Atlantic States Marine Fisheries Commission

Shad & River Herring Management Board

May 1, 2012
2:15 p.m. – 4:45 p.m.
Alexandria, VA

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. Duval)* — 2:15 p.m.

2. Board Consent — 2:15 p.m.
   - Approval of Agenda
   - Approval of Proceedings from February 7, 2012

3. Public Comment — 2:20 p.m.

4. 2012 River Herring Stock Assessment Report **Action** — 2:30 p.m.
   - Presentation of River Herring Stock Assessment *(J. Sweka)*
   - Presentation of Peer Review Panel Report *(K. Limburg)*
   - Technical Committee Report *(L. Miller)*
   - Consider acceptance of benchmark stock assessment and peer review report for management use

5. Review and Discuss NEFMC Draft Amendment 5 **Action** — 3:20 p.m.
   - Advisory Panel Recommendations *(P. Gromen)*
   - Working Group Recommendations *(K. Taylor)*
   - Review of Draft Amendment 5 management alternatives *(K. Taylor)*
   - Discuss preferred management alternatives in Draft Amendment 5

6. Review and Discuss MAFMC Draft Amendment 14 **Action** — 4:10 p.m.
   - Review of Draft Amendment 14 *(K. Taylor)*

7. Consider approval of Amendment 3 American Shad Sustainable Fishery Plans **Action** — 4:30 p.m.
   - Technical Committee Report *(L. Miller)*

8. Proposed Endangered Species Act Status Review of River Herring by NOAA Fisheries (*K. Taylor*) — 4:40 p.m.

9. Other Business/Adjourn — 4:45 p.m.

The meeting will be held at the Crowne Plaza Hotel, 901 North Fairfax Street, Alexandria, Virginia; 703-683-6000

MEETING OVERVIEW

Shad & River Herring Management Board Meeting
May 1, 2012
2:15 – 4:45 p.m.
Alexandria, VA

Chair: Michelle Duval (NC) Assumed Chairmanship: 02/12	Technical Committee Chair: Larry Miller (USFWS)	Law Enforcement Committee Representative: Bridi/Thumm
Vice Chair: Terry Stockwell (ME)	Advisory Panel Chair: Pam Lyons Gromen	Previous Board Meeting: February 7, 2012
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 February 7, 2012

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. 2012 River Herring Stock Assessment Report (2:30 – 3:20 p.m.) Action
Background • The river herring stock assessment was initiated in 2009 **(Briefing CD)**. • The peer review workshop was conducted in March 2012 (**Briefing CD)**. • The Technical Committee met on April 27, 2012 to review the peer review recommendations.
Presentations • Stock Assessment Overview by J. Sweka • Peer Review Report by K. Limburg • Technical Committee Report by L. Miller
Board actions for consideration at this meeting • Accept the Stock Assessment Report and Peer Review Report for management use.

5. Review and Discuss NEFMC Draft Amendment 5 (3:20 – 4:10 p.m.) Action
Background • Amendment 5 management alternatives include options to mitigate and monitor shad and river herring bycatch in the Atlantic herring fishery **(Briefing CD).** • At the February 2012 Board meeting the Board tasked a working group, comprised of a subset of Board and Advisory Panel members, to develop preliminary recommendations on the preferred alternatives in Draft Amendment 5 **(Briefing CD).**
Presentations • Advisory Panel Recommendations by P. Gromen

- Working Group Recommendations by K. Taylor
- Review of Draft Amendment 5 management alternatives

Board actions for consideration at this meeting

- Select preferred alternatives on Draft Amendment 5

6. Review and Discuss MAFMC Draft Amendment 14 (4:10 – 4:30 p.m.)

Background

- The Mid-Atlantic Fisheries Management Council approved a motion to address river herring bycatch in the Amendment 14 to the Mackerel, Squid and Butterfish (MSB) Fisheries at the MAFMC August 2009 Meeting. Public hearing will be held April - May 2012. The public comment period closes on June 4, 2012 **(Briefing CD)**.

Presentations

- Draft Amendment 14 management alternatives and timeline by K. Taylor

7. Amendment 3 American Shad SFMPs (4:30 – 4:40 p.m.) Action

Background

- The Board approved Amendment 3 (American Shad) at the Winter 2010 Meeting. Under Amendment 3 states and jurisdictions were required to submit a sustainable fishing and recovery plans by August 1, 2011. Fisheries without an approved plan in place (with the exception of catch and release fisheries) are to close by January 1, 2013.
- At the 2011 Annual Meeting the Board approved fishing plans from South Carolina and Florida. At the February 2012 Board meeting the Board approved fishing plans from: Georgia, PRFC, and the Delaware River Cooperative. The Board also approved American shad recovery plans from: Delaware, New Hampshire, and Pennsylvania. Based on Technical Committee advice, the Board requested additional information from North Carolina and Maryland prior to the approval of their plans **(Briefing CD)**.
- The Technical Committee met via conference call on April 27, 2012 to review the revised plans from North Carolina and Maryland.

Presentations

- Technical Committee Report by L. Miller

Board actions for consideration at this meeting

- Discuss and Consider Approval of American shad Sustainable FMPs **Action**

8. Proposed ESA Status Review of River Herring by NOAA Fisheries (4:40 – 4:45 p.m.)

Background

- In August 2011 the National Resources Defense Council petitioned NOAA Fisheries to list alewife and blueback herring (river herring) as threatened under the Endangered Species Act throughout all or a significant portion of its range. Alternatively, the petition requests designation of distinct population segments (DPSs) of alewives and blueback herring and list each DPS as a threatened species.
- In November, NOAA Fisheries released a positive 90-day finding on the petition to list river herring under the ESA based on the fact that the petition presents substantial scientific information indicating the petitioned action may be warranted.

Presentations

- Update on proposed river herring ESA listing by K. Taylor

9. Other Business/Adjourn

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

SHAD AND RIVER HERRING MANAGEMENT BOARD

Crowne Plaza Hotel - Old Town
Alexandria, Virginia
February 7, 2012

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3. **Move to accept the plans from the Delaware River Fish and Wildlife Cooperative, Georgia and the Potomac River Fisheries Commission** (Page 1). Motion by Roy Miller; second by Russ Allen. Motion carried (Page 2).

4. **Move to approve recovery plans as submitted for New Hampshire, Delaware and Pennsylvania**. (Page 2). Motion by Pat Augustine; second by John Duren. Motion carried (Page 2).

5. **Move for approval of the Potomac River Shad Bycatch Request for 2012** (Page 2). Motion by Pat Augustine; second by A. C. Carpenter. Motion carried (Page 3).

6. **Move that the board accept the recommendation to appoint Dr. Winnie Ryan to the Economics and Social Sciences Committee** (Page 19). Motion by Pat Augustine; second by Bill Adler. Motion carried (Page 19).

7. **Move to nominate Terry Stockwell for Vice-chair of the Shad and River Herring Management Board (Page 19)**. Motion by Jack Travelstead; second by A. C. Carpenter. Motion carried (Page 19).

8. **Move to adjourn by Consent** (Page 19).

ATTENDANCE

Board Members

Terry Stockwell, ME, proxy for P. Keliher (AA)
Steve Train, ME (GA)
Sen. Brian Langley, ME (LA)
Doug Grout, NH (AA)
Rep. David Watters, NH (LA)
G. Ritchie White, NH (GA)
Mike Armstrong, MA, proxy for P. Diodati (AA)
Bill Adler, MA (GA)
Rep. Sarah Peake, MA (LA)
Mark Gibson, RI, proxy for B. Ballou (AA)
Rick Bellavance, RI, proxy for Rep. Martin (LA)
Bill McElroy, RI (GA)
David Simpson, CT (AA)
Lance Stewart, CT (GA)
James Gilmore, NY (AA)
Brian Culhane, NY, proxy for Sen. Johnson (LA)
Pat Augustine, NY (GA)
Russ Allen, NJ, proxy for D. Chanda (AA)
Tom Fote, NJ (GA)
Leroy Young, PA, proxy for J. Arway (AA)
Gene Kray, PA, proxy for Rep. Schroeder (LA)
Loren Lustig, PA (GA)
John Clark, DE, proxy for D. Saveikis (AA)
Bernie Pankowski, DE, proxy for Sen. Venables (LA)
Roy Miller, DE (GA)
Tom O'Connell, MD (AA)
Russell Dize, MD, proxy for Sen. Colburn (LA)
Bill Goldsborough, MD (GA)
Jack Travelstead, VA, proxy for S. Bowman (AA)
Catherine Davenport, VA (GA)
Michelle Duval, NC, proxy for L. Daniel (AA)
Mike Johnson, NC, proxy for Rep. Wainwright (LA)
Ross Self, SC, proxy for R. Boyles (LA)
John Frampton, SC (AA)
Pat Geer, GA, proxy for S. Woodward (AA)
Aaron Podey, FL (AA)
John Duren, GA (GA)
Daniel Ryan, D.C.
Jaime Geiger, USFWS
A.C. Carpenter, PRFC
Steve Meyers, NMFS

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

Ex-Officio Members

Pam Lyons Gromen, Advisory Panel Chair
Larry Miller, Technical Committee Chair

Staff

Vince O'Shea
Bob Beal
Kate Taylor
Chris Vonderweidt

Guests

Dave Bethoney, SMAST
Greg Wells, Pew Environ. Group
Theresa Labriola, Pew Environ. Group
Matt Cieri, ME DMR
Ellen Cosby, PRFC
Dave Ellenton, Cape Seafoods, Inc.
Steve Weiner, CHOIR
Bob Ross, NMFS
Charles Lynch, NOAA
Derek Orner, NMFS
Wilson Laney, USFWS
Dan McKiernan, MA DMF
Peter Burns, NMFS
Roger Fleming, Earthjustice
Kristin Cevoli, Herring Alliance/PEG
Lori Steele, NEFMC
Patrick Paquette, Hyannis, MA

The Shad and River Herring Management Board of the Atlantic States Marine Fisheries Commission convened in the Presidential Ballroom of the Crowne Plaza Hotel, Alexandria, Virginia, February 7, 2012, and was called to order at 11:43 o'clock a.m. by Chairman Michelle Duval.

CALL TO ORDER

CHAIRMAN MICHELLE DUVAL: If members of the Shad and River Herring Board could please take their seats, we're going to go ahead and get started. First of all, I'd like to welcome everyone. For folks who don't know me, my name is Michelle Duval. I'm the new Chair of the Shad and River Herring Management Board.

APPROVAL OF AGENDA

CHAIRMAN DUVAL: The first item we have is the agenda. Are there any modifications to the agenda? Seeing none, the agenda stands approved.

APPROVAL OF PROCEEDINGS

CHAIRMAN DUVAL: Our next item is the proceedings from our previous board meeting at our November annual meeting, from November 10th. Are there any changes to those proceedings? Seeing none, the proceedings stand approved.

PUBLIC COMMENT

CHAIRMAN DUVAL: This is the point in the agenda where we allow public comment on items that are not on the agenda. Are there any members of the public that wish to address the board on items that are not on the agenda? Okay, seeing none, the next thing we have is a presentation on our American Shad Sustainable Fishery Plans, and I believe Mr. Miller is going to run us through that.

PRESENTATION ON AMERICAN SHAD SUSTAINABLE FISHERY PLANS

MR. LARRY MILLER: I'm going to let Kate take over for this because she actually was instrumental in preparing the slides that we have, so she is more familiar with the material that is there.

MS. KATE TAYLOR: As the board is aware, the requirement of Amendment 3, which is dealing with American shad management, states are required to submit their fishing and recovery plans for their American shad fisheries. As you remember at the November 2011 meeting, the board did review plans from some states and approved plans from South Carolina and Florida.

Prior to that meeting the technical committee also reviewed plans from the Delaware River Fish and Wildlife Cooperative, Georgia and the Potomac River Fisheries Commission. At that time the technical committee did not recommend approval of these three plans and asked for additional items from these jurisdictions.

These jurisdictions resubmitted their plans with the requested information, which the technical committee reviewed at their meeting in January. The technical committee recommends that the board consider approval of these three plans. Additionally, the technical committee also reviewed a plan from the state of North Carolina, which was requesting a fishery for the Albemarle Sound/Roanoke River, the Tar/Pamlico, the Neuse and the Cape Fear Rivers.

The technical committee recommends the board consider approval of the fishing plan within the Albemarle Sound/Roanoke River, the Neuse and the Tar/Pamlico Rivers. The technical committee found that the Cape Fear System is currently not sustainable based in the indices presented in their fishing plan.

The technical committee recommends consideration by the state of either closure of the system or a modified fishery with continued monitoring. The technical committee also recognizes that North Carolina will still have to go their own Marine Fisheries Commission Review Process and public comment process with their plan.

Additionally, the technical committee reviewed recovery plans from a number of jurisdictions. The technical committee recommends the board consider acceptance of the recovery plans from New Hampshire, Delaware and Pennsylvania. The technical committee requested additional information from the state of Maryland and the District of Columbia.

Also, I would like to point out that the technical committee thought that the plan from Pennsylvania was an adequate plan for the habitat recovery plans that states will be required to submit next year, and that the plan from Pennsylvania would serve as a good template of that plan that states will have to submit. Additionally, plans have yet to be submitted from Maine, Rhode Island, Connecticut, New York, New Jersey and Virginia. Thank you, Madam Chairwoman.

CHAIRMAN DUVAL: Thank you, Kate. At this point I think we would entertain a motion to approve the sustainable fishery plans for the Delaware

Cooperative, PRFC and Georgia, if anyone would consider making that motion. Roy.

MR. ROY MILLER**: I move that we accept the plans from the Delaware River Fish and Wildlife Cooperative, Georgia and the Potomac River Fisheries Commission**.

CHAIRMAN DUVAL: We have a motion; is there a second; Russ. Is there any discussion on that motion? Do states need time to caucus? A.C.

MR. A.C. CARPENTER: Was there a reason North Carolina was left out of that?

CHAIRMAN DUVAL: I can go ahead and answer that, A.C. Although the TC recommended approval of three of the four systems that North Carolina was asking for a sustainable fishery plan, they did request some additional information be included in the sustainable fishery plan and also recommended going back and doing a little bit more work on the Cape Fear System.

We thought it would be more appropriate to take that plan back to the workgroup that we have at the state, add that additional information, let the TC review it one more time, and the board could see it in May. Russ.

MR. RUSS ALLEN: I just want to take this time to thank the members of the Delaware River Cooperative, specifically New York, Delaware, Pennsylvania and U.S. Fish and Wildlife Service and NMFS for an awesome cooperative effort that we put forth for a shad fishery throughout the Delaware. We' like to see some of the other systems use this as a template to move forward with their different state jurisdictions in how they have to handle things.

It was a very rewarding effort. We had some really good stock assessment people involved with that, some high technical people and even some management level people; so a very good job by everyone there and I just want to put that out there. Thank you.

DR. JAIME GEIGER: I just want to reemphasize and second Russ' comments. This Cooperative has been in existence for many, many years and the level of cooperation, collaboration and consultation and work on the ground to support shad restoration is just outstanding.
Again, I really think this does set a good, strong model for other state and federal cooperation on a species-specific basis. I would look to this Cooperative as that model. Again, I congratulate all the fine biologists and managers that have been involved in this effort to make it so successful. Thank you, Madam Chairman.

CHAIRMAN DUVAL: Are there any other comments before we vote on this motion? Do states need time to caucus or is everyone ready to vote? It looks like we're ready to vote. Those states who are in favor of the motion please raise your right hand; those opposed; abstentions; null votes. **The motion passes with 19 in favor**. I think we might also need a motion to accept the recovery plans by the states of New Hampshire, Delaware and Pennsylvania. Is there someone who would be willing to make such a motion? Pat.

MR. PATRICK AUGUSTINE: **Madam Chair, move to approve recovery plans as submitted for New Hampshire, Delaware and Pennsylvania**.

CHAIRMAN DUVAL: Is there a second to that motion; John Duren, thank you. Is there any discussion of that motion? Bill.

MR. WILLIAM A. ADLER: Is it separate, the Maryland and District of Columbia one; is that coming up next or is that separate or what?

MS. TAYLOR: The technical committee requested additional information from Maryland and the District of Columbia, and those two jurisdictions are going to work on those plans, which will be resubmitted and reviewed by the technical committee and potentially reviewed by the board at the May meeting.

CHAIRMAN DUVAL: This seems fairly straightforward. Is there any opposition to this motion? **Seeing none, the motion stands approved**. The next thing on our agenda is consideration of 2012 American Shad Bycatch Request, and Kate will be taking us through this.

2012 AMERICAN SHAD BYCATCH REQUEST

MS. TAYLOR: At the ASMFC annual meeting in November the board preliminarily approved a bycatch request for American shad from the Potomac River Fisheries Commission with the understanding that the additional information requested by the technical committee would be included in a resubmitted report.

The Potomac River Fisheries Commission included this information and submitted their report to the technical committee. The technical committee reviewed the report at their January meeting and recommends that the board consider final approval of the Potomac River Shad Bycatch Request for 2012.

MR. AUGUSTINE: Madam Chair, move that the board approve the proposed bycatch and increase of their commercial allowance.

CHAIRMAN DUVAL: Is there a second to that motion; A.C. Is there any discussion on that motion? **Seeing none, the motion stands approved**.

UPDATE ON THE RIVER HERRING BYCATCH AVOIDANCE PROJECT

CHAIRMAN DUVAL:The next item on our agenda is actually an update on the River Herring Bycatch Avoidance Project by the Sustainable Fisheries Coalition, the School of Marine Science and Technology and the Massachusetts DMF. I believe Dave Bethoney is here to give us that update.

MR. DAVID BETHONEY: Thank you very much. I'd also like to thank the management board for allowing me to come down here and make this presentation. This project is a cooperative project between the Massachusetts Division of Marine Fisheries, the University of Massachusetts-Dartmouth and the Sustainable Fisheries Coalition, which represents the majority of the midwater trawl vessels that harvest Atlantic herring and mackerel.

The project has two primary goals. The first goal is to expand the Massachusetts Division of Marine Fisheries portside sampling program. The theory behind this is to give us a better idea of where, when and how much river herring is being taken by these vessels and to provide the Initiative with an information source. Additionally, we could achieve some biological information such as river herring lengths.

The second objective is to reduce alosine bycatch, and I'll be using the term "alosine" throughout this talk, and I'll be referring to both river herring and American shad. To achieve this goal we had two tactics. The first was to develop near real-time bycatch information systems. The theory behind this is to let the captains know as soon as possible where they're encountering large amounts of river herring and shad in hopes that they'll avoid going back there.

We ran two of these systems to completion in the winter of 2011 and the fall of 2011 and are currently running programs right now. The second metric was to test for environmental pictures of bycatch. The idea behind this was to take a proactive approach in trying to identify areas where the vessels were likely to encounter large amounts of alosines without them actually having to catch those fish.

The format of this talk is going to talk a little bit more about how the portside sampling program relates to this project and then really talk about the two tactics that we're taking to reduce alosine bycatch and focusing on these near real-time information systems as we've done the most work in that area.

The portside sampling program has three goals in relation to this project. As I mentioned before, the primary goal is to provide the system with accurate and timely catch information. This can be difficult in a midwater trawl fishery because of the amount of target species that are taken in comparison to river herring and shad and also the similarity of the species.

This picture in the top here is trying to demonstrate that with a river herring amidst the distribution of Atlantic herring. This is representative of a high bycatch event; this ratio of fish. To compensate for this or overcome this, portside samplers take a systematic sample during the entire offload of a vessel. The second goal was to sample 50 percent of trips landed in Massachusetts.
This represented a significant increase from the 15 percent that have been occurring prior to this project. We also thought it would give us a good idea of what is happening in the fishery since the majority of landings do occur in Massachusetts. The third goal was to help us establish communication systems.

By getting the scientists involved in the portside sampling program, getting us down to the docks, into the plants, it gets us face to face with the captains and other industry members, talking about what might work, what needs to be improved and other ways to adjust the program. We also established a joint e-mail address where the vessels could notify us when they're leaving and when they're coming into port as well as other details and we could issue bycatch advisories as well.

These advisories are part of this near real-time information system; the first of which we ran from January to March of 2011, and we focused in one area that has been identified by several sources as a high alosine bycatch area. It is depicted here in this figure off the coast of New Jersey, the Hudson Canyon Region.

We wanted to reduce the spatial scale of this area, and to do that we talked to the captains and figured if we use the 10 minute longitude lines and the 5 minute latitude lines we could create a grid in this area of an appropriate spatial scale for the fishery. Then if we gave each row a letter label and each column a number label we could simply e-mail the vessels the combinations of letters and numbers that would refer to a specific area on this grid that the vessels would understand if they had this grid in their possession.

We turned it into a handout that was distributed to all the captains by hand and by mail. With a way to easily communicate information, the next step was to try to figure out what exactly is a high bycatch event. There is no cap in the fishery for alosine bycatch. There is also no really biological metric to go by.

To answer this question we looked at the largest data set available and that was the Northeast Fisheries Observer Program Midwater Trawl Data Set. This figure shows on the vertical axis the total amount of river herring and shad observed. The horizontal axis is a single tow and it's arranged from lowest to highest.

You can see there is a distinct pattern to this; that there is a small amount of tows or very large tows that account for the majority of bycatch. In this figure you have 35 tows out of 343 accounting for 80 percent of the bycatch by weight. With this mind, we thought if we could identify areas where these tows were occurring and reduce the frequency of this type of tow, we could reduce the overall amount of bycatch occurring.

