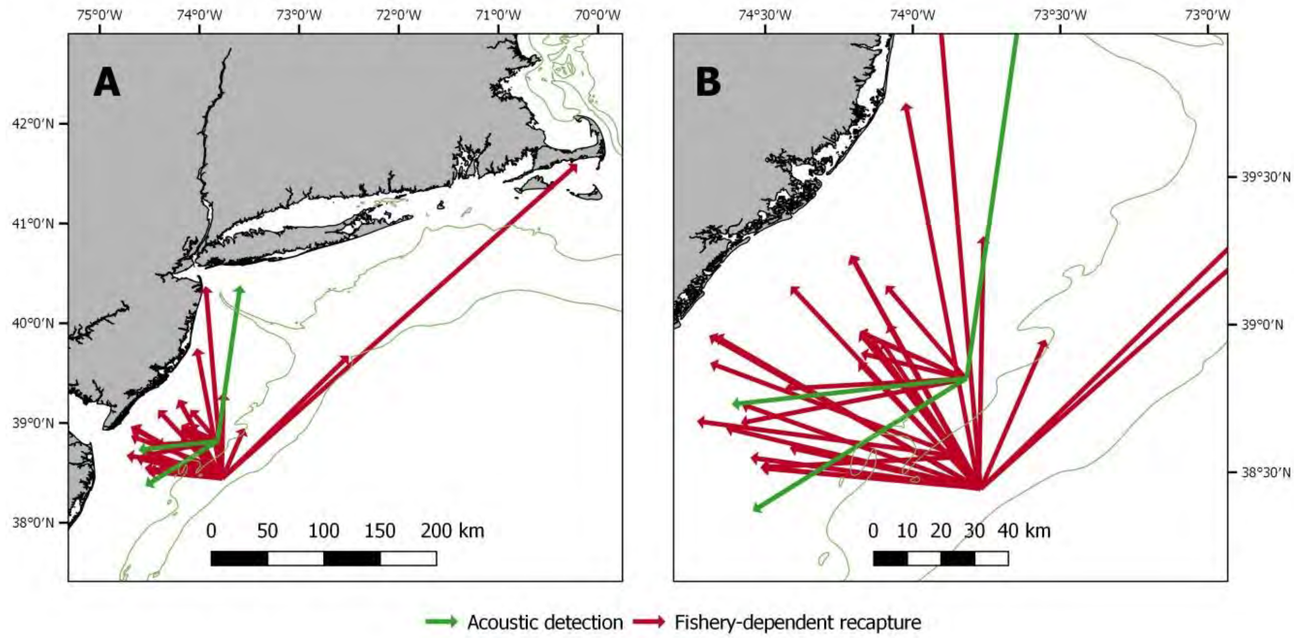

Figure 20 – Plot of fishery-dependent recaptures and acoustic detection events that occurred as of February 1, 2018. Directional arrows depict minimum linear displacement vectors. Note: three acoustic transmitters were reported as fishery-dependent recaptures. Panel A represents the full geographic area over which recaptures or detections occurred and panel B is a zoom of the southern New Jersey region.

Atlantic States Marine Fisheries Commission

Tautog Management Board

August 7, 2019
4:00 - 4:45 p.m.
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Call to Order *(D. McKiernan)*	4:00 p.m.
2.	Board Consent • Approval of Agenda • Approval of Proceedings from October 2018	4:00 p.m.
3.	Public Comment	4:05 p.m.
4.	Review Implementation Guidelines for the Commercial Harvest Tagging Program (*K. Rootes-Murdy*) **Possible Action**	4:15 p.m.
5.	Consider Approval of 2019 Fishery Management Plan Review and State Compliance (*K. Rootes-Murdy*) **Action**	4:35 p.m.
6.	Elect Vice-Chair **Action**	4:40 p.m.
7.	Other Business/Adjourn	4:45 p.m.

The meeting will be held at the Westin Crystal City, 1800 S. Eads Street, Arlington, Virginia; 703.486.1111

MEETING OVERVIEW

Tautog Management Board
August 7, 2019
4:00 - 4:45 p.m.
Arlington, Virginia

Chair: Dan McKiernan (MA) Assumed Chairmanship: 11/17	Technical Committee Chair: Linda Barry (NJ)	Law Enforcement Committee Representative: Snellbaker
Vice-Chair: VACANT	Advisory Panel Chair: VACANT	Previous Board Meeting: October 24, 2018
Voting Members: MA, RI, CT, NY, NJ, DE, MD, VA, NMFS, USFWS (10 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from October 2018

3. Public Comment – At the beginning of the meeting public comment will be taken on items not on the Agenda. Individuals that wish to speak at this time must sign in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Review Implementation Guidelines for the Commercial Harvest Tagging Program (4:15-4:35 p.m.) Possible Action
Background • Amendment 1 requires the implementation of a commercial harvest tagging program for Tautog. The Board moved to implement the program in January 2020. • Draft Guidelines for implementation of the tagging program were developed by Staff, Board Chair, Technical Committee (TC), and Law Enforcement Committee. (**Briefing Materials**) • The Board, TC, and Advisory Panel provided comments on the Draft Guidelines in July (**Briefing Materials**)
Presentations • Review of Implementation Guidelines for the Commercial Tagging Program by K.Rootes-Murdy
Board Actions for Consideration • Specify changes to guidelines • Determine whether specific implementation guidelines will be required for 2020

5. Consider Approval of 2019 Fishery Management Plan Review and State Compliance (4:35-4:40 a.m.) Action
Background • State Compliance Reports are due annually on May 1. • The Plan Review Team reviewed each state report and compiled the 2019 FMP Review. • Delaware and Maryland have requested and meet the requirements for *de minimis.*
Presentations • 2018 Fishery Management Plan Review by K. Rootes-Murdy (**Supplemental Materials**)
Board Actions for Consideration • Approve 2019 FMP Review and State Compliance Reports • Approve *de minimis* requests for Delaware and Maryland

6. Elect Vice-Chair

7. Other Business/Adjourn

Tautog 2019 Tasks

Activity Level: Low

Committee Overlap Score: High (Menhaden, BERP, Summer Flounder, Scup, and Black Sea Bass)

Current Committee Tasks:

- TC – Evaluate biological sampling requirements (assess the feasibility of adding pelvic spines as an acceptable ageing structure)
- TC – May 1, 2019: compliance reports due
- 2019: Consider initiating a benchmark stock assessment as per the 5-year trigger and MRIP data calibration

TC Members: Sydney Alhale (VA), Coly Ares (Vice Chair, RI), Linda Barry (Chair, NJ), Sandra Dumais (NY), Scott Newlin (DE), Deb Pacileo (CT), Craig Weedon (MD), Tiffany Vidal (MA)

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

TAUTOG MANAGEMENT BOARD

The Roosevelt Hotel
New York, New York
October 25, 2018

These minutes are draft and subject to approval by the Tautog Management Board
The Board will review the minutes during its next meeting

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INDEX OF MOTIONS

1. **Approval of Proceedings of May 2018** by Consent (Page 1).

2. **Move to postpone implementation of the tagging program until January 2020** (Page 7)**.** Motion by John Clark; second by Justin Davis. Motion carried (Page 7).

3. **Move to accept the FMP Review and compliance reports for tautog for the 2017 fishing year, and approve *de minimis* status for Delaware and Maryland** (Page 8). Motion by Dave Borden; second by Ray Kane. Motion carried (Page 8).

4. **Move to adjourn** by Consent (Page 8).

ATTENDANCE

Board Members

Dan McKiernan, MA, Chair
Raymond Kane, MA (GA)
Rep. Sarah Peake, MA (LA)
Jason McNamee, RI (AA)
David Borden, RI (GA)
Eric Reid, RI, proxy for Sen. Sosnowski (LA)
Justin Davis, CT, proxy for P. Aarrestad (AA)
Bill Hyatt, CT (GA)
Maureen Davidson, NY, proxy for J. Gilmore (AA)
Emerson Hasbrouck, NY (GA)
Michael Falk, NY, proxy for Sen. Boyle (LA)
Joe Cimino, NJ, proxy for L. Herrighty (AA)
Tom Fote, NJ (GA)
Adam Nowalsky, NJ, proxy for Asm. Andrzejczak (LA)
Roy Miller, DE (GA)
John Clark, DE, proxy for D. Saveikis (AA)
Russell Dize, MD (GA)
Mike Luisi, MD, proxy for D. Blazer (AA)
Ed O'Brien, MD, proxy for D. Stein (LA)
Rob O'Reilly, VA, proxy for S. Bowman (AA)
Peter Burns, NMFS
Mike Millard, USFWS

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Linda Barry, Technical Committee Chair

Staff

Bob Beal
Toni Kerns
Katie Drew
Jessica Kuesel
Caitlin Starks

Guests

The Tautog Management Board of the Atlantic States Marine Fisheries Commission convened in the Terrace Ballroom of the Roosevelt Hotel, New York, New York; Thursday, October 25, 2018, and was called to order at 8:00 o'clock a.m. by Chairman Dan McKiernan.

CALL TO ORDER

CHAIRMAN DAN McKIERNAN: Today we have a fairly light agenda; so we can get through that and if folks need to check out before the next meeting at nine o'clock that is probably a good strategy.

APPROVAL OF AGENDA

CHAIRMAN McKIERNAN: First on the agenda would be the approval of the agenda. Does anyone have any changes to the agenda? Seeing none; the agenda is accepted.

APPROVAL OF PROCEEDINGS

CHAIRMAN McKIERNAN: Next, the proceedings from the last Board meeting, May, 2018, are there any requested changes or amendments to that document?

Seeing none; I'll deem it accepted.

PUBLIC COMMENT

CHAIRMAN McKIERNAN: Next Public Comment, has anyone signed up for Public Comment? Do you know, Caitlin? Is there anyone who would like to speak on any issues that are not before the Board today?

I don't see anyone so we'll move on to our first substantive order of business, which is to Review the Technical Committee Report on Biological Sampling Requirements. That will be done by Linda Barry.

REVIEW THE TECHNICAL COMMITTEE REPORT ON BIOLOGICAL SAMPLING REQUIREMENTS

MS. LINDA BARRY: Good morning Mr. Chairman; members of the Board. Last year the Tautog Technical Committee was tasked to evaluate the biological sampling requirements. This was at the request of the Plan Review Team; due to several states falling short of the minimum sampling requirements during the last few years.

There were issues obtaining samples; including the tautog not being encountered in their traditional sampling methods. Much of the commercial harvest goes to the live market; and there is a developing market for the racks, what's leftover of the fish after the fillets have been taken. They are being sold for bait; and also for human consumption as a base for soup stock.

Then some states were also having issues with fishermen who were reluctant to participate in the sampling program; because of their frustrations of what they viewed as management measures that were continually eating away at their ability to harvest. Getting these age-length data is really, really critical for this stock; because the stock assessment process for tautog is based on age-structured models.

The annual biological sampling requirement was implemented with Addendum III in 2002. It required all states to collect data to support coastwide stock assessment; until the body of data and the analytical results were sufficient for regional assessment approaches. It specified that each state had to collect a minimum of 200 age and length samples. This is based on the rationale that you get five fish per centimeter; within a range of sizes that are commonly caught, not necessarily harvested, but caught by the fishermen. Here you have a portion of the age-length key from New Jersey's tautog samples from 2015. What you have here on the top are the ages; and then along the side are the other lengths. Where I've highlighted it, you can see that there is quite a lot of overlap in the ages and lengths. If you go with the 5-fish-per-centimeter length, you can very well see that each one of those five fish would be a different age. Again, there is this wide overlap of ages and lengths as the fish grows older and larger.

Tiffany Vidal Cunningham, from the Massachusetts Division of Marine Fisheries performed the sample size analysis using the tautog samples that were obtained in 2016 from three of their surveys, their trawl survey, the ventless trap survey, and they have a pilot rod and reel survey. You can see from the numbers of the tautog that they obtained that she had a sample size of nearly 600 fish.

She performed an analysis to determine the sample sizes required to obtain certain levels of precision around the length-at-age estimates. On the left hand side you see the results from her analysis. Within the different age categories you have the sample sizes that are necessary to achieve precision of either having a CV of 0.25 or 0.1.

The negative values in the sample sizes just indicate that extremely large sample sizes would be needed. I highlighted where you did have one age category with a precision level with a CV of 0.25, or you could actually get by without getting the full 200 samples. Then the ages on either side, you still needed at least 200 samples, but it was just slightly over that.

But then you look at all the other sample sizes; and they are much higher than 200. Basically what the analysis showed us were that and more to really achieve the level of precision for all the age categories; you really can't go below 200. The TC also looked at the level that the sampling requirements should be applied; whether it should be at a regional level or at a state level.

The advantages for going with a regional level would be that it would align with the regional stock structure of the stock assessment; and it would also potentially alleviate the sample shortage problems that some of the states were having. The disadvantages included that it would potentially reduce the quantity of the samples that would be obtained overall. That could negatively impact stock assessment if some states are consistently under sampled. The TC concluded that we should maintain the state level requirements.

This ensures that there is adequate sample numbers throughout the whole management region. The state samples will continue to be pooled; in order to develop regional age-length keys, and states should document their sampling efforts, especially if they're falling short. That way then they could show that there is a good faith effort to comply with the requirements. The TC also agreed that the minimum sample size of 200 samples should be maintained; due to the wide overlap of ages and lengths as the tautog ages.

The sample size analysis showing that the precision of the length-at-age estimates will definitely suffer if the sample sizes went below 200. The sample size reductions also might lead to a widening of data gaps that we have on our length distributions. The TC felt that these data gaps should probably be addressed with maybe more use of fisheries independent samples or possibly the use of non-lethal methods of sampling. If regions turned out to be consistently under-sampled, we would have to again revisit and reevaluate the sampling requirements. Through this process we did bring up the possibility of using pelvic fin spines as another aging structure. Recent studies have shown that you could get fairly precise to the age estimates using this structure; and it's a nonlethal sampling method. That way it would open up the ability to sample fish that are headed for the live market; or for the whole fish market, because it won't be disfiguring them enough to affect their marketability.

It would also allay some of the concerns that were expressed about sacrificing fish from a population that the stock status indicates that it's in need of recovery. Then it would also allow states that were having problems obtaining the minimum of samples to get to at least that minimum number.

The TC is generally supportive about the idea of using the pelvic fin spines; but before the TC could approve it as an alternate aging structure, there would need to be a full evaluation of the age information to ensure that the age estimates that you read from these structures would be compatible with what we've been reading with the opercula and the otoliths.

This would involve collecting paired samples of the pelvic fin spines or either opercula or otoliths; and then doing comparison studies to make sure that the age estimates are the same or comparable. If we had positive results from this comparison study, then we would perform paired aging exchange with the other states; although some states did have concerns that they might not have the budgeting or the staff to be able to participate fully in this process.

The TC is willing to partly consider collecting the paired samples; and then doing some comparison studies. The TC could consider supplementing the age samples if the collection of the preferred structure was really, really limited. However, the TC would not want to use the data from the pelvic fin spines for assessment purposes until after the TC has gone through the process of evaluating it and then approving it.

The first step the TC would like would be for the states to determine their ability and their interest in participating in this time of paired sample exchange. To wrap this up, the recommendations from the TC to the Management Board are to maintain state level biological sampling requirements.

Maintain the minimum number of 200 age and length samples per state per year, and to ask the states to determine their ability and the interest level to participate in a further study of the pelvic fin spines, with the goal of having a paired exchange of the aging structures with the other states. With that I would be happy to take any questions.

CHAIRMAN McKIERNAN: Thank you, Linda that was a great presentation. Are there any questions for Linda? John Clark.

MR. JOHN CLARK: Thank you for the presentation, Linda. With the pelvic spines, how much preparation is involved in that? I know the opercules take some work to get ready. Are the spines fin sectioned?

MS. BARRY: To tell you the truth, I'm not as familiar with the preparation of the pelvic fin spine structure. But you would have to section them. There would be some preparation involved; but I don't imagine it to be as time consuming, and as laborious as the opercula, because with opercula you have to boil it and then go through the whole letting it dry for a certain amount of time. There would have to be a little bit of, I guess some training involved, to make sure that whoever is reading the spines would know exactly where to start counting the annuli.

CHAIRMAN McKIERNAN: Another question from Jay McNamee and then Justin and Joe.

MR. JAY McNAMEE: Nice job, Lindy. Thank you for that report. I just wanted to make a couple of quick comments. I support recommendations of the Technical Committee. I think the challenge with the age-length key is always not in the kind of heart of the distribution but in the tail. You know shooting for that goal of 200; the idea is that you hope you get some little ones and some really big ones.

I think maintaining it's worked okay, I guess I'll say, over the years. I think it's still a good goal to shoot for. I do think though it would be good to have a discussion with the Technical Committee to also remind them that the idea is to get a full characterization of the length distribution; if you can get some smaller guys and some bigger guys that's a good thing to do.

Then quickly on the pelvic spines, I think that's a great idea. We should try and do that. I guess my question is; is the logistics part of that is that going to be a discussion with the Technical Committee? I'm guessing there would be a couple of states that would be interested. We get the full racks in Rhode Island, so we could get both structures.

Maybe there are some states that have some capacity where if some of the states can't manage processing; or maybe they could process them and not age them. Maybe some of the other states could help out. I think that would be a good discussion to have with the Technical Committee to kind of figure out those logistics, because I think that's a challenge with tautog. A lot of it goes to the live market; so anything we can do to get age structures and not kill the fish would be a benefit.

CHAIRMAN McKIERNAN: Justin.

DR. JUSTIN DAVIS: Thanks for that presentation. I really appreciate the degree to which the Technical Committee took a thorough look at this. We're one of those states where at times we've struggled to come up with those 200 samples; and I know there have been discussions amongst our staff of do we really need to collect 200 samples. I think this provides some really good sort of justification for keeping that high sampling level. My thoughts were along the same line of Jay's that looking at that age-length key.

You know those 52 centimeters, 20 inch fish; you had ages from 7 to 17. That may be an area where we really need to get a lot of samples to really parse out the age structure in those size categories. I'm wondering if the TC considered making a recommendation to states to prioritize collection of structures from older, larger fish. That general recommendation of 5 per centimeter category will probably lend itself to getting a whole bunch of samples right in the middle there; and not so much on the tails. I also wanted to make the comment that for a couple years now Connecticut has been collecting paired samples; opercula and the pelvic spines. But we haven't been able to process the pelvic spines due to lack of staff and time.

Along the lines of what Jay saying, if some states want to undertake one of these paired studies and process some structures, Connecticut has some that we would probably be willing to put in the mail and send to somebody, if they want to take a look at them.

MS. BARRY: Yes, I appreciate the suggestion about possibly, some states they might not be able to fully process and go the whole from collecting through comparison studies. But if they could at least collect the spines; and then if the other states that have the capacity and the skill to be able to then go through processing them, reading them, and then doing the comparison studies. I think that would make it a whole lot easier and a whole lot more acceptable to the general group. Thank you.

CHAIRMAN McKIERNAN: Joe Cimino.

MR. JOE CIMINIO: Thank Lindy and the TC for the work here. I appreciate; I guess the conservative approach, both to staying status quo. I guess it's on the Board to kind of understand that good faith attempt at achieving these goals. As we have with other Boards, just not turn that into a compliance issue.

It sounds like if the spines, one of the values are they are able to sample live fish, then my assumption would be that some of these states that are struggling are able to at least get lengths off of these fish. It sounded like the TC had a recommendation that fisheries independent sampling could be used. I just wanted to throw some support towards that too if needed for samples; as long as we're seeing the ability to get lengths from the actual fisheries.

I also appreciate the slow approach to looking into the spines; because I think at some point ASMFC would need to put forward some money towards a workshop or something along those lines. I think the work going into this year, as states are looking into what they can do, will give us time to see what we need to do in the future. I just want to thank you guys.

CHAIRMAN McKIERNAN: Linda, I have a question. The recommendation from the TC was to have states communicate about their interest and willingness to participate. Does that need a deadline?

MS. BARRY: Well, we haven't set a deadline as of yet; although it could be something that we start to discuss in the New Year.

CHAIRMAN McKIERNAN: There aren't any action items on this; because we're not changing the plan mandates for the minimum number of samples, so I guess we can move on.

DISCUSSION OF THE COMMERCIAL HARVEST TAGGING PROGRAM IMPLEMENTATION

CHAIRMAN McKIERNAN: Next on the agenda is a Discussion of the Commercial Harvest Tagging Program Implementation, and Caitlin, I think you'll start this.

MS. CAITLIN STARKS: I'll be providing an overview of the draft Implementation Guidelines for the Commercial Tagging Program. In my presentation I'll cover some background information on the tagging program; and then go over the contents of the document that was provided in materials, which include sections on each of these aspects of the tagging program listed on the slide. Then finally, I'll talk about a prospective timeline for implementation.

Under Amendment 1, approved in October, 2017, a commercial harvest tagging program was required for tautog to combat illegal and unreported harvest. Specifically, the requirements as described in the amendment include uniform-single-use tags; with unique identifiers be applied to tautog by the harvester before offloading that the number of tags allocated to harvesters would be determined by the state, based on a biological metric.

That unused tags should be returned to the state agency that issued them no later than February 15 of the next year; and then that each state much submit an annual compliance report, including an annual commercial tag report that would have information on the tags issued and used; as well as participating harvesters and reporting commercial harvest. The Amendment also required that this program be implemented by January, 2019; which I'll come back to at the end of the presentation.

Building on the requirements in Amendment 1, and drawing from some other tagging program regulations; I worked with the Board Chair, the LEC, and the TC to develop some draft guidelines for implementation of the Commercial Harvest Tagging Program. These draft guidelines are intended to provide some more direction to the states in constructing their regulations and administering the program.

In order to encourage consistency and compatibility between state programs, as well as enhance law enforcement's ability to monitor compliance with the program across the management unit, the document recommends procedures for all aspects of the tagging program; and it's meant to just avoid loopholes, and ensure its effectiveness when it's implemented.

The first section of the draft Guidelines provides recommendations for a tag distribution. To avoid confusion and reduce the opportunities for unauthorized individuals to obtain tags; it's recommended that each state's management agency acquire tags from the manufacturer directly, and then distribute those to their authorized harvesters.

The LEC and TC agree that accounting and reporting would be made a lot easier if harvesters were issued tags with consecutive numbers. The states would need to determine ahead of time what total number of tags they would order; and the number that they would allot to each harvester based on a biological metric like the prior year's harvest in numbers of fish, plus an additional amount of tags as a buffer.

Tags should not be transferable, and regulations should prohibit reusing altering and counterfeiting tags. Regarding tag application, the LEC recommended adding language to the Amendment 1 requirements to specify that all fish would need to be tagged prior to offloading, or before carring the vessel, to ensure that there aren't any untagged fish remaining on vessels without an authorized harvester onboard. It's also recommended that tags be applied consistently to the operculum on one side of the fish, and which side that is should be determined through discussions with the TC, to make sure that there isn't any conflict with their biological sampling. Again, application of tags in sequential order would simplify accounting and reporting; and there should be a requirement for tags to remain on the fish until final sale.

States should also take measures to ensure that tags are not being applied during closures in the middle of seasons. The Amendment requires that any unused tags be returned to the state agency by the harvester no later than February 15 of the following year. The LEC recommended adding some language to say; or within 90 days of the end of the fishing season, whichever is sooner, in order to reduce the gap between the end of seasons that end a little earlier in the year and the end of the fishing season, the final end.

It's also recommended that the states require tags to be returned prior to renewing harvester's permits. In reporting to the state, harvesters should include information on tags that were lost or broken; as well as those that were applied to fish. This information should also then be included in the annual tag report from the state. States should also implement tag expiration dates; such that it would be illegal for any harvester to sell fish with expired tags to a buyer or dealer, but that dealers in possession of fish with expired tags could still sell them to the final consumer.

It's recommended that tags expire at the end of the fishing year. The last sections of the document discuss penalties and outreach about the tagging program. Each state will need to determine what their penalties are for violating tagging program requirements; but they could include suspension of permits or licenses, confiscation of all fish that were caught, possessed or sold in violation of the program, seizure and forfeiture of properties in violation, as well as fines.

Finally, to promote compliance, the states should also include some aspects of outreach in their implementation of the program; to make sure that all levels of the supply chain are knowledgeable about the requirements of the program. As I mentioned earlier, the implementation of the tagging program was originally required by January of 2019. However, as most of you know we've run into some issues with obtaining an effective applicator from the tag manufacturer that we were working with; and we're still trying to source a reliable alternative.

Additionally, many of the states have lengthy regulatory processes; so starting this late in the year they would not likely be able to implement final regulations by January. Therefore, if the Board is in agreement, the date of implementation for the Tagging Program could be rescheduled to January, 2020, and in 2019 we can use that time as a trial period for the states that are able to do that. That concludes my presentation; and I can take any questions.

CHAIRMAN McKIERNAN: Any questions for Caitlin. Well just a comment from me. It looks like this Guidance Document gives jurisdictions a fair amount of flexibility; which is good. I'll forecast that this will become a perennial topic for the Law Enforcement Committee; as states sort of compare and contrast how to make this work. I'm sure there will be a lot of refinement as it goes forward. No questions for Caitlin at this time? Caitlin has another comment.

MS. STARKS: I just wanted to add that if you have a chance to read through the draft Guidelines, and have any recommendations for how to improve them, or as Dan said find ways to hone down some of that flexibility where possible, to make sure programs are compatible with each other across the states that would be wonderful. I would love to hear your feedback.

CHAIRMAN McKIERNAN: Caitlin, one question. Some of the details in here, could they be used in a noncompliance determination, how do you foresee that going forward?

MS. STARKS: I think the requirements as listed in Amendment 1 would be right now the basis for a noncompliance finding. However, I think it would be up to the Board if there is a desire to create some stricter language. I would see that as something the Board could decide to do.

CHAIRMAN McKIERNAN: Would that be done with an addendum?

MS. STARKS: Yes.

CHAIRMAN McKIERNAN: Just John Clark.

MR. CLARK: It's on the agenda as an action item. Do we need to have a motion to postpone until 2020?

CHAIRMAN McKIERNAN: Executive Director Beal recommends that so yes; would you make that motion?

MR. CLARK: Yes, I will make that motion. Move to postpone implementation until 2020; is it January, 2020, so January 2020.

CHAIRMAN McKIERNAN**: Is there a second? Justin. Is there any objection to the motion? If not it passes by unanimous consent.**

CONSIDER FISHERIES MANAGEMENT PLAN REVIEW AND STATE COMPLIANCE REPORTS

CHAIRMAN McKIERNAN: All right I guess the next is the Approval of the Fisheries Management Plan Review and State Compliance Reports. Caitlin.

MS. STARKS: It will actually be Jess.

CHAIRMAN McKIERNAN: Jess.

MS. JESSICA KUESEL: Good morning; I'll be presenting on the Tautog FMP Review for the 2017 fishing year. I'll start with changes to management, then landings trends, biological sampling, and the compliance and de minimis requests. There were no changes to the federal, commercial, or recreational measures from the 2016 to the 2017 fishing year.

The measures remained a 14-inch-minimum size limit, inclusion of degradable fasteners on one panel or door in pots and traps, and the state-specific management programs to achieve the target fishing mortality. State recreational and commercial regulations are summarized on Pages 21 and 22 of the FMP Review document.

The Board also approved Amendment 1 to the Tautog FMP for implementation in April, 2018. This graph shows trends in commercial and recreational landings from 1981 to 2017. Coastwide commercial landings increased by 7.3 percent from 2016, from 283,906 pounds in 2016 to 304,600 pounds in 2017. This is the highest value for commercial landings since 2008, when 310,940 pounds were landed. Recreational harvest decreased by 34 percent from 2016 to 2017; with totals of 2.7 and 1.8 million pounds in each year respectively. The 2017 recreational landings were the lowest recreational landings for tautog since 2011, when 1.5 million pounds were landed.

Recreational harvest has consistently made up about 90 percent of total coastwide landings each year; with commercial landings accounting for the other 10 percent. In 2017 the trend continued; with recreational harvest making up about 85 percent of total landings. Connecticut, New York, and Delaware were unable to meet the 200 age sample requirement in 2017. Connecticut shortage of samples was due to a lack of tautog caught in the Long Island Sound Survey, and funding and staff limitations that prevented additional sampling.

New York was limited in collecting samples for both the recreational and commercial fisheries due to several issues; including weather, recreational fishing crews unwilling to give them racks for aging, because they were using them as bait, and because the majority of commercially caught tautog was going to the live market and was therefore not available for collecting age samples.

Delaware was unable to collect the required number of samples due to issues with acquiring recreational samples. Difficulties of acquiring the required number of samples have been an issue for a number of states for the past several years. The Compliance Report shows these states all made a good faith effort to get their minimum number of samples.

The PRT still recommends the Board find all states in compliance with the sampling requirements through the FMP. Delaware and Maryland requested and qualified for continued de minimis status. The PRT recommends that the Board approve the state's request. With that I will take any questions, thank you.

CHAIRMAN McKIERNAN: Any questions from the Board? All right seeing none; I think we need a motion to accept the report, including the de minimis requests. David Borden.

MR. DAVID V. BORDEN: Staff prepared the motion for me**. I would move to accept the FMP Review and compliance reports for the 2017 fishing year, and approve de minimis status for Delaware and Maryland.**

CHAIRMAN McKIERNAN: Is there a second, Ray Kane. **Is there any objection to the motion; any abstentions? Seeing none; the motion is approved unanimously.**

ADJOURNMENT

CHAIRMAN McKIERNAN: All right now we're into other business. Is there any other business to come before the Board today? Seeing none; Bob, I think this is a good moment to be checking out of our rooms.

(Whereupon the meeting adjourned at 8:32 o'clock a.m. on October 25, 2018)

Atlantic States Marine Fisheries Commission

1050 N. Highland Street • Suite 200A-N • Arlington, VA 22201
703.842.0740 • 703.842.0741 (fax) • www.asmfc.org

MEMORANDUM

June 7, 2019

To: **Tautog Management Board**

From: **Dan McKiernan, Tautog Board Chair**

RE: **Implementation Guidelines for the Tautog Commercial Harvest Tagging Program**

In October 2017, the Tautog Management Board approved Amendment 1 to the Tautog Fishery Management Plan (FMP), which required implementation of a commercial harvest tagging program to combat illegal and unreported harvest of tautog. In October 2018, the Board moved to postpone implementation of the tagging program until January 2020, due to issues identifying a suitable tag and applicator. At that time, the Board also reviewed but did not take action on a draft document outlining implementation guidelines for the tagging program (enclosed).

A new tag and applicator have been tested in collaboration with several state partners and found to be suitable for the tagging program. Thus, the states will need to implement their regulatory programs by January 2020 to comply with Amendment 1. To provide guidance and maximize the compatibility, effectiveness, and enforceability of state programs, the Board will need to agree on implementation guidelines as soon as possible.

It is requested that all commissioners review the enclosed document and submit any comments or suggested changes to cstarks@asmfc.org no later than June 30, 2019. The Board will consider the draft implementation guidelines for approval at its next meeting in August 2019.

Enc: "Guidance for Implementing the Tautog Commercial Harvest Tagging Program"

M19-41

Guidance for Implementing the Tautog Commercial Harvest Tagging Program

1. Introduction

In October 2017, the Tautog Management Board approved Amendment 1 to the Tautog Fishery Management Plan (FMP). In addition to establishing new management goals and objectives and regional targets and biological reference points, Amendment 1 also addresses the increasingly pervasive issue of illegal harvest of undersized and unreported tautog by establishing a commercial harvest tagging program.

This document aims to provide guidance to the states for implementing the commercial harvest tagging program for tautog. Section 2 of the document provides the base requirements of the tagging program as defined in Amendment 1. Section 3 provides more detailed guidance on each element of the program, and additional considerations the states should address in their rules and regulations when implementing the tagging program.

The guidance provided in this document is intended to promote consistency in application of the tagging program across the management unit, while allowing the states some flexibility to align their program with the needs of their unique fisheries. Establishing similar and complementary tagging programs across the states will have numerous benefits, including enhanced enforceability of the program, reduced likelihood of regulatory loopholes, and consistent data collection for use in stock assessments, among others.

2. Commercial Tagging Program Requirements

Per Amendment 1 to the Tautog FMP, all states within a regional management unit are required to participate in the commercial harvest tagging program. *De minimis* status does not preclude a state from the requirements of the commercial harvest tagging program.

A. Tag Information and Type

All states will use the same single-use tag. The tag will be inscribed with the year of issue, state of issue and a unique number. The unique number will be linked back to the permit holder. States will distribute tags to participants. It is unlawful to sell or purchase commercially caught tautog (alive or dead) without a commercial tag. The cost of the tag will be financed by states or fishermen at the discretion of each state or jurisdiction.

B. Tag Application

All commercially caught tautog will be tagged by the commercially-permitted harvester at the time of harvest or prior to offloading. Tautog must be landed in the state that is identified on the tag.

C. Tag Allowance (Biological Metric)

States are required to allocate commercial tags to the commercially-permitted harvesters based on a biological metric, which will be described in the Annual Commercial Tag Report (Section G). This metric is an estimate to determine the number of fish tags that will be required per year; the goal is to avoid surplus tags. For example, the majority of states in the striped bass commercial tagging program use the average commercial weight per fish from the previous year, or some variation thereof as the biological metric.

D. Tag Accounting

All states will require the tag recipients to return unused tags from the previous fishing year no later than February 15.The return method will be further described by each state. The number of unused tags will be included in the Annual Commercial Tag Report (Section F), along with the disposition of other returned tags (e.g., used, broken, lost, etc.). Tag recipients who do not comply with this section may be subject to penalties set forth in Section E.

E. Penalties

It is recommended that states strengthen their penalties for tautog violations and include counterfeit tag operations, in order to deter illegal harvest of tautog. License revocation or suspension is supported as a primary penalty for state or federal violations. Civil and/or criminal penalties can be also effective deterrents. It is recommended that cases of undocumented "lost" tags should result in a 1-year suspension from the commercial tautog fishery (for the subsequent fishing year).

F. Annual Commercial Tag Report

The existing compliance report will be modified to include a Commercial Tag section that must be completed by each state. The report must include the following information. The Board may modify the sections of the report via Board action.

• Describe the biological metric

• Number of tag violations.

• Complete the following table:

State	MA	RI	CT	NY (LIS)	NY (south shore)	NJ	DE	MD	VA
Quota (if applicable)									
Maximum Commercial Harvest per Region									
Avg. Commercial Weight									
Number of Participants									
Number of Tags Issued									
Number of Tags Returned									

3. Commercial Tagging Program Recommendations

Tag Distribution

Tags must be purchased only from the approved manufacturer and distributed only to licensed/permitted commercial harvesters in their state.

Information on the approved manufacturer and specific tags will be provided to the state agencies responsible for distribution. Each tag will have an inscription including a letter to indicate the state, digits to indicate year, and additional digits to serve as a unique identifier.

Licensed commercial tautog harvesters must obtain standard tautog harvest tags only as instructed by the state fishery management agency in which they have a commercial tautog license. It is recommended that state agencies supply tags to permitted harvesters. There are a number of concerns associated with individual harvesters ordering tags directly from the tag supplier, including the administrative burden on the supplier, potential for harvesters to make errors when ordering tags, harvesters ordering tags in excess, and timing, among others. Harvesters may only obtain tags if they possess all required licenses/permits for commercial tautog. Tags are not transferrable.

An initial allotment of tags should be distributed prior to the start of the fishing season on a designated date, to be determined by each state agency dependent on the timing of the commercial season. Subsequent allotments of tags during the season can occur as needed.

State agencies will issue consecutive tag numbers to licensed harvesters, and record the numbers issued to each harvester. The state agency will issue a number of tags based on a sound biological metric (e.g. a scientific sample of the mean weight of legal-sized fish harvested in open season divided into the state's projected landings in weight). States may choose to order more than the estimated number of tags needed in order to have a buffer. For example, the number of tags ordered or issued to harvesters could equal the projected number of landings plus 20%. Each state can determine how much of a buffer would be appropriate.

It is unlawful for any person to reuse, counterfeit, alter or modify any tautog identification tag, or to possess, use or attempt to use any counterfeit, altered or modified tags. All such tags found by any state law enforcement agent are to be seized, together with any fish and all other tags in possession. It is recommended that the state or jurisdiction, after a hearing, revoke or suspend licenses and/or recall all tautog identification tags issued to any person found guilty, and restrict said person's future participation in the commercial fishery or market.

Tag Application

Commercially permitted harvesters must apply tags to all tautog on the fishing vessel prior to offloading or carring on the day of harvest. Tag application can occur in harbor or at sea. Tags must be applied consistently to the operculum bone on one side of the fish (Figure 1). The Board should determine which side would reduce interference with state biological sampling.

Figure 1. Tautog with properly applied commercial tag.

To enhance enforcement and compliance, states should require the following:

- tags be applied by the harvester in sequential order, so that it is easier to determine when tags were applied
- restrictions on the possession of tags during closed fishing periods
- restrictions on harvesters applying tags during closures

Tautog must remain tagged while in possession for purpose of resale (until they reach the final consumer). If portions of tautog are removed from the carcass and sold, the tag should be retained with the carcass until all portions are sold. Possession of untagged tautog or tautog fillets or steaks without an accompanying tag in establishments where fish are sold or offered for sale (including wholesale establishments, retail establishments and restaurants) is presumptive evidence of intent to sell, trade, or barter such tautog.

Tag Accounting

Any unused tags shall be returned by the harvester to the state agency that issued them. Unused tags must be returned no later than February 15 of the following year, or within 90 days of the end of the fishing season, whichever is sooner. It is recommended that states require tags to be returned prior to permit renewal.

Reporting

Each commercial fisherman participating in a tautog fishery is required to file a year-end tagging report to their state agency detailing all tautog landed no later than February 15 of the following year, or within 90 days of the end of the fishing season, whichever is sooner. All unused tags issued must be returned with the report.

It is recommended that the Board modify the table required in the annual commercial tag report to include additional information on tags used, and tags lost, broken or defective (see section F). The table should be modified as follows:

State	MA	RI	CT	NY (LIS)	NY (south shore)	NJ	DE	MD	VA
Quota (if applicable)									
Maximum Commercial Harvest per Region									
Avg. Commercial Weight									
Number of Participants									
Number of Tags Issued									
Number of Tags Used									
Number of Tags Lost/Defective/Broken									
Number of Tags Returned									

If feasible, harvesters could be required to submit reports more frequently than once per year, depending on season length. Monthly or quarterly reports would enhance law enforcement's ability to track tags. Reports that include the dates on which a sequence of tags was applied and the number of fish harvested (in addition to weight) would further enhance law enforcement's ability.

Any primary buyer permitted to purchase tautog could also be required to provide written reports to the state permitting agency of purchases and harvest information including the date of the purchase, buyer's and harvester's tautog permit numbers, and harvester's Commercial Fisherman Registration License number, the gear type, city or county of landing, weight of whole fish, and numbers of tags that apply to that harvest. Permitting and reporting requirements for buyers and dealers vary by state, so states should determine the requirements and timing of buyer reports.

Tag Expiration

Tags will expire when the fishing year for which they were issued ends (unless a state determines this would unnecessarily restrict harvest and sale at the end of the year, in which case an alternative expiration date could be determined). It will be illegal for any dealer to buy or sell any tautog with an expired tag. Tautog with expired tags may be sold only directly to the final consumer.

Tautog Exportation

It is unlawful to sell or purchase tautog without a commercial tag. This is to prevent the sale or purchase of untagged tautog into a state or jurisdiction where there is currently no commercial fishery program.

Any exported tautog must be marked with an unexpired numbered tag that identifies the state of origin and must be accompanied by documents that verify state of origin.

Penalties
States will enforce the requirements of the commercial tagging program and will determine the penalties associated with violating the regulations.

It is recommended that any violation of the commercial tagging program requirements result in one or a combination of the following actions:

- suspension or revocation of the commercial license/permit, wholesale dealer permit, retail dealer permit, or authorization to purchase tautog
- confiscation of all tautog caught, possessed or sold in violation
- seizure and forfeiture of all property used in violation
- fines

Outreach
States should implement outreach programs to raise awareness of the commercial tagging program among harvesters, dealers, restaurants, markets, consumers and any other parts of the supply chain for commercial tautog.

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Larry Hogan, *Governor*
Boyd Rutherford, *Lt. Governor*
Jeannie Haddaway-Riccio, *Secretary*

Ms. Caitlin Starks
Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200 A-N
Arlington, VA 22201

July 8, 2019

Dear Ms. Starks,

After review of the draft tautog commercial harvest tagging implementation guidelines, the Maryland Department of Natural Resources would like to provide comment on a few items of concern within the document.

Overall, this program is disproportionately burdensome for the Maryland commercial fishermen, which harvests less than 300 lbs. of tautog a year (2016-2018) as a de minimis fishery. Our commercial fishery accounts for 0.08% of the total coastwide commercial landings of tautog. The expected consequence of the program as proposed is that it will eliminate the commercial fishery in Maryland. While we understand the need to have all states participate in this program so that loopholes in the system are not created, we struggle with the administrative encumbrance of the tasks in the proposal and the effect on our small-scale bycatch commercial fishery for the purpose of enhancing enforcement of the illegal live-sale of recreationally harvested fish.

The implementation date of January 1, 2020 should be modified given that the tag applicator and tool were only recently approved and the implementation guidelines are not finalized. Spring or early summer 2020 should be considered. This would allow the Board time to finalize the guidelines and will provide participating states a cushion to fully complete their individual state's regulatory process.

Pertaining to tag application and the requirement stating that tautog must be landed in the state identified on the tag, we would like to point out that there should be a provision to accommodate safe harbor situations. There are occasionally situations where a vessel must land in another state for mechanical or navigation reasons.

In regards to tag accounting, based on our experiences with other tagging programs, expecting tags to be returned during the fishing year can be a challenge. It may be reasonable for states to have the flexibility to implement a fishing year that covers two calendar years, and have tag return during the period of time that the fishery is closed. For example, the tag year may run May 2018 – April 2019, with April being a closed season for tautog, and tag return would occur during April. States should have the flexibility to implement the tagging program for the easiest administration of the program.

Pertaining to tag expiration, there should be a 15 day grace period for fishermen and dealers to move product rather than restricting sales to the final consumer. The current wording of this section could create a loophole for illegal sales and inhibit commerce of legally harvested fish.

Requiring an annual tag report to include the number of tagging violations is not as specific or as straightforward as it may seem. It is unclear whether a warning counts as a violation; and it is unclear what is considered a violation of the tagging rules. Lastly, in Maryland the violations database is a function of the courts system, and if the courts have not entered all the information, or have not entered the information appropriately or timely, some information may be missing. For other species of higher economic importance, tagging violations are not required to be reported to ASMFC.

Lastly, regarding reporting, it is suggested in the draft guidelines that buyers licensed to buy tautog could also be required to provide written reports to the state permitting agency of purchases and harvest information including all trip-level information. Maryland does not currently require trip-level data from dealers (striped bass must pass through a striped bass check station for the state to collect trip-level data). If the Board believes trip-level data are important for accountability of harvest, it should work with other management boards and the ACCSP Coordinating Council to develop and implement trip-level dealer data as a harvest accountability standard required for all states to complete.

Sincerely,

Michael Luisi
Assistant Director, Fishing and Boating Services

Atlantic States Marine Fisheries Commission

Atlantic Striped Bass Management Board

August 8, 2019
8:30– 11:30 a.m.
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1. Welcome/Call to Order (*M. Armstrong*)	8:30 a.m.
2. Board Consent • Approval of Agenda • Approval of Proceedings from April 2019	8:30 a.m.
3. Public Comment	8:35 a.m.
4. Consider Draft Addendum VI for Public Comment (*M. Appelman*) **Action**	8:45 a.m.
5. Consider Postponed Motions from the April 2019 (*M. Armstrong*) **Action**	10:30 a.m.

Main Motion: Move to initiate an Amendment to the Atlantic Striped Bass Fishery Management Plan to address the needed consideration for change on the issues of fishery goals and objectives, empirical/biological/spatial reference points, management triggers, rebuilding biomass, and area-specific management. Work on this amendment will begin upon the completion of the previously discussed addendum to the management plan.

Motion to Amend: Move to amend to add reallocation of commercial quota between states.

6. Consider Approval of 2019 Fishery Management Plan Review and State Compliance (*M. Appelman*) **Action**	11:15 a.m.
7. Other Business/Adjourn	11:30 a.m.

The meeting will be held at the Westin Crystal City; 1800 S. Eads Street, Arlington, Virginia 22202; 703.486.1111

MEETING OVERVIEW
Atlantic Striped Bass Management Board Meeting

August 8, 2019
8:30 a.m. – 11:30 a.m.
Arlington, Virginia

Chair: Mike Armstrong (MA) Assumed Chairmanship: 02/18	Technical Committee Chair: Nicole Lengyel (RI)	Law Enforcement Committee Rep: Kurt Blanchard (RI)
Vice Chair: David Borden (RI)	Advisory Panel Chair: Louis Bassano (NJ)	Previous Board Meeting: April 30, 2019
Voting Members: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC, NMFS, USFWS (16 votes)		

2. Board Consent
- Approval of Agenda
- Approval of Proceedings from April 2019

3. Public Comment – At the beginning of the meeting, public comment will be taken on items not on the agenda. Individuals that wish to speak at this time must sign-in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance, the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Consider Draft Addendum VI for Public Comment (8:45 a.m. – 10:30 a.m.) Action
Background • The 2018 Benchmark Stock Assessment for Atlantic striped bass, which was reviewed and approved by the Board for management use in April 2019, indicates the stock is overfished and experience overfishing relative to the updated reference points defined in the assessment. • In response to the assessment findings and the tripping of the Amendment 6 reference point management triggers, the Board initiated the development of Draft Addendum VI to consider measures aimed to reduce F to the target level in 2020. • The Plan Development Team (PDT) met several times from May-July, 2019, to develop Draft Addendum VI for public comment (**Supplemental Materials**).
Presentations • Overview of Draft Addendum VI for public comment by M. Appelman
Board Actions for Consideration • Approve Draft Addendum VI for public comment

5. Consider Postponed Motions from April 2019 (10:30 a.m. – 11:15 a.m.) Action
Background • The Board postponed the following motions at its April 2019 meeting: *Main Motion: Move to initiate an Amendment to the Atlantic Striped Bass Fishery Management Plan to address the needed consideration for change on the issues of fishery goals and objectives, empirical/biological/spatial reference points, management triggers, rebuilding biomass, and area-specific management. Work on this amendment will begin upon the completion of the previously discussed addendum to the management plan.* *Motion to Amend: Move to amend to add reallocation of commercial quota between states.* • The motions are back on the table
Board Actions for Consideration • Consider action on the postponed motion

6. Consider Approval of 2019 Fishery Management Plan Review and State Compliance (11:15 – 11:30 a.m.) Action
Background • Annual state compliance reports for Atlantic striped bass are due June 15th • The Plan Review Team (PRT) reviewed the reports and drafted the 2019 Fishery Management Plan (FMP) Review (**Supplemental Materials**).
Presentations • 2019 FMP Review by M. Appelman
Board Actions for Consideration • Approve 2019 FMP Review and state compliance

7. Other Business/Adjourn

Atlantic Striped Bass

Activity level: High

Committee Overlap Score: Medium (TC/SAS/TSC/PDT overlaps with ERP, Atlantic menhaden, American eel, horseshoe crab, shad/river herring)

Committee Task List

- PDT – facilitates the adaptive management process by preparing and developing plan addendum or amendment
- SAS/TC – various taskings relating to management response to 2018 benchmark
- TC – June 15th: Annual compliance reports due

TC Members: Nicole Lengyel (RI, TC Chair), Kevin Sullivan (NH, Vice Chair), Alex Aspinwall (VA), Alexei Sharov (MD), Carol Hoffman (NY), Charlton Godwin (NC), Ellen Cosby (PRFC), Gail Wippelhauser (ME), Gary Nelson (MA), Heather Corbett (NJ), Jason Boucher (DE), Jeremy McCargo (NC), Kurt Gottschall (CT), Luke Lyon (DC), Peter Schuhmann (UNCW), Gary Shepherd (NMFS), Steve Minkkinen (USFWS), Wilson Laney (USFWS), Katie Drew (ASMFC), Max Appelman (ASMFC)

SAS Members: Mike Celestino (NJ, SAS Chair), Nicole Lengyel (RI, TC Chair), Alexei Sharov (MD), Gary Nelson (MA), Gary Shepherd (NMFS), John Sweka (USFWS), Justin Davis (CT), Hank Liao (ODU), Katie Drew (ASMFC), Max Appelman (ASMFC)

PDT Members: Angela Giuliano (VA), Heather Corbett (NJ), Jorge Holzer (UMD), Kevin Sullivan (NH), Nicole Lengyel (RI), Gary Shepherd (NMFS), Max Appelman (ASMFC)

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

ATLANTIC STRIPED BASS MANAGEMENT BOARD

The Westin Crystal City
Arlington, Virginia
April 30, 2019

These minutes are draft and subject to approval by the Atlantic Striped Bass Management Board.
The Board will review the minutes during its next meeting.