To identify these areas and these tows, we came up with a threshold scheme of identifying tows as high, moderate or low based upon the percentage of alosine bycatch compared to the amount of target species caught. You can see the different thresholds here; that above 1-1/4 percent would be high and less than 0.2 percent is low.

The next few slides are going to show the results from the complete information systems beginning with the winter of 2011. You're going to see several figures of this New Jersey grid. The cells that are green represent low bycatch events; yellow is moderate; red is high. The numbers inside each cell are the amount of tows that occurred through the time period, which is displayed on the bottom.

In this figure it says 2/1 in the middle, so that means this is basically what happened through February 1st, the month of January. You can see that effort in this grid was focused in the northwest region. Only low bycatch occurred. As you progress through the first two weeks of February in the same region, we start seeing high and moderate events.

As you move through the last two weeks of February into March, we saw that same pattern again, but now we have seen the fishery move to the southeast portion of the grid and only low bycatch was encountered there. I should mention that the advisories we issued reflect what you're seeing in these cumulative grids here.

Then through the month of March into April we had effort primarily focused in that southeastern region and low bycatch was maintained and some effort was back to that F row in between the high and low bycatch areas. In the fall we ran a similar system. However, this fishery was a little bit different as in the winter. It was a relatively long three-month fishery.

This fishery was occurring off of the southern coast of Maine and the northern coast of Massachusetts, Area 1A of the herring management plan that is closed to midwater trawling until October 14th. There was about a two-week period where they wanted to be in this general area, so we'd use a combination of tactics.

The first was to have the information grid, which we issued two advisories and sampled almost all the vessels that landed during this time period. The first advisory identified the northern region as having low bycatch, and the second advisory reiterated this, but also noted that C and D rows now had moderate bycatch.

As I mentioned, we anticipated a short fishery so to compensate for this we tried to circulate depth information that we had found out through environmental analysis and greater than fathoms of depth they were unlikely to encounter large amounts of alosines. We distributed that both by word of mouth and through a mailing, and it does seem like there is some evidence to support that this was listened to as the mean tow depth was 53 fathoms, significantly greater than 40 fathoms, and the fishery was deeper than previous years with greater than ten observations and significantly deeper all years except for 2009.

As we moved to look at metrics to evaluate the long-term utility of this type of program, if it can be used effectively, there are really two interannual criteria to look at. The first is collaboration; is this more than a collaboration in name only; is there evidence that the fleet is working with us and that we're altering fishing behavior?

From the participation standpoint, we are working with ten midwater trawl vessels, which is the vast majority of the fleet. We have had consistent communications throughout this entire program. Hundreds of e-mails have been sent. The captains have also been good about filling out these MADMF trip logs, which you see as a figure in this slide.

These logs give us detailed tow locations and tow sizes. If they do forget to fill out these logs and we can't get to them when they land, we just exchange phone calls. Sometimes they will just call us or we'll call them and get the information that way. From a behavioral standpoint, there also seems to be some evidence of cooperation. We've classified five cells in those two programs run to completion as having high bycatch. Only one was re-entered.

It did account for 25 percent of the bycatch we saw during that time period, so there is room for improvement, but it does suggest that they are listening to the advisories. We also had the fall depth advice that seems to be listened to. The second metric is bycatch reduction; can we show that this program is changing the amount of bycatch this fishery occurs?

We are looking at some direct measures such as comparing the bycatch rates between participating and non-participating vessels and seeing if we can change the profile of bycatch in this fishery. As I mentioned, there were few really high events, so can we find evidence that we're reducing the number of those events?

The other factor is, is there spatial/temporal separation between a target and alosine species if we can get the vessel to listen to us and to move from areas of high alosine bycatch? Is there evidence that they can move to an area where they'll get consistent low alosine bycatch but still adequate amounts of target species?

If you look at last winter's system, we do see some evidence of that with the fishery beginning in the northwestern area and 75 percent of the effort in terms of the amount of tows and 75 percent of the target catch in terms of weight occurred in this area and notice almost all the alosine bycatch as well. As the fishery progressed through the winter, we saw it move to the southeastern area where effort still reflected target catch but now alosine bycatch had decreased to almost none compared to the total seen in that time period.

This winter we have continued to work with the midwater trawl fleet. We started in December of this year instead of in January. We've also added another grid off of Rhode Island. We're also trying to do a similar system with Rhode Island Small-Mesh Bottom Trawl fishermen. If you're interested in following what we're doing, we have a website that you can get to through the SMAST main page by clicking on the Bycatch Avoidance Tab.

If you were to click, for example, on this top link here, it would bring you to our work with the small-mesh fishermen out of Rhode Island. This work includes five vessels. We've sampled over 50 trips since the middle of December, which represents a lot of increase in the knowledge of what is being caught in this fishery since only 75 trips were observed from 2007-2011.

We've also adapted this program. We've used different thresholds and we reduced the spatial scale with one cell in this grid seen here in this slide being equal to a quarter of a cell in the midwater trawl grid. If you're interested in finding updates, you can go to the website. We're also trying to improve this not only by adapting it to other fisheries but by including environmental information to predict where high bycatch events might occur.

This thought came from the fact that all five of these species make predictable seasonal migrations and their distribution have been linked to environmental parameters in published research. Our goal is to further investigate these links and see and assess these correlations and see if they will be useful in avoiding bycatch; and if so, to share that with the fleet. To do this, we need catch-at-sea information.
Right now we're focusing on using the National Marine Fisheries Bottom Trawl to build these correlations using a binary catch variable, so not necessarily presence or absence but some kind of threshold that indicates a large event or a small catch of alosines. That will allow us to compare catch or that variable to measurements that are taken during the bottom trawl survey and see if they increase the probability this binary variable will be a positive.

To test this to see if it will be useful, we plan using the Northeast Fishery Observer Program Midwater Trawl Data Set, and we can do that by linking environmental parameters from the finite volume community ocean model developed at UMass Dartmouth to the time and location of where the observer program documented these catches, and we can see if the predictions are holding true in reality.

I just want to mention that this analysis is planned to be restricted to the winter. This is where most of the bycatch occurs in the midwater trawl fleet. It's also the time period where the bottom trawl and the fish are in the same location, and it will help to alleviate problems caused by the animals being in a different migratory state depending on season and other restrictions that are caused by the difference in location of the animals.

I would like to thank all the vessels we have worked with, all the port samplers which includes people from Maine and Rhode Island state organizations and also funding from the National Fish and Wildlife Foundation that we're funded through this summer hopefully we can use this towards a PhD. If anybody has questions, comments or thoughts on how we can improve this type of work, I'd appreciate to hear that because, as I mentioned, we're always trying to adapt and figure out how to make this work for both the river herring species complex and the fishery.

CHAIRMAN DUVAL: Thanks a lot for that, Dave. I see a couple of folks who have questions or comments. Terry.

MR. TERRY STOCKWELL: Dave, great project and great presentation. The one question I have is the impact on the CPU of the targeted species and for the efficiency of the vessels that are relocating; have you tracked that.

MR. BETHONEY: We have not looked at that specifically. It's something that we want to look at and something that affects the utility of this program is we've seen that when you ask vessels to move on a larger scale over fish, they're less likely to do so. If you can move them on a smaller scale where there seems to be abundance of target species in that general area, maybe one specific subset of that area has alosine species. It's definitely something that we'd like to look into.

REPRESENTATIVE SARAH K. PEAKE: Thanks, Dave, for your presentation. I have to say I feel a little bit of pride in Massachusetts and UMass Dartmouth and the SMAST Program, so thanks for the good work on this. A couple of questions and I may have missed this in your presentation; your observer coverage, was it all shoreside or was there any on-board observation as you're monitoring the bycatch?

MR. BETHONEY: This program focuses on shoreside, but we do work with the Northeast Fishery Observer Program. This communication flow tries to show that – on the bottom right you see the NFOP there, and we work with the observer program. They send us logs when they've caught river herring within five days and we also try to communicate with them on just oral descriptions of the tow. They can get tow-by-tow resolution.

Shoreside you can only get trip resolution so when you have large bycatch events it's important to try to tease out where that happened. It also helps to corroborate what the captains are filling out to what the observer has in their log. We have seen very corroboration between those two data elements.

REPRESENTATIVE PEAKE: That's great, thank you. At previous meetings I have advocated for a hundred percent on-board observer coverage so we know exactly what we're catching, and I would just reiterate that again today. My next question or follow-up question is looking at the slide that you showed up there with SMAST Program and how this is modeled in some ways after the scallop bycatch with yellowtail, that program, as I recall, has catch caps. Do you think there is a movement towards putting a catch cap on river herring for this? As you gather more data, do you see us moving in that direction?

MR. BETHONEY: There definitely is a move toward that direction. It's in both Amendment 14 and Amendment 5 to some degree of having a catch cap on river herring bycatch. It would help if we could get more information on what stocks these river herring are coming from at sea to help us get a better idea of what the biological impact of the bycatch is, which could help determine biologically based caps which would be the best mechanism out of a bycatch cap if you have to put one in.

MR. MARK GIBSON: The information I've seen seems to be that the bycatch events are categorized by the percentage of shad and river herring that's in the sea herring catch. There are basically three tiers; is that correct?

MR. BETHONEY: Yes.

MR. GIBSON: Okay, it seems to me that the means for categorizing the severity of the bycatch events needs more information than that. The percentage of the alosines in the sea herring catch is always going to be small simply because sea herring populations will dwarf the size of river herring populations.

At this time of year, in the first quarter of the year as river herring stage closer and closer to their spawning areas at least my concerns in Rhode Island get larger as bycatch events occur. It seems to me that you need to incorporate somehow the absolute magnitude of bycatch events; that is, how many fish were in that particular catch event and not as a proportion of the sea herring catch but as a fraction of the local populations that they're likely to be drawn from.

That's the better measure of the impact. I don't really care what the percentage is in the sea herring catch. It doesn't tell me very much because those are giant populations and that's always going to be the case. I don't find the percentages to be particularly enlightening; but the absolute magnitude as it is coming in and particularly as it gets in the vicinity of this quarter of known runs that are being monitored for known sizes, which is happening in Rhode Island and Southern Massachusetts, it would seem to be a more relevant source of information for the industry to judge its potential impact. Thank you.

MR. BETHONEY: I agree with that but the problem is that information is not available, so we can't create that kind of very solid indication of the impact from our own classifications. Another thing is that the ratios are intended to try to get at the absolute values. With all these tows you see in this figure that were greater than 2,000 kilograms, they all fell into that percentage of having more than 1-1/4 percent river herring and alosines, and the ones that had the percent of less than 0.2 percent had less than 900 kilograms of river herring.

It was an attempt to try to get at absolute values without using absolute values; because one of the problems of using an absolute value is that the vessels have different catch sizes. So if you have a small vessel or a small trip, if your threshold is 2,000 kilograms and the vessel comes in and makes a hundred metric ton two and catches 1,500 kilograms of river herring, that would be under your threshold.

But then a larger vessel, based upon that advice, comes in and makes that same tow with that same portion of river herring to target species, you're going to wind up giving them bad advice and they're going to get a really big catch of river herring. I agree that it would be definitely ideal to move to some kind of classification that is based upon something biological or to a cap.

CHAIRMAN DUVAL: Thanks, Dave, good comments. Are there any other comments or questions for Dave? Doug.

MR. DOUGLAS GROUT: Just for clarification on how these grids worked in your presentation and on the report here is you have one picture here of a grid that was done in 2/1 and there were a couple of tows and the DNE rose and then some that had single tows. Then you have a 2/17 and the DNE rose – it looks like additional tows so you're adding on new tows that were done in there; and then there was one that suddenly lights up as red and will remain red through the next iterations even as subsequent tows are put in there; correct?

MR. BETHONEY: That is correct; the information in those grids is cumulative so it's never going to go down, and then it stays red unless someone goes back in there and had a tow that was low, which didn't happen in this case.

MR. GROUT: And just a follow-up comment; I agree with Mark, I think we've really got to be somehow getting at what the absolute bycatch is of river herring in these tows because that really is the critical part from a management standpoint. I understand your threshold was set on 2,000 pounds or kilograms?

MR. BETHONEY: Kilograms.

MR. GROUT: Kilograms, so I think at some point – I can understand during this period how you might be looking at it from a percentage standpoint, but it would be ideal to know the absolute poundage in the magnitude of these catches.

DR. GEIGER: Again, you know, certainly Mark and Doug made excellent points and continue to excellent points. I guess when are we going to get this kind of information? It seems we have these discussions year and year out and for a variety of different reasons we don't continue to look for what is the best biological source of information we need to do to make good management decisions. I would ask that we don't lose sight of Mark's question and that we don't lose sight of what we need to do to address that question in reasonable, responsible manner. Thank you, Madam Chair.

CHAIRMAN DUVAL: I believe Kate has a little bit of information that might inform some comments by board members.

MS. TAYLOR: Duke University is currently conducting genetic analysis of at-sea-caught river herring. Many of our Shad and River Herring Technical Committee members have offered to provide samples Duke so that they can further their analysis. This is I believe the second year that they are running the program and they're further refining their analysis. Of course, this work is not yet complete.

MR. DAVID SIMPSON: To that, I've heard information lately that suggests that there may not be nearly the – what am I trying to say – that there is likely to be just a couple of stocks and not hundreds of stocks; and the whole premise that we have been managing on that individual system runs of bluebacks or alewives are in fact – you know, show a degree of fidelity to that system; that assumption may not be correct. I wonder if this work so far that Duke has conducted could shed any light on that as we go through this process of developing sustainability plans system by system by system.

MR. MILLER: The results of the Duke Study haven't been made available yet, so I guess the jury is still out with respect to that question. As it becomes available, we'll apprise the board of that information.

MR. BETHONEY: We're actually working with Duke to provide them bycatch samples, so I can talk a little bit about what they're doing and what they have found out. Everything is preliminary, but from a genetic standpoint they do feel confident that they can identify the fish on a regional level, which would suggest that it's not just a couple of discrete stocks, but there are multiple. They're also using otolith chemistry that has indicated that you might be able to identify fish to a watershed, but there is definitely this incredible mixing in the ocean possibly that is a big question that needs to be answered to what degree that these stocks are mixing.

MR. AUGUSTINE: Thank you; very good information. The comments that were made relative to what we need to do in order to get this information brings us right back to our conversation yesterday morning where we had our Legislators and Governor's Appointee Workshop. It just seems to me here is another item that's super-critical that our representatives might want to move forward for consideration to put emphasis on our need for additional funding. I think it's a point that needs to be carried on through the board process to the ISFMP and back to the folks that put on a presentation for us and that represent us when they go up on the Hill to generate funds.

CHAIRMAN DUVAL: Thanks, Pat. Other comments or questions? I see a couple of folks in the audience. Very quickly, if you'd like to come up, please state your name and any organization you're representing.

MR. STEVE WEINER: My name is Steve Weiner and I represent the CHOIR Coalition, which is an organization that is interested in the proper management of herring. Mostly Atlantic herring is where I spend most of my time. I also represent ABTA, which is the bluefin tuna organization.

Dave, I think it's a great project that you have going on here, but I look at it as more as a tool to manage the fleet, to move the fleet along away from high catches of river herring. What I mean by that specifically is if this fishery had a cap, which is probably what it ought to have as someone that has been watching these proceedings for a long time, it would be good for the fishing fleet to have this kind of a tool because it moves them away from fish and prevents them from catching their cap, which would then inhibit their catching herring.

This is a great tool for the fleet. I personally don't see it as a great tool for management of river herring unless – and I just have a few questions. The observer coverage, is it the same observer coverage as whatever is being observed – you're not mandating anymore observer coverage than what is already in place; is that true?

MR. BETHONEY: In terms of the NFOP observers or –

MR. WEINER: Right.

MR. BETHONEY: This is a separate project. This is just portside sampling; so whatever they're observing, they're going to observe independent of us.

MR. WEINER: And how do you handle like knowing how many tows have been dumped or if tows have been dumped what is in those tows?

MR. BETHONEY: We've talked to fishermen about that and we've asked them to disclose if they do dump tows and we can also communicate with observers to find out if that happens.

MR. WEINER: But there aren't observers on all the trips, though?

MR. BETHONEY: Right.

MR. WEINER: So what I guess I wanted to say is the contentious issue in Amendment 5 in New England and what has driven it for four years and what has got the public so up in arms is that we want to know how this fishery is being monitored. We're concerned with dumping. It's dumping basically that brought us all to these meetings.

I have never come to a meeting like this until certain fleets showed up in our backyard in Maine. Until we have enough observer coverage, which I think is a hundred percent, on these boats we are not going to know what is being dumped. Human nature is if you bag full of fish that you shouldn't be bringing in, it's human nature you're not going to bring it in.

With this kind of scrutiny, you're just not going to do. I would like to see this program include maybe more – ask for more observer coverage. Do you do test tows; that's the other thing I was going to ask? The catchability of this fleet, with the amount of fish that they can catch in one tow is so great; do you in any way inhibit – do you sort of support the thought of test tows before you put the gear overboard?

MR. BETHONEY: We haven't done that with the midwater trawl fleet. We have done that somewhat with the smaller boats. We look at this system as an information system for captains to use. It's not trying to dictate exactly what they do or change an entire way they fish. It's an information system.

MR. WEINER: Right, and I guess that is my concern is that – it's a good program and I'm not critical of it, but I don't think it's really meant to manage river herring unless you do things like increase observer coverage and test tows and other things that would really show us what is going on. Thank you for the time.

MR. PATRICK PAQUETTE: I'm Patrick Paquette. I'm a recreational fishing advocate from Massachusetts. I'm just trying to understand or make sure that I'm clear about a couple of the aspects of the program. Dave, you said ten vessels are participating. Are you guys tracking or collecting any information on the vessels in the program and their movement and where they're fishing as opposed to vessels not in the program to sort of show that it's actually working, that vessels are behaving differently?

MR. BETHONEY: Yes, that's one of the measures we're trying to look at in terms of the bycatch rates of the vessels not participating and the bycatch rates of the vessels participating, and also we could look at their movement patterns. It's going to be difficult to do that. With so many of midwater trawl vessels participating, there is not really that control group to look at. That's something we're trying to overcome.

MR. PAQUETTE: Are you collecting any information – when you're doing the shoreside bycatch analysis, are you lining that up with – or are you even able to line it up with dumping events so that you know whether you're actually seeing the full bycatch picture or not? Are you doing any work in the program as far as trying to match them up?

MR. BETHONEY: Not dumping events, but we match up what the shoreside observers observe to what the observers observe when they're on a boat and there is very high correlation between those two different mechanisms of analysis.

MR. PAQUETTE: And one more; you made a statement and I was confused the way you said it. You mentioned something about when you're not able to see the catch, there is sort of a telephone interaction with the captain.

MR. BETHONEY: Not when we're not able to see the catch; it's if we are sampling the catch and we're not able to get the trip log in time or fast enough to get the information back out, we'll call the captain for him to describe the information that's on these logs. This information is where were you fishing, how much total did you catch. It has nothing to do with catch composition. That's all from the portside monitoring or from the observer program.

MR. PAQUETTE: One more; there was a rumor a while ago that you guys are only seeing what is being processed through the plant as opposed to what is being pumped directly into trucks on offload; is that true?

MR. BETHONEY: That is not true, we sample at the watering boxes that go directly in the trucks.

PRESENTATION OF NEFMC DRAFT AMENDMENT 5

CHAIRMAN DUVAL: I think we're going to move on to our next agenda item here, which is a presentation of Amendment 5, and I believe Lori Steele is here to do that. Thanks very much, Dave. That was a lot of great information and we really appreciate your coming here and giving your time to the board.

MS. LORI STEELE: Okay, my name is Lori Steele. I am the Herring FMP staff coordinator for the New England Fishery Management Council. I am here today to give you an overview of the elements of Amendment 5 to the Atlantic Herring FMP that address river herring bycatch. I've been here a few times and we've talked about Amendment 5 a few times, so hopefully this isn't entirely new information for everybody around the table.

We are at the point now of moving towards public hearings for Amendment 5, so we have a range of management alternatives that have been approved by the council and analyzed in a Draft EIS. In terms of where we are with the timeline, I'll start with this. This is the last slide in my handout, I apologize.

We did have a range of alternatives in the Draft EIS approved by the council at the September council meeting. I submitted a preliminary draft to the National Marine Fisheries Service in late November. We got a lot of comments back on the preliminary draft and I just finished the final formal Draft EIS in late January.

The formal Draft EIS is currently under review; and as soon as it moves its way through the process, we anticipate starting public hearings. Unfortunately, I'm still sitting here waiting for word that it is actually going to move its way through the process. I have all the public hearings scheduled and I'm ready to go.

We're hoping that we are going to have a 45-day comment period on the Draft EIS during March and April with most of the public hearings occurring in the later part of March. If we can meet this timeline, the New England Council will be selecting final measures for Amendment 5 at the April council meeting, at the end of April.

We'll come back in May and let you guys know what our final measures are. Hopefully the amendment and all of the elements of the catch monitoring program and any additional measures will be implemented by the start of the next fishing year. I'll go through the presentation as quickly as possible. It looks like a lot more than it is, but there are some summary slides that may be helpful for reference in terms of some of the measures and things and hopefully you can read them.