TABLE OF CONTENTS

These minutes are draft and subject to approval by the Atlantic Striped Bass Management Board.
The Board will review the minutes during its next meeting.

INDEX OF MOTIONS

1. **Approval of Agenda** by Consent (Page 1).

2. **Approval of Proceedings of February 2019** by Consent (Page 1).

3. **Move to accept the 2018 Striped Bass Stock Assessment and Peer Review Report for management use** (Page 16). Motion by Jim Gilmore; second by Ritchie White. Motion carried (Page 16).

4. **Main Motion**
   Move to initiate an addendum to achieve the fishing mortality target or lower within one year (Page 27). Motion by Rob O'Reilly; second by John McMurray. Motion substituted.

5. **Motion to Substitute** (Page 28).
   Move to substitute to initiate an addendum to address the overfishing status of striped bass and implement measures to reduce F back to the F target. Task PDT to develop options that would reduce F to the target that would include:
   - **Minimum fish size for the coast and a minimum fish size for Chesapeake Bay.**
   - **Slot limit that would prohibit harvest of fish over 40 inches.**
   - **Mandatory use of circle hooks when fishing with bait coastwide to reduce discard mortality.**
   - **A provision that states could use seasonal closures in conservation equivalency proposals.**
   - **Apply needed reductions equally to both commercial and recreational sectors.**
   - **Apply needed reductions to the recreational sector only.**

   Motion by Doug Grout; second by Justin Davis. Motion amended.

6. **Motion to Amend**
   Move to amend to delete "Apply needed reductions to the recreational sector only" from the substituted motion (Page 41). Motion by Tom Fote; second by Andy Shiels. Motion carried (Page 41).

   Motion to Substitute as Amended
   Move to substitute to initiate an addendum to address the overfishing status of striped bass and implement measures to reduce F back to the F target. Task PDT to develop options that would reduce F to the target that would include:
   - **Minimum fish size for the coast and a minimum fish size for Chesapeake Bay**
   - **Slot limit that would prohibit harvest of fish over 40 inches.**
   - **Mandatory use of circle hooks when fishing with bait coastwide to reduce discard mortality.**
   - **A provision that states could use seasonal closures in conservation equivalency proposals.**
   - **Apply needed reductions equally to both commercial and recreational sectors**

7. **Move to Amend**
   Move to add the following option: Apply needed reductions proportionally based on total removals in 2017 to both commercial and recreational sections (Page 41). Motion by Emerson Hasbrouck; second by Steve Train. Motion carried (Page 44).

8. **Motion to Substitute as Amended**
   Move to substitute to initiate an addendum to address the overfishing status of striped bass and implement measures to reduce F back to the F target. Ask PDT to develop options that would reduce F to the target that would include:
   - **Minimum fish size for the coast and a minimum fish size for Chesapeake Bay.**
   - **Slot limit that would prohibit harvest of fish over 40 inches.**
   - **Mandatory use of circle hooks when fishing with bait coastwide to reduce discard mortality**
   - **A provision that states could use seasonal closures in conservation equivalency proposals.**
   - **Apply needed reductions equally to both commercial and recreational sectors.**
   - **Apply needed reductions proportionally based on total removals in 2017 to both commercial and recreational sectors**

   Motion carried (Page 46).

   Main Motion as Substituted
   Move to initiate an addendum to address the overfishing status of striped bass and implement measures to reduce F back to the F target. Task PDT to develop options that would reduce F to the target that would include:
   - **Minimum fish size for the coast and a minimum fish size for Chesapeake Bay.**
   - **Slot limit that would prohibit harvest of fish over 40 inches.**
   - **Mandatory use of circle hooks when fishing with bait coastwide to reduce discard mortality.**
   - **A provision that states could use seasonal closures in conservation equivalency proposals.**
   - **Apply needed reductions equally to both commercial and recreational sectors.**
   - **Apply needed reductions proportionally based on total removals in 2017 to both commercial and recreational sectors**

9. **Main Motion**
   Move to initiate an Amendment to the Atlantic Striped Bass Fishery Management Plan to address the needed consideration for change on the issues of fishery goals and objectives, empirical/biological/spatial reference points, management triggers, rebuilding biomass, and area specific management. Work on this amendment will begin upon the completion of the previously discussed addendum to the management plan (Page 46). Motion by Mike Luisi; second by John Clark. Motion postponed until 2019 Summer Meeting.

10. **Motion to Amend**
    Move to amend to add reallocation of commercial quota between states (Page 47). Motion by Mike Luisi; second by John Clark. Motion postponed until 2019 Summer Meeting. Motion by Craig Pugh; second by Eric Reid. Motion postponed.

11. **Move to postpone consideration of the initiation of an amendment until the summer 2019 meeting** (Page 47). Motion by Adam Nowalsky; second by Russell Dize. Motion carried (Page 48).

12. **Move to forward the Block Island Transit Zone letter to NOAA Fisheries** (Page 49). Motion by Tom Fote; second by Justin Davis. Motion carried (Page 49).

13. **Motion to adjourn** by consent (Page 49).

ATTENDANCE

Board Members

Megan Ware, ME, proxy for P. Keliher (AA)
Steve Train, ME (GA)
Sen. David Miramant, ME (LA)
Doug Grout, NH (AA)
G. Ritchie White, NH (GA)
Dennis Abbott, NH, proxy for Sen. Watters (LA)
Mike Armstrong, MA, proxy for D. Pierce (AA)
Raymond Kane, MA (GA)
Rep. Sarah Peake, MA (LA)
Jason McNamee, RI (AA)
David Borden, RI (GA)
Eric Reid, RI, proxy for Sen. Sosnowski (LA)
Justin Davis, CT (AA)
Bill Hyatt, CT (GA)
Sen. Craig Miner, CT (LA)
Jim Gilmore, NY (AA)
Emerson Hasbrouck, NY (GA)
John McMurray, NY, proxy for Sen. Kaminsky (LA)
Heather Corbett, NJ, proxy for J. Cimino (AA)
Tom Fote, NJ (GA)
Adam Nowalsky, NJ, proxy for Sen. Andrzejczak (LA)
Andy Shiels, PA, proxy for T. Schaeffer (AA)
Loren Lustig, PA (GA)
John Clark, DE, proxy for D. Saveikis (AA)
Roy Miller, DE (GA)
Craig Pugh, DE, proxy for Rep. Carson (LA)
Mike Luisi, MD, proxy for D. Blazer (AA)
Russell Dize, MD (GA)
Phil Langley, MD, proxy for Del. Stein (LA)
Rob O'Reilly, VA, proxy for S. Bowman (AA)
Steve Bowman, VA, proxy for B. Plumlee (GA)
Sen. Monty Mason, VA (LA)
Chris Batsavage, NC, proxy for S. Murphey (AA)
Jerry Mannen, NC (GA)
Martin Gary, PRFC
Derek Orner, NMFS
Mike Millard, USFWS
Bryan King, DC

AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Nicole Lengyel, Technical Committee Chair
Kurt Blanchard, Law Enforcement Representative

Staff

Robert Beal
Toni Kerns
Jessica Kuesel
Caitlin Starks

Guests

Bill Anderson, MD DNR
John Ballo, VA Saltwater Sportfishing
Dave Bard, ECS NOAA
Mike Bednarski, VA DGIF
Karl Blankenship, Bay Journal
Robert Brown, MD Watermen
Steve Cannizzo, NY RFHFA
John Carmichael, SAFMC
Joe Cimino, NJ DEP
Josey Cline, ASA
Allison Colden, CBF
Genevieve Croker, Delmarva Fisheries
Mark Cusumano, NY RFHFA
Raymond Curiale, NY
Jeff Deem, VMRC
Don Frei, NOAA OLE
Kathryn Frens, NOAA
John Gans, TRCP
Joseph Gordon, PEW
Ken Higgins, NY RFHFA
Des Kahn, Newark, DE
Catherine Krikstan, ECS/NOAA
Rob Latour, VIMS
Arnold Leo, E. Hampton, NY
Mike Lightfoot, Twin River
Dee Lupton, NC DMF
Rep. Jay McCreight, ME
Katie Moore, USCG
R. Newberry, Delmarva Fisheries
Patrick Paquette, MSBA
Dan Ryan, DOEE
Monica Schenemann, Potomac River
Dave Sikorsky, CCA MD
Tom Sminkey, NOAA
Ron Southwick, NVA DGIF
John Sweka, USFWS
Joe Targel, NY RFHFA
Jack Travelstead, CCA
Mike Waine, ASA
Scott Ward, DC
Kate Wilke, TNC
Phil Zalesak, SMRFO, Inc
Rene Zobel, NH F & G

The Atlantic Striped Bass Management Board of the Atlantic States Marine Fisheries Commission convened in the Jefferson Ballroom of the Westin Crystal City Hotel, Arlington, Virginia; Tuesday, April 30, 2019, and was called to order at 10:10 o'clock a.m. by Chairman Michael Armstrong.

CALL TO ORDER

CHAIRMAN MICHAEL ARMSTRONG: Good morning everyone. I would like to call to order the Striped Bass Board. I'm Mike Armstrong from Massachusetts your Chair. We have lots to do today. I would encourage everyone to be succinct, non-redundant, and I think we can do a lot of good things today.

APPROVAL OF AGENDA

CHAIRMAN ARMSTRONG: Every Board so far has ended early. I think that should be our goal. Everyone has an agenda; are there any changes, amendments, additions? Seeing none; I see approval by consent.

APPROVAL OF PROCEEDINGS

CHAIRMAN ARMSTRONG: You have seen the proceedings from the February meeting; any changes? They will be approved by consent.

PUBLIC COMMENT

CHAIRMAN ARMSTRONG: At this point we have a few people signed up for public comment. With the reminder, public comment should be brief and aimed at things that are not on the agenda today. There may be opportunity to speak to motions et cetera later on, so please keep your comments to things concerning striped bass that are not on the agenda. Monica Schenemann.

MS. MONICA SCHENEMANN: Good morning everyone! Good job on pronouncing my name, by the way. Yes, I'm Monica Schenemann and I'm the President of the Potomac River Working Waterman's Association. We're a group of Virginia/Maryland Watermen and women who work on the Potomac.

We also have members who do not necessarily work on the water; but they appreciate what we do, providing seafood to the public. I just wanted to take the opportunity to thank each of you for working to the best of your abilities to manage our fisheries for future generations. May God grant you the wisdom you need today to make some difficult decisions regarding some gap variances. Thank you for your time.

CHAIRMAN ARMSTRONG: Mike Lightfoot.

MR. MICHAEL LIGHTFOOT: Thank you very much for listening to us. I'm Mike Lightfoot as you said. I'm a commercial waterman in Virginia, and with Potomac Striped Bass Quota. I also represent our Twin Rivers Watermen's Association, and I'm a member of the Virginia Watermen's Association. We appreciate the focus on different options on reducing the mortality, and reducing the overfishing. We also appreciate the focus on the recreational side; which catches a big portion of the fish, and the recognition that the commercial sector is just a small portion, 10 percent or less coastwide of what's caught. We appreciate all of your efforts and we look forward to some good results, thank you.

CHAIRMAN ARMSTRONG: Robert Brown.

MR. ROBERT T. BROWN: Robert T. Brown, President of the Maryland Watermen's Association. I would like to thank you all for listening to me today; and hope we have a good deliberation here today. I just want to talk to you for just a minute or so just about our tagging system that we use in the Chesapeake Bay in the northern portion of it.

On our rockfish we are issued a certain amount of tags every year; according to our quota. Each fisherman gets his individual tags which are numbered with the state on it, so they can be tracked wherever they may go. What other state you may ship fish to; they can be traced back to the person who catches them.

Also, besides that when we get these tags, once we catch a fish we have to tag it immediately. Once we tag them we have to take them in to a check-in station. They are counted, and the weight is taken on them to make sure that we are very accurate on what we do. At the end of the season if we haven't used up all our tags, we have to return those tags in as we are accountable for them.

I'm just reminding you all of this to show you how our regulations are very tight on the commercial men in the state of Maryland; and it's like that pretty much up and down the Bay, with a few different pieces into it. I would like to thank you very much for your time.

2018 ATLANTIC STRIPED BASS BENCHMARK STOCK ASSESSMENT

CHAIRMAN ARMSTRONG: Thank you for your comments. That is all the folks we have signed up. Moving along, we're going to an action item; ultimately to consider acceptance of the Striped Bass Benchmark Stock Assessment. The first presentation will be by Mike; an overview of the assessment.

OVERVIEW

MR. MIKE CELESTINO: I have a very short presentation; just a recap of the presentation I gave in February, to largely set the stage for Dr. Latour's presentation. We'll start this presentation the way we like to start all of these presentations, with a huge thank you to the entire Assessment Team; the Technical Committee, the Stock Assessment Subcommittee, the Tagging Subcommittee.

It won't be possible to thank all these people enough for all the work that they did to get us through the assessment. In February I talked about the bridge building process and so forth that we had gone through. We started with the 2013 SAW-57 Stock Assessment Model; and updated that with calibrated MRIP data, and made a variety of other changes that are displayed on the slide.

Really quickly of course, bringing in the calibrated MRIP data was one of the larger data changes that we had made. We extended the plus group from Age 13 to 15. We removed the commercial dead release fleet; and were able to portion those fish into their respective Chesapeake and coastal fleets. We developed a revised methodology for estimating commercial dead discards. We made a number of index changes. We removed several indices; the Northeast Fisheries Science Center Trawl, the Virginia Pound Net Index. We brought in some new indices; CHESMAP Trawl Index, Delaware 30 Foot Trawl Index. We were able to incorporate some age composition information into what were formally age-aggregate indices.

As an example, the MRIP Index Catch per Angler, we have age composition information associated with that Index; and the Connecticut Trawl Index, we were also able to bring in some age composition information. We also were able to develop a single unified young-of-the-year index for the Chesapeake Bay; incorporating the Maryland and Virginia young-of-year indices.

We updated the female maturity ogive, and the terminal year of the model is 2017. The Stock Assessment Subcommittee and Gary Nelson in particular, put a great deal of effort into a two-stock migration model. This model involved two stocks, the Chesapeake stock, in which fish could move from the Chesapeake into the ocean region, and it jointly modeled the Hudson River/Delaware River stocks, set the Hudson River/Delaware River stocks.

They would mix in a common ocean region. The Peer Review Panel didn't think that model was quite ready to provide management advice; and I suspect Dr. Latour's presentation will go into some of their deliberations and reasons for that. We are using again the same model that was reviewed in 2013 to provide management advice.

That statistical-catch-at-age model incorporates the changes that I outlined in the first or second slide. The catch-at-age model provides information on recruitment, fishing mortality, selectivity, catchability. It provides abundance-at-age female spawning stock. I'll show some of those results now.

First a recap on our reference points, we maintain for this assessment the same definitions that had been used previously. Our threshold definition is female spawning stock biomass; as estimated in the model from 1995. Fishing mortality reference point is the fishing mortality that gets us to that SSB level over the long term.

The target is defined as 125 percent of the threshold; and there is an analogous F reference point that gets us there over the long term. In terms of actual point values, on the left we have the Addendum IV reference point values. Female spawning stock biomass in 1995 was estimated at just under 58,000 metric tons.

After incorporation of the calibrated MRIP data and a variety of other changes that we've incorporated into the model, the new estimate is quite a bit higher; it's just over 91,000 metric tons. As I described earlier, the associated F reference points are the fishing mortalities that get us those SSB levels over the long term.

The next slide shows model estimates of recruitment. The horizontal line shows the time-series-average recruitment. We've highlighted in blue several strong year classes in recent years; and the plot does show the Y axis is in millions of Age 1 fish. The plot shows a period of very low recruitment from the early eighties through the mid-nineties; a period of higher recruitment for the mid-nineties through the early two thousands, then a period of low but variable recruitment since the early two thousands. It does illustrate several strong year classes; the 2011, 2014, and 2015 year classes are fairly strong year classes. The next plot is the time series of fishing mortality. The horizontal line shows the threshold level; fishing at that level over the long term should get us to the 1995 level of SSB.

Then you can see from the plot the terminal year 2017 fishing mortality is above the threshold. The next plot is female spawning stock biomass; a horizontal line shows again the threshold that by definition is our 1995 level of SSB. The terminal estimate, 2017's estimate is below the threshold. With that I would be happy to take any questions.

CHAIRMAN ARMSTRONG: Any questions? I have one, Mike. We saw this previous; it was termed preliminary, but in fact this is now official and there are no changes since what you gave last time, correct?

MR. CELESTINO: Correct.

CHAIRMAN ARMSTRONG: Okay, just making sure. Rob.

MR. ROB O'REILLY: I was just wondering. The impact of the recalibrated MRIP, so for example I know with summer flounder the comments were that it definitely scaled up the spawning stock biomass. Do we get the same impression here? I think that the idea was that there was overall an average of maybe 260 percent difference; as the average over the older MRIP. But I guess more important is what did the revised MRIP do to the spawning stock? How did that figure in?

MR. CELESTINO: Yes thank you for that question. We did see scaling up of abundance quite a bit. In our bridge-building process to sort of help us diagnose the impact of incremental data changes, including the new calibrated MRIP data that change alone scaled up abundance and female spawning stock biomass by quite a bit. It made sense institutively to us if we were catching more fish than we were initially aware of, there had to be more fish in the population. We did see an increase in abundance and spawning stock as a result of the calibrated MRIP data.

CHAIRMAN ARMSTRONG: Emerson.

MR. EMERSON C. HASBROUCK: Thank you Mike for your presentation. Mike, during your presentation you said that the model provided partial F's for each fleet; and that the model was based on two fleets. Is that correct?

MR. CELESTINO: Yes.

MR. HASBROUCK: What were the two fleets that were modeled; and do you have the partial F's related to those two?

MR. CELESTINO: Thank you for that question. Yes, the two fleets were the Chesapeake Fleet, and that incorporates commercial and recreational fisheries combined and their associated dead releases; and a coastal fleet, everything except for Chesapeake Bay. It also incorporates commercial and recreational catches. In this presentation I don't have the partial F's. I think we can probably pull that up for you if you would like to see it. I don't have that in this presentation; but we can probably get that for you.

CHAIRMAN ARMSTRONG: Ray.

MR. RAYMOND W. KANE: Mike, going back to that slide you showed us the MRIP reports on recreational fishing and commercial landings; and you do the tag with commercial landing. You know so many tags are sent out, so many come back. How is bycatch mortality considered in the commercial industry beyond the tagging program? Are vessels different gear types that catch striped bass and discard them dead? How is that accounted for?

MR. CELESTINO: Thank you for that. We have gear-specific discard mortality rates. I can get those for you. It ranges from very low for things like pound net to very high to things like staked gill nets. We look at the proportion of tag returns proportionally across those different gear types and apply those gear-specific mortalities to the ratio of dead discards based on those tag returns.

MR. KANE: Follow up. Once again we're talking about tag returns. I'm talking about gear types; not tag returns, not vessels that are permitted to land, commercial vessels that are permitted, you know that have tags. I'm talking about gear types that might interact with striped bass. How is that accounted for, their dead discards, how is that accounted for in the stock assessment?

MR. CELESTINO: As best I can recall we are assuming that those are proportional to the tag return; so we're assuming that what we see in those fisheries based on our tag returns is proportional across all of the fisheries. It's just an assumption we have to sort of make; and Dr. Drew would like to add to that.

DR. KATIE DREW: We do assume sort of a non-reporting rate for those tags; based on other studies that we've done to figure out what's the rate of reporting from those different fisheries that indicate how many people are actually reporting those tags to us. Then we scale up by kind of an estimate of how many people are not reporting those tags to us.

But I think also, so the other thing that we looked at for this assessment is we did look at the Northeast Fisheries Science Center Observer Program data. We did go through and look at what are the estimates of commercial discards coming from vessels that actually carry observers on them; and the estimates were very similar in terms of trend and generally in terms of magnitude.

But, they were lower than what we were estimating with our tag-based methods and that's partly because the Observer Program really only has good sampling data for the gillnets and for the otter trawls, and we know a lot of the fisheries that direct on striped bass are things like pound nets that aren't well covered by the Observer Program, as well as hook and line fisheries. The fact that we had similar numbers coming out of the Observer Program, where we don't have to rely on the tag-based method, and is similar to our tag-based method, gave us more confidence in the results that we are seeing from the tag-based method.

CHAIRMAN ARMSTRONG: One more follow up.

MR. KANE: Once again though, we know about the lack of observer coverage in the commercial fleet over the years. But thank you very much.

CHAIRMAN ARMSTRONG: I have John McMurray and then John Clark.

MR. JOHN G. McMURRAY: Mike, I noticed we took out the Northeast Trawl Survey from the assessment process. What was the reason for that?

MR. CELESTINO: We felt it had very low proportion of positive tows.

MR. McMURRAY: That trawl survey generally takes place offshore outside of three nautical miles, correct?

MR. CELESTINO: Correct.

MR. McMurray: Okay thank you.

CHAIRMAN ARMSTRONG: John Clark.

MR. JOHN CLARK: Thanks again for the amazing work on this assessment. I've got kind of a follow up about the discard question. The target fishing mortality from this assessment and the previous one both seem very low for a species with a life history of the striped bass. Was there any thinking that there could be sources of mortality that are not being picked up; that for example discard mortality could be higher than we're estimating?

MR. CELESTINO: Thank you for that question. Our discard mortality rates or estimates, across whether it's in the commercial sector by gear or in the recreational fishery across the entire fishery is an average, so in some cases we know it's going to be lower, and in some cases we know it's going to be a little higher given angling behavior or water temperature or salinity, those kinds of things. It's perfectly conceivable that yes it's going to be higher or lower in certain circumstances. Our best estimate is sort of a global average.

CHAIRMAN ARMSTRONG: Any more questions for Mike? Emerson.

MR. HASBROUCK: If nobody else has a question I'll come back around if it is okay, Mr. Chairman. Relative to my question before about partial F's and I understand your response. But we know what the removals are by the recreational fishery and the commercial fishery. Did the model provide any information about what F is for the recreational fishing industry overall and the commercial fishing industry overall; including discards?

MR. CELESTINO: Because of the way the fleets are constructed, they combine commercial and recreational fleets. We don't have independent estimates of that. One of the suggestions that review panels in the past, not necessary this Review Panel, but from the 2013 panel they did make that suggestion of sort of breaking fleets out by sector. But we haven't done that for this implementation. To your earlier question, we do have the partial F's. In general you can see that Chesapeake F is generally lower. Coastal fleet is higher. They showed similar trends; high in the early part of the time series, a low through the mid to late eighties, and then a generally increasing trend from early to mid-nineties through the present.

PEER REVIEW REPORT

CHAIRMAN ARMSTRONG: Thank you Mike, right now I would like to hand off to Rob Latour to give the Peer Review Report.

DR. ROB LATOUR: Good morning. It's been a while since I've been before the Board of any of the species; so some familiar faces. It's good to see some new. Welcome. I guess I have the envious job this morning of being the messenger about the Peer Review. In general I would say it was a very positive and constructive peer review.

As you know, striped bass were on the calendar for benchmark assessment in 2018. The benchmark assessment was put together by the Stock Assessment Subcommittee, the Tagging Subcommittee, and the Technical Committee as a whole. They did the heavy lifting for many months; and then the external peer review consisted of a Chair and three members of the Center of Independent Experts.

The emphasis of the review was strictly on the science. The fundamental charge we were given involved whether or not the modeling and the results could be used to form the basis for management advice. We were implored to recommend an acceptance or a non-acceptance to elements of the model put forth.

Background material can be found on the Northeast Fisheries Science Center's website for the SAW/SARC process. You'll find the summary report that I authored of the review; and then the Independent Peer Review Summary Reports, as well as all the associated assessment documentation and supporting material therein.