On your disk I believe you were given the September version of the Draft EIS, which is the version that the council approved. That's an old version of the Draft EIS; however, for your awareness none of the measures have changed. All of the measures that are described in the amendment are still under consideration. All of the elements of the analysis are there.

Once we have the formal EIS approved by NMFS, I will be able to distribute and I think you'll see there has been a lot of work done in terms of rewriting the document. All of the elements of the document are in the version that you have at least in terms of considering the range of alternatives and their potential impacts. The overall goal of Amendment 5, which we did start quite a while back when it was Amendment 4, is to develop an amendment to improve catch monitoring and obviously to comply with the Magnuson-Stevens Act.

There are several objectives that are laid out here on this slide. The biggest issues in Amendment 5 relate to catch monitoring and addressing river herring bycatch. The alternatives in Amendment 5 essentially fall into four general categories; adjustments to the fishery management program, which a lot of that relates to catch monitoring and reporting; catch monitoring at sea; measures to address river herring bycatch; and measures to address midwater trawl access to the groundfish closed areas.

Right now in this presentation I'm just going to focus on the measures to address river herring bycatch primarily. This is just sort of a graphic that kind of tries to visually display the alternatives in the amendment and how the measures all relate to each other. This presentation will focus on the lower left quadrant there, the green, which are the measures to address river herring bycatch.

However, there are several measures that proposed as part of a catch monitoring program and part of the catch monitoring at sea that also address river herring bycatch, so I'm going to touch on those as well. This afternoon, for those of you who are on Herring Section, I'm going to try to go through the other stuff without being overly repetitive.

In terms of the lower left quadrant there in the green management alternatives, these are the management alternatives that the council is considering to address river herring bycatch specifically. They are in Section 3.3 of the larger document, and they're spatial-based management approaches.

You'll see, as I go through the presentation and in the document, depending on what the goal is, each alternative is associated with a management goal, and then there are several options for how to achieve to that goal under the alternatives. The first alternative, obviously, is no action. The second alternative, the goal would be monitoring of river herring bycatch and avoidance to the extent possible, so within Alternative 2 for monitoring and avoidance there is a suite of options being considered.

And then within Alternative 3, the goal for Alternative 3 is protection, so there are a couple of options under consideration for protecting river herring under Alternative 3. Just a quick slide here to show you and just give you an idea of the vessels in the fishery and how many vessels we're talking about; the herring fishery is broken up by four permit categories; A, B and C being limited access and D being open access.

A and B are the directed limited access vessels. These are the major players in the fishery. Area A permit holders have access to all management areas. Area B permit holders have access to areas two and three only and not the Gulf of Maine. But A and B are sort of the major vessels; they make up about 98 percent of the catch in this fishery, so you're looking at about 46 vessels.

The Category C are your limited access incidental catch vessels. These make up another maybe 1.5 percent of the catch in the fishery. So together the limited access fleet is 100 vessels, and then are over 2,200 open access Category D permit holders. These vessels all participate primarily in other fisheries. The Category D permit is limited to three metric tons of herring or 6,600 pounds and anybody can get that permit. Within all of the measures in Amendment 5, the council is considering which permit categories these measures are going to apply to.

The document is constructed in such a way that right now the catch monitoring program, the observer coverage, all of the major elements of the catch monitoring program are intended to apply to the limited access fishery, which is A, B and C, but the council may consider just A and B. And then the measures to address river herring bycatch, there are options to include A, B and C or A, B, C and D, which obviously makes a huge difference in terms of the scope of the management action and the potential impacts.

So that is just to give you some perspective and something to think about as you're thinking about these measures. The council ultimately will have to decide which permit categories all of these measures are going to apply to, and that is something that we'll be seeking public comment about. As I mentioned with river herring, Alternative 1 is no action, and I'm going to go ahead and skip that one.

Alternative 2 is our first sort of major management alternative to consider for river herring bycatch, and this is the monitoring and avoidance alternative. The areas that were selected under this alternative – essentially what this alternative does is it sets up monitoring and avoidance areas. These are bimonthly areas, January/February, and then the next set of areas would be March/April and then May/June and so and so forth.

The areas were selected based on observer data from 2005-2009. We ran the observer data through a statistical analysis and we found the break points in the data and used those as thresholds to identify areas. The monitoring and avoidance areas you'll see are larger in scope than the protection areas in the next alternative, so the threshold for selecting the monitoring and avoidance areas is lower, less conservative.

These areas are based on one observed tow in the area quarter degree square greater than 40 pounds from 2005-2009. And then, as I mentioned, we have identified these areas, which I'll go through in a minute, in this alternative, and then the council is considering several options as to what to do in these areas.

These are sort of the areas where based on the observer data we would potentially expect to see river herring encounters in the herring fishery; and so under this alternative we would be monitoring the catch in these areas more closely and potentially encouraging bycatch avoidance. The first option is to implement a hundred percent observer coverage in these areas, and this would be whatever permit categories the council decides, and this is where you really have to think about A, B, C and then 2,200 D vessels that may be fishing in these areas.

The second option is to implement the Closed Area 1 sampling provisions whenever there is an observer on board in these areas. The Closed Area 1 sampling provisions require that all fish at least be pumped across the deck for the observer to sample. Slipping or discarding fish before they come on board is prohibited. There is also a requirement to fill out a released catch affidavit if a slippage event occurs under certain exceptions.

The third option is a trigger-based approach, and I'll go over this in a few minutes. Under this option river herring catch in all areas would be monitored until a trigger is hit. When the trigger is hit in a particular area, that would then trigger these monitoring and avoidance areas, and it would either trigger Option 1 or Option 2 here. It's very similar to Options 1 and 2; it just doesn't implement the actual measures until a catch trigger is reached.

And then the fourth options is within these areas to adopt sort of a two-phased bycatch monitor and avoidance approach that is based on the SMAST projects that you just heard Dave talk about. Phase 1 would occur in Amendment 5 where we identify the areas and potentially encourage or increase monitoring in those areas and work with the industry through SMAST to get more information about bycatch avoidance.

And then Phase 2 would be after the SMAST Project is completed, the council would review the project results and determine whether or not any of the outcomes of the project would need to be adopted formally in the Herring Plan as sort of a bycatch avoidance type strategy. Very briefly, I'll flip through these areas just to give you some perspective.

These maps are all in the document. As I mentioned under the monitoring and avoidance alternative, the areas are larger because they're just monitoring areas. They're not closed areas or anything like that. The threshold was 40 pounds. The shaded blocks here are the January and February proposed monitoring avoidance areas; and these are March and April.

All of these shaded quarter degree squares would become your monitoring and avoidance areas where a hundred percent observer coverage would be required or Closed Area 1 sampling provisions or something. This is May and June, July and August in the northern Gulf of Maine, and then September/October and November/December. The blocks change every two months. Those would be for monitoring and avoidance under Alternative 2.

And then next is Alternative 3, which the goal would be river herring protection. This alternative proposes to protect river herring in the areas where encounters with the herring fishery are most likely, so we used a higher threshold of observed bycatch to identify these areas. The areas are based on one observed tow of river herring catch greater than 1,233 pounds. I know these are really weird numbers but that's just the way the statistical analysis broke it out.

The first option is to close the areas; just make them closed areas to herring fishing, either A and B or A, B and C or A, B, C and D; to be determined. And then the second option is use a trigger-based approach where the areas would not become closed areas until a catch trigger is hit during the fishing year. Again, these are smaller areas because of the more conservative bycatch threshold.

These would be the protection areas under Alternative 3 in January and February; March and April. There are no protection areas proposed for May/June or July and August, so the next group would be this one block in September/October; and then these blocks in November/December.

Now, regarding the trigger-based approach, this is complicated. This is an option under Alternatives 2 and 3, either the monitoring alternative or the protection alternative. What we've done here is we've identified three different areas. They're shaded differently on the map, and those are your trigger-monitoring areas. I was going to put the table in here. There is a table in the document that gives the various options for the catch triggers that are being considered.

The idea here is there would be three catch triggers in these three different shaded areas; and if any one of those triggers is hit during the fishing year in that area, whatever monitoring or avoidance or protection measures are selected would then apply from that point forward in that area for the rest of the year.

So it's basically delaying the implementation or the effectiveness of any of the monitoring, avoidance or protection measures until a catch trigger is hit in the particular area. There was a question earlier about river herring catch caps. The council has included a placeholder in the document for establishing a river herring catch cap in the Atlantic herring fishery after ASMFC completes a river herring stock assessment.

The council did vote to – I think the council made this clarification at the September meeting that the catch cap could be implemented in the future through either a framework adjustment or through the specifications process. The mechanism is in the document. It is consistent with what the Mid-Atlantic Council is proposing for setting catch caps through the mackerel specifications process in the future.

Because we're considering this catch trigger-based approach, we actually have already laid the technical groundwork for catch caps because the triggers are based on work that the PDT did to try to develop a catch cap for the fishery. By going through the process of establishing the triggers and mechanisms to monitor the triggers, we've kind of already laid the groundwork in this amendment for setting caps in the future, so we will be able to do that in the future without having to do a full amendment.

We can do it either through the specifications process every three years or through a framework adjustment at any time. Okay, just because it's not confusing enough to read, I went ahead and put together a flow chart that kind of gives you a graphical illustration of what the river herring management alternatives look like.

Hopefully, you can read it on your handout. I'm sorry the slides didn't print as well as I had hoped. This just sort of gives you an idea of what we're looking at here in terms of monitoring and avoidance or protection and the various decisions that have to be made. There are also exemptions being considered for the Northern Shrimp Fishery in the Gulf of Maine as well as for vessels fishing with mesh greater than 5-1/2 inches. All of that information is in the document as well.

As I mentioned, that's that green lower left quadrant, but that's the section of the document that really focuses in on just specifically addressing river herring bycatch. If the council chooses Alternative 1 on that, no action, that doesn't mean that river herring bycatch does not get addressed in Amendment 5. That just means that we're not going to take one of those very specific spatial-based approaches for addressing it.

We have a slew of management measures in this document as part of the catch monitoring program that will address river herring bycatch either directly or indirectly. The entire catch monitoring program is designed and intended to enhance sampling, improve monitoring and improve information; all of these things which we need to do for river herring. I'm not going to go into all of them right now, but you can come back after lunch for the herring presentation if you want to hear a little bit more about some of the catch monitoring elements.

There are a bunch of quota monitoring and reporting provisions in the document, changes to reporting requirements, trip notification requirements, things like that to improve reporting and monitoring in the fishery. Then we also have options proposed for reporting requirements for dealers; alternatives for increased observer coverage, an alternative for a maximized retention experimental fishery, and measures to maximize sampling and address net slippage.

Reporting requirements for dealers, Section 3.1.6, there is an option being considered to require dealers to accurately weigh all fish. The option is pretty straightforward, I guess, in that it just says that dealers are going to accurately weigh all fish. It's a little bit unclear how that is going to happen because the operations, dealers, processors, the herring fishery, as small as it is, is incredibly diverse in terms of the way the fish are handled.

The council is considering some suboptions to try to clarify that, and these things like if the dealers don't sort their catch by species they would be required to document for NMFS either annually or for each landing event how they're going to estimate the relative species composition of a mixed catch. Also, there is a suboption being considered to require dealers to get a vessel representative confirmation of a SAFIS transaction at the first point of sale.

We're just trying to resolve some data entry issues and try to – we have a lot of different data bases for herring landings; you know, dealer, VTR, now we have VMS, and we're trying to reconcile some of the differences in these data bases. To the extent that we can get the dealers to start documenting more clearly how they are estimating their species composition in a mixed catch, we may be able to get some more information about how much river herring is moving through some of the dealers.

Now as I mentioned, one of the big elements of this amendment and the catch monitoring program are the alternatives to allocate observer coverage on the limited access herring vessels. These are the A, B and C vessels, the hundred vessels that catch 99.5 percent of the fish. There are several alternatives under consideration.

I won't go into them in great detail right now, but they each include four elements; one being what the priorities are for coverage; two being what the process is for reviewing and allocating and prioritizing coverage; three, options for funding coverage; and, four, provisions for utilizing service providers and authorizing waivers. This is in the event of some additional coverage outside of what the Science Center and the Observer Program currently provides.

In the event that is needed, we need to have a process for other service providers and a process in place in for what happens if a boat tries to get an observer and can't get an observer for some reason. This table that you can't read is a summary of the alternatives to allocate observer coverage on the limited access herring vessels, and it goes through each of those four elements that I just described.

The first alternative is no action. The second alternative is to require a hundred percent observer coverage on A, B and C vessels, so those are sort of your two extremes. The third alternative is to use the formerly current SBRM process and to require that whatever the SBRM coverage levels are for the herring fishery, require that those at least be minimum levels. I know that sort of sounds like the status quo, but right now the SBRM, the way the process works the council can reprioritize and can move days around in order to deal with funding shortages and things like that. This alternative would not allow for days to be moved out of the herring fishery. It would require that at least what comes out of the SBRM is a minimum of coverage.

And then Alternative 4 is to use sort of a different set or priorities for allocating observer days on these vessels. One of these priorities under Alternative 4 would be river herring. Right now because river herring is not federally managed, it is not part of the SBRM process. Obviously, river herring bycatch is accounted for through the SBRM because observers observe everything, but it is not a driving factor in terms of allocating days.

Alternative 4 would specify that a 20 percent CV for river herring bycatch would be one of the driving factors for allocating days on limited access herring vessels. Chances are that at least Alternative 2, for sure, Alternative 4 and possibly Alternative 3 would all require funding above and beyond current federal funding, so the option exists under each of these alternatives for an industry-funded observer program.

The details of an industry-funded observer program are going to have to be fleshed as the program is developed and implemented if the council chooses to go that way. I tried to fit as many words on this slide as I possible could. Measures to maximize sampling and address net slippage; this is another big issue that is going to affect river herring.
The council has included in the document several options to enhance sampling by observers and several options to address net slippage. I think it was referred to in the earlier discussion as dumping. Amendment 5 includes a very specific definition of what slippage is and this slide gives you that definition.

Slippage is unobserved catch that is discarded prior to being observed, sorted, sampled or brought on board the fishing vessel. It can include the release of fish from a cod end or seine prior to completion of pumping or the release of an entire catch or bag while the catch is still in the water. Slippage does not include operational discards which are the fish that remain in the net after pumping operations are finished, after a successful pump and there is a little bit of fish still in the net.

The observers have done a pretty job of documenting operational discards, and there are still some measures in the amendment that continue to improve their ability to do that. In general, though, operational discards represent a very small portion of discarded fish, so they are not considered slipped catch.

Any discards that occur after the catch is brought on board is not considered slipped catch. Those are obviously discards and bycatch but they're not slipped. In terms of measures to maximize sampling, I'm not going to go through these in detail, you can read them in the document.

We have requirements to require a safe sampling station, requirements to provide observers with reasonable assistance, requirements to notify observers when pumping is starting and finishing, communication between pair trawl vessels and requirements that vessel operators provide observers with visual access to the cod end after pumping is completed. Measures to address net slippage; we are considering an option to require a release catch affidavit for slippage events similar to the Closed Area 1 requirements on any trip when there is an observer on board.

We are also considering an option to implement the Closed Area 1 sampling provisions across the fishery any time there is an observer on board. I should mention those Closed Area 1 sampling provisions that are being considered here across the entire fishery are considered in the river herring monitoring and avoidance areas. That's one of the options for river herring monitoring and avoidance.

Again, if the council were to adopt this across the entire fishery, there really isn't a need to adopt it in the river herring monitoring and avoidance areas; it would already happen. So as I mentioned if the council does take no action on those specific measures to address river herring bycatch, there are many other measures in the plan that would potentially address river herring bycatch.

We're also considering an option to apply a catch deduction and possibly trip termination for any slippage events that are observed. There are several sorts of suboptions in the document related to that. And then as I mentioned there is an alternative in the document that would allow for a maximized retention experimental fishery. The details of that are not in the document.

All that it would do, it's a mechanism that would allow NMFS actually to run an experimental fishery to test maximized retention in the herring fishery after the amendment is implemented, so NMFS would actually have to develop the details of the experiment. I'm not going to go through this in detail. These are some of summary tables that we've put together to try to let everybody know where options are that are being considered and what goals and objectives they meet.

I'll get into this later this afternoon. These are the actions for improving sampling. Here on this slide are the options for addressing that slippage that I just discussed. These are all in the document, in these various section numbers if you want to take look at them. And then here are the two alternatives for the maximize retention experimental fishery.

Okay, this I'm sure you can't read, but hopefully you can on the paper and these are also in the document although now that we've revised the document and submitted the formal draft these tables have been updated. I would encourage you, once we have the formal draft available, to take a look at these summary tables. These get into the impacts.

I didn't want to spend too much time on impacts today because I figured everybody kind of wanted to hear a little bit more about the actual measures. In terms of the impacts, we looked at it across – they're called valued ecosystem components. It's a NEPA requirement, VEC, so we selected several VECs to analyze the impacts in the amendment; one being the Atlantic herring resource.

The second one is non-target species in other fisheries. River herring is identified specifically in that VEC. The third VEC is essential fish habitat; fourth is protected resources; and the fifth is fishery-related businesses and communities. Without getting into any detail, I'm happy to go back through these if people have questions. These three summary tables here just sort of give you a very general summary of what the impacts analysis is showing you.

In terms of the impacts of the measures to address river herring bycatch, I did just want to point this out. A lot of this is in the September document. For the actual formal Draft EIS that hopefully will be available very soon, I've actually taken this whole analysis and moved it into an appendix and condensed everything in the Draft EIS into a much hopefully easier to read summary of the impacts.

But, if you go into the impact analysis, it has a lot of elements in it that I think that this board would be very interested in. This is all now going to be an appendix in the amendment, but the analysis takes a look at the coincidence of river herring and shad in the fishery and concludes essentially that any measures that are implemented in this fishery to protect river herring are going to have very similar impacts on shad because of the overlap of the two species and the overlap of interactions in the fishery.

There is also a very detailed river herring catch comparison in the document, which I think it's like a four-page table, that provides every estimate of river herring catch and bycatch that has ever been generated that we were able to find from any source anywhere; and it also provides the CVs and the estimates and precision associated with those estimates.

Migration patterns and looking at the monitoring and avoidance areas, that is in there; assessment of the protection areas and then, of course, the impact analysis of spatial closures and triggers. The river herring analysis is extremely detailed, very technical and very complicated. Hopefully, the formal Draft EIS will be a little clearer to follow but all of those elements are in there.

Just to give you on the catch comparison table, I did put some tables in here to give you an idea of what kind of analysis you might be able to find in the document. As part of the catch comparison, one of the things that we did do, the Herring PDT took the 2010 catch data and went ahead and derived a river herring catch estimate for the Atlantic Herring Fishery.

We had really good observer data in 2010. Almost 30 percent of the fishery was observed, so we generated a catch estimate for river herring removals in the directed herring fleet. The CV associated with that catch estimate I think is about 0.35, 0.36, so it's not terrible given some of the really large CVs we were seeing in the past. It's one of our more precise estimates.

This table just kind of puts it into perspective. The directed herring fleet we're estimating in 2010 caught about 166,000 pounds of river herring based on about a 30 percent observer coverage in the fishery. All fleets estimated from the SBRM were estimated to catch about 531,000 pounds of river herring, and then, of course, as you know the Maine directed fishery landed 1.3 million pounds in 2010.

That just tries to put some of this into perspective, because we've heard a lot about the impact of river herring bycatch by the Atlantic Herring Fishery. The other thing that you'll find in the document regarding the areas that have been chosen, the monitoring and avoidance areas and the protection areas, is a qualitative assessment, and this is just an example.

If you go into the document and you see the quarter degree square on the maps, each of them have a letter in the, A, B, C, D, all the way through the alphabet. In these tables you'll see letters across the top and that gives you the block in the map that we're talking about. This right here is for the monitoring and avoidance areas in January and February. It goes through each of the blocks that's proposed for monitoring and avoidance and answers relatively simple questions; are there areas adjacent to those blocks that were fishery based, meaning are there areas adjacent that had interactions with the fishery and river herring; are there adjacent areas that were picked up in the survey as being river herring areas; and do these areas overlap.

The question is are we picking the right areas; are we picking the areas that really do reflect where the most encounters with the fleet are going to be; or, if we close these areas and everybody goes fishing outside of the areas, are we going to make the problem worse because everybody is going to catch river herring outside of the areas.

The answer is we really don't know; so what we have tried to do is provide a qualitative assessment of the areas and what might be in the surrounding or adjacent blocks. You'll also see a lot of maps like this in the document. What this is, is it gives you – in terms of looking at the potential impacts on the fishery, this gives you a bimonthly illustration of where the fishing effort is. This is just A, B and C. I believe we have some of the D vessels in the document as well.

The hatched blocks are the ones that are proposed for monitoring and avoidance, and then the colored blocks are where the fleet operates, so it gives you a sense of what the overlap is between the fleet activity and the areas that are proposed. The other thing you'll find in the document is for each of the areas and each of the options by gear type and permit category, we looked at A, B and C and we did look at D separately here for each of the blocks how much time is spent fishing in the areas, how much time is spent fishing outside the areas and how much catch comes from inside and outside those areas.

Okay, here are your triggers. This table in the upper left gives you the nine options under consideration for the river herring catch triggers. What we did in the document, there is a series of histograms like the one here on the bottom right that show you what the probability of reaching the triggers is in each of the various areas.