My role as Chair came about, for those of you who don't know me, I'm a professor at the Virginia Institute of Marine Science. I'm also a member of the Mid-Atlantic SSC. The companion species for this review that took place last November was summer flounder; which is jointly managed of course here and the Mid-Atlantic Council, but we generally have an SSC member chair the review for the Council who has a vested interest in those species.

My role came to be as Chair largely because of that position. The panelists were from the CIE, Dr. Robin Cook, who actually was a reviewer for the striped bass assessment the last time it went through review. It was nice to have some continuation there. John Casey from SEFIS retired as a consultant now and Yan Jiao from Virginia Tech also an SSC member of the Mid-Atlantic.

We met last November in nice warm Woods Hole. I'll spend a few moments here in the beginning kind of outlining the focus of the discussions and deliberations regarding the material put forth by the Stock Assessment Subcommittee. I'm sure as you know there was a huge effort put forth by the team to develop a very innovative, in my opinion one of a kind, stock assessment model that took into consideration stock structure. Explicitly it broke the annual time step into periods; so there was a seasonal element to it. It considered things spatially as well two regions; the coastal ocean versus the Bay. In the catch-at-age-modeling framework, herein noted as the 2 SCA model, the 2-stock model, and to be fair and honest most of our discussion with the team was revolving around this model. It was really intriguing, very innovative. I would say the group as a whole was very supportive.

But, as many new innovative models come online there are lots of questions, there are lots of research interests, and there are lots of academic concerns when a model comes into its infancy like that. There were just too many uncertainties for the Panel to suggest that it should be accepted for management advice, but that being said; I'll go over here in a little bit a lots of discussion lots of guidance that we gave for the group to move forward.

I'll highlight two things. Simultaneous with this massively new structure the Stock Assessment

Subcommittee also attempted to redefine the reference points to be stock specific for the SSB the spawning stock biomass reference points there was a Delaware SSB reference point and a Chesapeake Bay reference point, and three fishing mortality reference points, two for the Bay stock one for Delaware. I'll talk about that a little bit in a second.

Part way through the meeting when it was clear the Panel was not going to accept the two-stock model as Mike has described, the Team brought forward a revised version of the traditional statistical-catch-at-age model, the same model in principle that was used for SARC-57, the most recent peer review.

They did incorporate some new structural modifications and some advancement based on that SARC 57 peer review, which I think provide you with some of the same management options or opportunities as the two-stock model might have gained. We were able to view that in a little bit more contracted period.

Part of the impetus for the two-stock model was this notion that we have Bay versus Coastal fisheries, and the Panel was very strongly wanting to recommend against this idea of spatial reference points, and so I highlight it here for your benefit. That should not be synonymized with spatial management. Spatial management is certainly viable; and certainly something I think you have the freedom and flexibility to consider, especially with the revised SCA model.

But this idea that you can have a stock, a single biological entity be experiencing overfishing in one region and not experiencing overfishing in another region simply because it moved, based on the season of the year or the age it might have achieved. It's sort of not biologically meaningful; because cumulative F or the total fishing mortality experienced by a stock or members of the population should be what determines an overfishing target, overfishing threshold, and the overall reference point framework that you're familiar with.

There are some infinite ways you can partition F across different regions, different time periods and things like this. I want to draw a distinction between spatial reference points and spatial management. Spatial reference points, are what the Panel suggested are not necessarily meaningful. Spatial management that is changing regulations in one region, changing regulations in another region is certainly within bounds; because that's a total accumulative F over that biological entity of that stock. It's not really fair of us as a Peer Review Panel to whirl in, come in and say we don't accept your model, and send you home without any guidance, right? We spent a lot of the meeting going through questioning the group about aspects of this two-stock model, and I list here some of the ideas of some of the recommendations. We strongly supported continued innovative development of this model; we think it has potential to, with refinement, become one that would pass a Peer Review Panel and thus be the basis for management advice.

But just a flavor of some of the things that were discussed were simulation testing. These are I realize technical things, but testing different effects of various assumptions regarding movement. The movement ecology of striped bass is extraordinarily complicated and not well understood; yet this model has explicit emigration patterns and movement patterns in it, so there is lots of uncertainty there.

There may be advancements with the tagging data to bring things into a spatial framework; further explanation of some of the tagging data to help with time-varying estimation, further exploration of whether or not this biological reference point for a two-stock model concept with mixing is estimable, in a very general sense. When applied the output for the two stocks wasn't all that different; that seemed curious to us.

With all this model complexity and structure embedded, why were the results generally the same for the Delaware stock and the Chesapeake Bay stock? That seemed peculiar to us. Some other assumptions about selectivity, weaknesses of data, stock composition, not to bore you with the technical things, but this was I think a very good faith-based effort to provide constructive feedback for the group moving forward on things that we thought would be beneficial moving this model forward.

The rest of my presentation is pretty boring. I just thought in the interest of transparency I would go through each of the terms of reference associated with what became in the evaluation of the single-stock-traditional SCA model. I'll give you the highlight. We accepted virtually everything. I thought the group did a very good job.

There weren't a lot of major criticism or comments moving forward. We think that the group responded very nicely to the SARC 57 recommendations and made some significant advancement. They did a nice job on Terms of Reference 1, collating all the life history data, all the fisheries independent data, the surveys as Mike described, the data sources, talking about M.

All those data were nicely put together and served as a good starting point. Striped bass are not data poor. Landings, this is probably the most notable advancement. There has been some discussion already this morning about reconfiguring the single-species model to have only two fleets; that is the Bay fleet with its discards, its recreational component and its commercial component, and then the non-bay or coastal fleet with its recreational, commercial, and discards.

This is, I think, something that gives you the opportunity to think about spatial management, again not with spatial reference points. MRIP was here, it's here to stay. We're seeing hundreds of percents increase in the new calibrated data. This is not anything new to everybody here. Mike talked about it already. But in general the group did a nice job characterizing the landings data. This sort of highlights some of the additional commentary regarding the modeling components; the two-stock model now accepted, single stock model accepted, Bay Fs as you saw a moment ago are generally lower than ocean Fs. The SSB pattern was low in the eighties, peaked in 2003, and declined steadily since 2010, leading to the 2017 SSB estimate being on par with that of 1992 timeframe which was when the resource was declared restored. Scientifically speaking, estimates of uncertainty were fairly low; which is a good thing, good precision.

The major diagnostic of these models is this retrospective pattern; and so the team did a retrospective analysis where they peeled off a year of data and re-estimated everything and went back several years in time. There was a hint of a pattern; but it was certainly not egregious by any means, and the hint of a pattern might suggest a slight overestimation of F, and a slight underestimation of SSB, but it wasn't anything that the Panel felt was concerning of alarming.

It was generally mild in the grand scheme of how bad these patterns can emerge for some assessments. The tagging data you are well aware of these data; they've been around since the 1980s. There may be some advancement that could be brought along in the tagging arena by bringing multistate or spatial models to bear there, a lot of work, those are challenging.

But still there is a rich dataset that could be utilized. But in general the tagging data were useful for comparisons of the mortality estimates and the stock size estimates, and will become actually I should say, more vital if this two-stock model continues to move forward, because these are probably the most valuable data sources for understanding stock composition and movement, or at least that are in hand at the moment.

The take-home message as Mike showed. We have a 1995 SSB as the threshold; and the associated F that comes along with that. The target is 125 percent of that threshold; and there is another F that comes along with that. The Assessment Committee elected to go with again these sort of empirical; that is they are just static numerical values for reference points.

An area moving forward might be to consider why the SPR or the spawning potential ratio, which are reference points that are tied to underpinning the productivity of the resource, are not able to perform well. It's unclear, the group did not have a clear answer, but it's likely that there may be some sex specific male/female dynamics that are still not well articulated within the modeling framework that could be responsible.

We have empirical reference points, and Mike showed this slide, so we have simple comparison. When you look at the 2017 estimate of SSB it is below the threshold; and when you look at the 2017 estimate of F it's above the threshold, so we have a status determination of overfished and overfishing occurring.

Short term projections were run under a variety of different scenarios; and virtually all of them showed high probabilities of remaining overfished, greater than 95 percent. There was some, maybe a little bit more uncertainty regarding the probabilities of maintaining overfishing; but they were generally about 50 percent, depending on some assumptions of the configurations depending on the recruitment assumptions and things like this. But still, short term projections suggested high probabilities of maintaining the current status determination. In general I think we were very complementary and positive; even though the outcome may not have been ideal. I think the team did a great job; they did a lot of work, a tremendous amount of work, and the innovation associated with some of the modeling was really great to see. Great progress on SARC 57, and just moving forward a high priority put on maybe moving that two-stock model forward.

To kind of wrap up, the two-stock model was great but not accepted. The single-species model was modified and brought forth in a way that I think made great sense, and is a more useful tool for you as a management group. That model was accepted; the outcome unfortunately had an overfished, overfishing occurring status determination for 2017. The group had great progress in a lot of areas; and we support their efforts moving forward. Thanks for your time, and I'll be happy to answer any questions.

CHAIRMAN ARMSTRONG: Questions for Rob. Jay.

MR. JASON McNAMEE: Thank you, Dr. Latour. I appreciate the presentation. One question that I was wondering and the answer might be you got kind of jammed up with going through the model that wasn't accepted in trying to get to the other. But one thing I wondered about is discussions on natural mortality that you may have had. I guess I'll offer the context of I'm trying to wrap my head around some of the SPR, or if that was done and why it kind of went off into the stratosphere.

The reviewers and you mentioned this kind of implicated this notion of sex-specific dynamics. The females move out earlier and things like that. But I wondered if natural mortality came up as another discussion. I think it's like a Lorenzen type curve, but scaled to the tagging. I'm wondering about the discussion around that if that was also implicated as a factor in the response of the SPR reference points.

DR. LATOUR: We did not spend a great deal of time talking about M. The Lorenzen curve as you pointed out is a commonly accepted approach. It was scaled to tagging; which is also another viable way of estimating natural mortality, so the methodologies underpinning both are well accepted. It was nice to see them treat M as age varying as opposed to a static singular value for the entire age class, or age structure.

But you're hinting at what ended up happening. We couldn't dive into some of the details associated with the SPR stuff; because there really just wasn't a great deal of time. We spent probably 70 percent of the meeting on the two-stock model; and then had to kind of move along through the single one quickly. But I will say there was nothing alarming with the approach used by the group.

Nothing seemed to come up in the discussion with the Panel that raised concerns. The SPR stuff likely is tied to the male/female thing. It could be a function of M; it could be some other stock dynamic that's occurring there. I think your intuition is probably correct. This is the first place to start thinking about it.

CHAIRMAN ARMSTRONG: Emerson and then Mike

MR. HASBROUCK: Thank you Rob for your presentation. Could you put the slide back up please for TOR 6? I had a question on that. The bullet for short-term projections was run under four harvest scenarios. Could you expand on that a little bit please, in terms of what those harvest scenarios were and what the output was?

DR. LATOUR: I might rely on Katie or Mike, because I don't remember those scenarios, the details of them. But I'm sure they were under different assumptions of removals. Do you want specific values of those removals? It was sort of bracketing a status quo, probably a reduction of some kind. I don't know the percentage off the top of my head.

MR. CELESTINO: We looked at a constant catch scenario; so holding 2017s catch constant. We looked at a constant F scenario holding 2017s F constant. We also looked at fishing at the threshold, 0.240 I believe, to get to the 1995 value of SSB, and we also looked at the F value to get to the 1993 value of SSB as well.

DR. LATOUR: In summary there is some status quo and then some first cut ideas getting back to threshold or target values from the reference points.

CHAIRMAN ARMSTRONG: Mike and then Rob.

MR. MICHAEL LUISI: Rob, thank you for your presentation. I'm having a little trouble figuring out a couple of the comments that were made; specifically about the spatial reference points being not biologically meaningful. But there is also optimism that this two-stock model could be something for the future. I'm wondering how to bridge the gap between what the peer review was saying about the meaningfulness of reference.

You know spatial reference points, spatial management are certainly something that we're highly interested in pursuing for future management. I wonder if you could comment about how we can get from a point where a peer review is saying something isn't meaningful, yet it's optimistic that it can ultimately achieve, it can get there someday. Then after that Mr. Chairman, I have one more follow up on reference points.

DR. LATOUR: Yes thank you for the question regarding clarification. We're scientists; and models are cool. A lot of this modeling was very innovative and very interesting. But there is still some fundamental biological things that the single-stock model overlooks; that is you have two genetically, possibly more, but at least two genetically isolated stocks that each likely have their own underpinning life history and life cycle.

The Delaware stock may have an entirely different reproductive strategy; it may have a different recruitment strategy than the Bay, and all of these sorts of things which are not accounted for in this one-stock model. From an analytical point of view; building in the two-stock structure was very attractive from that perspective, because it allows that flexibility to play out.

Regarding reference points being spatial, if you have a single stock it is a single biological entity. In this room we are the ASMFC participants of this meeting for this day. We could say there are enough of us; there is an adequate number to move our agenda forward. If we all split up and go into separate rooms every room itself might not have enough; but there is still collectively enough to move the agenda forward. Where you're located doesn't really matter; because you've achieved a certain threshold of having enough abundance, if you will by analogy, versus maybe spatially there is not enough room for us to conduct our business most efficiently here.

We need to move ourselves around and do different things to go different places; because that is a better way of managing how we're going to move forward. From that point of view we're managing ourselves spatially; but we're not saying anything about whether there are enough of us to move it forward or not.

This idea that the Chesapeake stock could be overfished in the Bay and not overfished in the ocean or vice versa doesn't make sense; because it's the underlying biological productivity of the stock that defines what's allowable in terms of removals, and what's balancing that with its own productivity. I'm not sure if that analogy helps; but that is sort of where we were as a group on that comment. Spatial management is different than spatial reference points.

CHAIRMAN ARMSTRONG: Go ahead, Mike.

MR. LUISI: Thanks for that. It helps me get a little bit closer to understanding. I guess my follow up question to your comments is that I am aware. Staff has informed me that even through the single-stock model that reference points were generated for both Chesapeake Bay and the coastal fishery. Is the reasoning you just gave the reason why the peer review, even under one-stock model wouldn't be suggesting those for management use?

DR. LATOUR: Exactly, exactly, because again you have a single stock now; not separate ones being treated in the same model. It's exactly the same logic that would apply.

MR. LUISI: One more question Mr. Chairman, if that's okay. Regarding the reference points that we're currently using, there was some discussion in the peer review about the 1993 reference point. We've had concerns over the reference points for quite some time. In our mind they're a bit too high. I think they provide for an unrealistic expectation to the public that we're going to be able to achieve that level.

You know, currently the threshold reference point is 91,000 metric tons and 125 percent of that puts us at a target value, and when you look at the estimates of spawning stock biomass that came out of the benchmark. We have never achieved the target in all of that time as we're evaluating that.

With that said, I also understand thresholds as being something where the stock is in what I would think is considerable trouble. When I look back as to when that threshold was developed, you know a date was chosen, a period of time was chosen when the stock was considered recovered.

It's difficult to communicate with stakeholders about the appropriateness of thresholds and targets; when you have a threshold that you think the stock is in trouble, but at the same time when it was recovered. Then you have a target that you never have achieved. I just wonder if you could expand a little bit on the discussion about the 1993 empirical point in time; and whether or not you would consider that to be maybe a more appropriate threshold and target moving forward.

DR. LATOUR: As a Panel we did not challenge the choice of reference points. There is a history of them; and from the Panel's perspective unless there is some obvious modeling-type failure or problem with the assessment that would be tied to the choice of reference points, it's generally not the place of the Peer Review Panel to do that.

Only if it sort of linked to some sort of scientific failure, at least in my view, and that's kind of how the Peer Review Panel that we had for this assessment viewed it as well. I personally would have liked to have seen the SPRs work. I think you have a conceptual divide here. You have an empirical-based reference point that as you say is a marker in the sand; it's not tied to the biological processes of the resource.

That is where the SPRs offer some different insight. They're not working. They are giving drastically unrealistic estimates of abundance and SSB just cannot pass the red face test type scale of the estimate. There is something inherently off there; and it would be nice to understand why.

But usually it's nice to have an empirical marker; or something that's tied to the underlying biology to give you a sense of whether the empirical is based in a reasonable level of what the resource can sustain moving forward, in terms of removal. Long comment here perhaps; but we didn't spend a lot of time discussing it. We just assumed that this is what the management regime and the management system was happy with; so it wasn't initially our place to suggest otherwise.

CHAIRMAN ARMSTRONG: Rob.

MR. O'REILLY: I guess I'm interested about the recruitment stream or vector that when the projections were done. Was it the entire time series of recruitment data; and if not were there other time periods looked at before the complete time series? How did that work?

DR. LATOUR: I'll take a stab at my memory. I believe the full time series was used. Random draws from the full time series cast forward, hockey stick too.

MR. CELESTINO: We looked at two; the hockey stick recruitment relationship. Just to be clear, is your question regarding the migration model or the non–migration model. For the migration model we used the full stock recruitment relationship for the Chesapeake stock. We felt like the asymptotic recruitment had been reached for the Chesapeake stock.

For the combined Delaware/Hudson stock, we used what we termed as hockey stick recruitment relationship where we didn't believe we had reached asymptotic recruitment in that stock. It was more of sort of an ascending relationship. We used Beverton Holt model predicted recruitment through median SSB, and then median recruitment for SSB greater than that for the migration model. As an alternative we looked at random recruitment draws from just 1990 forward; the period of time during which the stock was restored but not recovered, as a sort of sensitivity analysis.

CHAIRMAN ARMSTRONG: Further questions, sorry, Justin.

DR. JUSTIN DAVIS: Thanks for that presentation, Rob. I'm curious when you look at the landscape of data gaps and information gaps that led the Peer Review to conclude that the two-stock model couldn't pass. Can all those readily be addressed with the existing data sources we have; with as you indicated maybe just more simulation work, or just accumulation of longer time series, or do states need to be thinking about initiating new data collection or research survey efforts to produce new sources of information that we don't currently have?

DR. LATOUR: Thank you, it's a good question. I do recall the Panel having some discussion saying that it would be wise for the management body, the management system, to integrate with the TC regarding whether or not this is the direction they want to go, because there are some different data configurations that the two-stock model would require.

I think several of those can be dealt with, with extant data. I don't necessarily think major new data collection programs need to be initiated. But there is the human resource time allocation issue, and so which way does the management system want to go, in terms of its technical supporting information.

There may be some worthwhile effort devoted to prioritization of the modeling tools; and the things that you want to see for what you're envisioning management wise moving forward, because I think that would help guide TC and stock assessment folks with respect to what they're going to tackle next.

But in general striped bass as you know are very data rich. You have one of the longest tagging datasets in the history of fish tagging, to be blunt. It's one of the most-rich in terms of the number tagged and the length of recoveries and things. There is a wealth of information there that can aid the two-stock model in terms of movements and stock composition type questions.

There is a ton of simulation work that could be done that is all analytical computer time that could advance estimability questions that the Panel had. I think a lot of it can be dealt with; with resources currently in place. It's a matter of prioritization. As a general comment, you know I've been around enough to know that when you bring a new model online there is always skepticism.

I don't think this lack of acceptance of the two-stock model should be viewed as some sort of criticism of the group, or fault of anyone in particular. It's just there is reticence to bring on a new modeling tool; because unless it has been fully vetted and quite frankly fully vetted means can take years, in terms of developing it.

It starts out in its infancy and it grows, it grows, it grows. At some point it reaches a threshold where everybody feels comfortable. I don't think there is anything wrong with that. I think it's just a natural progression; and we've started it now, or you've started it with this two-stock model. It's a matter of whether you want to continue it.

CHAIRMAN ARMSTRONG: Jay then John.

MR. McNAMEE: Maybe I'll start off with a comment based on what Dr. Latour was just saying, just to support. I think this idea of bringing in new modeling approaches, having them run kind of parallel. It's a good process. It allows you to do these cross comparisons and to get multiple reviews done on them.

We did a similar thing with black sea bass. I think that process is great. I applaud the group for getting it to the Peer Review. I hope you continue to carry it forward. That was a quick comment. My question is probably not for Dr. Latour, maybe for Mike. I was hoping to put notions of uncertainty and risk in a little bit of context. The one thing that wasn't clear to me in the projections that you did there are these envelopes of uncertainty.

There has been a comment or two made about 95 percent probability of not reaching the target and that sort of thing. I know that you tested stochasticity in recruitment. You also have the two different methods that you talked about. But what I was wondering; was there stochasticity put on any other elements in the projections, like catch or anything like that? When we're looking at that uncertainty are we only considering recruitment uncertainty in that projection?

MR. CELESTINO: Another place that we incorporate uncertainty is where the projection starts; or taking the initial abundances at age and sampling from a normal distribution from each of those starting values, based on the model estimate of standard errors. We're incorporating some variability from where those projections are starting; and then incorporating recruitment variability in addition to that.

MR. McNAMEE: Thank you for that Mike. Just to confirm, so you are doing some sort of Boot Strap routine where you're kind of grabbing from some reasonable sense of variability around the terminal year estimates; and then pitching those forward.

MR. CELESTINO: Exactly. We have estimates of abundance at age and the standard error around those estimates at age; so we're sampling from a normal distribution based on that standard error from each abundance at age.

MR. McNAMEE: Awesome, thank you.

CHAIRMAN ARMSTRONG: John.

MR. McMURRAY: I don't want to get caught up on this. I think there is plenty of time to get caught up on it later; and hopefully this is a quick question, quick answer. But to Mike's reference points comments, I understand that we're dealing with empirical rather than biological reference points. What was the rationale for 1995 as the rebuild year; and is there any reason to believe, based on JAIs and other information that we have that we can't get back there?

DR. LATOUR: From the perspective of the Peer Review Panel those were on the books as preexisting, so the rationale was never really brought to bear. Your question may be dating back to times prior to the most recent assessment review. Mike.

CHAIRMAN ARMSTRONG: Maybe Katie can give us the best background on the invention of those.

DR. DREW: I certainly think there are other people around the table who have been here longer; in terms of why that was declared the restored period. But it was related to the JAI trends over time; as well as sort of the condition of the stock, the age structure of the stock later, when we were able to estimate that through the assessment process.

But it was based predominantly on the JAI index over time. There is no biological reason that we can't get back there. That SSB was the product of good years of strong recruitment and low fishing mortality. But it is within the biological capacity of the stock to show those kinds of year classes again; even now.

MR. McMURRAY: Just one quick comment on that. In the last ten years we've had four pretty good JAIs. I hope the Board keeps that in mind.

CHAIRMAN ARMSTRONG: Roy Miller.

MR. ROY W. MILLER: I didn't hear this morning any discussion of F based estimates, or tag-based estimates of F. I was wondering if Dr. Latour or Mike. My reading of the stock assessment, I recall values for the tag-based estimates of F 0.07, 0.09, somewhere in that range.

How do we reconcile those differences compared to the SCA model estimates of F? What should we do with that? It seems like every assessment we have these independent F-based estimates of F. My recollection is we never know exactly how to reconcile them. Are we any closer to that now?

MR. CELESTINO: I think what the Tagging Committee and the Stock Assessment

Subcommittee sort of makes of those very low F estimates is that they are likely unrealistically low. We think it has a lot to do with the reporting rate. The reporting rate and the tagging model helps partition total mortality into fishing mortality and natural mortality.

The natural mortality tends to be a little bit higher than we think is realistic, and Fs tend to be a little lower than we think is realistic. We instead look at just the total trends in total mortality, and look really good. When we look at those trends, not looking at the distinction between F and M, but just total mortality, we see a high degree of overlap between the tagging model and the statistical catch-at-age model.

This is another sort of line of evidence of support for the migration model, as we saw similar trends with the migration model as well. We at least right now, one of our primary research recommendations that we have in the Assessment Document and the Tagging Committee has talked about for a number of years is trying to get a really good handle on reporting rate that we think will help really tease apart that distinction between F and M.

DR. LATOUR: I can add a little bit to that too. As someone who started their career working on tagging models, I published on the darn things. I would echo Mike's comments in that unless the situation meeting the assumptions of the methods can be truly met then there is likelihood that they are missing a lot of what's going on, because they are relying on a very simple process. You tag 100 animals, you get 10 returns back. That means 90 have survived, 10 have died. You can figure out the mortality rate very quickly.

Missing from that is all the catch activity, all the landings, underlying biology. There is no biology in those methods; and such that I don't think, unless there is a data-poor situation that tagging emerges to the top of the list as a tool for formalized assessments. It's a nice complementary tool. It gives insight into comparability and cross modeling that sort of thing. But relying on this catch-at-age model is by far your best tool for supporting management activities moving forward.

CHAIRMAN ARMSTRONG: Go ahead, Roy.

MR. MILLER: Quick follow up. Is the principle weakness in the tag-based estimates the fact that tag reporting is variable and not well known? Is that the principle problem?

DR. LATOUR: That is a major problem. There are other things called mixing. In order for the information you get from the tagging data regarding survival and mortality to be representative of what the entire population is doing, recognizing that we're tagging a tenth of the percent. A thousand animals tagged in a year is really great; but that is way low compared to what the total population and size is.

What we require is, for every one of those tagged animals to be preferably mixed with the untagged animals, behaviorally, age, size, male/female, all of those classifications. If there is any divergence there, then you're getting a false sense of what the mortality rate of the population is, because it's based only on those tagged population animals.

That is another one that is very hard to validate, or assumption is very hard to control for. We hope it's there; but it's very difficult to know. There is the fisher behavior side of it, like will a fisher return the tag if it's in their hand, and that's a behavioral thing. We would like to know that. Maybe we have a better chance of knowing that. But then there is the biological side of what we're attempting to do with the tagging program in general.

CHAIRMAN ARMSTRONG: Rob O'Reilly.

MR. O'REILLY: Just a point of information. I'm not sure I heard everything Katie was saying earlier; but I think there was an inference about the recovery, and the average of the 1960 and the 1972 spawning stock biomass was what that was all based on. The Technical Committee at that time was very pleased when that milestone was reached.

CHAIRMAN ARMSTRONG: Are there any other questions for Rob or Mike? Jim.

MR. JAMES J. GILMORE: Are you ready for a motion?

CHAIRMAN ARMSTRONG: I thought I had to say something first; but go right ahead.

CONSIDER ACCEPTANCE OF THE 2018 STRIPED BASS STOCK ASSESSMENT AND PEER REVIEW REPORT FOR MANAGEMENT USE

MR. GILMORE: I was helping you move it along. I'm taking over the Pat Augustine role of New York. **Move to accept the 2018 Striped Bass Stock Assessment and Peer Review Report for management use.**

CHAIRMAN ARMSTRONG: Do I have a second; second Ritchie White? Let me read that into the record. Move to accept the 2018 Striped Bass Stock Assessment and Peer Review Report for management use. **Discussion, seeing none; is there any opposition? Seeing none we approve the motion by consensus.**

CONSIDER MANAGEMENT RESPONSE TO THE 2018 BENCHMARK STOCK ASSESSMENT

CHAIRMAN ARMSTRONG: Moving on, now that we have a Benchmark Assessment and a Peer Review, we need to consider management responses to this. The first point is Nicole will present a response from the Technical Committee to our request for what was needed to achieve fishing mortality reductions.

TECHNICAL COMMITTEE REPORT

MS. NICOLE LENGYEL: Today I will be presenting a Technical Committee Report on the task assigned by the Board at the last Board meeting. I'll start by going over some background information; and then I'm going to present each task assigned by the Board. For each task I'll review the methods, results and the Technical Committee comments.

At the February 2019 Board meeting, the Board was presented with preliminary findings of the 2018 Benchmark Assessment. Those findings, which we just reviewed again today, found that SSB in 2017 was estimated at 151 million pounds of fish, which is below the threshold of 202 million pounds, resulting in an overfished status. Fishing mortality in 2017 was estimated at 0.31, which is greater than the threshold of 0.24; meaning that we are also in an overfishing status.

As a result of these findings, the Board passed the following motion: *Move to task the Technical Committee with providing the Board with a report that shows the reductions in harvest needed to reduce F to F threshold, and F target, and also provide one example of recreational bag and size limit combination, and if necessary seasonal restrictions needed to achieve these conditions, A, on the coast and B in the Chesapeake Bay, and report back to the Board in May.*

The first task from that motion that I'll review are the projections that were done to estimate what total removals need to be in 2020 to have a 50 percent probability of bringing fishing mortality back down to the target and threshold. For the projections the Technical Committee had to make several assumptions.

The first of that being, that any management would not be implemented until 2020. Next, because estimates of commercial removals for 2018 to 2020 are not yet available, the Technical Committee assumed that commercial landings would be the average ratio of commercial removals to total removals for the period of 2015 to 2017; with commercial removals including landings and discards. For recreational removals for 2018 to 2020, the Technical Committee assumed that 2018 removals would be equal to the preliminary 2018 MRIP estimates. For 2019 we looked at two different scenarios. The first scenario was assuming that 2019 removals would be equal to the 2018 preliminary MRIP estimates; and the second scenario was assuming that 2019 removals would be equal to the average removals from 2016 through 2018.

That three-year average was chosen to capture the variability in landings over the three-year time period. Under both those scenarios we got very similar results. From the projections it was estimated that total removals in 2020 need to be 7.1 million fish to achieve F threshold; which is a 0 percent reduction from 2017, and total removals need to be 5.9 million fish in 2020 to achieve F target, which is a 17 percent reduction in total removals from 2017.

For these projections there is a 50 percent probability of achieving the target and threshold. For all scenarios the spawning stock biomass was projected to be below the target and threshold in 2020. This plot shows female spawning stock biomass over time in metric tons; and shows that by 2020, spawning stock biomass is expected to increase slightly, but will still be below both the target and the threshold.

The TC had several comments related to the uncertainties in these projections. At this point 2018 recreational data are still preliminary; and assumptions had to be made about what 2019 removals are expected to be, as well as commercial landings and discards for 2018 and 2019. Additionally, preliminary recreational landings in 2018 decreased by 25 percent compared to 2017, with no management changes, adding to the uncertainty.

This decrease was likely due to a decrease in total effort and directed trips. This is a plot of recreational removals over time in millions of fish. As you can see from the preliminary estimate for 2018, the black bar, it's quite low and it hasn't been that low since about the mid-1990s, when the stock was declared rebuilt.

The next task assigned by the Board was to provide an example recreational option to bring F back down to the target and threshold. As mentioned, the projection showed that we needed a 17 percent reduction in total removals in 2020, to have a 50 percent probability of bringing F back down to the target and threshold. For this exercise to come up with an example recreational option, the TC assumes that reductions would be taken from both the recreational and commercial fisheries, in order to achieve that overall 17 percent reduction and total removals.

It's at the Board's discretion to decide how they want reductions to be allocated to the different sectors; but for this exercise the Technical Committee made this assumption, and therefore we looked at an example for the ocean and the Chesapeake Bay to achieve a 17 percent reduction in total removals relative to 2017, to achieve F target.

On the coast we're currently at a one-fish bag limit. Looking at a reduced bag wasn't an option. Seasons vary drastically along the coast; depending on the jurisdiction, so only a size limit analysis for simplicity was conducted for the coast. In the Chesapeake Bay the bag limit reduction resulted in a decrease greater than 17 percent; and the season analysis had many options that would achieve 17 percent. Again, for simplicity and for ease of comparison to the ocean, only the size limit analysis is presented. Length frequency data from 2016 to 2017 was used; as it was thought to be most representative of the population size structure in 2020. In 2016 and 2017, the 2011 year class was about the same age as the 2014 and 2015 year classes are expected to be in 2020. Maryland and Virginia have different size limits at the present; so separate analyses were conducted for each state.

Maryland was at 20 inches for 2016 to 2017, and then decreased to 19 inches in 2018. The proportion of 19 inch fish had to be estimated; as the average proportion from 2000 to 2014,

when the minimum size was 18 inches. The results show that to achieve the 17 percent reduction in the recreational fishery by 2020, the coast would have to increase their minimum size from 28 inches to 35 inches.
Maryland would have to increase their minimum size from 19 inches to 21 inches; and Virginia would have to increase their minimum size from 20 inches to 22 inches. Increasing the minimum size will increase dead discards; approximately 3 to 4 percent; but the reduction in harvest offsets this.

The proportion of total removals made up of dead discards also increases; due to the small increase in dead discards and the larger reduction in harvest. The TC made several assumptions in the size limit analysis; including the availability of different size classes will be the same, and there will be no changes in effort or angler behavior.

Realized reductions could end up being very different from what was estimated; with fishing mortality and removals varying under constant regulations. We've seen this with Addendum IV, where we initially saw a decrease in harvest following implementation in 2015. We subsequently saw an increase in harvest in 2016 and 2017; and now again we've seen another decline in harvest by 25 percent in 2018.

The Technical Committee did discuss season changes as a way to reduce harvest; but noted that with reduced seasons dead discards are likely to increase, as anglers will target other sportfish and still encounter striped bass, and anglers may switch to catch and release. With that we can take any questions.

CHAIRMAN ARMSTRONG: Steve.

MR. STEPHEN TRAIN: Thank you, Nicole. I have a question. I'm trying to equate something on this. One of our past slides, and it's in this packet too from the SAW, says we essentially have on catch and release we keep 40; it's about a 50/50 balance. It's 48/42 on how many die versus how many are kept alive when we harvest, because of catch and release.

We essentially for catch and release we kill more than we keep. The summary and your results says if we go up from 28 inches to 35, which to me seems like a lot more catch and release to get that 35. We'll only increase mortality by 3 percent. Those numbers just don't seem to add up to me.

MS. LENGYEL: In doing those calculations, we're not accounting for any changes in angler behavior. We're just taking the savings from those 28 to 34 inch fish that will no longer be caught, and applying 9 percent discard mortality to those fish. We're not adding any additional mortality from a catch and release fishery that might occur.

DR. DREW: To add to that. You have to keep in mind that ten times as many fish are released alive as are kept for this fishery. Yes, half of the mortality on the recreational side comes from those fish that are released alive; but that's because ten times as many fish are being released alive or they're being retained.

When we reduce the harvest the number of dead discards increases by about 3 percent; because 90 percent of those fish that we release alive now live, as opposed to being died and being harvested the way they were before. That is why yes there is a lot of release mortality in this fishery, but that is because of the number of trips that are taken that release alive so many fish.

CHAIRMAN ARMSTRONG: We have lots of people to get to here. Justin.

DR. DAVIS: Nicole, I'm wondering if you can comment a bit on the choice of 2017 as the reference year to calculate percent reductions; rather than using 2018.

MS. LENGYEL: The Technical Committee looked at 2017 and 2018. When we looked at both of those years, 2017 presented the largest reduction that would be necessary; and so the most extreme case. We chose that to present. When we look at 2018, it appears that there may be no reduction necessary; and because of the great discrepancy between 2018 and 2017, we thought let's just present the most extreme of those cases.

CHAIRMAN ARMSTRONG: Chris.

MR. CHRIS BATSAVAGE: Nicole, just out of curiosity. What was the percent reduction for dropping the bag limit in the Chesapeake Bay?

MS. LENGYEL: I don't have the exact number in front of me; but I believe it was on the order of 30 percent, somewhere in that realm.

CHAIRMAN ARMSTRONG: Rob.

MR. O'REILLY: I think last meeting there were at least a half a dozen comments about the dead discards; and I did not look back that far. But I looked back to 2006; when the fishery was doing very well and the stock was doing very well, and there were a lot of dead discards then as well. If you happen to have something that shows the time series of dead discards; it may be important for all of us to realize that that's the way this fishery has been prosecuted over the years. It's not something new. But I don't know whether you have anything like that handy or not.

DR. DREW: This graph is from our last meetings assessment; and it's showing the APAIS calibrations. But it's also relevant that you can see the harvest on the left, and the live releases on the right. Again, notice the scale difference that there is literally an order of magnitude larger on the live release side. We assume that about 9 percent of those die; bringing them down to essentially equivalent to the magnitude of the harvest over the entire time series.

CHAIRMAN ARMSTRONG: I have Eric.

MR. ERIC REID: Under the scenario you presented; you're saying there is going to be a 3 to 4 percent increase in dead discards. Is that 3 to 4 percent of 9 percent or is it in total, which would be a 33 to 44 percent increase relative to 9?

DR. DREW: The way we calculated that is that we have the number of dead releases in 2017; so that's 9 percent of that. Then we calculated how many of those fish that were no longer legal harvest that would be thrown back would die. That resulted in a 3 to 4 percent increase in the dead discards. Compared to the level of dead discards that we estimated for 2017, in 2020 the result would be about 3 to 4 percent higher. That is the total number of dead discards would be 3 to 4 percent higher; not the mortality rate itself.

MR. REID: Then that means dead discards would go up somewhere between 33 and 44 percent.

DR. DREW: No, the total number of fish that would be released alive would go up a lot. But of the fish that actually die as a result of that it's only about 3 to 4 percent different from what it was in 2017. The total, including the ones that we assumed before would have been released alive, as well as the new ones that are released alive. That difference of the dead more releases is only 3 to 4 percent.

MS. LENGYEL: The 9 percent discard mortality has already been applied to those fish.

CHAIRMAN ARMSTRONG: Sarah.

REPRESENTATIVE SARAH PEAKE: As you're looking at dead discards; are you taking into account the effects of climate change and the warming of, whether it's Buzzards Bay or Chesapeake Bay or the Delaware Bay, and whether a stressed fish that is released into ever warming waters, if we're going to see a trend for more dead discards as we're seeing the trend up for warming waters.

DR. DREW: For this analysis no, we only applied a constant 9 percent release mortality across the entire population. We do recognize that there are certain times of year and certain situations where that is different. There are also times of year where that is lower. That 9 percent is kind of an average for the overall population.

It's something we could consider looking into as we go forward but, when we've tried in the past to kind of get more spatial or temporal better estimates of release mortality, we've found it's very hard to kind of connect the when and where that fish is being released with enough detail, in terms of water temperature, to relate that back to what we know about the relationship between release mortality and water temperature. But in the future it could have a larger impact.

CHAIRMAN ARMSTRONG: All right, I've got Mike and John and Tom and Jay and Andy. Mike.

MR. LUISI: Thank you, Nicole for your presentation. Just a quick question, are we still doing questions at this point or are you entertaining comments as well?

CHAIRMAN ARMSTRONG: Let's keep it to questions right now.

MR. LUISI: Okay, great. My question Nicole is in your report you were specific in that the calculations and the percent reduction that would be required to achieve a 17 percent reduction in total removals was a combination of all the sectors involved, so both recreational and commercial sectors. I wondered would it be possible as a follow up action to take a look at and analyze each of those sectors independently; if one were removed from the equation.

Meaning that if it were going to be the case at some point that we would be considering perhaps removing the commercial fishery from being part of this addendum, due to its, I guess size in comparison to the recreational fishery. Would it be possible then to calculate reductions solely based on a recreational fishery; if that were going to be what was going to take the reductions?

MS. LENGYEL: If the Board decides to task the Technical Committee or the Plan Development Team with that we can certainly calculate that. If the commercial fishery is not involved it could change the numbers slightly; but we would have to look at that and we certainly can look at that.

CHAIRMAN ARMSTRONG: Go ahead, Mike.

MR. LUISI: Just a quick follow up. But that wasn't anything that you guys discussed at this time. You would need further tasking at this time for that.

MS. LENGYEL: Correct. We were just tasked with providing the example; and we chose applying the 17 percent to both sectors, as we didn't have any other clear guidance on how to allocate the percent reduction, and that is what was done for Addendum IV. We thought for this simple exercise that would be the simplest approach. But, we would be looking, any future tasks that the Board assigns, clear definition on how you want to see those allocations to each sector would be helpful.

CHAIRMAN ARMSTRONG: John.

MR. McMURRAY: One thing I'm not clear on is the Board tasked the TC with developing percent reduction that would get us back to F target. But as far as I'm aware there was no discussion about what would get us back to SSB target. Now my question is; is F target calculated to get us to SSB target or are the two things independent? Do we need to be discussing an F rebuild?

MS. LENGYEL: Theoretically yes. Your F target is supposed to be the level of fishing mortality that gets you to your spawning stock biomass target. It's on what time frame are you talking about thought. On the short term when we look at the slide that we had presented, by 2020 we do see an increase; but by 2020 will not be back up at the target.

CHAIRMAN ARMSTRONG: Go ahead.

MR. McMURRAY: I understand that and thank you, but my question was; were the calculations done given say average juvenile abundance indices that this F target would get us to SSB target within ten years?

MS. LENGYEL: We did not do any long term projections looking at past 2020. The example that we looked at was strictly what do removals need to be in 2020 to get back to F target; and that resulted in the 17 percent reduction.

MR. McMURRAY: Thank you. Okay that's good to know. But I would just remind the Board that part of that second trigger in Amendment 6 is to not only address overfishing, but to rebuild. It's something we need to think about moving forward.

CHAIRMAN ARMSTRONG: Tom Fote.

MR. THOMAS P. FOTE: In the benchmark stock assessment there is a chart that shows the commercial discards, the recreational discards, both harvest and discards. Could you put that table up for me please? It's a yellow/gray spot, it's a bar graph. That is the one I'm looking at. Now we keep saying hook and release mortality is 52, and catch is 48.

If I'm looking at the last three years, and maybe I'm reading this wrong, I look at the hook and release mortality in '15 with 6.5 million, where the TAC is only about 4 million. In '16 it was 7.5 million by the catch and release mortality to 3.5. In '17 it was even more different. It's really not 52/48 anymore according to those last three years, and I don't know what it is in 2018.

I'm hoping you have the numbers for 2018. But it looks to me like the catch and release mortality actually makes about two-thirds of the kill, and about one-third is actually the harvest. When you keep saying 42 to 48, if I'm looking at this correctly, it's a lot larger than that in the last three years.

MS. LENGYEL: I can tell you that in 2018, dead recreational releases accounted for 49 percent of total removals and 55 percent of recreational removals.

MR. FOTE: Explain those charts to me that they don't basically add up to those figures; because according to those charts hook and release mortality is much greater than the catch, it's not on a 42 to 55.

MS. LENGYEL: The numbers that I just gave you were 2018; and this plot only goes through 2017.

MR. FOTE: But on these three years it's a lot larger numbers than that; am I right or wrong?

DR. DREW: That's the correct number for 2017. It's true that in the most recent couple of years it has been higher than it has in the past; and that is a combination of some of the management changes and also a couple of strong year classes moving through, so that when we have more stronger year classes moving through we generally have higher release rates on that. But this is the data that we have.

MR. FOTE: It doesn't add up to the chart though. That's what I'm trying to figure out. If the numbers that are there, I'm looking at the numbers they don't add up to what you're putting up there.

CHAIRMAN ARMSTRONG: Jay.

MR. McNAMEE: I think I'm maybe on the same theme here. One of the comments made about the projections; and Nicole, nice presentation by the way. One of the comments you made, Nicole, was you sort of projected some size structure that you expect in 2020. I'm curious if I'm understanding that correctly. Are you guys making an assumption about those recruitment events in 2015/2016, and kind of pushing those fish forward in some way? The reason, just to put my question in context, I'm wondering.

We're talking about reductions and expectations of discards and things like that. I'm wondering if you have gotten us to a better point with that expectation by doing something like that by propagating forward 2015 and 2016. Maybe they are not old enough yet; it's only a couple years. But you understand my question. I'm wondering how you projected that size structure for 2020.

MS. LENGYEL: I'll let Mike take this; because he actually did the projection.

MR. CELESTINO: Yes, we are starting the projection in 2017; so we have some information on cohort strength from the previous cohorts, and we're projecting that forward. I think to the extent that we can we are accounting for those cohorts coming through the population. The projections are kind of a continuation of our catch-at-age model; so we're projecting those cohorts forward. Does that help?

MS. LENGYEL: Then on the example regulations size we're also accounting for the year class in that and how that is going to impact dead releases. That is why we chose the 2016 and 2017 years; because we're expecting that the 2014 and '15 year classes are going to be the same age as the 2011 year class was; so we're kind of accounting for it in the example regulations as well.

MR. McNAMEE: Okay great, thank you.

CHAIRMAN ARMSTRONG: Andy.

MR. ANDREW SHIELS: Nicole, the TC chose to limit the analysis to minimum length rather than season limits or bag limits. My question is; did the TC consider maximum length limits or slot limits, and if not why not?

MS. LENGYEL: We did not look at a slot limit. The TC thought that for this because it was just an example exercise that the easiest option was just to look at a straight increase in size limit.

CHAIRMAN ARMSTRONG: Emerson.

MR. HASBROUCK: My question is similar to one that Mike Luisi asked; and it was partially answered. I'm wondering why the Technical Committee chose to take a reduction for both the commercial fishery and the recreational fishery; because my recollection of our discussion back in February was really about the recreational catch, and even more so the recreational dead discards.

I was under the assumption, and maybe I'm the only one, perhaps other people have a different view that the task that we were asking the Technical Committee to perform was relative to, or both parts of that motion, were relative to the recreational fishery.

MS. LENGYEL: The Technical Committee discussed it. We were unclear from the Board's motion whether those reductions were to come from the recreational fishery alone or apply to both sectors. We chose to make the assumption that equal reductions would come from each side; as this was just an example.

If you were to look at just the recreational fishery and not take any reductions on the commercial side that 17 percent would be higher. I don't know exactly what that number would be, but it would be greater than 17 percent. You would be looking at greater than 35 inches on the coast; and greater than the minimum sizes in Maryland and Virginia as well.

CHAIRMAN ARMSTRONG: Ritchie.

MR. G. RITCHIE WHITE: Following up on what Jay was asking about. We projected the 2011 year class going forward; and did that turn out to be, has the 2011 year class turned out to be what we projected it to be at this point?

DR. DREW: Yes the model still thinks that was a very strong year class. If you look at the catch at age, you can see that 2011 year class is more abundant relative to the other ages around it going through. I think we only hit our removal target in one year out of the three years that we had under Addendum IV. As a result I think the full benefits of that were not as realized as the projections would have suggested; if we had managed to maintain that harvest reduction through ’16 and ’17 as well as ’15.

CHAIRMAN ARMSTRONG: Justin.

DR. DAVIS: To return to the topic of using the 2016/17 size structure data for harvest and catch for formulating the new regulations. I would agree that that is a good choice; because of the issue of the 2011 year class was at about the same point then as the ’14 and ’15 year classes will be in 2020. But in 2020 we’ll have not one but two strong year classes starting to come into the fishery; make themselves sort of known. I would guess that might be one reason to believe that the projections of dead discards with a higher minimum length limit might be a little bit conservative. It’s possible we might have more discards than projected with those two year classes coming in.

MS. LENGYEL: Yes that absolutely goes into the uncertainties with these exercises. You’re basically assuming that your population size is going to stay the same. Even though we chose those years for the length frequency; to kind of incorporate that a little bit. It is very uncertain.

CHAIRMAN ARMSTRONG: Russ.

MR. H. RUSSEL DIZE: When we were here in February, and I want to back up what Emerson said, everyone was aghast that we had 48 percent dead discards in the recreational fishery. It looks to me at this point that we’re going to punish the commercial for doing a good job. As the chart reads, 2 percent dead discards, and even if it goes up to 10 percent that the problem we have is in the recreational fishery. I was just wondering why we didn’t concentrate on what the meeting in February was all about.

MR. CELESTINO: Again, the motion did ask explicitly for a recreational measure to achieve F target. But there was no guidance on how to apply those reductions to the two sectors. The TC used Addendum IV as a template; which applied those reductions equally to the commercial and recreational sectors. That’s what they did with this example, right to set the stage for a management response discussion.

MR. DIZE: Thank you for that. I will nearby guarantee that if we go with this and raising the size that dead discards are going to be much higher than 48 percent.

MS. LENGYEL: We just wanted to reiterate that this is an example option; and also that the motion tasked us with looking at reductions in harvest needed to achieve F and F threshold. It wasn’t specific to recreational harvest. That’s why we made that assumption.

CHAIRMAN ARMSTRONG: All right Rob, go ahead.

MR. O’REILLY: Will you take a comment, Mr. Chairman, or is it still questions?

CHAIRMAN ARMSTRONG: Still questions, but we are right on the fringe of comments.

MR. O’REILLY: Okay, can I break through the fringe?

CHAIRMAN ARMSTRONG: Are there any further questions for Nicole about the work that she did? John.

MR. McMURRAY: One quick question here. It looks like the TC did calculate the effects of the 2015 year class entering the fishery. If I'm understanding correctly that is not something that we did with Addendum IV with the 2011's. Is that correct?

DR. DREW: The problem was with the 2011 that we ran into was that there had not been a strong year class in the last five or six years before that 2011 year class came through; so we essentially had no historical data in order to provide a proxy length frequency. That was certainly something that we were concerned about when we did that analysis for the Board.