You'll also see in the document again sort of a qualitative sort of wrap-up of the potential impacts, positive and negative, going through by option and things like that; just sort of a summary of the impacts. I'm not going to read that now. And then again more summary tables summarizing across each of the five VECs what the potential impacts of all of these measures are. Hopefully, you can read those. I already went through the timeline. That's it and I'm happy to answer any questions.

As I mentioned, we're just literally sitting here waiting to find out when the public comment period is going to start. Most of the public hearings are scheduled for late March. I'm going to do a public hearing at the Maine Fishermen's Forum on March 2nd, and then I believe that the next one isn't until I think the 16th of March. I pushed everything towards the end of March hoping that we'll be okay timing-wise waiting for the comment period to start. As long as the comment period ends before the April council meeting, we'll be making final decisions hopefully at the April council meeting so that we can implement in January of 2013.

CHAIRMAN DUVAL: Thank you, Lori, for that very thorough presentation and for coming before the board once again. We very much appreciate that. I see Terry had a comment or question.

MR. STOCKWELL: Both, Madam Chair, and thank you, Lori, for compressing multiple years of work in

550 pages of DEIS into a relatively concise report. I notice on the agenda there is select preferred alternatives on the draft. I have a lot of angst about that. It's still a draft amendment. We haven't received public comments.

I would prefer personally and it would be the will of the board that we defer comments with the caveat that if the public comment closes prior to the commission being able to provide comments, that you would form a working group with representatives of the board and draft some comments, circulate it to the board and then provide them to the council in a timely manner.

CHAIRMAN DUVAL: Thanks for that, Terry. Other thoughts on that particular option with regard to providing input on the board's thoughts on the management options that are contained in Amendment 5? I guess maybe just a quick question for Lori; how confident are you of the timeline? I know you're waiting the formal Draft EIS to come out so that you can go through with public hearings, and right now I understand that the comment period would close before the board meets again in May; correct?

MS. STEELE: I have no way of – if it were up to me, I'd be really confident but the next commission meeting is April 30th. Unless everything goes badly and the council can't make its final decisions at the April council meeting, there won't be another meeting. We have a little bit of wiggle room.

The 45-day comment period for us has to end like April 24th or whatever; so worse case scenario we wouldn't go into a public comment period until some time in March. But, as long as it ends before the first day of our council meeting, we can make decisions. At this point I'm pretty confident that's going to happen, but I've also learned never to be surprised.

CHAIRMAN DUVAL: Thanks for that. I think Vince has a couple of comments for us.

EXECUTIVE DIRECTOR JOHN V. O'SHEA: This is an important issue for our commission and for this board. It seems to me that Terry's idea of getting a group together and start working on a response right now wouldn't hurt this board at all. If the Draft EIS is delayed in being released and they don't make the deadline, the worse happens is that the work of the committee could come before the board in May for discussion and final approval. If the thing comes out earlier than that, then the board would be in a position to respond in time to have the input being considered. I don't see how you could lose by agreeing today to go forward with Terry's idea.

CHAIRMAN DUVAL: Thanks for that, Vince, and I had had similar thoughts prior to the meeting that it would certainly be more efficient to have a subgroup of board members work on comments. I think it's easier than trying to hash out specific recommendations here particularly since the Draft EIS has not been released yet.

Do other board members have any other comments to the contrary or thoughts or is there a general consensus around the board that would be an acceptable approach? I'm seeing heads nodding; so with that I guess would – I see going to ask for volunteers to serve on this subcommittee, but I see Lori has her hand up.

MS. STEELE: I was just going to mention a couple of things. First of all, I will have a public hearing document available before the end of February because I'm going to do the hearing at the Maine Fishermen's Forum. If that's not a real official public hearing, it's still going to be a public hearing. It will be an unofficial public hearing. I'll have a public hearing document available.

The other thing I was going to suggest is for the commission in general, you know, I'm going to give a presentation this afternoon to the Herring Section on some of the other elements of the amendment. All of these things are so interrelated, I would hope that the commission would want to sort of maybe work on submitting one collective set of comments rather than river herring comments and herring catch monitoring comments.

CHAIRMAN DUVAL: Thanks, Lori; that's also a good suggestion and I think certainly any comments that would be submitted by this board, we would not want those to be in conflict with any comments submitted by the Atlantic Herring Section. Vince.

MR. ROBERT E. BEAL: Hopefully, Vince and I are about to say the same thing. If the management board and the section disagree or have conflicting comments, the policy board is the group that would sort that out and make sense of it. Obviously, competing or conflicting comments going to the National Marine Fisheries Service from this group is not very effective so you have to go through the policy board, formulate one position for the commission, and bring that forward for the council and the National Marine Fisheries Service.

CHAIRMAN DUVAL: So with that, do I have some volunteers? I see Terry; Doug; Pam, our AP Chair. I will also volunteer to be on that; Mike Armstrong. Anybody else? Okay, if that's all we can get right now, we'll start there but we might need to strong arm a couple of other folks into participating later, so don't be surprised if you get a phone call.

There was one other item that is relevant to the information that is contained in Amendment 5 that I did want to bring up, and that was a letter that was submitted by the National Coalition for Marine Conservation with regard to updated river herring regulations. The states have been going through the Amendment 2 implementation process for river herring, and I believe several states have probably had to update their regulations recently.

I'm not sure if – I know the September draft of the amendment may not have had the most up-to-date regulations. I believe that some of the states are still working on that. One of the points in the letter that was made is how the states handle those state and federal waters ocean bycatch, and I think it's particularly important to perhaps try to include a column in that chart on how do states handle ocean bycatch.

I know, for example, in North Carolina our rule is a no possession rule. You can't have it. I took a quick glance at that table. As an example, Massachusetts I know has a moratorium on river herring, but I believe allows a 5 percent tolerance by weight for federally permitted vessels. Well, that information isn't included in that chart.

I'm just wondering, Lori, is there the opportunity for the board members to update and make sure that the regulations that we have for the states are the most up to date as they can possibly be given some of the changes we have gone through with Amendment 2 implementation and would it be possible to include some kind of comment column that would account for what do states do with or how do they handle ocean bycatch of river herring.

MS. STEELE: Yes, absolutely, if any of that information could be provided as part of the comments on the amendment, we can certainly incorporate it into the final draft. The other thing that we should do – and I can work Kate and Chris on this – is we did in the amendment include a summary state by state of the regulations – I think it was the regulations for river herring so we certainly should update that as well.

MR. GROUT: Well, my thought was that we do provide plan reviews every year that include the state regulations that pertain to river herring and also the sea herring, and that information could easily be drawn out of the most recent plan reviews for both of those teams. Either we could do that as part of the subcommittee providing comments or the staff could just ship those plan reviews off to Lori.

CHAIRMAN DUVAL: To that point, Kate.

MS. TAYLOR: Yes, we do include the fishing regulations in our FMP Review; however, it would be for the prior fishing year, so it's not including the most up-to-date 2012 information for this year's FMP Review.

MR. STOCKWELL: My first comment was similar to Doug's, and my second comment is that the state of Maine is currently in a rule-making process and it would be premature for me to include anything other than proposed rules because there is no way in being assured that is what will actually be the outcome.

DR. GEIGER: Madam Chairman, to a slightly different point. I'm still a little confused about the process for this board providing comments to some subset and then a process after that. I heard Bob Beal say that appropriately the policy board should send comments forward representing ASMFC. Could I just get a clarification of what is the proposed process by which the ASMFC will provide comments back on this issue?

CHAIRMAN DUVAL: Thanks, Jaime, that's a great question and I think Bob is going to chime in here.

MR. BEAL: This board just formed the working group. They're going to come up with draft comments on Amendment 5 once they get the working draft from Lori or the public comment draft. Then they will circulate those draft comments to this entire board for review and hopefully sign off.

That may be the end of it, but I think the Herring Section is going to meet later this afternoon and they're going to decide on what process they would like to use for providing comments. If at the end of both of those processes we end up with conflicting comments or comments that don't mesh well together and won't provide some valuable information to the National Marine Fisheries Service, we'll have to formulate something so the policy board sorts out those differences between the section and the board. We can do that offline through correspondence with the policy board. Depending on the timeline, we can do it at the May meeting if the timeline that Lori presented does slip.

DR. GEIGER: Is it appropriate for both the advisors to weigh in on this as part of this process as well as the technical committee or is this should be just to the board itself?

MR. BEAL: Usually comments are signed off finally by the board. There can be input from the advisory panel, and it may be best if the advisors give input to the working group and then the working group distills that and provides that as part of their comment.

DR. GEIGER: I just want to make sure that the advisors do have a mechanism to provide input as well as the technical committee and I think that's a good process. Thank you very much.

CHAIRMAN DUVAL: So does that sound okay to everyone; people are clear on the process that we're going to follow to provide some comment on this amendment? Back to the other issue of having a state's most updated regulations, the point that was made is just that some states may have actually implemented new rules since the prior FMP Review and really just to try to incorporate those updated versions of rules and also how states actually treat ocean-related bycatch of river herring into the chart that Lori has already in Amendment 5.

For states like Maine that are in the middle of rulemaking, obviously you can't do anything like that and we certainly wouldn't ask that. Are there any other questions with regard to Amendment 5 right now? Okay, if there are no more questions, Kate is going to give us a quick update on where the Mid-Atlantic Council's Amendment 14 process stands.

UPDATE ON MAFMC DRAFT AMENDMENT 14

MS. TAYLOR: In your briefing material, it included a revised timeline for the Mid-Atlantic Council's Amendment 14 to the Squid, Mackerel, Butterfish Fishery. As you can see on the revised timeline, the public comment period is expected to close in early May. I have talked to council staff and confirmed that would be after our May board meeting, so you can expect that you will have a draft of the Mid-Atlantic Council's Draft Amendment 14 for review at the board meeting at that time.

CHAIRMAN DUVAL: Any questions for Kate on that? Okay, seeing none, we do have a couple more items on our agenda. The first one is to review and populate the Committee on Economics and Social Sciences membership, and I think Kate has a name for us.

POPULATE THE COMMITTEE ON ECONOMICS AND SOCIAL SCIENCES MEMBERSHIP

MS. TAYLOR: The Committee on Economics and Social Sciences recommends the board approve Dr. Winnie Ryan as a social scientist to the Shad and River Herring Technical Committee and plan development team.

CHAIRMAN DUVAL: I would entertain a motion. Pat.

MR. AUGUSTINE**: I move that the board accept the recommendation to put Dr. Winnie Ryan on the Economics and Social Sciences Committee.**

CHAIRMAN DUVAL: Second by Bill Adler. Is there any discussion on this motion? Any opposition to this motion? **Seeing none, that motion is approved.** I believe our final item of business today **is election of a vice-chair**. Mr. Travelstead.

ELECTION OF VICE-CHAIR

MR. JACK TRAVELSTEAD: **Madam Chair, I would like to nominate Terry Stockwell for vice-chair.**

CHAIRMAN DUVAL: Motion by Jack Travelstead; second by A.C. Carpenter to nominate Terry Stockwell as vice-chair of the Shad and River Herring Board. Comment by Pat Augustine.

MR. AUGUSTINE: I move that the board close nominations and cast one vote to approve Mr. Stockwell as the man.

ADJOURNMENT

CHAIRMAN DUVAL: So done. Congratulations, Terry. Is there any other business to come before the board before we adjourn? Seeing none, we stand adjourned.

(Whereupon, the meeting was adjourned at 1:30 o'clock p.m., February 7, 2012.)

Please refer to

"Shad & River Herring Management Board 2"

for a copy of the River Herring Peer Review and Stock Assessment Report.

Please note that these files are very large.

Please refer to the Atlantic Herring Section briefing material for a copy of NEFMC Draft Amendment 5 to the Atlantic Herring FMP

NEFMC Amendment 5 Working Group Recommendations
Board Members: Leroy Young, Mike Armstrong, Michelle Duval, Doug Grout, and Terry Stockwell
AP: Pam Lyons Gromen
Staff: Kate Taylor

The working group reviewed the NEFMC Draft Amendment 5 management alternatives on March 30th and makes the following recommendations to the Shad and River Herring Management Board. The working group recommends that the both the New England and Mid-Atlantic Councils should strive for the highest level of consistency possible in approving the final management measures in Amendments 5 and 14. Where consistency is not possible, the Councils should opt for measures that will provide the least amount of discord.

FMP ADJUSTMENTS **–** The working group is supportive of any measures that will improve accuracy and accounting of catch reporting for all species, including river herring, as well as reduce river herring bycatch where it is occurring. The working group does not have any specific recommendations on Section 3.1.

CATCH MONITORING AT SEA

Observer Coverage (Section 3.2.1.2) - The working group recommends 100% observer coverage. The working group recommends that observer coverage be funded by Federal resources, but that phased-in, cost sharing alternatives be considered and the differences in observer costs between the east and west coasts be examined.

Measures to Improve Sampling (Section 3.2.2.1) – The working group recommends all of the measures under Section 3.2.2.1 to improve sampling by NMFS observers.

States As Service Providers (Section 3.2.1.2.2.) – The working group recommends authorization of all States in the Northeast Region as service providers for sea sampling on limited access Atlantic herring vessels, with State data collection standards and methods being consistent with NEFOP standards and methods for the herring fishery.

RIVER HERRING BYCATCH

Observer Coverage (Section 3.3.2.2.1) - The working group recommends 100% observer coverage. The working group recommends that observer coverage be funded by Federal resources, but that phased-in, cost sharing alternatives be considered and the differences in observer costs between the east and west coasts be examined.

Closed Area I Sampling Requirements (Section 3.3.2.2.2) – The working group supports the Closed Area I Sampling Provisions when fishing in the River Herring Monitoring/Avoidance Areas.

SMAST/DMF/SFC Approach (Section 3.3.2.2.4) – The working group recommends support of the SMAST/DMF/SFC river herring bycatch avoidance program.

Closed Area and Triggers (Section 3.3.3.2.1 and 3.3.3.2.2) - The working group does not recommend the use of triggers a management tool without a method to link the trigger to a peer reviewed biological estimate of coastwide river herring populations. However, if the NEFMC approves the use of closures in the areas/times that are identified as River Herring Protection Areas, then these closures should be implemented through a trigger system rather than occurring automatically. The working group notes that the trigger levels presented in Draft Amendment 5 are based off of the levels of bycatch that has occurred in the past (2005-2009). Using this information in the development of a trigger may only sustain the current level of river herring bycatch, rather than reduce bycatch.

MID-WATER TRAWL ACCESS TO GROUNDFISH CLOSED AREAS – The working group is supportive of any measures that will improve the accuracy and accounting of catch reporting for all species, including river herring, as well as reduces river herring bycatch where it is occurring. The working group does not have any specific recommendations on Section 3.4.

ASMFC Shad & River Herring
Advisory Panel Conference Call
March 16, 2012

Attendance

AP Members	Joe Fletcher
Michael Blanchard	Pam Lyons Gromen, Chair
Alison Bowden	George Loring
Louis Ray Brown	William Richkus
Dave Ellenton	Byron Young
Richard Fasanello	Kate Taylor, ASMFC

NEFMC Atlantic Herring PDT
Jamie Cournane

Advisory Panel Call Overview

The Advisory Panel convened via conference call on March 16th to craft recommendations for the New England Fishery Management Council's (NEFMC) Amendment 5 to the Atlantic Herring Fishery Management Plan. Jamie Cournane was invited to join the call to assist AP members in their understanding of Amendment 5 and to answer questions. In preparation for the call, the AP was sent links to the NEFMC web site containing a number of documents, including the: 1) ***Public Hearing Document for Amendment 5;*** 2) ***Draft Amendment 5 including Draft Environmental Impact Statement (Volume I) dated February 16, 2012, and*** 3) ***Amendment 5 Volume II (Appendices)***. Table 179 from Amendment 5 Volume I entitled "Overlap between Amendment 14 to the Squid, Mackerel Butterfish FMP (MAFMC) and Amendment 5 to the Herring FMP (NEFMC)" was distributed before the call and was used to structure the meeting discussion. The table provided a useful frame of reference since the AP had convened last year to provide feedback on Amendment 14 alternative development.

Kate Taylor began the call by explaining the process the ASMFC will use to provide Amendment 5 recommendations to the NEFMC. The AP's recommendations will be provided to a working group of the Shad & River Herring Management Board, which will report to the full board during the April 30 meeting week. Likewise, the Atlantic Herring Section AP will provide its recommendations to an Atlantic Herring Section working group. Any disparity between Atlantic Herring Section and Shad & River Herring Management Board positions will be addressed by the Policy Board so that a single set of Amendment 5 comments is submitted to the NEFMC.

Advisory Panel Recommendations:

General

- The AP feels strongly that consistency issues between Amendment 5 and Amendment 14 to the Atlantic Mackerel, Squid and Butterfish (MSB) FMP (outlined in Amendment 5, Table 179) must be reconciled in the selection of final action alternatives. Given the overlap between the Atlantic herring and Atlantic mackerel fisheries, it is unduly burdensome to the industry and to enforcement to apply different requirements for vessel

and dealer reporting and at-sea observer measures. River herring incidental catch reduction strategies (e.g., area closures or incidental catch caps) also require inter-council coordination to be effective.
- While portside monitoring program options were dropped from Amendment 5, the AP believes that portside sampling programs provide important information on shad and river herring incidental catch, especially for high-volume fisheries where catch may be difficult to sort at sea. The AP notes that an analysis provided in Amendment 5 Volume II, Appendix II (B) discusses how portside sampling data can be effectively combined with at-sea sampling data to improve bycatch estimates.

The below recommendations are organized into the four major categories identified in the Amendment 5 Public Hearing Document.

FMP Adjustments

- Vessel Reporting Measures
    - The AP is supportive of measures that will improve the timeliness, efficiency and accuracy of vessel reporting. Consistency between the Atlantic Herring FMP and the Mid-Atlantic MSB FMP must be addressed.
    - The AP is concerned about compliance with vessel reporting requirements and believes enforcement of these requirements should receive more attention.
- Dealer Reporting
    - The AP notes that an accurate accounting of all catch is important. Recent river herring incidental catch estimates are calculated by extrapolating observer data to total catch reported. **The AP is generally supportive of Section 3.1.5, Option 2, Sub Options 2A-2C (Require Dealers to Accurately Weigh All Fish).**
    - Consistency between Amendment 5 and Amendment 14 dealer reporting measures is a very important issue.

Catch Monitoring At Sea

- Alternatives to Allocate Observer Coverage on Limited Access Herring Vessels
    - Dave Ellenton informed the AP of a meeting of many A/B permit holders that took place at the Boston Seafood Show. Industry representatives at the meeting decided to support 100% observer coverage for limited access (A, B and C) permit holders. They also agreed to pay for observers if costs did not exceed $325 per observer sea day. They have not yet included C permit holders in the discussion but plan to do so. The AP commended Dave and the industry for their proposal.
    - The cost of $325 per observer sea day is based on the west coast Pacific whiting fishery, which is also a high-volume fishery. The observers deployed in this fishery are certified by NOAA's Northwest Fisheries Science Center Observer Program but are not federally-employed. They are contracted privately by the industry. Observers are required for Pacific whiting vessels to fish, and the industry has accepted this requirement as the cost of doing business. AP members felt that if the west coast fleet could succeed while bearing observer costs then east coast boats could do the same.
    - **The AP reached consensus in supporting Alternative 2 under Section 3.2.1 (100% Observer Coverage on Limited Access Herring Vessels) for Category A & B permits. However, the AP did not reach consensus as to whether 100%**

coverage should apply to C permit holders. The group did agree that it is important to accurately and precisely estimate incidental river herring/shad catch from Category C vessels. The group also expressed concern as to whether 100% observer coverage was adequate for larger vessels that travel far offshore. A single trip can last several days and many long hours would be required of an observer. Observers need down time to rest and sleep.

- The AP notes that A/B boats (approximately 50 vessels) catch 97-98% of Atlantic Herring. C permit holders comprise another 55 vessels and the incidental catch of shad and river herring could be significant. A breakdown of permit category by gear type was not available, but it is believed that most Category C vessels are bottom trawlers. Based on analyses in Amendment 5 (Amendment 5 Volume II, Appendix 3), the costs of an observer as a percentage of revenue or daily operating cost is much greater than it is for mid-water trawls or purse seines.
- **The AP also supports Funding Option 2 under Alternative 2 (Federal and Industry Funds),** including provisions for utilizing observer service providers as a more cost-effective alternative to federal observers.
- **The AP supports the no action alternative (Option 1) under *State Agencies as Service Providers for Observer Coverage*.** The AP believes states should not be exempt from applying to NMFS to be authorized as providers and should not be exempt from complying with observer provisions found in current regulations.

- Management Measures to Improve/Maximize Sampling At-Sea
  - **The AP generally supports the suite of sub-options under Section 3.2.2 Option 2 (Implement Additional Measures to Improve Sampling).** The AP notes that Amendment 14 contains most of these options but does not include an option to address communication on pair trawl vessels (sub-option 2E). Once again, consistency between amendments needs to be addressed.
  - **The AP stressed support for sub-option 2D to require that an observer be deployed on any vessel taking on fish (e.g., an observer on each vessel of a pair trawl operation.)** For limited access herring vessels in 2010, 54% (692,000 lbs) of catch classified as "fish unknown" in the observer database was attributed to fish being pumped to the pair trawl vessel not carrying the observer (Amendment 5 DEIS, p 397). Catch documented by observers as "fish unknown" or "herring unknown" hampers an accurate accounting of incidental catch.