CHAIRMAN ARMSTRONG: Go ahead, John.

MR. McMURRAY: Thanks for that answer. With that analysis in mind we're not expecting that sort of jump in recreational landings in the Bay states with a 21 or 22 inch limit.

DR. DREW: I think this analysis is probably going to be closer than the previous analysis was. But we can't guarantee that there will not be a difference.

CHAIRMAN ARMSTRONG: Tom.

MR. FOTE: I think I finally figured out this chart; and why I was making a different comparison than you were. If I'm reading this, and Joe was trying to explain to me what the chart shows it should be better explained; is that bar is not what the individual catches are. It shows the accumulation of the three catches.

Usually when I'm looking at a bar graph like this, when I see that yellow line that is the number of the yellow line that is basically that is why this is a confusing chart. That is why I was having a problem. I better understand it now. Now I understand where you are getting the numbers. But if I just look at that chart I'm not getting it.

I've been at this a long time and when I get confused, I feel how the public must get confused. When we put up a chart like that we've got to explain this better that this is the percentages one. When you combine all three of them that makes up your hundred percent, am I right or wrong now?

DR. DREW: You are correct. They are stacked on top of each other.

MR. FOTE: I apologize, but I was confused. I figured if I'm confused I've really got to find the answer for it. Thank you.

CHAIRMAN ARMSTRONG: Further questions? We're starting to get into the comment phase. Before we do that Max has a very brief presentation to guide us; in terms of Addendum versus Amendment and the timelines involved, and what we should be thinking. That would be the first order of business.

Are we going through Addendum or Amendment; and how do we approach it? Arnold, I'm going to hold off on public comment until we have perhaps a motion; because we've been all over the place, so I would like to bring us back a little bit, a question, Okay, Arnold.

MR. ARNOLD LEO: Yes thank you. Arnold Leo, I represent the fishing industry of the Town of East Hampton. Since I'm paid to be here to do that I appreciate getting a couple of minutes to address you and ask a question; which I think needs to be clearly answered. As I understand it, the overfishing has occurred entirely in the recreational sector. Is that correct?

MR. CELESTINO: We're unable to determine stock status by sector. We have an area, sort of an area-partial F rather than a sector partial F, so we're unable to develop stock status by sector.

MR. LEO: No, not stock status, the landings. The landings that accounted for overfishing occurred entirely in the recreational sector; true or false?

MR. CELESTINO: We do have a time series of landings by sector. That is true; we have a time series. I don't think we have it in this presentation; but we can make that available.

MR. LEO: I can't understand your answer; but it's not an answer.

CHAIRMAN ARMSTRONG: Arnold. We will come back to the question of commercial versus recreational and we'll take comments then.

MR. LEO: But why can't I get an answer to that simple question at this point?

MR. CELESTINO: The answer has never been calculated; so there is one that could be derived. The current stock assessment does not allow that question to be answered; thus it remains unknown.

MR. LEO: Okay however, it seems to be that is the essential question when it comes to what measures should we take to address the problem. I would beseech you in the next few minutes to come up with an answer to that question; so we would know for sure where the curtailment of effort has to be applied. Thank you.

CHAIRMAN ARMSTRONG: Rob, can your comments hold off after Max?

MR. O'REILLY: Absolutely.

CHAIRMAN ARMSTRONG: Max, go ahead.

REVIEW ADAPTIVE MANAGEMENT TIMELINE

MR. MAX APPELMAN: Again just a couple slides here to highlight some of the issues that could be considered in an addendum or an amendment, and also to review a few possible action timelines. As it has been discussed over this last few agenda items, by accepting the new benchmark assessment for management use the triggers in the plan relating to fishing mortality threshold and the biomass threshold have been tripped.

The Board is required to adjust the management program to reduce F to a level at or below target within one year; and to rebuild biomass to the target, and that rebuilding schedule cannot exceed a ten year period. The adaptive management section in Amendment 6 is very flexible. There are a lot of issues that could be considered in an addendum; and so it's very important that the Board provide good direction to the Development Team on which issues to consider, and also on how those issues should be approached or explored.

Looking at the regulatory program for example, if the Board tasked the PDT to look at new measures for the recreational sector, it would go back and look at bag limits and size limits, because that's currently what manages the recreational sector. If the Board wanted to look at a coastwide season or regional seasons that direction would need to be explicit.

Similar for the commercial sector, it's managed through size limits and quotas. If a seasonal aspect, you know the Board wanted to explore that. That would also have to be explicit. Sort of along the lines of developing alternative regulations, we would also need some guidance on how to apply those reductions to the different sectors.

I think that is definitely a topic that has been discussed around the table already. Also, a regional allocation of fishing mortality, if you use Addendum IV as an example, there were different reductions taken for the Chesapeake Bay and the coast. However, within those two regions the reductions were applied relatively equally to the commercial and recreational sectors.

Guidance along a regional breakdown and also the sector breakdown would be needed. There are a number of other issues that could be considered in an addendum. This list is not exhaustive by any means; it's just a few of the issues that have been raised at this table over the last few meeting. Reference points, management triggers, those would sort of be tied together.

Monitoring requirements, looking at some of the recommendations that came out of the benchmark assessment, a little coordination with the Technical Committee to see if our data needs are being met for the new two-stock model, or other assessment needs. Then I put up here FMP goals and objectives.

That has been discussed some times over the last few meetings. That last bullet, goals and objectives, would require an amendment. Everything else I've talked about could be done through an addendum. A couple action timelines, possible timelines, if the Board were to initiate an addendum at this meeting the PDT would work to bring a draft for public comment in August.

Following approval hearings would be held during the fall; and then final action could occur in October of this year. If an amendment were initiated today, similar timeline in the beginning, first with a PID in August, hearings in the fall, and then at the annual meeting the Board would task the PDT to develop a draft based on that comment received. In February the Board would see a draft for public comment; and then following approval of that we would have hearings on the draft in the fall of 2020.

Actually that is the spring of 2020, sorry, and then the final action would occur this time next year. You know it's important to consider any back and forth between the Development Team, the Technical Committee, and this Board may delay these timelines; so keeping those implementation dates and targets in your mind as we go through this would be helpful. Other than that that is just a couple slides to sort of set the stage, Chair. Thank you.

CHAIRMAN ARMSTRONG: Okay to further set the stage we have a decision tree here. The first point is Amendment/Addendum. I've talked to many of you and I know your opinion; so as soon as we can get a motion to go in that direction would be good. Then we can flesh things out; Rob and then Mike, and then John.

MR. O'REILLY: I'll just take a minute or two, Mr. Chair. Actually Max, you did a great job helping out on some of these issues we've been talking about; as did Nicole. I think that we now know there was an example; and there was an example that was provided by the Technical Committee, and that is what was in front of us today to talk about a little bit.

We also know that we have conservation equivalency; and I think that I will propose that we provide today an amendment for later, much later, maybe after the dust settles on our addendum. It's crucial that we start on an addendum. You probably have seen the information from Virginia, Massachusetts, and Connecticut imploring quick action; and lots of other things as well.

You also have seen from Commissioner Bowman a letter saying that we were proposing emergency action in order to eliminate the spring trophy seasons; which have been in Virginia since 1995, and in fact our Commission in Virginia did just that through an emergency. I can't answer all the questions about these dead discards.

For some reason in Virginia that is not a problem in the recreational fishery; we are 3.8 percent of the total coast for dead discards, and it's always been that way since the fishery reopened in 1990 the recreational fishery does not have a lot of dead discards, usually ranking seventh or eighth.

But where are the spawners? Where is the spawning stock? Where are the large fish? That is what Virginia is interested in right now. I do want to note that we do have a commercial fishery as well; and like Maryland it's an ITQ fishery. That makes things a little bit different than the recreational side.

You can't just put in a size limit and walk away. You have to have the right mesh sizes. I'm hoping that when we come up with conservation equivalency plans for the Technical Committee that we can certainly be looking at mesh sizes; in companionship with size limits and we can have options that are not just cut and dried raising the size limit.

The big currency in Virginia is to try to curtail the number of large fish that are taken; regardless of where they are taken, because this is a spawning area and it's very important. One example just to give you is that we are seriously considering having a single tag per individual for one trophy fish for the entire recreational season; and that's a big step forward. Really when you think about it that is 36 inches; which is commonly a ten year old fish, more often than not. What is the need for harvest of more than one?

With that I would like to initiate an addendum and move that we do start on that today. Then I know there will be several comments about how that goes forward; what steps need to be undertaken Max has already outlined. I guess that it's a very simple motion; because I think in a way the Technical Committee is going to be seeing a variety of information from the states, from the jurisdictions as to how they would meet the reduction. I think it's going to be difficult today to wrap all those in; although you started Max, with the size, season, and bag. Mesh size is there; establishing just finite maximum sizes will be there as well, so that is really just a start Mr. Chair, **and I'm welcome to someone seconding my motion to initiate an addendum to achieve the target fishing mortality rate or lower within one year through this addendum process.**

CHAIRMAN ARMSTRONG: We have a motion; do we have a second, John McMurray second? Before we discuss that I had Mike and John and Doug. Do you want to provide your comments first?

MR. LUISI: Sure, thank you Mr. Chairman. You asked the question; you know amendment or addendum, and the answer in my opinion is that we need to do both. I think there is certainly a need to initiate an action today. We have concerns over the ten year decline in spawning stock that has occurred since its peak.

We certainly believe those to be concerns that we need to correct. Taking the reference points out of the picture there is a concern there. We have to do something today. There is a problem that exists; which was discussed pretty in depth back in February, and for us that problem is the dead discard issue in the recreational fishery. I have to say that while Nicole and the technical staff produced a nice report, which was considered an example for us to use in understanding what reductions may come in the shape of through this addendum.

I'm a little disappointed and slightly discouraged that we're sitting here talking about options to increase minimum size limits across the board; only knowing that it's going to exacerbate the situation that we are currently in with dead discards being as high as they are. I really hope that those examples are just examples of what things we could put forth in this addendum; to try to be creative in an approach to solving a problem.

We're not going to solve a problem taking the easy road; and simply using the same tools we've used in the past. We did it in Addendum IV. We've done it with other species that we manage; summer flounder for instance. Increasing minimum size limits across the board isn't going to work in my opinion. Therefore, I support the action to move forward today with an addendum.

I hope we can have a more thorough discussion about elements of the addendum that could be developed over the summer; to take into consideration the problem that exists, and let's try to solve a problem rather than on paper just putting numbers down, so we can walk away thinking that we've accomplished something.

Lastly, what I'll say is that I think an amendment is absolutely necessary. I don't believe that a parallel track amendment at this time, given the ambitious timeline that Max put forth just in the addendum itself is appropriate. There is only one Max. He can't work on two things at the same time and expect to get them both done.

I do have an interest Mr. Chairman, when we finalize the discussion on the addendum today. I do have a motion prepared for the initiation of an amendment. But that amendment would be initiated, and work would begin upon completion of this addendum later this year.

CHAIRMAN ARMSTRONG: John.

MR. CLARK: Well, I just had a simple question about the timeline that kind of gets to what Mike was just asking. I agree with Mike; we need an amendment as well as an addendum, but Max was that timeline showing doing both concurrently or either/or when you said it looked like either one would be done in a certain time?

MR. APPELMAN: Yes, I was highlighting two possible routes if those documents were initiated today. As Mike just pointed out, it would be difficult to work on both simultaneously. More effort would be put into one and the other would be put on hold probably. If both were initiated today they likely wouldn't follow the timeline that I put up on the screen.

CHAIRMAN ARMSTRONG: Doug.

MR. DOUGLAS E. GROUT: I agree with what has been already stated by my colleagues to the south. I think we need to initiate an addendum today and follow it up with a full-scale amendment to look at a variety of issues that we need to look at. But I think our plan right now specifically calls for us to take action to reduce to the target. I had a similar motion to Robs with an additional wording with specific tasks of the PDT to try and give them guidance in developing this addendum.

I could make a substitute motion; which would give fuller instructions to the PDT on what the Board will do, or we could take this up and approve it. Then I could add the tasking afterwards. Which would you feel would be the smoother; to either substitute right now or to take this motion up right now and then have a second motion?

CHAIRMAN ARMSTRONG: I think Doug we should go with the substitute motion.

MR. GROUT: I've given that to staff here and as soon as that substitute comes up. **Okay, I move to substitute to initiate an addendum to address the overfishing status of striped bass and implement measures to reduce F back to the F target. Task the PDT to develop options that would reduce F to the target that would include: a minimum fish size for the coast and a minimum fish size for Chesapeake Bay; a slot limit that would prohibit harvest of fish over 40 inches.**

Mandatory use of circle hooks when fishing with bait coastwide to reduce discard mortality. A provision that states could use seasonal closures in conservation equivalency proposals. Apply needed reductions equally to both commercial and recreational sectors. If I get a second I would like to provide rationale for all of these charges.

CHAIRMAN ARMSTRONG: Is there a second; Justin.

MR. GROUT: I am using the minimum fish sizes as something to begin with as a concept that we could task the Technical Committee with doing. They've already done some of that work. As far as a slot limit, I'm looking at trying to protect some of the larger spawning fish at this point. I have no idea what that is going to do to the minimum size of that; but I would let the Technical Committee come up with that. I am very concerned about the amount of discard mortality; and I think it behooves this Board as we move forward to try and address this with circle hooks. To be honest with you, I've never been a big fan of mandatory circle hooks; because of the enforceability problem. But after I saw the results of what happened in Maryland when they implemented mandatory circle hooks, and they got 95 percent compliance.

I felt that even though it is going to still be difficult to enforce, clearly the vast majority of people are willing to follow those rules in trying to put conservation measures and reducing discard mortality. A note about the statement I have here, a provision for states to use seasonal closures and conservation equivalency proposals.

That is already in the plan. We don't have to put that in there. But I put that forward as another possibility for states to reduce discard mortality if you were to choose to; and some of the states where their bay temperatures and the temperatures get warmer and the discard mortality is higher that you could put your closures during the summer.

But clearly under conservation equivalency we have a lot of other options that states can bring forward; as far as measures that would be conservationally-equivalent. I want to make it clear that this is not limiting conservation equivalency only to seasonal closures. You could use net sizes; you could do a variety of things.

Just to clarify; I wanted an option that would apply needed reductions equally to both commercial and recreational sectors. I certainly would not be opposed to another option that might consider just applying it to these measures to recreational fishery; if somebody wanted to put an additional task on the PDT. But from my standpoint I feel that the commercial sector should take some measures to try and get us back to the target. Thank you very much and that is my motion.

CHAIRMAN ARMSTRONG: There are a lot of elements there; and clearly this is not going to be a quick discussion, and it is 12:30. Right after Rob has his piece we will break for lunch so we can all come back with full bellies and wise minds and work on this. Rob.

MR. O'REILLY: Thank you, Doug. I think it's a good motion. You can talk later on about Doug's last point; but he did add the conservation equivalency in there, which is always there with the ASMFC. But it's good to know that we'll have that looked at carefully by the Technical Committee.

The slot limit over 40, Virginia would not be interested in having a fish that size in a slot limit, but nonetheless that might be important somewhere else but not in Virginia. Circle hooks are something we've already started to introduce to our Advisory Committee; as a matter of fact we've met three times. I think all in all Doug has crafted a good motion. It's going to take a little more talk after lunch; but I appreciate the motion.

CHAIRMAN ARMSTRONG: Mike.

MR. LUISI: Just a quick question.

CHAIRMAN ARMSTRONG: You're between us and lunch, keep that in mind.

MR. LUISI: I'm not going to keep you; just a really quick question so I can think about this as I'm trying to eat today. Would it be the intent that each one of these as guidance would have, like let's pick the circle hook example? Would the document have a status quo and a mandatory use of circle hooks; or is the intent that all of this applies together, and that everything would be initiated at once?

Because I'm thinking that as Doug mentioned, I certainly would like to amend the last bullet and have another alternative added or another option added to that set. But if we take each one of these as an independent set, I just wonder if we're going to be deciding at the end of the day either status quo or mandatory circle hooks. If we apply both to commercial recreational, or maybe we just do recreational. Just trying to get a sense as to what you're thinking about how this is going to structure; to get my act together over lunch. Thanks.

CHAIRMAN ARMSTRONG: I see it as a pick and choose menu; but I'll let the maker of the motion comment on that.

MR. GROUT: Yes, my intent here was for the PDT to develop options that they would bring back to the Board for consideration for inclusion in the addendum; and that we eventually when we're making final decision here, we're going to come up with a suite that we choose that will accomplish that 17 percent reduction, whatever it's going to take to get us back to the target.

MR. APPELMAN: Mike, I also need to mull this over a little bit. But just looking at the first two bullets for example; I see those kind of falling under the same issue right, in a draft addendum status quo, and then Option A would be a minimum sizes, Option B would be slot sizes and things like that. But again the PDT needs to do some work to flesh out how this would look in an addendum; the same with the circle hooks might be a second issue, status quo versus mandatory circle hooks, to your point, still fleshing this out in my own mind.

CHAIRMAN ARMSTRONG: Okay if we could all be back at our desks 1:30 sharp. We only have an hour to get this out the door.

(Whereupon a recess was taken.)

CHAIRMAN ARMSTRONG: Could you find your seats, please? Thank you that got quiet amazingly fast. You've all mulled over these options. At this point the TC has told us that they need some flesh on the bones. They need some numbers associated with these. There are a few ways to approach it.

We're trying to figure out the easiest way. But I think the first thing we want to look at is the last one; because all analyses on the recreational side, which is the rest of them, will be dependent on which way we go with that. We either do it friendly amendment, hang on just a second.

MR. APPELMAN: I think the first bit of guidance that might be helpful is there has been a lot of talk about how to apply these reductions to the commercial and recreational sector. We have up here on the board equal; apply them equally to both sectors. If the Board wants to see another way of doing that more applied to the recreational than the commercial that is something we want to tease out first; because that is going to sort of duplicate or triple the types of options that are up on the screen already. I think that is what the Chairman was getting at.

CHAIRMAN ARMSTRONG: Mike and then Tom.

MR. LUISI: I won't go back through all the comments that I made earlier in regards to the concern that we have with the stock and the problems that we see existing in the stock. I want to remind everybody that we're not deciding today on whether or not reductions are going to be applied to both commercial and recreational fishermen.

We're trying to develop a range of alternatives to go out to the public to get feedback as to how those reductions would apply. I see this as an opportunity to get that feedback; only if we are to add something to the last bullet that sets a second set of options, which would be for the recreational fishery only, essentially excluding the commercial fishery from necessary reductions.

My intent there to add something like that or add language to this motion, we're not saying that anyone is to blame. Recreational fishermen as well as commercial fishermen have complied with and participated in the fisheries that we developed through our own state process through Addendum IV; and conservation equivalency program, so there is no blame being associated with any one particular individual or individual sector.

But I do think in order to have the conversation based on the level of removals being taken by the recreational fishery compared with the commercial fishery, and just that sheer magnitude in itself has opened the door for this conservation. The only way to truly have it is to have some additional language on this bullet. Mr. Chairman you said we could maybe do this through friendly. I'm happy to suggest language; but I also have a motion if we want to do it by motion.

CHAIRMAN ARMSTRONG: Would the makers of the motion consider amending to provide some range of options of commercial involvement in the reduction?

MR. GROUT: From my standpoint I would not object to there being another option to that effect. Justin's okay.

CHAIRMAN ARMSTRONG: Then I think, and keeping in mind this is to go out to public hearing, no decisions are being made and it sounds like we can make that as a friendly motion.

MR. LUISI: I have language if you want me just to read it.

CHAIRMAN ARMSTRONG: Yes let's see what they figure out down the end here. Doug, Justin, is that fine?

MR. APPELMAN: Just to clarify. It would be a suite of options where reductions are applied equally and then a separate suite of options where the reductions were only applied to the recreational sector. Is that correct?

MR. LUISI: Yes that is how I would intend it to be. It's partially based on the question that I asked Nicole earlier regarding an analysis. If you were to take that analysis that was done in the report by the Technical Committee, and now apply that analysis throughout just the recreational sector, you're going to come up with different levels of reductions that will be necessary. I think this is the way that you get at it; so you almost have two columns for each option as you go forward, one with recreational and commercial together and one with recreational only.

CHAIRMAN ARMSTRONG: Justin.

DR. DAVIS: For clarification based on what Mike is saying. Would that mean that we're setting up a binary choice; where the two options in the document would either be commercial takes no reduction or commercial takes and equal reduction, and there wouldn't be a possibility of doing something in the middle after it comes back from public comment?

CHAIRMAN ARMSTRONG: I will have to take advice I would guess; because we went to public hearing with the extremes so that we could pick something in the middle.

MS. TONI KERNS: Unless you specify you cannot.

CHAIRMAN ARMSTRONG: That would be what I said is wrong.

MS. KERNS: I think if you said on the record today that you were only taking one or the other then that could apply. But if you just leave it, you would have to write that into the document. You could say that the Board would not be able to choose an option in between. But otherwise normally you can go anywhere from one end of the spectrum to the other.

CHAIRMAN ARMSTRONG: All right, I think this accomplishes what we're trying to do then. Doug.

MR. GROUT: I would just point out that I believe that if we were to pick something in the middle at final decision, you wouldn't know what any of these measures would be when you're making that decision.

CHAIRMAN ARMSTRONG: You're completely correct, Doug. We either go with zero or a hundred, or we throw in another option at this point and give the TC yet another avenue to analyze. Jim.

MR. GILMORE: I just wanted to echo Mike's comments. I think what a lot of us have gone through is that with all the suggestions we've had since the February meeting, and there are many of them that we've had at our Council meeting in New York. We don't want to prejudge this. We want to come up with a bunch of options that when we come back in August and we put this out on the street that we're going to have a suite of things to look at that consider all different alternatives. Everybody wants to get this done quickly; and if we don't include things now, we could end up delaying this even further. I clearly want to see the numbers from this stuff; because a lot of it is more a concept at this point, and once we get numbers wrapped around some of these options, I think it will maybe guide our final selection more efficiently.

CHAIRMAN ARMSTRONG: John.

MR. McMURRAY: I just want to be clear that what this does is provides us analysis of what the effects are going to be; whether we go across the board reductions or just on the recreational side. I'm assuming that's going to prove to be quite a bit more impactful to the recreational side than what we're looking at now. That is probably going to play out at the public hearing side of things. Am I correct in that assumption? I mean we're not looking to make a decision here; we're just looking to get the analysis, see what it looks like to provide context for a future decision.

MR. APPELMAN: Yes this is all guidance to develop alternative measures to put into a draft to eventually go out to public comment.

CHAIRMAN ARMSTRONG: Tom Fote.

MR. FOTE: I've got a question first to ask when these 2018 catch figures are going to be finalized. Is it May?

MR. APPELMAN: That's MRIP; May, June. Commercial harvest will come in; in the June 15 Compliance Reports.

MR. FOTE: But the recreational will be before that.

MR. APPELMAN: Hopefully.

MR. FOTE: Here is what I'm getting at. I just want to say one statement on it. The last time we did the reduction it was supposed to be 25 percent equally in both the commercial and the recreational sector. But a lot of states by the way they implemented the regulations it was a 32 percent reduction or 33 percent reduction, 34 percent reduction on the recreational sector; and only a 25 percent reduction on the commercial sector, because that was setting line.

But by the time they went to one fish or a bigger fish and one fish, it winds up being a bigger reduction. On the other point, what I'm trying to say is if we're going to have the final figures, and 2018 is a 25 percent reduction, I would like to basically have that included in the projections. I mean why are we not using the best information that we have available to basically do that; because we've done this before?

I've also been down this road before; as you made me change my slot limit years ago, when I basically go for a regulation and four years down the road, three years we find out we were not in as bad a shape as we thought we were. I think there are a lot more reasons why we saw a 25 percent reduction in 2018; if that's the number. I think that is going to continue because of the drop off of anglers going out, and reduction of trips again. I really would think it's important so we can justify; because if people see we have a 25 percent reduction when we need a 17, we average it out between 16, 17, and 18. It will smooth it out some and we should have an idea with the '18.

I'm asking to include that when we do it; at least one option to show what those numbers are, because we have the numbers. It's based on the best science available at the time that we're making our decision; and we should be making it with the best available science that is there. That is what I'm asking for; because we're not going to public hearings until later after that.

MR. APPELMAN: I don't know if there was a question in there; but are we talking about the reference year of these analyses, and whether it should be 2017, 2018 or an average across the most recent three years, something like that?