- Measures to Address Net Slippage
  - **The AP supports Option 3 under Section 3.2.3 which would apply Closed Area I sampling provisions to all limited access herring vessels carrying an observer.** The Amendment 5 DEIS reports that these measures have been highly effective at preventing slippage in Groundfish Closed Area I with no slippage events reported for 99 hauls in 2010 (p.393).

River Herring Bycatch

- River Herring Monitoring/Avoidance
  - **The AP supports Option 2 and sub-options A and C under Section 3.3.2.2, which would apply Closed Area I sampling provisions and 100% observer coverage to**

Category A, B, and C vessels when they fish in the identified River Herring Monitoring/Avoidance Areas.
  - **The AP also supports evaluation and review of the SFC/SMAST/DMF Project as described under Option 4 (Section 3.3.2.2.4).** The AP believes a river herring catch cap in combination with avoidance strategies could be a very effective means of minimizing incidental catch. If not implemented sooner, a river herring catch cap should be considered as part of Phase II (Framework Adjustment) of this option.

- River Herring Protection
  - **The AP supports Option 1 under Section 3.3.3.2 (Closed Areas) as an interim measure until a more robust strategy is implemented (e.g., avoidance strategies with a bycatch cap as discussed above).** The AP believes that the closed areas will provide immediate relief to river herring populations but is concerned that the distribution of river herring is too variable for these small closed areas to be effective in the long-term. If adopted, the NEFMC should request the Mid-Atlantic Council to take reciprocal action through Amendment 14. All small-mesh gear types capable of significant river herring bycatch should be prohibited from fishing in the closed areas regardless of the target species.

- River Herring Bycatch Caps
  - **The AP agreed that incidental catch caps are an effective tool and that Section 3.3.5 (River Herring Catch Caps) should be adopted and incorporated into the Atlantic Herring FMP.** This measure would allow a river herring catch cap to be developed through a framework adjustment or Atlantic herring specifications package after the ASMFC completes its stock assessment.
  - The river herring stock assessment is undergoing peer review and is expected to be ready for Board review during the April 30th meeting week. Kate reported that a "depleted" status is likely. She also informed the AP that the catch of immature river herring in ocean fisheries is of concern.
  - There was some disagreement among AP members regarding the mechanism and urgency for a cap. Some felt that the cap should be biologically based, and the measure could wait until the science to construct such a cap is available. Others felt that the need for a cap was more urgent and that a cap could be constructed from catch data initially and replaced with a biologically-based number later.
  - Because of the overlap between Atlantic herring and Atlantic mackerel fisheries, the benefits of a cap would be greatly diminished if the New England and Mid-Atlantic Councils did not cooperate on development and implementation of the measure. The AP is unclear how a cap could be shared between the Councils. (Amendment 14 does contain alternatives to implement river herring and/or shad caps.)

Table 179 Overlap Between Amendment 14 to the Squid/Mackerel/Butterfish FMP (MAFMC) and Amendment 5 to the Herring FMP (NEFMC)

VESSEL REPORTING MEASURES

Measure	MSB Amendment 14	Herring Amendment 5 (*existing requirements in italics*)	Consistency Issues
Weekly VTR	• 1bMack: All mackerel permits • 1bLong: Longfin/butterfish moratorium permit • 1c: all MSB permits	• *Existing: Weekly VTR requirement for all herring permits recently implemented by NMFS (76 FR 54385; September 1, 2011)*	NONE
Pre-trip notification to observer program	• 1d48: 48 hr prior to trip for mackerel permits • 1d72: 72 hr prior to trip for mackerel permits	• *Existing: 72-hr requirement for Cat A/B permits on declared herring trip with midwater trawl /purse seine gear* • *Existing: 72-hr requirement for Cat C/D permits using midwater trawl gear in Areas 1A, 1B, or 3 (NE Multispecies FW 46)* • Section 3.1.4.2: 48-hr requirement for all limited access herring permits and herring carrier LOAs	• Need to ensure that third-party providers could handle a 48 hr notification (could just be one of requirements to apply • Should have the same pre-trip notification times within an FMP --For Herring, Am 5 – the option for a 48 hr requirement is different than that put in place in FW 46 --For MSB, there is a 72 hr notification for longfin already; may be good to be consistent • Vessels often target mackerel and herring on the same trip, best for industry and enforcement if requirements are the same
VMS requirement	• 1eMack: Limited access mackerel permits • 1eLong: Longfin/butterfish moratorium permits	• *Existing: VMS already required for limited access herring permits* • *Existing: VMS trip declaration required for limited access herring permits* • Section 3.1.4.2: Gear declaration for all limited access herring permits	
VMS catch reporting	• 1fMack: Daily for limited access mackerel vessels • 1fLong: Daily for Longfin/butterfish moratorium permits	• *Existing: Daily VMS requirement for all limited access herring permits recently implemented by NMFS (76 FR 54385; September 1, 2011)*	
Pre-landing notification	• 1gMack: 6-hr pre-land via VMS to land over 20,000 lb mackerel • 1gLong: 6-hr pre-land via VMS to land over 2,500 lb longfin	• *Existing: 6-hr pre-landing requirement for Cat A/B permits on declared herring trip with midwater trawl /purse seine gear* • *Existing: 6-hr requirement for Cat C permits using midwater trawl gear in Areas 1A, 1B, or 3 (NE Multispecies FW 46)* • Section 3.1.4.3: 6-hr requirement for all limited access herring permits and herring carrier LOAs	

Table 179 continued. Overlap Between Amendment 14 to the Squid/Mackerel/Butterfish FMP (MAFMC) and Amendment 5 to the Herring FMP (NEFMC)

DEALER REPORTING MEASURES

Measure	MSB Amendment 14 (alternative number and description)	Herring Amendment 5 (alternative number and description)	Consistency Issues
SAFIS dealer and vessel counter- signature	• 2b: Landings over 20,000 lb mackerel; 2,500 lb longfin; or 10,000 lb *Illex*	• Section 3.1.5.2, Sub-Option 2C: All herring landings	If action alternatives are selected, it is probably most convenient for mackerel/herring vessels and dealers if the requirements are the same for all 3 species.
Dealers must weigh all fish, and document estimation of relative composition <u>annually on dealer application</u> if not sorted	• 2c: over 20,000 lb mackerel • 2e: over 2,500 lb longfin	• Section 3.1.5.2, Sub-Option 2A: All herring landings	
Dealers must weigh all fish, and document estimation of relative composition <u>at each transaction</u> if not sorted	• 2d: over 20,000 lb mackerel • 2f: over 2,500 lb longfin	• Section 3.1.5.2, Sub-Option 2B: All herring landings	
Allow volume to weight conversions	• 2g: allow volume to weight conversions if dealers cannot weigh catch	• Section 3.1.5.2, Sub-Options 2A and 2B: Neither of these alternatives exclude the use of volume to weight conversions	

AT-SEA OBSERVER OPTIMIZATION MEASURES

Measure	MSB Amendment 14 (alternative number and description)	Herring Amendment 5 (alternative number and description)	Consistency Issues
Safe Sampling Station	• 3b	• Section 3.2.2.2, Sub-Option 2A	Most convenient for observers in high volume fisheries if the same action items are selected in both plans
Reasonable Assistance	• 3b	• Section 3.2.2.2, Sub-Option 2B	
Haul back notice to observers	• 3c	• Section 3.2.2.2, Sub-Option 2C	
Observers on any vessel taking on fish whenever and wherever possible	• 3d	• Section 3.2.2.2, Sub-Option 2D	
Pair Trawl Communication	NONE	• Section 3.2.2.2, Sub-Option 2E	
Visual Access to Codend	• Included in 3f and 3g	• Section 3.2.2.2, Sub-Option 2F	

Table 179 continued. Overlap Between Amendment 14 to the Squid/Mackerel/Butterfish FMP (MAFMC) and Amendment 5 to the Herring FMP (NEFMC)

AT-SEA OBSERVER OPTIMIZATION MEASURES

Measure	MSB Amendment 14 (alternative number and description)	Herring Amendment 5 (alternative number and description)	Consistency Issues
Slippage reports/affidavit from vessel operator	• 3e	• Section 3.2.3.2	If plans select incompatible measures from this range, vessels targeting both mackerel and herring could end up with a complicated layering of rules that could apply on the same trip.
Vessels with observers prohibited from releasing discards before they a brought aboard for sampling	• 3f: mackerel vessels • 3g: longfin vessels	NONE	
Trip termination following slippage on observed trip	• 3h: after 1 slipped haul • 3i: after 2 slipped hauls	• Section 3.2.3.4, Option4A	
Closed Area I Provisions	• 3j: No trip termination	• Section 3.2.3.3	
Closed Area I Provisions with Trip Termination	• 3k: mackerel vessels, may be selected with 3j; trip termination for every observed slippage event after 5 events • 3l: mackerel vessels, same as 3k but after 10 events • 3m: Same as 3k but for longfin vessels • 3n: Same as 3l but for longfin vessels	• Section 3.2.3.4, Option 4C; after 10 events • Section 3.2.3.4, Option 4D; after 5 events	
Closed Area I Provisions with Trip Termination and Catch Deduction	NONE	• Section 3.2.3.4, Option 4B; assumed that 100,000 lb herring caught in each slipped haul, catch deducted from area sub-ACL	
Annual slippage quota for individual vessels	• 3p: mackerel/longfin vessels assigned annual slippage quota; trip termination on every slippage event after quota attained.	NONE	

Table 179 continued. Overlap Between Amendment 14 to the Squid/Mackerel/Butterfish FMP (MAFMC) and Amendment 5 to the Herring FMP (NEFMC)

AT-SEA OBSERVER COVERAGE REQUIREMENTS

Measure	MSB Amendment 14 (alternative number and description)	Herring Amendment 5	Consistency Issues
Percentage based	• 5b: Mackerel MWT; 25%, 50%, 75%, and 100% options • 5c: Mackerel SMBT; 25%, 50%, 75%, and 100% options • 5d: Longfin SMBT; 25%, 50%, 75%, and 100% options	• Section 3.2.1.2, only 100%	• If the preferred coverage rates are different for mackerel and herring, there may be difficulties for the observer program • Administration for industry funding for mixed mackerel/herring trips will need to be developed
Coverage levels to achieve target CVs	• 5e1: CV below 0.3 for RH species for MWT • 5e2: CV below 0.2 for RH species for MWT • 5e3: CV below 0.3 for RH species for SMBT • 5e4: CV below 0.2 for RH species for SMBT	• Section 3.2.1.4: CV below 0.2 for river herring, and below 0.3 for Atlantic herring and haddock	
Modified SBRM	NONE	• Section 3.2.1.3	
Funding alternatives	• 5f: Vessels pay for observers greater than existing sea day allocation • 5g: Phase-in industry funding over 4 yrs., NMFS would pay for 100%, then 75%, 50%, 25%	• Funding options (Federal or Federal and Industry) are specified within above alternatives	

Table 179 continued. Overlap Between Amendment 14 to the Squid/Mackerel/Butterfish FMP (MAFMC) and Amendment 5 to the Herring FMP (NEFMC)

MEASURES TO ADDRESS PORTSIDE SAMPLING

Measure	MSB Amendment 14 (alternative number and description)	Herring Amendment 5 (alternative number and description)	Consistency Issues
Industry-funded 3rd party port-side sampling program	• 4b: landings over 20,000 lb mackerel • 4c: Landings over 2,500 lb longfin	NONE	NONE
Vessel hold volume certification	• 4d: Tier 3 mackerel • 4e: Longfin/Butterfish moratorium	NONE	NONE

RIVER HERRING CATCH CAPS

Measure	MSB Amendment 14 (alternative number and description)	Herring Amendment 5 (alternative number and description)	Consistency Issues
Mortality Caps	• 6b: River herring for the mackerel fishery • 6c: Shads for the mackerel fishery • 6d: River herring for the longfin fishery • 6e: Shads for the longfin fishery	• Section 3.3.5: Mechanism to establish River herring catch caps through Framework adjustment or specifications package in the future after a RH stock assessment is completed	If Atlantic herring fishing continues during a mackerel closure, the fleet could continue to catch river herring in the same location while discarding mackerel. Benefits to river herring may be diminished.
Caps added through a future framework	• 6f	• Section 3.3.5: River herring (same as above)	None

ADD RH/S AS STOCKS IN THE FISHERY

Measure	MSB Amendment 14 (alternative number and description)	Herring Amendment 5 (alternative and description)	Consistency Issues
Add as stock in MSB fishery, would confer full Magnuson-Stevens benefits, i.e. ACLs/AMs and EFH	• 9a: blueback • 9b: alewife • 9c: American shad • 9d: hickory shad	NONE	NONE

Table 179 continued. Overlap Between Amendment 14 to the Squid/Mackerel/Butterfish FMP (MAFMC) and Amendment 5 to the Herring FMP (NEFMC)

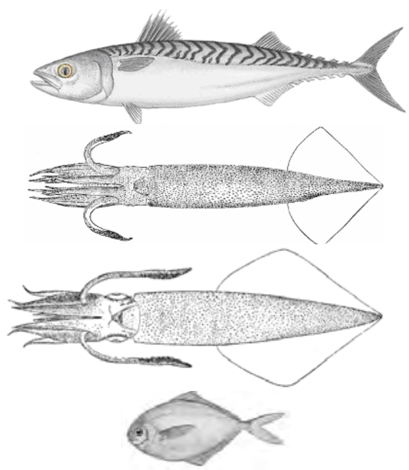
RESTRICTIONS IN AREAS OF HIGH RH/S CATCH

Measure	MSB Amendment 14 (alternative number and description)	Herring Amendment 5 (alternative and description)	Consistency Issues
Closed area alternatives	• 7bMack: Q1 prohibition on retention of more than 20,000 lb mackerel in management area • 7bLong: Full year prohibition on retention of more than 2,500 lb longfin in management area • 8eMack: Possession over 20,000 lb mackerel prohibited in Am5 Protection Areas (bimonthly closures) • 8eLong: Possession over 2,500 lb longfin prohibited in Am5 Protection Areas (bimonthly closures)	• Section 3.3.3.2.1, bimonthly closure areas	• Confusing for industry if different action alternatives are selected in each plan • If different approaches are selected, benefits to river herring may be diminished
Observers required in management areas	• 7cMack: required to possesses over 20,000 lb mackerel; industry funded • 7cLong: required to possess over 2,500 lb longfin; industry funded • 8cMack: Same monitoring/avoidance areas as Am 5; required to possess over 20,000 lb mackerel • 8cLong: Same monitoring/avoidance areas as Am 5; required to possess over 2,400 lb longfin	• Section 3.3.2.2.1, with sub-options to apply this provision either to just limited access permits (A) or all permits (B)	
Closed Area I Provisions	• 8dMack: in Am 5 monitoring/avoidance areas • 8dLong: in Am 5 monitoring/avoidance areas	• Section 3.3.2.2.2, with sub-options to apply this provision either to just limited access permits (A) or all permits (B)	
Above requirements with mortality trigger	• 7d for Alt Set 7 • 8f for Alt Set 8	• Section 3.3.2.2.3 for observer coverage or Closed Area I provisions • Section 3.3.3.2.2 for closed areas	
Formally review results of SFC bycatch avoidance program, and possibly incorporate by framework	• 4f	• Section 3.3.2.2.4	
Mechanism to adjust areas (specifications)	• 7e: bi-annually	• Section 3.3.4: every 3 years or during interim years through a revised specs package	

THIS IS THE PUBLIC HEARING DOCUMENT FOR DRAFT AMENDMENT 14 TO THE ATLANTIC MACKEREL, SQUID, AND BUTTERFISH FMP. THE FULL DOCUMENT IS AVAILABLE ON THE MID-ATLANTIC COUNCIL WEBSITE AT: www.mafmc.org/fmp/msb_files/msbAm14current.htm.

AMENDMENT 14 TO THE
ATLANTIC MACKEREL, SQUID, AND BUTTERFISH (MSB)
FISHERY MANAGEMENT PLAN (FMP)

Draft Environmental Impact Statement
The Executive Summary will serve as the Public Hearing Document



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Mid Atlantic Fishery Management Council
in cooperation with
the National Marine Fisheries Service (NOAA Fisheries)

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MID-ATLANTIC FISHERY MANAGEMENT COUNCIL

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

Note: Only the sections through Section 3 are included in this public hearing document but the full table of contents for the full draft environmental impact statement is included in case the public is interested in additional information.

1.0 TABLE OF CONTENTS

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2.0 EXECUTIVE SUMMARY

This Amendment deals with incidental catch and general management of blueback herring, alewife, American shad, and hickory shad. In this document, "river herrings" include blueback herring and alewife. "Shads" include American shad and hickory shad. These four species are described together as **"RH/S"** and the Amendment addresses three potential RH/S management problems, described below (A,B, and C). Considering, and if appropriate, implementing solutions to these potential problems are the purposes of this Amendment. The analytical goals described below summarize the analyses conducted to support decisions for this Amendment.

Problem A: Relatively low levels of catch monitoring have resulted in relatively high uncertainty about the incidental catch of river herrings and shads in ocean intercept fisheries.

> **Purpose A**: "**Implement Effective RH/S Catch Monitoring**" **–** Purpose A is to consider alternatives that would implement monitoring programs for the Mackerel, Squid, and Butterfish (MSB) fisheries that are sensitive enough and robust enough to the spatial and temporal variability of RH/S distributions so that good RH/S catch estimates can be generated. The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires Councils "to specify the pertinent data which shall be submitted to the Secretary with respect to…fishing…in the fishery" (Section 303(a)(5)) and Section 8 under discretionary fishery management plan provisions allows implementation of observer requirements.

Analytical Goals:

A1. "**RH/S Catch**" - Establish the best available information on the catch of RH/S in the MSB and/or other fisheries.

A2. **"Effectiveness"** - Evaluate how effective various alternatives would be in terms of improving the precision of RH/S catch estimates.

A3. **"Practicability"** - Evaluate the socioeconomic impacts from the alternatives and the ability of management to implement them.

Problem B: Catch of RH/S in the MSB fisheries may be negatively impacting RH/S populations.

> **Purpose B**: "**Reduce RH/S Bycatch and/or Catch**" **–** Purpose B is to consider alternatives to reduce bycatch (discards) and/or total catch of RH/S in the MSB fisheries. The MSA requires Councils to minimize bycatch (discards) to the extent practicable (Section 301 – National Standard 9) and provides discretionary authority to "include management measures in the plan to conserve…non-target species…considering the variety of ecological factors affecting fishery populations" (Section 303(b)(12)). Because information on how much RH/S catch might be sustainable is lacking, it is not currently possible to quantify the impact on RH/S stocks of any catch reductions that may occur but such catch reductions would be likely to have a positive impact to some degree.

Analytical Goals:

B1. "**RH/S Bycatch**" - Evaluate if bycatch (discards) of river herrings and shads in the MSB fisheries has been minimized to the extent practicable (National Standard 9).

Analytical Goals: (continued)

B2. **"Effectiveness"** - Evaluate how effective various alternatives would be in reducing the bycatch and/or or catch of RH/S.

B3. **"Practicability"** - Evaluate the socioeconomic impacts from the alternatives and the ability of management to implement them.

Problem C: The overall existing federal/state/regional management framework may be insufficient to adequately conserve RH/S stocks.

Purpose C: "**Consider RH/S NS1 Stock Issues**" **–** Purpose C is to consider alternatives that would bring RH/S into the MSB plan as a managed stock in terms of Council management responsibilities, including annual catch limits and accountability measures, in order to improve overall RH/S management and conservation. The Magnuson-Stevens Fishery Conservation and Management Act's National Standard One (NS1) states "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery…" NMFS guidance on NS1 suggests that Councils have the discretion to add additional non-target species as stocks in the fishery to existing FMPs.

Analytical Goals:

C1. **"Effectiveness"** - Evaluate how effective various alternatives would be in terms of improving RH/S management.

C2. **"Practicability"** - Evaluate the socioeconomic impact on the fisheries of various alternatives and the ability of management to implement them.

Alternatives

In this document, each purpose will be referenced by the bolded phrases in quotes above. Each purpose is addressed by one or more related set of alternatives, organized below by each purpose, summarized later in this executive summary, and fully described and analyzed in this document. Throughout this document the reader will note that the focus of the alternatives is on the Atlantic mackerel and longfin squid fisheries. This is intentional because those are the MSB fisheries that appear to have substantial RH/S interactions. Butterfish is primarily a incidental catch fishery and the *Illex* fishery appears to rarely interact with RH/S (see table 21).

Alternatives Related to Purpose A: Implement Effective RH/S Catch Monitoring

Alternative Set 1: Additional Vessel Reporting Measures

Alternative Set 2: Additional Dealer Reporting Measures

Alternative Set 3: Additional At-Sea Observation Optimization Measures

Alternative Set 4: Port-side and Other Sampling/Monitoring Measures

Alternative Set 5: At-Sea Observer Coverage Requirements

Alternatives Related to Purpose B: <u>Reduce RH/S Bycatch and/or Catch</u>

<u>Alternative Set 6</u> : Mortality Caps

<u>Alternative Set 7</u> : Restrictions in areas of high RH/S catch

<u>Alternative Set 8</u> : Hotspot Restrictions

Alternatives Related to Purpose C: <u>Considering RH/S NS1 Stock Issues</u>

<u>Alternative Set 9</u>: Addition of RH/S as "Stocks in the Fishery" in the MSB FMP.

<u>Approximate Timeline</u>

April/May 2012– Public hearings for Am 14 with DEIS
June 2012 – Council receives comments on the Draft Environmental Impact Statement, (DEIS) , Council makes edits to the DEIS as appropriate, Council chooses alternatives to recommend to NMFS, and Council approves submitting FEIS to NMFS
July 2012 – FEIS Document Perfection w/ NMFS
Sept 2012 – Proposed Rule and FEIS made available for public comment
Nov 2012 – Comment Period Closes
Feb 1, 2013 – Final Rule Publishes
Mar 1, 2013 – Rule Effective

<u>Wording Conventions</u>

All acronyms and abbreviations used in this document should be listed in **Section 3.0, List of Acronyms and abbreviations**. Several critical wording conventions are noted below.

The Magnuson-Stevens Fishery Conservation and Management Act is the primary law governing marine fisheries management in United States federal waters. The Act was first enacted in 1976 and amended in 1996 and in 2007. In this document, the abbreviation "MSA" refers to the Magnuson-Stevens Fishery Conservation and Management Act as currently amended.

RH/S refers to blueback herring, alewife, American shad, and hickory shad collectively. "Mackerel" refers to "Atlantic mackerel." "Am14" refers to "Amendment 14 to the Atlantic Mackerel, Squid, and Butterfish (MSB) Fishery Management Plan (FMP)." "The Council" refers to "the Mid-Atlantic Fishery Management Council." "Bycatch" refers to discards while "Incidental catch" is the catch of one species while directing upon another species (incidental catch may be retained or discarded).

Longfin squid have previously been referenced as *Loligo pealeii* or just *Loligo*. There has been a scientific name change for this species from *Loligo pealeii* to *Doryteuthis (Amerigo) pealeii*. To avoid confusion, this document will utilize the common name “longfin squid” wherever possible. Some historical documents will still refer to these squid as “*Loligo*.”

2.1 SUMMARY OF THE ALTERNATIVES AND THEIR IMPACTS

The alternatives are primarily designed to 1) improve monitoring and observing of incidental RH/S catch; 2) consider ways to reduce RH/S catch; and 3) consider adding RH/S as managed stocks in the MSB FMP (i.e. as stocks in the fishery) so as to improve overall RH/S conservation. While there are some potential impacts related to the managed species, habitat, and protected resources, those effects are secondary to the primary goals of Amendment 14. Given the impacts to the managed species, habitat, and protected resources are generally low, indirect, and positive, the textual summary in this Executive Summary focuses on impacts related to non-target species, especially river herrings and shads, and the related fishery business and human community impacts (Socio-Economic impacts). Managed species, habitat, and protected resource impacts are described in Section 7 and summarized in Table 8 later in this Executive Summary. Some alternatives with very similar impacts are grouped together.

Note: There are over 80 alternatives in this document. This means that there are millions of different possible combinations. At the beginning of each Alternative Set, it is noted which alternatives may, and which alternatives may not be, grouped together within the Alternative Set. Between Alternative Sets, alternatives generally may be combined without problem. The only broad exception to this rule is that it would appear unlikely that alternatives from both of the area-based alternatives (Sets 7 and 8) would be chosen together.

Note: To the extent that alternatives lead to better management (i.e. sustainable fisheries producing optimal yields) of RH/S or other species, then choosing such alternatives might result in long term additional benefits related to future commercial revenues, recreational opportunities, ecosystem services, cultural values for RH/S, and/or other non-market existence values (i.e. value gained by the public related to the knowledge that these species are being conserved successfully). However, due to the uncertainty about how the productivity of RH/S is impacted by current incidental catch levels, it is difficult to quantity such benefits. One would expect that higher related benefits would result from actions that were more likely to restore RH/S populations. This theme is repeated as appropriate in the Impacts Section (Section 7) and in the rest of this Executive Summary the following sentence is used to reiterate the ideas described in this paragraph rather than repeating the paragraph many times: "While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1."

2.1.1 Alternative Set 1: Additional Vessel Reporting Measures

Background/Statement of Problem/Need for Action:

The current suite of reporting and monitoring requirements may be insufficient to precisely enough estimate RH/S incidental catch in the mackerel and longfin squid fisheries based on the Council's management goals.

The measures in this Alternative Set would (alone and/or in combination with other alternatives) increase vessel reporting and/or monitoring with the overall goal of improving the precision of RH/S incidental catch estimates. While some of the focus may appear to be on mackerel and/or longfin squid general reporting compared to just RH/S in those fisheries, because extrapolations of non-target species are often made based on total landings (including the target species), accurate monitoring of the target species can be as important as determining the encounter rates of RH/S. A summary of the key biological and human community impacts (detailed in section 7) follows for each alternative.

NOTE ON COMBINATIONS: Most of the Alternative Set 1 action alternatives could be implemented individually or collectively. However, 1c (weekly VTRs for all MSB permits) would encompass 1bMack and 1bLong so these would not be selected together. The 48-hr mackerel pre-trip notification (1d48) and 72-hr mackerel pre-trip notification (1d72) would also be mutually exclusive – only one would be chosen if either. The VMS reporting alternatives (1f's and 1g's) would need the respective 1e's (that require VMS) for each fishery as a prerequisite before requiring VMS reporting.

1a. No-action

If this alternative is selected, then no measures from Alternative Set 1 would be implemented and the existing reporting measures (as described in section 5.1) would remain in place. Thus there would be no incremental impacts compared to the status quo, but there are relative impacts compared to the action alternatives, as described below.

1bMack. Institute weekly vessel trip reporting (VTR) for mackerel permits.

Summary of Biological Impact Analysis

To the degree that more rapid VTR reporting could be used to cross check dealer data to ensure that fishery closures occur appropriately, there could be potentially low positive impacts. Such closures could be related to directed fishery closures or mortality cap closures for non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

The number of total mackerel permits can vary from month to month. Of the 1,974 vessels that had mackerel permits in November 2011, 67 did not also have a weekly VTR reporting requirement from another permit (herring or NE multispecies). Thus, about 67 vessels would ultimately be subject to additional reporting requirements because of this measure. Those 67 vessels must currently submit VTR reports monthly. This alternative would result in 40 (52 (weeks) -12 (months) = 40) additional VTR submissions per year for permit holders that don't currently submit weekly VTRs. This would result in additional mailing costs of $19.36 per year (40 x $ 0.44 postage) per permitted vessel.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

1bLong. Institute weekly vessel trip reporting (VTR) for longfin squid/Butterfish permits.

Summary of Biological Impact Analysis

To the degree that more rapid VTR reporting could be used to cross check dealer data to ensure that fishery closures occur appropriately, there could be potentially low positive impacts. Such closures could be related to directed fishery closures or mortality cap closures for non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

The number of incidental squid/butterfish permits can vary from month to month. Of the 1,891 vessels that had longfin squid//Butterfish Moratorium permits or squid/butterfish incidental permits in November 2011, 74 did not also have a weekly VTR reporting requirement from another permit (herring or NE multispecies). Thus, about 74 vessels would ultimately be subject to additional reporting requirements because of this measure. Those 74 vessels must currently submit VTR reports monthly. This alternative would result in 40 (52 (weeks) -12 (months) = 40) additional VTR submissions per year for permit holders that don't currently submit weekly VTRs, resulting in additional mailing costs of $19.36 per year (40 x $ 0.44 postage) per permitted vessel. For informational purposes, about 9 of the 351 longfin squid//Butterfish moratorium permits do not currently have a weekly VTR reporting requirement from another permit (herring or NE multispecies).

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

1c. Institute weekly vessel trip reporting (VTR) for all MSB permits (Mackerel, longfin squid//Butterfish, *Illex*) so as to facilitate quota monitoring (directed landings and/or incidental mortality cap if applicable) and cross checking with other data sources.

Summary of Biological Impact Analysis

To the degree that more rapid VTR reporting could be used to cross check dealer data to ensure that fishery closures occur appropriately, there could be potentially low positive impacts. Such closures could be related to directed fishery closures or mortality cap closures for non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

The number of total mackerel permits and the number of squid/butterfish incidental permits can vary from month to month. Of the 2,622 vessels that have MSB permits in November 2011, 121 did not also have a weekly VTR reporting requirement from another permit (herring or NE multispecies). Thus about 121 vessels would ultimately be subject to additional reporting requirements because of this measure. This alternative would result in 40 (52 (weeks) -12 (months) = 40) additional VTR submissions per year for permit holders that don't currently submit weekly VTRs, resulting in additional mailing costs of $19.36 per year (40 x $ 0.44 postage) per permit holder. The 121 vessels encompass the same affected vessels from 1bMack and 1bLong above (there is also some overlap between 1bMack and 1bLong).

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1. One specific advantage of this alternative compared to 1b and 1c is that there would be uniformity of reporting in the MSB FMP and with other Northeast Region fisheries.

1d48. Require 48 hour pre-trip notification to NMFS to retain/possess/transfer more than 20,000 pounds of mackerel so as to facilitate observer placement.

This would be used to facilitate observer placement. If vessels did not notify they would not be able to land more than an incidental catch (20,000 pounds).

Summary of Biological Impact Analysis

To the degree that better observer data leads to more effective reduction of incidentally-caught species, and to the degree that this alternative leads to better observer data collection, this alternative could lead to positive impacts for non-target species. If a mortality cap on RH/S is implemented, obtaining a complete list of trips to sample becomes very important to ensure that unbiased estimates can be estimated.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

This is similar to a 72-hour trip notification requirement in the longfin squid fishery that became effective in 2011. Fishermen have reported that the 72-hour notification sometimes means they are unable to target fleeting aggregations of longfin squid because they are not able to put to sea on short notice, especially if they are selected to take an observer (if they are not selected then they often obtain a waiver sooner than 72 hours).

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

1d72. Require 72 hour pre-trip notification to NMFS to retain/possess/transfer more than 20,000 pounds of mackerel so as to facilitate observer placement.

This would be used to facilitate observer placement. If vessels did not notify they would not be able to land more than incidental catch (20,000 pounds).

Summary of Biological Impact Analysis

To the degree that better observer data leads to more effective reduction of incidentally-caught species, and to the degree that this alternative leads to better observer data collection, this alternative could lead to positive impacts for non-target species. If a mortality cap on RH/S is implemented, obtaining a complete list of trips to sample becomes very important to ensure that unbiased estimates can be estimated.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

This is similar to a 72-hour trip notification requirement in the longfin squid fishery that became effective in 2011. Fishermen have reported that the 72-hour notification sometimes means they are unable to target fleeting aggregations of longfin squid because they are not able to put to sea on short notice, especially if they are selected to take an observer (if they are not selected then they often obtain a waiver sooner than 72 hours).

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>1eMack</u>. Require VMS for limited access mackerel vessels.

Vessel Monitoring Systems are currently utilized in many New England fisheries. They are generally used to facilitate compliance and enforcement of area-based management measures as well as catch monitoring by means of a satellite connection between shore and a fixed electronic unit installed on vessels.

<u>Summary of Biological Impact Analysis</u>

If area-based management alternatives are eventually selected for purposes of reducing catch of RH/S, VMS can be a useful tool for compliance/enforcement of area-based management. If port-side sampling requirements are eventually selected for purposes of monitoring landings of RH/S, VMS could also be used for compliance/enforcement if catch reporting via VMS is also required (see 1fMack and 1gMack below).

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

Of the approximately 2,200 vessels that had open access mackerel permits at some point in 2011, 684 were not also required to have VMS. While not all of these vessels will qualify for mackerel limited access (being implemented currently), 684 would be an upper bound on how many vessels could have to buy new VMS units. Amendment 11 estimated that around 400 vessels might qualify for limited access. If one maintains the ratio of open access boats (684/2,200 = 31%) that would need VMS for the 400 likely qualifiers for mackerel limited access, 31% of 400 equals 124 vessels that would actually need new VMS units. Since limited access qualifiers, being more active participants, may be more likely to have other permits that require VMS, the likely range is from somewhat lower than 124 up to 684. Until the final number of qualifiers is determined it is not possible to further quantify the number of vessels that may require VMS units under this provision. The costs to equip a vessel with a VMS are approximately $1,700-$3,300, with operating costs for the unit of approximately $40-$100 per month. In addition, the vessel would need a constant power source such as a generator, or access to dockside energy, which would add to the costs.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>1eLong</u>. Require VMS for longfin squid/butterfish moratorium vessels (see 1f and 1g below).

Vessel Monitoring Systems are currently utilized in many New England fisheries. They are generally used to facilitate compliance and enforcement of area-based management measures as well as catch monitoring by means of a satellite connection between shore and a fixed electronic unit installed on vessels.

Summary of Biological Impact Analysis

If area-based management alternatives are eventually selected for purposes of reducing catch of RH/S, VMS can be a useful tool for compliance/enforcement of area-based management. If port-side sampling requirements are eventually selected for purposes of monitoring landings of RH/S, VMS could also be used for compliance/enforcement if catch reporting via VMS is also required (see 1fLong and 1gLong below).

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

Of the 351 vessels that had longfin squid//butterfish moratorium permits in 2011, 7 were not also required to have VMS because of other permits and would have to equip their vessel with VMS under this provision. The costs to equip a vessel with a VMS are approximately $1,700-$3,300, with operating costs for the unit of approximately $40-$100 per month. In addition, the vessel would need a constant power source such as a generator, or access to dockside energy, which would add to the costs.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

1fMack. Require daily VMS reporting of catch by limited access mackerel vessels so as to facilitate monitoring (directed and/or incidental catch) and cross checking with other data sources. Requiring VMS (see 1eMack above) and requiring trip declarations (would be a prerequisite for this alternative.

Summary of Biological Impact Analysis

If area-based management alternatives are eventually selected for purposes of reducing catch of RH/S, VMS catch reporting can be a useful tool for compliance/enforcement of area-based management.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

This alternative could only be selected if 1eMack was also selected. VMS costs are discussed under the 1eMack alternative. The cost of transmitting a catch report via VMS is $0.60 per transmission.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>1fLong</u>. Require daily VMS reporting of catch by longfin squid moratorium permits so as to facilitate monitoring (directed and/or incidental catch) and cross checking with other data sources. Requiring VMS (see 1eLong above) and requiring trip declarations would be a prerequisite for this alternative.

<u>Summary of Biological Impact Analysis</u>

If area-based management alternatives are eventually selected for purposes of reducing catch of RH/S, VMS catch reporting can be a useful tool for compliance/enforcement of area-based management.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

This alternative could only be selected if 1eLong was also selected. VMS costs are discussed under the 1eLong alternative. The cost of transmitting a catch report via VMS is $0.60 per transmission.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>1gMack</u>. Require 6 hour pre-landing notification via VMS to land more than 20,000 pounds of mackerel, which could facilitate quota monitoring, enforcement, and/or portside monitoring.

This would be used to facilitate catch monitoring (directed or incidental catch), cross checking with other data sources, and portside monitoring (if applicable).

<u>Summary of Biological Impact Analysis</u>

Pre-landing notifications could facilitate enforcement of landings limits, proper landings reporting, and port-side monitoring.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

This alternative could only be selected if 1eMack was also selected. VMS costs are discussed under the 1eMack alternative. The cost of transmitting a catch report via VMS is $0.60 per transmission.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>1gLong</u>. Require 6 hour pre-landing notification via VMS to land more than 2,500 pounds of longfin squid, which could facilitate quota monitoring, enforcement, and/or portside monitoring.

This would be used to facilitate catch monitoring (directed or incidental catch), cross checking with other data sources, and portside monitoring (if applicable).

<u>Summary of Biological Impact Analysis</u>

Pre-landing notifications could facilitate enforcement of landings limits, proper landings reporting, and port-side monitoring.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

This alternative could only be selected if 1eLong was also selected. VMS costs are discussed under the 1eLong alternative. The cost of transmitting a catch report via VMS is $0.60 per transmission.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

2.1.2 Alternative Set 2 – Additional Dealer Reporting Measures

Background/Statement of Problem/Need for Action:

The current suite of reporting and monitoring requirements may be insufficient to precisely estimate RH/S incidental catch. Also, practices on how landing weights are determined are not standardized.

The measures in this Alternative Set would (alone and/or in combination with other alternatives) increase reporting and/or monitoring with the overall goal of improving the precision of RH/S incidental catch estimates. While some of the focus may appear to be on mackerel and/or longfin squid general reporting compared to just RH/S in those fisheries, because extrapolations are often made based on total landings, accurate monitoring of the target species can be as important as determining the encounter rates of RH/S. A summary of the key biological and human community impacts (detailed in section 7) follows for each alternative.

NOTE ON COMBINATIONS: Most of the Alternative Set 2 action alternatives could be implemented individually or collectively. However, 2c and 2d (weighing mackerel) would be mutually exclusive – only one would be chosen if either. Likewise, 2e and 2f (weighing longfin squid) would be mutually exclusive – only one would be chosen if either. 2g (dealers can use volume to weight conversions) would modify 2c, 2d, 2e, or 2f so 2g could only be chosen if at least one of those four alternatives was also chosen.

2a. No-action

If this alternative is selected, then no measures from Alternative Set 2 would be implemented and the existing reporting measures (as described in section 5.2) would remain in place. Thus there would be no incremental impacts compared to the status quo, but there are relative impacts compared to the action alternatives, as described below.

2b. Require federally permitted MSB dealers to obtain vessel representative confirmation of SAFIS transaction records for mackerel landings over 20,000 lb, *Illex* landings over 10,000 lb, and longfin squid landings over 2,500 lb.

This would be accomplished by vessels via Fish Online, an existing internet-based program that currently allows vessels to voluntarily check their landings records. Dealers would have to confirm with vessels that a vessel representative had checked Fish Online to confirm landings.

Summary of Biological Impact Analysis

Accurate landings data is important to ensure that quotas are not exceeded. To the extent that landings data informs incidental catch mortality caps, accurate landings data can also be important for managing catch of non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Since internet access is pervasive in the Mid-Atlantic and New England, either vessel owners or their representative should be able to make an internet-based confirmation of dealer transactions records without substantial cost. Improving records could benefit fishermen if additional qualifications are ever considered for holding MSB permits.

2c. Require that federally permitted SMB dealers weigh all landings related to mackerel transactions over 20,000 pounds. If dealers do not sort by species, they would need to document in dealer applications how they estimate relative compositions of a mixed catch.

Summary of Biological Impact Analysis

Accurate landings data is important to ensure that directed fishery quotas are not exceeded. To the extent that directed landings informs incidental catch mortality caps (often substantially), accurate directed landings data can be important for managing catch of non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

Economic impacts would likely be varied among dealers. Some dealers currently weigh all landings in some manner and impacts for them would be low. Other dealers use volume to weight conversions and could have to purchase scales. Purchasing a truck or hopper scale can range up to $100,000 per installation or $50,000 per installation respectively while smaller scales could be bought for several hundred dollars with a wide range in between. Smaller scales could slow down processing however.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

2d. Require that federally permitted SMB dealers weigh all landings related to mackerel transactions over 20,000 pounds. If dealers do not sort by species, they would need to document with each transaction how they estimated the relative composition of a mixed catch.

Summary of Biological Impact Analysis

Accurate landings data is important to ensure that directed fishery quotas are not exceeded. To the extent that directed landings informs incidental catch mortality caps (often substantially), accurate directed landings data can be important for managing catch of non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

Economic impacts would likely be varied among dealers. Some dealers currently weigh all landings in some manner and impacts for them would be low. Other dealers use volume to weight conversions and could have to purchase scales. Purchasing a truck or hopper scale can range up to $100,000 per installation or $50,000 per installation respectively while smaller scales could be bought for several hundred dollars with a wide range in between. Smaller scales could slow down processing however.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

2e. Require that federally permitted SMB dealers weigh all landings related to longfin squid transactions over 2,500 pounds. If dealers do not sort by species, they would need to document in dealer applications how they estimate relative compositions of a mixed catch.

Summary of Biological Impact Analysis

Accurate landings data is important to ensure that directed fishery quotas are not exceeded. To the extent that directed landings informs incidental catch mortality caps (often substantially), accurate directed landings data can be important for managing catch of non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

Economic impacts would likely be varied among dealers. Some dealers currently weigh all landings in some manner and impacts for them would be low. Other dealers use volume to weight conversions and could have to purchase scales. Purchasing a truck or hopper scale can range up to $100,000 per installation or $50,000 per installation respectively while smaller scales could be bought for several hundred dollars with a wide range in between. Smaller scales could slow down processing however.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

2f. Require that federally permitted SMB dealers weigh all landings related to longfin squid transactions over 2,500 pounds. If dealers do not sort by species, they would need to document with each transaction how they estimate relative compositions of a mixed catch.

Summary of Biological Impact Analysis

Accurate landings data is important to ensure that directed fishery quotas are not exceeded. To the extent that directed landings informs incidental catch mortality caps (often substantially), accurate directed landings data can be important for managing catch of non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

Economic impacts would likely be varied among dealers. Some dealers currently weigh all landings in some manner and impacts for them would be low. Other dealers use volume to weight conversions and could have to purchase scales. Purchasing a truck or hopper scale can range up to $100,000 per installation or $50,000 per installation respectively while smaller scales could be bought for several hundred dollars with a wide range in between. Smaller scales could slow down processing however.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

2g. If any options 2c-2f were chosen, allow dealers to use volume to weight conversions if they cannot weigh landings – they would need to identify their conversion methods in their dealer application and explain why they cannot weigh all landings.