MR. FOTE: I'm asking a way of how to handle the 2000s; I just don't want to make it 2018 figures because it might be lopsided. But if you average it with the 2016, 2017, and 2018 it shows the trend over three years; and it might not be a 25 percent reduction, but it will be something different than it is right now as 17. Less than a 17 percent reduction, it might be less. I want to look at the figures of the best available science that we have.

MR. APPELMAN: Thanks for teeing that up; because I think that is still a missing piece of this motion here is what the reference year is when we say reduce F back to the target by what time, what year, and also what that reference would be.

MR. FOTE: That is what I am suggesting is do we do an average of '16, '17, '18 to get what the three years are showing; not just use one '17. I think since we have the science for all three of those years let's use all three of those years.

CHAIRMAN ARMSTRONG: Doug.

MR. GROUT: Correct me if I'm wrong; but when you did the example analysis you did an example with using the 2017 as the terminal year, and then you did a three-year average of I forget which three years. It came out to be almost exactly the same percent reduction. Am I incorrect? I thought I saw that in the analysis.

MS. LENGYEL: That was our assumption that we made for 2019. We did one scenario where 2019 equaled 2018 preliminary landings; and then we did another scenario where 2019 equaled the three-year average.

MR. FOTE: Follow up on that Mike.

CHAIRMAN ARMSTRONG: Go ahead, Tom.

MR. FOTE: But did you use proxies in that number so it was the complete 2018 catch? You said it was the preliminary numbers; so where were the preliminary numbers coming from, and is the same preliminary numbers that you have now that we'll have in the final numbers?

MS. LENGYEL: The numbers that we used are the numbers we currently have; which are just preliminary estimates.

CHAIRMAN ARMSTRONG: Eric. If we could concentrate on the changes we just made re the commercial allocation; so we can move past that one and then move on to the other items. Eric. Is this not concerning that?

MR. REID: It's just an indication of effort in both commercial and recreational sectors. Is that in bounds, Mr. Chairman or not? I'll make it quick.

CHAIRMAN ARMSTRONG: Sure.

MR. REID: I appreciate Mr. Luisi's motion; but my position is about what we know and what we don't know. What we know is the commercial fishery for striped bass we know reasonably well what the potential effort is on any given year; because as far as Rhode Island goes you can't just go out and get a license.

I don't know about the rest of the states; but I'm pretty sure it's limited entry up and down the coast. That is one universe that is reasonably finite; and that effort can be defined. But when it comes to the recreational sector, if the number of saltwater recreational licenses is a metric for potential effort those numbers are staggering.

I know in Rhode Island when the license came out; the first year it came out we had 20,000 recreational licenses issued. The next year there was over 30,000. Virginia is in the same position; only the numbers are much bigger in Virginia. The rest of the states I couldn't find and figure it out; or else I would have them for every one of you, but I couldn't do it.

My position is it is better to isolate the commercial sector; because of the potential effort versus the recreational sector for the exponential increase in any given moment for that effort. If that is some data you can look at I don't know; but that is a question for you.

CHAIRMAN ARMSTRONG: Ray.

MR. KANE: Eric, we still have people can get endorsements; we don't have limited entry in Massachusetts. But getting back to Mike's, apply needed reductions to the recreational sector only. What is the timeframe on this? After the technical team runs all the scenarios, when will we be seeing this again at the summer meeting or at the annual meeting?

CHAIRMAN ARMSTRONG: I think I know this one. We'll be seeing it the summer. We'll finalize it for public hearing. We'll go out to public hearing, we'll come back in October and vote.

MR. KANE: Thank you.

DR. DREW: Unless you guys get really carried away with all of the options that you want to see here. This is a reasonable set of options. But just keep that in mind as you add to this list.

CHAIRMAN ARMSTRONG: Adam Nowalsky.

MR. ADAM NOWALSKY: My comment did not pertain to the last two current bullet points; so would you like me to hold off?

CHAIRMAN ARMSTRONG: No. Go ahead.

MR. NOWALSKY: I don't think we could reasonably request a technical analysis of this; but an item I would like to see included in the document would be something that references the potential for disproportionate impacts to the different recreational users of the resource. Unlike a lot of the recreational fisheries this Commission manages across other boards, this fishery has two very distinct user group; those who target the fish with the intent to harvest, and those that target the fish with the intent to release.

We've had conversation about the concerns about release mortality. We've heard the concerns here this morning about simply increasing the size is probably not a preferred way to proceed; based on what we know about this fishery, and many of our individual experiences with other recreational fisheries management in recent years.

When I look at some of these options here, increasing a minimum fish size or having a slot limit that prohibits harvest; there is potentially an entire user group out there in industry in fact that this will have zero impact on, zero. I think that's a disproportionate impact that this management action could have; and I would at least like to see that referenced in the document.

Anything that can be put forward about it, any thoughts about it by the PDT for our consideration when we come back here to consider sending this document out for public comment in the summer. I think it's very, very important; so any thoughts other people have as we go around the table here, but my request would just be to see that included and referenced in the document as a concern.

CHAIRMAN ARMSTRONG: Do you have that Max? Okay, Steve Bowman.

MR. STEVEN G. BOWMAN: Mr. Chair, my comments will be a little bit more simplistic. I'm adamantly opposed, in all due respect, to my colleague from Maryland. When you've got to add a clarifier which basically singles out a specific user group, the law of the Commonwealth of Virginia prohibits specifically the consideration of one user group over another.

I know what we're trying to get at. But if we leave from here today with that statement on there, you can rest assured from a constituency perspective, maybe not some but primarily from a lot of us, if you leave that statement on there, it's going to be read as if that is the direction that we're going. I have some significant heartburn with the addition of that specific statement.

In addition, there has been I think a false presumption; and I know it's hard to keep up with. But from a law enforcement background, we're considering the fact that in the commercial sector the numbers are what they are. Now I realize the recreational sector they are what they are as well. But in the commercial sector there is a heck of a lot more of product lost than is being accounted for. I will mention one specific investigation where we know, and one would say well why don't you take care of it, because there is a reason that persons are fishing well over the quota based on the system that we have in place in Virginia, which we'll be looking at? I want to make sure everybody keeps in mind that it's not as clean as it looks as far as on paper is concerned; as far as the commercial sector is concerned.

I really do believe if we could do something to massage the next to the last item we would be a lot better off; because if you leave here I know what the constituency is going to think. They're going to think ah ha there they go. What they're doing basically is going to single out the recreational sector for application to these measures. With that I thank you for your time.

CHAIRMAN ARMSTRONG: Tom Fote.

MR. FOTE: I agree with Steve; and it's going to be a bad message to send out. But the other thing I want to follow up is on what Adam was saying. I'm reading a blog one day from one of my friends; and they talk about the fact they went out and caught and released 203 fish in an afternoon of fishing, and they were using blood worms.

Now, nowhere in the article did they put on the blog that not only they caught 203 fish, but they basically killed 16 fish through hook and release mortality. That is what I'm concerned about. When we start looking at this, people are going to fish for striped bass. We always knew it was going to be a higher mortality when we opened the fishery up in '92, because we knew at that time.

What happened over the years and I wasn't going to go into this, is the history went out with regulations. When you push people with closed seasons on summer flounder and black sea bass, remember in 1995 we had no closed seasons on black sea bass, scup. We didn't have any bag limits as a matter of fact, and summer flounder was 10 fish at 14 inches coastwide, and that was the regulations and no closed season.

Then we started inching. By the time we got to 2000 the striped bass had all gotten big from the years we protected them. All of a sudden the guys that didn't want to fish for striped bass, because they said they weren't good to eat. They wanted to catch summer flounder, black sea bass and other species; now turned their attention to striped bass.

Because it ain't like the old days; when I was fishing in the '60s and '70s and crawled on J's and lost my two front teeth on top by falling on the rocks, because it was a lot different. You were skinning eels to use eel skins and everything else. Now to become a striped bass fisherman all you have to do is throw a hook in a bunker and you were king.

You could catch a 50 pounder. It introduced a lot more people into striped bass fishing; and again for food, because you couldn't catch other species. Now this is what we do. We always do single-species management, and we're talking about ecosystem. We should look at the impacts when you do this on striped bass. What are the impacts going to be on black sea bass? What are the impacts going to be on summer flounder; because if you start closing those things then you're directing people to go into other fisheries, and that's what has happened over the last 15 years? Again, 15 or 20 years ago the guys who were fishing summer flounder would sooner fish summer flounder. They didn't want to fish for striped bass, because they wanted those fish to take home to eat. Then there were black sea bass, and we pushed them to now become striped bass fishermen. We redirected their behavior. That is the new world we're facing now.

Now we want to do largely catch and release; but there is another sector that basically harvests. A lot of our businesses that we have in our states from the recreational sector, the charterboats the party boats the tackle stores, depend on both individual groups functioning in unison. When you start eliminating one of those you wind up with a collapse of businesses up and down the coast.

My job is to make sure first is the fishery sustainable. If we did a 25 percent reduction last year, they said in a statement earlier, we might not have to do anything. If we're going to do something, make sure we include that year in there to see what we actually have to do; and then we make sure we do it equally so everybody takes an equal hit if we're going to do that.

CHAIRMAN ARMSTRONG: Sarah. We are running out of time. We need to get to brass tacks very quickly here. Sarah.

REPRESENATIVE PEAKE: I'll try to be brief and concise in my comments. I think that the last bullet point could in effect be radioactive in Massachusetts. There has been a push for a number of years to make striped bass, give it a game fish status in the Commonwealth. We have I think a well-managed, both commercial and recreational fishery.

I think that as we look at management measures we should look at both commercial and the recreational sectors. I think the word equally is where we're getting hung up. Maybe each sector doesn't need to take the "same hit." Maybe what we're really looking at is applying management measures to both commercial and recreational sectors in an equitable manner.

It doesn't mean that if we're asking for a 15 percent or 25 percent reduction in one sector it's got to be 25 percent in the other. I mean we look at what the mortality rate is in each. We have to look at something that is an equitable solution; and maybe it's not an equal solution.

CHAIRMAN ARMSTRONG: Ritchie.

MR. WHITE: I'm concerned that we're not gaining and running out of time. I see two alternatives to get this thing going; either to call the question on this and then if anybody wants to change it they make a motion, or limit debate. I would ask for your choice Mr. Chair, and I would be willing to make either motion.

CHAIRMAN ARMSTRONG: All right, let me go a third tact. I think we can move this along. This one needed to be a friendly amendment. The rest just need advice for the TC. If people have comments on the other ones, then I'll ask the TC what they need also. I think we can move along faster. There were comments over here? Procedurally we will vote when we're done amending this to our liking we will vote for this versus the original simple motion made by Rob O'Reilly. If this wins then that substitutes for that motion, okay?

MR. APPELMAN: To try to help move this along. I have a couple questions and we can start from the top of the motion; maybe work our way down, some questions for the Board to provide some clear direction here. The first I had is talking about by what year we would implement or by what year we would bring F back to target; would that be 2020? It's asking for bringing to target within one year.

Also, trying to work my way down here, talking about the quota, how we would apply reductions to the commercial sector. Would that just be via quota reductions or are we talking about exploring size limits or bag limits for the commercial sector? Direction on that would be helpful; otherwise I see the Technical Committee and PDT just showing quota cuts. Also a reference year, so maybe let's just start with those three; reference year, when we would achieve F target, and when we talk about reductions to the commercial sector are we just talking about quota?

CHAIRMAN ARMSTRONG: Doug.

MR. GROUT: My intent with this, and I'm sorry if I didn't put 2020 in, is that it has to be in place by 2020. The reason I didn't put it into the motion was because within Amendment 6 it requires it within one year. To me it was already implicit that that was our direction. But if you want to have a modification to it we can do that. My concept with the next to the last bullet, when we were talking about commercial reductions, it was to take a 17 percent reduction in the quota.

But how a state reduces that quota is up to them. If they want to come in with a conservation equivalency that is up to them, but that is what I was looking at was a 17 percent reduction. As far as the base year, terminal year is 2017 in the assessment. My intent was that we would be basing it off of 2017; unless the Technical Committee felt that there would be a more appropriate year or range of years to use in this analysis.

CHAIRMAN ARMSTRONG: You've addressed all three questions. Could I ask the TC what is the default that you'll be using for the analysis?

MR. APPELMAN: I think that's good guidance; and if the TC has a better recommendation for a reference year that will come out in the next step. Also just for clarification, the first four bullets there we're assuming that those all apply to the recreational sector; and that the commercial sector is not involved with those first four bullets, seeing a nod from Mr. Grout, thank you.

CHAIRMAN ARMSTRONG: Andy.

MR. SHIELS: My arm is so tired. I wanted to move back above the bullets; and I've been trying to get my hand up sooner so that I could get there sooner. I guess my question. I'm confused about why we have gone to the lowest possible common denominator, the lowest possible denominator to start.

With respect to Doug, who I value his opinion greatly. We have a threshold and we have a target. We have instantly agreed that we're going to shoot for the lowest possible thing on the target here. We're going to go for the target. We're going to task the TC to look at alternatives for all these bullet items. But we have limited ourselves to only going as far as the target. The TC told us that the example we were given was a 50 percent chance of a 17 percent reduction in mortality. If I went to the doctor and I was going to have surgery; and he said you have a 50 percent chance of dying. I would say I am going to go to another doctor and find one that will give me an 80 percent chance of surviving.

In looking at this situation, I'm wondering can we move back up to the body of this; accepting that the bullets have been worked over pretty well, and increase that either from target to threshold or somewhere between target and threshold, so that if we miss on our 50 percent shot we don't come up short after doing all this work and all this planning. Thanks for Doug's consideration and for the time to speak.

CHAIRMAN ARMSTRONG: Doug.

MR. GROUT: The reason I went specifically to the target is because that's what is called for in Amendment 6. It says this is what we need to do within one year; come back to the target. I didn't see that we had at this point any other option until we start looking at the amendment that has been discussed here. In the future maybe that is something that we will consider in the future. But right now we're operating under Amendment 6; and we don't have the option to be looking at the threshold.

CHAIRMAN ARMSTRONG: Jay McNamee.

MR. McNAMEE: Just on this topic to Commissioner Shiels. The target is the more conservative of the two. With fishing mortality you want the lower number. I think you're maybe reversing target and threshold. That was just a clarification. The other point is the probability. That is something we need to specify, I believe.

I will start the volley at suggesting 50 percent is a good probability. I think people often mischaracterize. This isn't a binary live or die situation. This is a continuous situation. When you say 50 percent what you're saying is your highest probability is being at that target; and then the distribution decreases as you get away from it.

You're still really probable of being somewhere around that target; if you think of like a bell curve. The middle of the bell curve would be your target; and you can kind of slide to either side, depending on the uncertainty. I think that is a fair place to start; and so I'll offer that we should give that guidance to the PDT or the Technical Committee, a 50 percent probability of achieving the F target.

CHAIRMAN ARMSTRONG: Okay. That is guidance to the TC. We don't need to amend this at all for that. Megan Ware.

MS. MEGAN WARE: I just wanted to join the Massachusetts and Virginia Commissioners in our discomfort with that last bullet. I realize that this is for a range of alternatives; and we're exploring analysis right now. But I just want to flag that as a source of heartburn for Maine moving forward.

CHAIRMAN ARMSTRONG: Thank you. John McMurray.

MR. McMURRAY: Just to contribute to the F target confusion here. I think I want to go back to the question that I asked during the first presentation on the stock assessment; or on the TC report. We're looking to reduce F to F target. But I still did not get clarification; and to Andy's point about half measures and 50 percent probabilities.

Where is the calculation of what's going to get us to SSB target? I think that needs to be part of this document; because if it's not we're going to get accused of half measures and not taking enough steps to get us back to where we should be.

CHAIRMAN ARMSTRONG: Mike.

MR. LUISI: To John's point. I mentioned earlier that I don't think that we're solving anything. I mean this is a short term. We need to take action short term here. But I think where we solve some problems is for the long term outlook. I have prepared a motion to initiate an amendment after we take this issue up; and I have the rebuilding of the biomass as one of the functions in that amendment discussion.

I think you know we've talked. The timeline here is ambitious. We can't have any hiccups. There can't be any questions as we move forward. We've got to be clean and smooth in all of this; and I think the more we add into this document the more complicated it's going to get, and the less likely we're going to have it in place by 2020, as a caution. But I just wanted to put that back out there that I do have intent for a motion on an amendment after we take up this issue.

MR. McMURRAY: I just want to be clear though that the trigger, Trigger Number 2 in Amendment 6, requires us not only to address overfishing but to rebuild the stock. The feedback that I got from staff is that maybe F target does do that. If it does I would like to see that it does; and if it doesn't I would like to see what would. I don't think that's unreasonable to ask that of the TC for this document.

CHAIRMAN ARMSTRONG: Nicole.

MS. LENGYEL: It would be completely reasonable to task the TC with doing a projection that shows you at what point in the projection SSB comes back up to the target. We could do that. If the Board tasked us to do that we can certainly do that.

CHAIRMAN ARMSTRONG: Consider yourself tasked. I'm not sure I have that power; but you guys can tell me otherwise. Justin.

DR. DAVIS: At the risk of not following Katie's advice to task the Technical Committee folks with coming up with too many options. I would like to expand a little bit upon the slot limit options that are going to be looked at. In particular I would be interested in seeing slot limits options with a 28 or a 32 inch minimum size; and then figuring out what the accompanying upper size limit would need to be to achieve the necessary reductions. I feel pretty strongly that slot limits are something we should really be thinking about. I've heard a lot of support from the public for it. I'm concerned about like has been mentioned many times around the table today, the potential increase in recreational discards that will come with a higher minimum length limit.

As Adam alluded to earlier, I have heard from some of my constituents in the party charter industry, in certain areas of Long Island Sound they have trouble accessing fish larger than 28 to 32 inches. By having a slot limit we would still allow access to abundant small fish for some folks that still do rely on harvest for their business; or because that's what they're interested in out of the fishery, while still potentially providing the conservation we need.

Also encouraging folks to put those bigger fish back in the water; which I think we all know is really important for the productivity of the stock. If it's possible I would like to see those options looked at under slot limits; not just the slot limit with an upper end of 40, but with a lower end of 28 or 32, and where that gets us.

CHAIRMAN ARMSTRONG: Okay I regard that as advice to the TC. Short of anyone with vehement objections, we'll move that forward. I hesitate. Are there any more amendments that people would entertain here? Steve Bowman.

MR. BOWMAN: Mr. Chairman just very, very quickly. The Commonwealth of Virginia is prepared to support this motion with the amendment to the next of the last bullet; which changes as Sarah had indicated from equally to equitably, and eliminating the last line.

CHAIRMAN ARMSTRONG: I think the PDT is going to have trouble with equitable; of what that means.

MR. BOWMAN: Okay what would the PDT not have a problem with?

CHAIRMAN ARMSTRONG: They need specific numbers; as in the commercial fishery will not have a reduction, they'll have 50 percent of that 17, they'll have 100 percent of that 17.

MR. BOWMAN: Okay, I'll yield to Ms. McPeake, is that her name?

CHAIRMAN ARMSTRONG: Sarah Peake.

REPRESENTATIVE PEAKE: It's not going to be helpful; because it goes in the other direction. I was saying if we just take out the word equally. Apply needed reductions to both commercial and recreational sectors; and then can you show us a menu of options? I guess beyond this.

What are we doing in terms of tying the hands of our state managers to determine where you have both a commercial and a recreational sector; to understand state by state how big the recreational sector is versus the commercial? I'm struggling with how we can take a one-size-fits-all approach here; where there may be not so nuance differences state to state relative to the size of the commercial harvest versus the recreational sector. Maybe I am missing something.

CHAIRMAN ARMSTRONG: Historically this Board has, when we take a 17 percent cut everyone takes it. There has been some consideration that maybe because commercial has been static; recreational has grown that it's time to look at it in a different way. That would be the option on the board.

REPRESENTATIVE PEAKE: Thank you for the explanation.

MS. KERNS: I will just add Sarah that any state can use conservation equivalency proposals to address something that they feel as though they want to treat their states fishery in a more unique way. Therefore, you can move forward with changing your percentages of how you're going to address the reduction that your state takes; as long as it equals the total amount that your state would have taken, and it's approved by the Board.

MR. APPELMAN: I wanted to piggyback off of what Toni was just saying about conservation equivalency. I see seasonal closures could be part of a conservational equivalency proposal. I just want to point out that if the intent is to have conservation equivalency as part of the addendum development process; that is an added step in the timeline. Keep that in mind.

States would have to do their homework, bring it back to the Technical Committee for review; in order to build those alternatives into the draft document. How it worked out with Addendum IV for example is the addendum went forward without conservation equivalency; and that was actually done after the addendum was implemented. To stick to the timeline that I showed, conservation equivalency would happen as a second step, as a second process after the addendum was completed.

CHAIRMAN ARMSTRONG: Tom.

MR. FOTE: I cannot support this with the last bullet in; so I'll make a motion that we remove the last bullet, and handle that in the amendment not in the addendum, because that's the one that's going to be the lightning rod we go out to. **I make a motion that we remove the last bullet that has been put up there; apply needed reductions to the recreational sector only.**

CHAIRMAN ARMSTRONG: Is there a second to that motion; yes, Dennis Abbott.

MR. DENNIS ABBOTT: We had an original motion and we have an amended motion. I think that it's a requirement that we vote on the amendment first. We can't keep amending the amendment.

CHAIRMAN ARMSTRONG: Doug, do you have some help here?

MR. GROUT: As you indicated, you said that the best thing would just be a substitute motion. As you know with Roberts Rules of Order we need to amend both a substitute motion and make any amendments to the underlying motion. Then once all the amendments are done and we approve, we vote on the substitute motion. If it is approved then that becomes the main motion. If it fails the underlying motion becomes a main motion. Amendments at least by Roberts Rules are, in fact we suggest that you get all the amendments in place, so you've got your substitute and your main motion exactly the way you want it.

CHAIRMAN ARMSTRONG: Is there a second to this motion; Andy Shiels., discussion. I'll call the question. The motion –

MR. LUISI: Can we caucus?

CHAIRMAN ARMSTRONG: Yes, caucus. **The motion is to amend to delete; apply needed reductions to the recreational sector only from the substituted motion.** Two minutes please. Please have your seats please, so we can call the question. All right in regards to the motion on the board by Mr. Fote, all in favor raise your hand.

All against raise your hand. Are there any null, abstentions? The motion passes 9 to 5, two abstentions. Going back to the **main motion; which is a substitute motion**, do we need to caucus? All affirmative raise your hand. I'm sorry. Okay, we will be voting on the amended substitute motion. Emerson.

MR. HASBROUCK: **I would like to amend this motion to remove in the last bullet – I'm doing this on the fly, so excuse me – remove the word equally and replace it with equitably based on harvest.**

CHAIRMAN ARMSTRONG: Is there a second; Steve Train. Would you like to speak to that?

MR. HASBROUCK: The commercial fishery has been operating under a quota; and they have not exceeded that quota, at least not that I am aware of over the past, I don't know how many years that commercial quota has not been exceeded. To ask the commercial fishing industry to take the same percentage reduction as the recreational fishery, you know earlier today we saw the bar graph that Tom Fote was having trouble with, showing what the harvests are. I think it's more fair and more equitable.

CHAIRMAN ARMSTRONG: Doug Grout.

MR. GROUT: I'm going to speak against this amendment; because I think that for the purposes of analysis we need to give the PDT and the Technical Committee a specific figure. Because they don't have, from what we heard from their response there it was they need something like that; because they don't know what equitably means to us. I urge the Board not to approve this, to support this. But if you want to have something like that you need to come up with some kind of specific percentage reductions for each entity.

CHAIRMAN ARMSTRONG: Further discussion. Mike.

MR. LUISI: I understand where Emerson is going with this. I think it's something to consider in this addendum. I just wonder if we could apply some numbers as Doug mentioned; if we were to change the language from equitably to proportionately, based on total removals.

We're taking that total removal picture of dead discards and harvest by the two sectors, and proportionalizing the (if proportionalizing is a word). We're doing something with those numbers, which is close to 90/10, and applying reductions in that capacity. I don't know if that is what your intent was, Emerson. But that could fix the problem that Doug brought up.

MR. HASBROUCK: Yes that was my intent; so I'll accept that as a friendly.

CHAIRMAN ARMSTRONG: You will accept that as a friendly amendment. Steve Train. I'm just checking to see if the TC is clear on that charge.