Summary of Biological Impact Analysis

Accurate landings data is important to ensure that directed fishery quotas are not exceeded. To the extent that directed landings informs incidental catch mortality caps (often substantially), accurate directed landings data can be important for managing catch of non-target species including RH/S. Volume to weight conversions may not be as accurate as simple weighing and this option could essentially make 2c-2f equivalent to the status quo because dealers would no longer have a requirement to weigh all landings.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact. This alternative would only be selected if 2c-2f were chosen. Determining volume to weight ratios would be less expensive than purchasing scales for those dealers that would need to do this, so compared to if 2c-2f were chosen alone, impacts would be expected to be positive. However to the extent that not getting accurate measurements interfered with sustainable management, there could be long-term negative impacts.

2.1.3 Alternative Set 3: Additional At-Sea Observation Optimization Measures

Background/Statement of Problem/Need for Action:

The current suite of observer monitoring requirements may be insufficient to precisely estimate RH/S incidental catch.

The measures in this Alternative Set would (alone and/or in combination with other alternatives) facilitate more accurate monitoring by observers with the overall goal of improving the precision of RH/S incidental catch estimates. Each alternative addresses an aspect of observer coverage that potentially could be improved to ultimately lead to better RH/S estimates. A summary of the key biological and human community impacts (detailed in section 7) follows for each alternative.

NOTE ON COMBINATIONS: Many of the Alternative Set 3 action alternatives could be implemented individually or collectively. However, 3h (trip termination after 1 slipped haul) and 3i (trip termination after 2 slipped hauls) would be mutually exclusive – only one would be chosen if either. Likewise, 3k (fishery-wide slippage cap at 5 mackerel slippage events) and 3l (fishery-wide slippage cap at 10 mackerel slippage events) would be mutually exclusive – only one would be chosen if either. 3m (fishery-wide slippage cap at 5 longfin slippage events) and 3n (fishery-wide slippage cap at 10 longfin slippage events) are also mutually exclusive – only one would be chosen if either. 3p would replace fishery-wide slippage caps with vessel slippage caps and it would be expected that either 3p could be chosen or 3k-3n could be chosen (if any). Also, if 3j (slippage prohibition with exceptions) was chosen then 3f or 3g could not be selected (3f and 3g require all catch to be brought aboard but 3j provides some exceptions).

If alternatives 3f – 3p are selected for mackerel, they would also require the selection of Alternative 1d48 (48-hr pre-trip notification) or 1d72 (72-hr pre-trip notification). There is already a pre-trip notification requirement in effect for longfin squid moratorium permit holders.

3a. No-action

If this alternative is selected, then no measures from Alternative Set 3 would be implemented and the existing monitoring measures (as described in section 5.3) would remain in place. Thus there would be no incremental impacts compared to the status quo, but there are relative impacts compared to the action alternatives, as described below.

<u>3b</u>. Require the following reasonable assistance measures: provision of a safe sampling station; help with measuring decks, codends, and holding bins; help with bycatch collection; and help with basket sample collection by crew on vessels with mackerel limited access and/or longfin squid/Butterfish moratorium permits.

<u>Summary of Biological Impact Analysis</u>

Such assistance could help improve observer data by allowing the observer to focus on technical aspects of observing such as species identification, weighing, measuring, etc. To the degree that such data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. Most vessels do most of these things already so impacts would be low.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts should be minimal as most vessels provide such assistance voluntarily.

<u>3c</u>. Require vessel operators to provide observers notice when pumping/haul-back occurs on vessels with mackerel limited access and/or longfin squid moratorium permits.

<u>Summary of Biological Impact Analysis</u>

Such notification could help improve observer data by making sure the observer is aware of all sampling opportunities. To the degree that such data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. Most vessels do most of these things already so impacts would be low.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts should be minimal as most vessels provide such assistance voluntarily.

<u>3d</u>. When observers are deployed on trips involving more than one vessel, observers would be required on any vessel taking on fish wherever/whenever possible on vessels with mackerel limited access and/or longfin squid moratorium permits.

<u>Summary of Biological Impact Analysis</u>

If vessels are working in pairs conducting pair trawling and both vessels are receiving fish, having observers on both vessels ensures that all catch from the pair trawling trip is observed. To the degree that such data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. The observer program usually does this already so impacts would be low.

Summary of Socio-Economic Impact Analysis

This is generally occurring already (pers com Amy VanAtten). To the extent that it is not, NMFS would have to spend additional funds on observers, or if industry funding is approved in this amendment pair-trawl vessels would always have to arrange for two observers.

3e. On vessels with mackerel limited access and/or longfin squid moratorium permits, require slippage reports - "Released Catch Affidavits" from captains on observed trips if they slip a haul.

Slippage is an important concept in this amendment and is defined as:

Unobserved catch, i.e., catch that is discarded prior to being observed, sorted, sampled, and/or brought on board the fishing vessel. Slippage can include the release of fish from a codend or seine prior to completion of pumping or the release of an entire catch or bag while the catch is still in the water.

- Fish that cannot be pumped and that remain in the net at the end of pumping operations are considered to be operational discards and not slipped catch. Observer protocols include documenting fish that remain in the net in a discard log before they are released, and existing regulations require vessel operators to assist the observer in this process. Management measures are under consideration in this amendment to address this issue and improve the observers' ability to inspect nets after pumping to document operational discards.

- Discards that occur at-sea after catch brought on board and sorted are also not considered slipped catch.

Summary of Biological Impact Analysis

This alternative would be used to improve the quality of data collected by observers by developing a better understanding of slippage events. To the degree that such data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. Since there no direct incentive not to slip impacts should be low. If a "trip termination because of slippage" alternative was selected (see below), the slippage reports could also be used by enforcement to determine if vessels had terminated appropriately after reaching the trigger number of slippage events.

Summary of Socio-Economic Impact Analysis

Minimal impacts would be expected. Vessel captains would have to fill out a form explaining the reason for any slipped hauls.

<u>3f</u>. Prohibit vessels with Mackerel limited access permits that have notified for a mackerel trip and are carrying an observer from releasing any discards before they have been brought aboard for sampling by the observer.

<u>Summary of Biological Impact Analysis</u>

If vessels being observed can release incidental catch without it being recorded, observer data will be biased. Avoiding such events would improve the observer data and any analysis or management measures that depend on observer data, including reducing incidental catch of non-target species including RH/S.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

Some fishing time may be lost because nets have to be fully brought aboard after each haul. Also, this alternative could create safety problems if a vessel attempts to bring aboard a catch and/or net in dangerous conditions. The observer program reports that most vessels are already doing this a majority of the time on a voluntary basis (pers com Amy VanAtten).

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>3g</u>. Prohibit vessels with longfin squid moratorium permits that have notified for a longfin squid trip and are carrying an observer from releasing any discards before they have been brought aboard for sampling by the observer.

<u>Summary of Biological Impact Analysis</u>

If vessels being observed can release incidental catch without it being recorded, observer data will be biased. Avoiding such events would improve the observer data and any analysis or management measures that depend on observer data, including reducing incidental catch of non-target species including RH/S.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

Some fishing time may be lost because nets have to be fully brought aboard after each haul. Also, this alternative could create safety problems if a vessel attempts to bring aboard a catch and/or net in dangerous conditions. The observer program reports that most vessels are already doing this a majority of the time on a voluntary basis.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

3h. On vessels with mackerel limited access and/or longfin squid moratorium permits, require trip termination following 1 slipped haul on an observed trip so as to minimize slippage events.

This alternative would seek to discourage slippage events by requiring a vessel to terminate a trip if they slip any hauls on an observed trip so that data can be obtained on the composition of all catches. It would apply to vessels that had notified for a mackerel or longfin squid trip.

Summary of Biological Impact Analysis

If vessels being observed can release incidental catch without it being recorded, observer data will be biased. Avoiding such events would improve the observer data and any analysis or management measures that depend on observer data, including reducing incidental catch of non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

It is difficult to predict the socio-economic impacts because participants are likely to have a wide variety of responses. Some vessels may just not slip where they would have previously, and the only extra cost is sorting fish on deck. If slippage occurred previously because of safety issues and vessels now took higher risks to avoid trip termination then vessel/crew safety could be reduced. If vessels are forced to terminate then they would lose the value of catch they might have made on the rest of the trip. Because of the impossibility of predicting fishery participant responses, the diversity of trips types, and the impossibility of predicting when a slipped haul might occur, it is not possible to further quantify revenue impacts related to this alternative.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>3i</u>. On vessels with mackerel limited access and/or longfin squid moratorium permits, require trip termination following 2 slipped hauls on an observed trip so as to minimize slippage events.

This alternative would seek to discourage slippage events by requiring a vessel to terminate a trip if they slip 2 hauls on an observed trip so that data can be obtained on the composition of all catches. It would apply to vessels that had notified for a mackerel or longfin squid trip.

<u>Summary of Biological Impact Analysis</u>

If vessels being observed can release incidental catch without it being recorded, observer data will be biased. Avoiding such events would improve the observer data and any analysis or management measures that depend on observer data, including reducing incidental catch of non-target species including RH/S.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

It is difficult to predict the socio-economic impacts because participants are likely to have a wide variety of responses. Some vessels may just not slip where they would have previously, and the only extra cost is sorting fish on deck. If slippage occurred previously because of safety issues and vessels now took higher risks to avoid trip termination then vessel/crew safety could be reduced. If vessels are forced to terminate then they would lose the value of catch they might have made on the rest of the trip. Because of the impossibility of predicting fishery participant responses, the diversity of trips types, and the impossibility of predicting when a slipped haul might occur, it is not possible to further quantify revenue impacts related to this alternative. Negative socioeconomic impacts would presumably be less than with 3h where just a single slippage event causes a trip termination.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

3j. With the exceptions noted below, mackerel limited access and/or longfin squid moratorium permitted vessels that have notified the observer program of their intent to land 2,500 pounds of longfin squid or 20,000 pounds of mackerel and have been selected to carry an observer would be required to pump/haul aboard all fish from the net for inspection and sampling by the observer. Vessels that do not pump fish would be required to bring all fish aboard the vessel for inspection and sampling by the observer. Vessels would be prohibited from releasing fish from the net (slippage), transferring fish to another vessel (that is not carrying a NMFS-approved observer), or otherwise discarding fish at sea, unless the fish have first been brought aboard the vessel and made available for sampling and inspection by the observer.

Exceptions: 1) pumping the catch could compromise the safety of the vessel/crew
2) mechanical failure precludes bringing some or all of the catch aboard the vessel; or
3) spiny dogfish have clogged the pump and consequently prevent pumping of the rest of the catch.

If a net is released, including the exemptions above, the vessel operator would be required to complete and sign a Released Catch Affidavit providing information about where, when, and why the net was released, as well as a good-faith estimate of the total weight of fish caught on the tow and weight of fish released. Released Catch Affidavits must be submitted within 48 hours of completion of the trip.

Summary of Biological Impact Analysis

If vessels being observed can release incidental catch without it being recorded, observer data will be biased. Avoiding such events would improve the observer data and any analysis or management measures that depend on observer data, including reducing incidental catch of non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

Vessel captains would have to fill out a form explaining the reason for any slipped hauls. Since there are no termination provisions in this particular alternative, there should be minimal impacts.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

3k. Related to 3j, for mackerel limited access permitted vessels, NMFS would track the number of slippage events. Once a cap of 5 slippage events (adjustable via specifications) occur in any given year for notified and observed mackerel trips then subsequent slippage events on any notified and observed Mackerel trip would result in trip termination for the rest of that year. The goal is to minimize slippage events.

This alternative would seek to discourage slippage events by requiring a vessel to terminate a trip if they slip a haul once 5 slippage events have occurred overall in a year by vessels declaring mackerel trips. The goal is to minimize unnecessary slippage events.

Summary of Biological Impact Analysis

If vessels being observed can release incidental catch without it being recorded, observer data will be biased. Avoiding such events would improve the observer data and any analysis or management measures that depend on observer data, including reducing incidental catch of non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

It is difficult to predict the socio-economic impacts because participants are likely to have a wide variety of responses. If less than 5 slippage events occur the impacts may be minimal. Once terminations are triggered, some vessels may just not slip where they would have previously, and the only extra cost is sorting fish on deck. If slippage occurred previously because of safety issues and vessels now took higher risks to avoid trip termination then vessel/crew safety could be reduced. If vessels are forced to terminate then they would lose the value of catch they might have made on the rest of the trip. Because of the impossibility of predicting fishery participant responses, the variety of trip types, and the impossibility of predicting when a slipped haul might occur, it is not possible to further quantify socio-economic impacts related to this alternative.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

3l. Related to 3j, for mackerel limited access permitted vessels, NMFS would track the number of slippage events. Once a cap of 10 slippage events (adjustable via specifications) occur in any given year for notified and observed mackerel trips then subsequent slippage events on any notified and observed Mackerel trip would result in trip termination for the rest of that year. The goal is to minimize slippage events.

This alternative would seek to discourage slippage events by requiring a vessel to terminate a trip if they slip a haul once 10 slippage events have occurred overall in a year by vessels declaring mackerel trips. The goal is to minimize unnecessary slippage events.

Summary of Biological Impact Analysis

If vessels being observed can release incidental catch without it being recorded, observer data will be biased. Avoiding such events would improve the observer data and any analysis or management measures that depend on observer data, including reducing incidental catch of non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

It is difficult to predict the socio-economic impacts because participants are likely to have a wide variety of responses. If less than 10 slippage events occur the impacts may be minimal. Once terminations are triggered, some vessels may just not slip where they would have previously, and the only extra cost is sorting fish on deck. If slippage occurred previously because of safety issues and vessels now took higher risks to avoid trip termination then vessel/crew safety could be reduced. If vessels are forced to terminate then they would lose the value of catch they might have made on the rest of the trip. Because of the impossibility of predicting fishery participant responses, the variety of trip types, and the impossibility of predicting when a slipped haul might occur, it is not possible to further quantify socio-economic impacts related to this alternative. Negative socioeconomic impacts would presumably be less than with 3k where 5 slippage events triggers trip terminations upon additional slippages.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>3m</u>. Related to 3j, for longfin squid moratorium permitted vessels, NMFS would track the number of slippage events. Once a cap of <u>5 slippage events</u> (adjustable via specifications) occur in any given trimester for notified and observed longfin squid trips then subsequent slippage events on any notified and observed longfin squid trip would result in trip termination for the rest of that trimester. The goal is to minimize slippage events.

This alternative would seek to discourage slippage events by requiring a vessel to terminate a trip if they slip a haul once 5 slippage events have occurred overall in a trimester by vessels declaring longfin squid trips. The goal is to minimize unnecessary slippage events.

<u>Summary of Biological Impact Analysis</u>

If vessels being observed can release incidental catch without it being recorded, observer data will be biased. Avoiding such events would improve the observer data and any analysis or management measures that depend on observer data, including reducing incidental catch of non-target species including RH/S.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

It is difficult to predict the socio-economic impacts because participants are likely to have a wide variety of responses. If less than 5 slippage events occur per trimester the impacts may be minimal. Once terminations are triggered, some vessels may just not slip where they would have previously, and the only extra cost is sorting fish on deck. If slippage occurred previously because of safety issues and vessels now took higher risks to avoid trip termination then vessel/crew safety could be reduced. If vessels are forced to terminate then they would lose the value of catch they might have made on the rest of the trip. Because of the impossibility of predicting fishery participant responses, the variety of trip types, and the impossibility of predicting when a slipped haul might occur, it is not possible to further quantify socio-economic impacts related to this alternative.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>3n</u>. Related to 3j, for longfin squid moratorium permitted vessels, NMFS would track the number of slippage events. Once a cap of <u>10 slippage events</u> (adjustable via specifications) occur in any given trimester for notified and observed longfin squid trips then subsequent slippage events on any notified and observed longfin squid trip would result in trip termination for the rest of that trimester. The goal is to minimize slippage events.

This alternative would seek to discourage slippage events by requiring a vessel to terminate a trip if they slip a haul once 10 slippage events have occurred overall in a trimester by vessels declaring longfin squid trips. The goal is to minimize unnecessary slippage events.

<u>Summary of Biological Impact Analysis</u>

If vessels being observed can release incidental catch without it being recorded, observer data will be biased. Avoiding such events would improve the observer data and any analysis or management measures that depend on observer data, including reducing incidental catch of non-target species including RH/S.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

It is difficult to predict the socio-economic impacts because participants are likely to have a wide variety of responses. If less than 10 slippage events occur per trimester the impacts may be minimal. Once terminations are triggered, some vessels may just not slip where they would have previously, and the only extra cost is sorting fish on deck. If slippage occurred previously because of safety issues and vessels now took higher risks to avoid trip termination then vessel/crew safety could be reduced. If vessels are forced to terminate then they would lose the value of catch they might have made on the rest of the trip. Because of the impossibility of predicting fishery participant responses, the variety of trip types, and the impossibility of predicting when a slipped haul might occur, it is not possible to further quantify socio-economic impacts related to this alternative. Negative socioeconomic impacts would presumably be less than with 3m where 5 slippage events per trimester triggers trip terminations upon additional slippages.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

3o. For mackerel and/or longfin squid permitted vessels, if a trip is terminated within 24 hours because of any of the anti-slippage provisions (3g, 3h, 3k-3n), then the relevant vessel would have to take an observer on its next trip.

This would reduce a vessel's incentive to slip a haul early in a trip in order to cause a trip termination and thereby avoid having an observer on board for an extended trip.

Summary of Biological Impact Analysis

This alternative would seek to discourage observer avoidance strategies so that data can be obtained on the composition of typical trips. To the degree that such data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

Vessels may experience reduced revenue and/or higher costs due to waiting for another observer or due to paying for another observer if an industry-funded observer program is in place.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

3p. Allow mackerel and/or longfin squid permitted vessels to be assigned an annual quota (set during specifications) of slippage events related to 3j, specified annually. Once their slippage quota was reached, vessels would have to terminate an observed trip as well as upon any slippage event on subsequent observed trips for the remainder of the calendar year.

This alternative would seek to discourage slippage events by requiring a vessel to terminate a trip if they slip a haul once a certain number of slippage events have occurred annually by that same vessel. While this is more intensive to track (by vessel versus by fleet), the advantage is that one vessel is not penalized for another vessel's slippage event.

Summary of Biological Impact Analysis

If vessels being observed can release incidental catch without it being recorded, observer data will be biased. Avoiding such events would improve the observer data and any analysis or management measures that depend on observer data, including reducing incidental catch of non-target species including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

This alternative would allow the Council to consider implementing slippage triggers for trip termination upon additional slippage events at the individual vessel level. The advantage of having the slippage quota be vessel based is that vessels have a direct incentive to minimize unnecessary slippage events to save their slippage quota for when they really need it (e.g. due to safety issues) and thereby avoid situations where subsequent slippage events result in forced trip terminations. Trip terminations could still occur however.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

2.1.4 Alternative Set 4 - Port-side and Other Sampling/Monitoring Measures

Background/Statement of Problem/Need for Action:

The current suite of reporting and monitoring requirements are insufficient to precisely estimate RH/S incidental catch.

The measures in this Alternative Set would (alone and/or in combination with other alternatives) increase reporting and/or monitoring with the overall goal of improving the precision of RH/S incidental catch estimates.

From a practical standpoint, it is more efficient to subsample the landings of river herring and other non-target species when a mackerel vessel reaches the dock than when it is at sea. Discards that occur at sea of non-target species are easier to monitor than are the landed fractions that go into the hold due to the large volumes that go into the hold. Dockside sampling could have higher sampling rates to better characterize the species in retained catch and an entire catch could be evaluated in one day or less as opposed to having a person at sea for multiple days. This option does not mean that at sea monitors are unnecessary – they are essential to monitor discards. However, since most RH/S are retained (esp. for mackerel trips), portside sampling could increase sampling coverage from current levels with lower costs than at-sea observers. For longfin squid trips the preceding discussion probably does not apply because most RH/S are discarded so they are not available dockside.

Several other sampling/monitoring alternatives are also included in the Alternative Set as described below including alternatives to require volumetric hold certification of Tier 3 mackerel limited access permits and longfin squid moratorium permit holders. While in Amendment 11 the fish hold certification was primarily for purposes of capacity control (not allowing vessels to reconfigure to have substantially larger fish holds), in this Amendment the measure is being considered for purposes of facilitating rapid catch weight estimates based on vessel volume for portside sampling, observer data hail weight estimates, and vessels' VTR kept-weight estimates. There is also an ongoing voluntary project by industry to use fleet communication to avoid river herring hotspots. Since this project uses extensive post-side sampling it was included in this Alternative Set – the relevant alternative in this document just commits the Council to consider the project's results once completed to determine potential management implications. A summary of the key biological and human community impacts (detailed in section 7) follows for each alternative.

NOTE ON COMBINATIONS: All of the action alternatives in this Alternative Set could be implemented singly or in combination with any other alternative(s) in this Alternative Set.

4a. No-action

If this alternative is selected, then no measures from Alternative Set 4 would be implemented and the existing monitoring measures (as described in section 5.4) would remain in place. Thus there would be no incremental impacts compared to the status quo, but there are relative impacts compared to the action alternatives, as described below.

4b. Require industry-funded 3rd party port-side landings sampling program (including total weight documentation) for mackerel landings over 20,000 pounds. Required coverage levels would be specified annually during specifications. NEFSC would accredit samplers and manage the program/data. Vessels would contract directly with providers and pay providers directly. If selected, vessels would have to wait until their sampler arrived unless a waiver is obtained from the observer program.