MR. LUISI: Mr. Chairman if it's okay, I would just add to the point I forgot to mention that we could pick a year, maybe the terminal year. That would set the proportional allotment to the sectors; that again to the maker and the seconder.

MR. HASBROUCK: That's fine.

CHAIRMAN ARMSTRONG: Steve Train, are you okay with that?

MR. STEPHEN TRAIN: Yes.

CHAIRMAN ARMSTRONG: The makers are okay with another friendly amendment. Tom Fote.

MR. FOTE: According to the plan there is no quota on the commercials to the recreational. There is no split. We have no problem when it's scup, when it's 17 percent of the recreational catch it's 17 percent of the quota. When we start making reductions, which won't affect the overall quota, even goes with the scup fishery is not even being caught, and yet we'll put those fish reductions in equally on the recreational sector that is only catching 17 percent of the fishery.

That's our historical way of doing business. To start trying to do business in another way to be accommodating to one or two sectors is not going to work; and I don't want that firestorm. If you're going to do it, do it in an amendment where we actually spell out everything, and basically go through and take the time to really study this.

But, you try to do it under this addendum you're going to wind up with a firestorm in the recreational community just opposing the whole addendum; and so you might not get what you want for when we get up here and basically want to vote on it in October. If you want to really get it in October, make a cleaner addendum and put it in the amendment.

CHAIRMAN ARMSTRONG: All right I'm going to move this question. We are running out of time. Do we need to caucus; one minute caucus? A point of clarification, this would get rid of the option to equally split it. I don't think that is the intent of the motioner. I think you would rather add this as another option. Keep equally as an option and then have this as an option.

MR. HASBROUCK: Yes, I would be comfortable with that as an additional option to look at, yes. I don't know if I need to reword my original motion but that's fine. Steve, I don't know if you're comfortable with that or not.

MR. TRAIN: It's not that I'm trying to wordsmith here; but there is a pretty specific definition of the word equal, and when you have two parties involved but one party has a smaller interest, equal isn't fair.

CHAIRMAN ARMSTRONG: It would be 17 percent of the commercial quota, 17 percent of the recreational harvest, which would be much larger of course. That would remain. This new option would bring it down to 10 percent reduction for the commercial.

MR. TRAIN: I'll be satisfied with the second option, yes.

CHAIRMAN ARMSTRONG: All right we will restructure that and let's caucus now as this evolves. Okay one minute. Adam.

MR. NOWALSKY: I just need a clarification on that last comment that you just made. What does proportionally based on total removals mean? I heard you just say that that would bring the commercial reduction from 17 percent down to 10 percent.

CHAIRMAN ARMSTRONG: Yes let me step back from that.

MR. NOWALSKY: I interpreted the proportionally as that instead of taking 17 percent reduction on the commercial side, the commercial side would take the proportion of the harvest times 17 percent as their reduction. If their proportion of the harvest was 10 percent, the reduction in harvest needed was 17 percent.

The commercial side would be reducing by 1.7 percent and the recreational side was reducing by the rest. That's a big difference between a 1.7 percent reduction and a 10 percent reduction. I think we need to be very clear what we're adding here on the record; and I appreciate your help with that.

CHAIRMAN ARMSTRONG: Yes let us clarify that. I misspoke on that. I believe it's multiplying 10 percent times the reduction.

DR. DREW: It's complicated because it's percentages. What we're doing with all this percentages is we came up with a number of fish that you need. The removals in 2020 need to be about 5.9 million fish in order to reach the target; and so that's coming down from a set number. That's coming down from about 7 million in 2017.

What we're saying is that in this case the way the TC I think would interpret this is proportionately based on total removals, if the commercial sector represents 10 percent of the total removals, then they are going to take 10 percent of that reduction necessary to get down to the 5.9 million fish. The rest of that will go to the recreational side will be responsible for taking the 90 percent of that reduction of going down to 5.9 million fish in 2020. When we say equally we mean everybody takes the same amount of a cut across the board. When we say proportionally based on harvest, we're saying the recreational side is going to take 90 percent or is going to take their proportion of total removals out of that reduction that we need to come from 7 million down to 5.9 million fish, in order to achieve the target. Versus everybody taking the same amount of the same percent cut. Did that make sense?

MR. NOWALSKY: That would get the total cut for the commercial side would be closer to 1.7 percent than it would be to 10 percent.

DR. DREW: Yes. It would be, yes. I can't guarantee that those numbers are exactly right because it's percentages but yet. The idea would be it would be a much lower percentage than if that percentage is applied equally.

CHAIRMAN ARMSTRONG: All right I think we all get it. Did you caucus? I need to caucus very briefly, 30 seconds. All right, are we ready?

MR. APPELMAN: I was informed that it might help to clarify what the Technical Committee interprets equally as. When we talk about equal reductions, to make round numbers are easy to work with. Take a million fish, we're not talking about 500,000 fish would apply to the commercial, 500,000 to the recreational. We're talking about proportional percent reductions. It's not the same amount of fish we're talking about; we're talking proportional reductions for the sectors. That is what equally means to us in this case.

CHAIRMAN ARMSTRONG: To the motion on the board. All in the affirmative raise your hand. Okay opposed, null, abstention. The motion passes 13 to 3. This will be added back to the substitute motion. We know where this is heading. We've seen it ten times so far, so caucus while we're waiting if you could. Tom

MR. FOTE: I'm just asking for a roll call vote.

MR. LUISI: Point of order, Mr. Chairman.

CHAIRMAN ARMSTRONG: Adam Nowalsky.

MR. NOWALSKY: Did you want to address the point of order first?

CHAIRMAN ARMSTRONG: I'm sorry, what was the point of order? Who had the point of order?

MR. LUISI: It was my mistake; forget about it, I'm sorry.

MR. NOWALSKY: Just a clarification with the provision for circle hooks with bait coastwide. We heard comments earlier about blood worms, smaller fish. Is that intended to mean all states, all areas inshore and offshore coastwide, or did that just mean coastwide in terms of the coastal waters as we talk about the two differences in the fishery?

CHAIRMAN ARMSTRONG: Doug.

MR. GROUT: My intent was it would be an option that all states would implement that for anybody fishing for striped bass with bait would need to have circle hooks. Again, this is just an option to go in there. I understand the potential enforcement issues behind it; but it's an option that could potentially get us to reducing the discard mortality, which is an important part of this addendum.

CHAIRMAN ARMSTRONG: Sarah Peake.

REPRESENTATIVE PEAKE: A related question then based on the response. Circle hooks for bait, what does that mean for fly fishing where there is a feather attached to the end? Would they not be required to have circle hooks?

MR. GROUT: No. Any bait. It would not be attached to a lure. It would not be attached to a lure or to a fly; because that's where you have from the studies that we've seen is when you're using bait, whether it's chunk bait, whether it's live bait, whether it's worms, not artificial, no artificial. It would not apply to artificial. Does that answer the question?

REPRESENTATIVE PEAKE: It answers the question; and I'll talk to you offline, I guess about why does it matter bait versus non-bait? If we're looking to diminish the stress on the animal so it has a greater chance of surviving when it's caught and released. I don't understand why it makes a difference whether you have bait or a lure.

MR. GROUT: I would be glad to talk to you offline. I've got a variety of studies that will explain why it only applies to bait.

CHAIRMAN ARMSTRONG: If it's helpful, and I hope it is, we can flesh this out more. This will not be able to be analyzed by the TC. There are no data appropriate for coming up with a quantitative answer.

DR. DREW: I think the TC would be very hesitant to use this to apply to any of the reductions; but we can look at sort of the studies and see if we assume perfect compliance. Where would this be applicable is something we could look at; but I think we would be very hesitant to say this will count towards your X percent reduction.

CHAIRMAN ARMSTRONG: It would be a positive measure that is unquantifiable and not necessarily a bad thing. Can we move the question? Yes Tom Fote.

MR. FOTE: You said all bait. Now like Massachusetts is all hook and line fishery and New York has a hook and line fishery, and they use bait on those fisheries. Are you basically directing them now that they should be using circle hooks; the same way the recreational fishermen are doing, or is it just pertaining again just to the recreational sector?

MR. GROUT: The original intent of this was it would just apply to the recreational sector; because they are the lion share of it. But if someone would like to offer an amendment to have it include the commercial sector I would not oppose that. But my intent was just to have it apply to the recreational sector.

CHAIRMAN ARMSTRONG: Yes and I think it can be done at a later meeting. Chris Batsavage.

MR. BATSAVAGE: I assume the Law Enforcement Committee will review this as the addendum is being developed for enforceability issues; which will be challenging over a wide area. But just so the PDT is aware when they're putting this together. For North Carolina not all of the striped bass fisheries in North Carolina are managed through the ASMFC FMP; so in our case it would just be the coastal ocean waters that this would be applied to, not the estuarine waters.

CHAIRMAN ARMSTRONG: All right let's vote, okay to the motion, it has been requested that this is a roll call vote and so we shall do that.

MR. APPELMAN: Okay working north to south. Maine.

MS. WARE: Yes.

MR. APPELMAN: New Hampshire.

MR. GROUT: Yes.

MR. APPELMAN: Massachusetts.

MR. KANE: Yes.

MR. APPELMAN: Rhode Island.

MR. REID: Yes.

MR. APPELMAN: Connecticut.

SENATOR CRAIG A. MINER: Yes.

MR. APPELMAN: New York.

MR. GILMORE: Yes.

MR. APPELMAN: New Jersey.

MS. HEATHER CORBETT: Yes.

MR. APPELMAN: Pennsylvania.

MR. SHIELS: Yes.

MR. APPELMAN: Delaware.

MR. CLARK: Yes.

MR. APPELMAN: Maryland.

MR. LUISI: Yes.

MR. APPELMAN: District of Colombia.

MR. BRYAN KING: Yes.

MR. APPELMAN: Potomac River Fisheries Commission.

MR. MARTY GARY: Yes.

MR. APPELMAN: Virginia.

MR. BOWMAN: Yes.

MR. APPELMAN: North Carolina.
MR. BATSAVAGE: Yes.

MR. APPELMAN: National Marine Fisheries Service.

MR. DEREK ORNER: Yes.

MR. APPELMAN: U.S. Fish and Wildlife Service

U.S. FISH & WILDLIFE SERVICE: Yes.

CHAIRMAN ARMSTRONG: **The motion carries unanimously**, the next order of business. Mike.

MR. LUISI: Just a reminder Mr. Chairman that was a substitute motion that we'll need to now make the main motion and vote again.

CHAIRMAN ARMSTRONG: That is correct. Given the previous vote we could do this by consensus. **Is there any objection to moving the substitute motion over Rob O'Reilly's original one? Seeing no objection it passes.** Go ahead, Mike.

MR. LUISI: I know we are incredibly behind the time here that we have allotted for this discussion; but I wonder if you would consider what I've mentioned a few times already today, a motion that I've prepared and sent to staff, which would initiate an amendment today, **well initiate an Amendment to the Striped Bass Fishery Management Plan. To address the needed consideration for change on the issues of fishery goals and objectives, empirical/biological/spatial reference points, management triggers, rebuilding biomass, and area specific management.**

Work on this amendment will begin upon the completion of the previously discussed addendum to the management plan. I would like to make that motion. If I can get a second I'll add quick brief points about why I think this is the direction we should take.

CHAIRMAN ARMSTRONG: Second by John Clark. Go ahead, Mike.

MR. LUISI: Well I've made the point a few times already; so I won't restate that again. I just think that Amendment 6 has been in the works since 2003. We've seen declines over time to get us to the point where we are now. I think it's time for a comprehensive look at the plan; addressing not only the issues that are listed here, but any others that the members of the Board may want to add as we take this on. I don't think a parallel track with the Addendum that we just started is appropriate; so we would essentially postpone any work on this until after the Addendum is complete. Thanks.

CHAIRMAN ARMSTRONG: Discussion. Craig.

MR. CRAIG D. PUGH: One question to the motion. Would you accept reallocation as a discussion with this amendment?

MR. LUISI: There is a lot to any kind of reallocation. There are the commercial/recreational splits there are state-specific allocations. I think I would want to start with this. But that could be something that we might want to add later.

MR. PUGH: Specifically in my interest it would be to relook at the commercial end of that not so much recreational. But the commercial end of that in our minds in the state of Delaware has been that we have been allocated a disproportional amount of the quota for a number of years, well over 30 years, and it has been a bit of a chip on our shoulder for a long, long time.

These are things that need to be addressed. I see that New York wants to address this with their summer flounder; but we also have had this issue for a long time in the state of Delaware with striped bass. We think it's time to reassess this. You know we're working off of 1970s catch data; and we're looking at a 2020 fish. I don't think it's too much to ask to bring this up to date.

We have issues with climate change and other things that everybody would like to throw into these things; and I think it's high time that we proportionally look at these allocations in a different manner and as they apply to the coast today. I think it's important; and it should be added to this. **I guess I would like to make an amendment to the motion to add the issue of commercial reallocation.**

CHAIRMAN ARMSTRONG: Do we have a second; second by Eric Reid? Adam Nowalsky.

MR. NOWALSKY: Let me ask a question. I understand we're now on an Amendment and we should be limiting debate to that. But I think it's relevant here with regards to our path forward. This issue of allocation has now been brought up; specifically on the commercial side. With regards to the MRIP re-estimates, there is discussion about commercial/recreational allocation for almost all other species. That box is being opened very soon.

What is the advantage to initiating this amendment today; as opposed to postponing this until after the Addendum is completed, at which time in that interim time we could have some conversation about the allocation issues, both within one sector and across sectors? Why would we need to do this today? We got it up on the board. We've got it here to digest. We've heard some other issues that we want to consider. What advantage do we gain today?

MS. KERNS: An option that the Board could take here is because this document wouldn't start work until after the Addendum is done. If you all want to spend the time this week talking with each other and maybe even between now and the August meeting about the things that you would really want to include, and put some thought into what you would want in an amendment.

Then we could bring this back up again at the August meeting when we meet again. We can make sure we have the proper amount of time to discuss fully the issue; and so you could potentially table this to the next meeting, which would be August. Postpone, sorry.

CHAIRMAN ARMSTRONG: We would need a motion to table it at this point. Adam Nowalsky.

MR. NOWALSKY: I'm assuming you had a second to Craig's motion before; so that motion was completed. Okay. **I'll go ahead and make the motion to postpone until the summer meeting initiation of an amendment.**

CHAIRMAN ARMSTRONG: What we're going to do is make a motion to postpone both, because there are two motions on the table right now. We can table both of them right now. Really, you know this is a big issue. We need to devote time to it; because this is back of the envelope at this point. A second; Russell, is there any discussion? John McMurray.

MR. McMURRAY: I don't know why we would even consider this in August. I mean for God's sake let's get through this Addendum first. Let's put these options that we developed today out to the public and see what their reaction is. I mean we're talking about a complete look at the goals and objectives, Mike. You're basing it on assumptions about productivity that aren't supported by the science.

I mean just from my perspective looking at the young-of-the-year indices, there are plenty of fish coming up that could jumpstart the rebuilding to the SSB target, as long as we keep them alive to get there. I think we're getting way ahead of ourselves by starting this now. I'm perfectly willing to consider it after we're done with the Addendum; but this is premature.

CHAIRMAN ARMSTRONG: **All right, we have a motion to postpone until next meeting two motions. Is everyone clear on what we're going to vote for? All affirmative raise your hand; opposed, null, abstention. The motion passes 15 to 1.**

CONSIDER FORWARDING COMMENTS TO NOAA FISHERIES OPPOSING PROPOSED MEASURES TO LIFE BAN ON RECREATIONAL STRIPED BASS FISHING IN FEDERAL BLOCK ISLAND SOUND TRANSIT ZONE

CHAIRMAN ARMSTRONG: All right the last agenda item is we need to consider the letter that has been crafted in response to a request to lift the ban on recreational fishing in the Federal Block Island Transit Zone. In your materials you've seen the letter; which essentially says no, given the stock conditions we think it's unwise to open up part of the EEZ, comments Emerson.

MR. HASBROUCK: I would not support sending that letter to National Marine Fisheries Service. I spoke at length at the February meeting as to why I didn't support drafting the letter. I'm still in a position where I would support allowing fishing in the transit zone for a couple of reasons; one is the amount of area that is going to be open there, the amount of area of the EEZ is very, very small.

Having that closure also prohibits the charterboat fleet and private boats from fishing for other species in that area; if they've already caught a striped bass. If a charterboat goes out and they've got their six fish in a box, then they can't go into this other area to fish for scup or sea bass or summer flounder for instance.

Also, in the meeting materials there was a couple of letters that were sent in by charterboat fishermen in New York suggesting that that area be opened for fishing; that the transit zone be opened for fishing on a temporary basis. I would like to put that on the record; and recommend to National Marine Fisheries Service that they consider that as well.

Then lastly, at our February meeting I asked what the impact was on recreational fishing effort when the EEZ was closed. I would like to bring that question back up again and ask our technical people and staff what the impact was when the EEZ was closed to striped bass fishing.

MR. APPELMAN: The question was, with the closure of the EEZ in 1990, if we could figure out what those effects were on harvest/effort, those two pieces. We looked back at it and essentially there were a lot of things going on at that time. Regulations were relaxing throughout the 1990s. Effort was increasing during that time.

It's hard to see how that closure actually affected effort and harvest in the EEZ or across the coast in general. I hope that answers the question. But the point is that there were a lot of things changing in the fishery and the management of the fishery; and so it's hard to pinpoint the exact effects of the EEZ closure during that time.

CHAIRMAN ARMSTRONG: Go ahead, Emerson.

MR. HASBROUCK: Thank you, Max for that response. Also, thank you Max for sending me some information last week relative to that. In looking at that information that you sent, yes I agree there is no clear trend. But the one thing that I do see is that the proportion of striped bass directed trips in the EEZ really did not decline after that ban was put into place.

In fact, they continued through 2017 to be striped bass directed trips conducted in the EEZ in the recreational fishery. I don't see where opening up this little sliver of the EEZ is going to make any difference. Recreational harvest is going to be constrained by what we put in place; in terms of size and bag and season.

CHAIRMAN ARMSTRONG: I have Jay McNamee and Tom Fote.

MR. McNAMEE: Just make a quick comment in support of the letter. But one thing, and it's with due respect to Commissioner Hasbrouck. We see the potential for this opening to complicate the enforcement issues in that area. It has to do with the location of some of the existing lines and where the actual activity goes on in this area. They are not in the same spot. This would actually complicate enforcement of rules in that area further; and so for that reason along with the findings from the stock assessment, we are in support of submitting the letter that we crafted.

CHAIRMAN ARMSTRONG: Tom Fote.

MR. FOTE: It was the only time that Larry Sims, Jerry Schill and I, all three of us were on a Congressional testimony saying that the EEZ should be shut and kept shut. That was 1995, and you all know Jerry and you knew Larry who passed away. But we couldn't agree on a lot of things; but we agreed on that.

It has basically been a sanctuary out there. Once we start opening it if we start doing that the catch of striped bass would go up dramatically; because we know there are fish in the EEZ, so the guys would be targeting. Nobody fishing in the EEZ, whether if they're targeting striped bass they're doing it illegally, and they should be caught.

I mean, one of the reasons I think Virginia trophy tag probably started going down was because NMFS started really enforcing the closure of the EEZ so that nothings felt right away around the bridge opening, because the guys were fishing in the EEZ. That's happened in areas of New Jersey when they did the same.

I can't support. I support the letter, because I can't support opening up the EEZ for anything. At the same time we're talking maybe of doing a 25 or 17 percent reduction on the whole recreational sector; and now we're opening up another fishery. We look like kind of hypocritical.

CHAIRMAN ARMSTRONG: **Tom, would you like to make a motion to forward the letter to NOAA Fisheries?**

MR. FOTE: **I'll make that motion**.

CHAIRMAN ARMSTRONG: Second; Justin Davis, discussion. Is there any caucus needed; brief caucus**? The motion on the table is to forward the Block Island transit zone letter to NOAA Fisheries. All affirmative raise your hand; okay, opposed, null, abstain. The motion carries 13 to 1, with 2 abstentions.**

ADJOURNMENT

CHAIRMAN ARMSTRONG: Is there any other business to come before this Board? Seeing none; we are adjourned. Oh, hold it.

MR. APPELMAN: I do want to just remind the Board that we'll be developing a Plan Development Team for the Addendum that just passed today; the initiation of the Addendum I should say. Look for an e-mail from me looking for nominations. It will include a couple sentences of what types of skill sets and knowledge of the fishery and data those personnel should have. Thank you.

(Whereupon the meeting adjourned at 2:55 o'clock p.m. on April 30, 2019

The Maryland Watermen's Association, Inc.

7-1-2019

TO: Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200A-N
Arlington, VA 22201
Attn: Tina Berger

REF: **Reduction to the Atlantic Striped Bass due to overfishing by the Recreational Sector.**

To whom it may concern:

I understand at the last ASMFC meeting held in the winter that Atlantic Striped Bass Benchmark Stock Assessment reported a finding that the resource had been overfished and overfishing was occurring. ASMFC Technical Committee was tasked to come back to the spring meeting with alternative to bring us back to the "F" Target. Now I understand that in the spring meeting that the Technical Committee has presented that a 17% reduction could be assess to the Commercial and the Recreational Fisheries.

I understand the importance, however the Commercial Fishery only harvest 10% of the overall quota and the Recreational Fishery has 90% of the Quota and that the Recreational Fishery is the part that needs to come back to the target. The Maryland Commercial Fishery for Striped Bass has been diligent in their process for accountability for many years with their tagging system, reporting and checking stations. We have already taken in the Chesapeake Bay a 20.5% reduction, which was supposed to be for 3 years. Now we are told we need to continue that reduction and have an additional 17% possibly.

I recommend that a system of accountability for the Recreational Fisheries be mandatory for all states and that fishing for spawning large fish be stopped or decreased. Raising the size has proven that this is one of the causes of death discard. The catch and release of Striped Bass during hot weather month could be discontinued fish during the colder months for catch and release might help with mortality. Another, way to reduce the Recreational Fishery is to revisit the spawning areas to ensure that no fishing is occurring by use of enforcement. Maryland

1805A Virginia Street Annapolis, MD 21401 PHONE (410) 216-6610 Cell (240)-925-1596

commercial Fishery has more accountability on Striped Bass than any other fishery in the State and we should not have the commercial industry penalized for doing a good job tracking their catch. The state of Maryland has a clean commercial industry with accountability and I ask that you not penalized these hard working Watermen for something they have no control over. The recommendation is to not cut the Commercial Industry with any reduction in quota. Thank you for your time in this matter.

Very Respectfully,

Robert T. Brown, Sr.
President, MWA
240-925-1956

Atlantic States Marine Fisheries Commission

Wind Power Workshop for New England and Mid-Atlantic Commissioners and NOAA Fisheries

(Note: This Workshop is focused on wind energy activities in New England and the Mid-Atlantic, however, all Commissioners are welcome to participate.)

August 8, 2019
12:30 p.m. – 5:00 p.m.
Arlington, Virginia

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Introductions (*J. Gilmore/M. Pentony*)	12:30 p.m.
2.	Public Comment	12:35 p.m.
3.	Presentation on Scope and Status of Planned Offshore Wind Projects (*A. Lipsky*)	12:45 p.m.
4.	Presentation on NOAA Fisheries Role in Offshore Wind Activities (*M. Pentony*)	1:15 p.m.
5.	Questions and Discussion on Projects and Federal Role	1:45 p.m.
6.	Presentations on State Level Policy and Research Activities Associated with Offshore Wind Development • Massachusetts • Rhode Island • Connecticut • New York • New Jersey	2:05 p.m.
7.	Break	2:45 p.m.

The meeting will be held at the Westin Crystal City, 1800 S. Eads Street, Arlington, Virginia 22202; 703.486.1111

8. Fishing Industry Engagement in Research and Development (*A. Hawkins*) 2:55 p.m.
    - Responsible Offshore Development Alliance (RODA)
    - Responsible Offshore Science Alliance (ROSA)

9. Discussion on Coordination of State and Federal Activities 3:20 p.m.
    - Would Increased State Coordination Improve Engagement in Wind Power Development?
    - What is the Best Approach to Ensure State Coordination?
    - What is the Best Approach to Ensure State/Federal/Regional Council Coordination?
    - Is There a Role for ASMFC in State Coordination or State/Federal Coordination?

10. Other Business/Adjourn 4:45 p.m.