Summary of Biological Impact Analysis

To the degree that better non-target landings data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. Non-target species would also benefit if the costs of monitoring generally discouraged effort which would reduce interactions.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

Dockside monitors for groundfish are paid $50-$70/hr and each trip would only require 1 sampling event compared to the $800/day of at-sea samplers (plus $400 in administrative costs). Different sized vessels would have different costs for offload monitoring due to different hold sizes and processor offload speeds, but a 6-14 hour offload from a 3-5 day trip would costs $300-$980 for dockside monitoring versus $3,600-$6,000 for observer costs. If the Council required 25%, 50%, 75%, or 100% of trips to be monitored then participants would have to pay for approximately that percentage of their trips to be monitored unless additional funds are available. Revenue information for different mackerel vessels/trips is available in Alternative Set 5 below.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>4c</u>. Require industry-funded 3rd party port-side landings sampling program (including total weight documentation) for longfin squid landings over 2,500 pounds. Required coverage levels would be specified annually during specifications. NEFSC would accredit samplers and manage the program/data. Vessels would contract directly with providers and pay provider directly. If selected, vessels would have to wait until their sampler arrived unless a waiver is obtained from the observer program.

<u>Summary of Biological Impact Analysis</u>

To the degree that better non-target landings data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. However, since most RH/S caught on longfin squid trips are discarded rather than retained, portside sampling is probably would not be an effective way to obtain RH/S catch information. Non-target species would benefit if the costs of monitoring generally discouraged effort which would reduce interactions.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

Dockside monitors for groundfish are paid $50-$70/hr and each trip would only require 1 sampling event compared to the $800/day of at-sea samplers (plus $400 in administrative costs). Different sized vessels would have different costs for offload monitoring due to different hold sizes and processor offload speeds, but a 6-14 hour offload from a 3-5 day trip would costs $300-$980 for dockside monitoring versus $3,600-$6,000 for observer costs. If the Council required 25%, 50%, 75%, or 100% of trips to be monitored then participants would have to pay for approximately that percentage of their trips to be monitored unless additional funds are available. Revenue information for different mackerel vessels/trips is available in Alternative Set 5.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>4d</u>. Require volumetric vessel-hold certification for Tier 3 limited access mackerel permits and specify a volume to weight conversion.

<u>Summary of Biological Impact Analysis</u>

This alternative could facilitate rapid catch weight estimates based on vessel volume for portside sampling, observer data hail weight estimates, and vessels' VTR kept-weight estimates.
To the degree that better non-target landings data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

Informal contacts by council staff with several marine surveyors during the Amendment 11 development process revealed that a fish hold measurement could run approximately $13.30-$40 per foot of vessel length, which could range from as low as $1,000 for a 75 foot vessel to as high as $6,000 for a 150 foot vessel, not including travel expenses. To the extent that surveys are already required for insurance purposes these costs may be already part of a vessels operating costs. Industry members have communicated to Council staff that, while some smaller vessels are configured in a way that could facilitate hold certifications (the refrigerated seawater or "tank" boats), many vessels that participate in a "fresh" product fishery are not configured in a way that facilitates a certification of a fixed hold capacity.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

4e. Require volumetric vessel-hold certification for longfin squid moratorium permits and specify a volume to weight conversion.

Summary of Biological Impact Analysis

This alternative could facilitate rapid catch weight estimates based on vessel volume for portside sampling, observer data hail weight estimates, and vessels' VTR kept-weight estimates.
To the degree that better non-target landings data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

Informal contacts by council staff with several marine surveyors revealed that a fish hold measurement could run approximately $13.30-$40 per foot of vessel length, which could range from as low as $1,000 for a 75 foot vessel to as high as $6,000 for a 150 foot vessel, not including travel expenses. To the extent that surveys are already required for insurance purposes these costs may be already part of a vessels operating costs. Industry members have communicated to Council staff that, while some longfin squid vessels are configured in a way that could facilitate hold certifications (the refrigerated seawater or "tank" boats), many vessels that participate in a "fresh" product fishery are not configured in a way that facilitates a certification of a fixed hold capacity.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

4f. Within 6 months of the completion of the Sustainable Fisheries Coalition bycatch avoidance project (expected late 2012), the Council will meet to formally review the results and consider the appropriateness of developing a framework adjustment to implement any additional incidental catch avoidance strategies that are suggested by the results of the Sustainable Fisheries Coalition bycatch avoidance project.

This would commit the Council to consider the findings from this project as they could apply to reducing the catch of RH/S in pelagic fisheries. Full details on this project are included in Appendix 7, but generally the project is testing if oceanographic and fishery data can be used to help industry avoid potential RH/S hotspots. Implementing measures similar to this project (i.e. making participation mandatory) would be a frameworkable action.

Summary of Biological Impact Analysis

Minimal immediate impacts would be expected. This would ensure that the Council considers the findings from this project as they could apply to reducing the catch of river herrings and/or shads in pelagic fisheries. Impacts would not be known until completion of the Sustainable Fisheries Coalition bycatch avoidance project and alternatives were developed, which would be subsequently analyzed .

Summary of Socio-Economic Impact Analysis

There are no costs associated with considering the results of the Sustainable Fisheries Coalition bycatch avoidance project. If the project revealed a way for industry to cooperatively and voluntarily avoid RH/S such work could lead to a cost-efficient way to reduce RH/S interactions.

2.1.5 Alternative Set 5 – At-Sea Observer Coverage Requirements

Background/Statement of Problem/Need for Action:

The current suite of reporting and monitoring requirements is insufficient to precisely estimate RH/S incidental catch.

The measures in this Alternative Set would (alone and/or in combination with other alternatives) increase reporting and/or monitoring with the overall goal of improving the precision of RH/S incidental catch estimates. The focus of these alternatives is on increasing the observer coverage rates of mackerel and longfin squid trips. Implementation of mandatory coverage would require a trip notification provision to be implemented as well (see Alternative Set 1). NMFS has strongly communicated that the at-sea portion of any additional observer coverage would have to be paid for by industry. A summary of the key biological and human community impacts (detailed in section 7) follows for each alternative.

NOTE ON C.V.s (coefficient of variation): A C.V. of 0.30 means that the true value has approximately a 95% probability of being within ± 60% of the estimate. A C.V. of 0.20 means that the true value has approximately a 95% probability of being within ± 40% of the estimate (both assuming a normal distribution of data). Also, since some sources of uncertainty are not integrated into the C.V. calculations, the C.V.s generated by the science center are lower (look better) than they really are. As described in Section 5 of the DEIS, since obtaining a given C.V. can require very different coverage levels from year to year, and the inter-annual variability in the data drives the precision, it may be quite difficult to consistently obtain precise catch estimates via observer data when the coverage levels are determined from prior years' data (as occurred with the SBRM).

NOTE ON COMBINATIONS: Only one of the 5b (observer coverage for mackerel mid-water trawl) alternatives could be chosen. Likewise, only one of the 5c (observer coverage for mackerel small mesh bottom trawl) and one of the 5d (observer coverage for longfin squid small mesh bottom trawl) alternatives could be chosen. One alternative from each of these could be selected (a total of three). 5e1 and 5e2 (strata-fleet alternatives for mid-water trawl) are mutually exclusive as are 5e3 and 5e4 (strata-fleet alternatives for small mesh bottom trawl) but one alternative from the first pair could be chosen with one from the second pair. If any of the 5e alternatives were chosen, they would not be combinable with any of the 5b, 5c, or 5d alternatives (coverage could be based on a set percentage of trips or a set target coefficients of variation (C.V.s) but not both). 5f, 5g, and 5h provide for industry funding and review of the increased observer coverage levels proposed in 5b-5e so they could be added on to any of the other action alternatives.

If any measure in this Alternative Set is selected for mackerel, the Council would also need to select Alternative 1d48 (48-hr pre-trip notification) or 1d72 (72-hr pre-trip notification). There is already a pre-trip notification requirement in effect for longfin squid moratorium permit holders.

5a. No-action

If this alternative is selected, then no measures from Alternative Set 5 would be implemented and the existing observer measures (as described in section 5.5) would remain in place. Thus there would be no incremental impacts compared to the status quo, but there are relative impacts compared to the action alternatives, as described below.

5b. Mackerel Mid-Water Trawl (MWT)

There is currently no pool of observer coverage for general mid-water trawl vessels and the only coverage of this fleet occurs when herring-directed activity happens to catch mackerel (the observer program actually selects against declared herring trips that state their primary target is mackerel). The sub-alternatives below would require a range of percentage-based coverage levels to improve coverage from the very low levels currently occurring and improve incidental catch estimation.

5b1. Require 25% of MWT mackerel trips by federal vessels intending to retain over 20,000 pounds of mackerel to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 20,000 pounds of mackerel unless they had notified their intent to retain more than 20,000 pounds of mackerel.

5b2. Require 50% of MWT mackerel trips by federal vessels intending to retain over 20,000 pounds of mackerel to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 20,000 pounds of mackerel unless they had notified their intent to retain more than 20,000 pounds of mackerel.

5b3. Require 75% of MWT mackerel trips by federal vessels intending to retain over 20,000 pounds of mackerel to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 20,000 pounds of mackerel unless they had notified their intent to retain more than 20,000 pounds of mackerel.

5b4. Require 100% of MWT mackerel trips by federal vessels intending to retain over 20,000 pounds of mackerel to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 20,000 pounds of mackerel unless they had notified their intent to retain more than 20,000 pounds of mackerel.

Summary of Biological Impact Analysis

Coverage of this fishery has historically been low, leading to low precision of RH/S catch estimates. Higher coverage would lead to better precision. To the degree that better data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. Since mackerel trips do not comprise all MWT activity, one can not specify the precision for RH/S catches in MWT gear if only mackerel trips increase observer coverage. Details on expected precision if all MWT activity achieved the above coverage levels can be found in Section 7. Non-target species would also benefit if the costs of coverage generally discouraged effort which would reduce interactions.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

NMFS has strongly communicated that the at-sea portion of any additional observer coverage would have to be paid for by industry. The cost to vessels of at-sea observers would be about $800 per day at sea while NMFS incurs about $400/day in administrative costs. Since different vessels have different average trip lengths and trip length varies by trip it is not possible to describe the impact on any given vessel. However, cost data collected through the observer program was used to estimate the increase in daily trip costs that $800/day would cause for mackerel trips:

-23% for single MWT mackerel trips ($3,494 to $4,294)
-31% for paired MWT mackerel trips ($2,602 to $3,402)

The average trip cost values cited in this analysis include variable costs such as fuel, oil, ice, food, fishing supplies, vessel/gear damages, and water but does not include crew shares/wages, dockage fees, or boat mortgage payments. Trip costs were estimated based on 2010 observer data. These are the larger, higher-volume vessels – smaller vessels that start off with lower costs would see a higher percentage increase.

While the per trip costs are most relevant to vessels, total costs can also be considered. Since coverage in this alternative would be related to 20,000 pound mackerel trips, 2006-2010 VTR data was analyzed to determine the approximate number of seadays fished on midwater trawl trips that kept 20,000 pounds or more of mackerel. These trips averaged 643 sea days each year ranging from 272 in 2010 to 926 in 2006. If 25%, 50%, 75%, or 100% of the average seadays (643) were observed it would require 161, 322, 482, and 643 days respectivly. Given the low levels of current coverage and an uncertain future funding situation, most if not nearly all of these would or could have to be industry funded (see 5f below) if mandated. Multiplying these days by $800/day results in at-sea costs for 25%, 50%, 75%, or 100% coverage of the average seadays of approximatley $0.13 million, $0.26 million, $0.39 million, and $0.51 million per year respectivly. Multiplying these days by $400/day results in administrative costs for 25%, 50%, 75%, or 100% coverage of the average seadays of approximatley $0.06 million, $0.13 million, $0.19 million, and $0.26 million per year respectivly.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

5c. Mackerel Small Mesh Bottom Trawl (SMBT)

A very small percentage of mackerel trips are observed overall. The sub-alternatives below would require a range of percentage-based coverage levels to improve coverage from the very low levels currently occurring and improve incidental catch estimation. Analysis in the document relates these coverage levels to potential ranges of uncertainty that would result from such coverage levels.

> **5c1. Require 25% of SMBT (<3.5 in) mackerel trips by federal vessels intending to retain over 20,000 pounds of mackerel to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 20,000 pounds of mackerel unless they had notified their intent to retain more than 20,000 pounds of mackerel.**
>
> **5c2. Require 50% of SMBT (<3.5 in) mackerel trips by federal vessels intending to retain over 20,000 pounds of mackerel to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 20,000 pounds of mackerel unless they had notified their intent to retain more than 20,000 pounds of mackerel.**
>
> **5c3. Require 75% of SMBT (<3.5 in) mackerel trips by federal vessels intending to retain over 20,000 pounds of mackerel to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 20,000 pounds of mackerel unless they had notified their intent to retain more than 20,000 pounds of mackerel.**
>
> **5c4. Require 100% of SMBT (<3.5 in) mackerel trips by federal vessels intending to retain over 20,000 pounds of mackerel to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 20,000 pounds of mackerel unless they had notified their intent to retain more than 20,000 pounds of mackerel.**

Summary of Biological Impact Analysis

Coverage of this fishery has historically been low, leading to low precision of RH/S catch estimates. Higher coverage would lead to better precision. To the degree that better data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. Since mackerel trips comprise a small part of SMBT activity, one can not specify the precision for RH/S catches in SMBT gear if only mackerel trips increase observer coverage. Details on expected precision if all SMBT activity achieved the above coverage levels can be found in Section 7. Non-target species would also benefit if the costs of coverage generally discouraged effort which would reduce interactions.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

NMFS has strongly communicated that the at-sea portion of any additional observer coverage would have to be paid for by industry. The cost to vessels of at-sea observers would be about $800 per day at sea while NMFS incurs about $400/day in administrative costs. Since different vessels have different average trip lengths and trip length varies by trip it is not possible to describe the impact on any given vessel. However, cost data collected through the observer program was used to estimate the increase in daily trip costs that $800/day would cause for mackerel trips:

-49% for higher volume SMBT mackerel trips ($1,639 to $2,439)

The average trip cost values cited in this analysis include variable costs such as fuel, oil, ice, food, fishing supplies, vessel/gear damages, and water but does not include crew shares/wages, dockage fees, or boat mortgage payments. Trip costs were estimated based on 2010 observer data. These are the larger, higher-volume vessels – smaller vessels that start off with lower costs would see a higher percentage increase.

While the per trip costs are most relevant to vessels, total costs can also be considered. Since coverage in this alternative would be related to 20,000 pound mackerel trips, 2006-2010 VTR data was analyzed to determine the approximate number of seadays fished on SMBT trips that kept 20,000 pounds or more of mackerel. These trips averaged 172 sea days each year ranging from 113 in 2009 to 286 in 2006. If 25%, 50%, 75%, or 100% of the average seadays (172) were observed it would require 43, 86, 129, and 172 days respectivly. Given the low levels of current coverage and an uncertain future funding situation, most if not nearly all of these would or could have to be industry funded (see 5f below) if mandated. Multiplying these days by $800/day results in at-sea costs for 25%, 50%, 75%, or 100% coverage of the average seadays of approximatley $0.03 million ($30,000), $0.07 million, $0.10 million, and $0.14 million per year respectivly. Multiplying these days by $400/day results in administrative costs for 25%, 50%, 75%, or 100% coverage of the average seadays of approximatley $0.02 million, $0.03 million, $0.05 million, and $0.07 million per year respectivly.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

5d. Longfin Squid Small Mesh Bottom Trawl (SMBT)

While coverage has increased in 2011 related to the implementation of the butterfish mortality cap on the longfin squid fishery, a small percentage of longfin squid trips have been observed historically. The sub-alternatives below would require a range of percentage-based coverage levels to improve coverage from the very low levels currently occurring and improve incidental catch estimation. Analysis in the document relates these coverage levels to potential ranges of uncertainty that would result from such coverage levels.

5d1. Require 25% of SMBT (<3.5 in) longfin squid trips by federal vessels intending to retain over 2,500 pounds of longfin squid to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 2,500 pounds of longfin squid unless they had notified their intent to retain more than 2,500 pounds of longfin squid.

5d2. Require 50% of SMBT (<3.5 in) longfin squid trips by federal vessels intending to retain over 2,500 pounds of longfin squid to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 2,500 pounds of longfin squid unless they had notified their intent to retain more than 2,500 pounds of longfin squid.

5d3. Require 75% of SMBT (<3.5 in) longfin squid trips by federal vessels intending to retain over 2,500 pounds of longfin squid to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 2,500 pounds of longfin squid unless they had notified their intent to retain more than 2,500 pounds of longfin squid.

5d4. Require 100% of SMBT (<3.5 in) longfin squid trips by federal vessels intending to retain over 2,500 pounds of longfin squid to carry observers. The NEFSC would assign coverage based on pre-trip notifications. Vessels would not be able to retain more than 2,500 pounds of longfin squid unless they had notified their intent to retain more than 2,500 pounds of longfin squid.

Summary of Biological Impact Analysis

Coverage of this fishery has historically been low, leading to low precision of RH/S catch estimates. Higher coverage would lead to better precision. To the degree that better data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. Since longfin squid trips do not comprise all SMBT activity, one can not specify the precision for RH/S catches in SMBT gear if only longfin squid trips increase observer coverage. Details on expected precision if all SMBT activity achieved the above coverage levels can be found in Section 7. Non-target species would also benefit if the costs of coverage generally discouraged effort which would reduce interactions.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

NMFS has strongly communicated that the at-sea portion of any additional observer coverage would have to be paid for by industry. The cost to vessels of at-sea observers would be about $800 per day at sea while NMFS incurs about $400/day in administrative costs. Since different vessels have different average trip lengths and trip length varies by trip it is not possible to describe the impact on any given vessel. However, cost data collected through the observer program was used to estimate the increase in daily trip costs that $800/day would cause for mackerel trips:

-85% for higher volume SMBT longfin squid trips ($939 to $1,739)
-189% for lower volume SMBT longfin squid trips ($424 to $1,224)

The average trip cost values cited in this analysis include variable costs such as fuel, oil, ice, food, fishing supplies, vessel/gear damages, and water but does not include crew shares/wages, dockage fees, or boat mortgage payments. Trip costs were estimated based on 2010 observer data.

While the per trip costs are most relevant to vessels, total costs can also be considered. Since coverage in this alternative would be related to 2,500 pound longfin squid trips, 2006-2010 VTR data was analyzed to determine the approximate number of seadays fished on SMBT trips that kept 2,500 pounds of more of longfin squid. These trips averaged 5,357 sea days each year ranging from 3,932 in 2010 to 6,743 in 2006. If 25%, 50%, 75%, or 100% of the average seadays (5,357) were observed it would require 1339, 2678, 4017, and 5,357 sea days respectivly. Given the low levels of current coverage and an uncertain funding situation, most if not nearly all of these might have to be industry funded (see 5f below) if mandated. About 10% of 2,500 pound longfin squid trips were observed in 2011, so up to 10% of these might be funded but such funding is not guaranteed. Multiplying these days by $800/day results in at-sea costs for 25%, 50%, 75%, or 100% coverage of the average seadays of approximatley $1.1 million, $2.1 million, $3.2 million, and $4.3 million per year respectivly. Multiplying these days by $400/day results in administrative costs for 25%, 50%, 75%, or 100% coverage of the average seadays of approximatley $0.5 million, $1.1 million, $1.6 million, and $2.1 million per year respectivly. However, there may be returns to scale in the sense that at higher coverage levels NMFS marginal costs may become less than $400/day.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

5e. Strata-Fleet-Based Alternatives

Analysis performed for the amendment and detailed in Section 7 suggests that around 65% coverage could result in a 0.3 C.V. goal and about 90% coverage could result in a 0.2 C.V. goal for Mid-Atlantic MWT for alewife and blueback. Also, for small mesh bottom trawl, around 40% coverage could result in a 0.3 C.V. goal and about 60% coverage could result in a 0.2 C.V. goal for alewife and blueback. This was determined by averaging the required sea days from 2009-2010 for these goals, and then comparing those averages with total average days at sea for relevant trips from VTR data, 2009-2010. However it is emphasized that from year to year it will be very hard to hit a particular C.V. target due to the inherent variability from year to year in both the directed fisheries involved and their incidental catch of river herrings. Since one cannot predict which years will require the highest coverage, some years would likely be over covered and some years would be under covered if coverage rates are determined by the previous year's data.

Note: This alternative has a major implementation issue in that NMFS has said it will not approve increased observer coverage that is not funded by industry but the MAFMC cannot compel all fisheries by gear type to pay for observer coverage (only its own).

The following sub-alternatives would require coverage levels that would be expected to result in the specified C.V. levels for river herrings. Shad were not included because very high coverage levels would be required to achieve the respective C.V.s due to lower encounter rates.

5e1. Require NMFS to allocate sea days such that Mid-Atlantic alewife and blueback catch C.V.s for MWT would each be expected to be at or below 0.30.

5e2. Require NMFS to allocate sea days such that Mid-Atlantic alewife and blueback catch C.V.s for MWT would each be expected to be at or below 0.20.

5e3. Require NMFS to allocate sea days such that alewife and blueback catch C.V.s for SMBT would each be expected to be at or below 0.30.

5e4. Require NMFS to allocate sea days such that alewife and blueback catch C.V.s for SMBT would each be expected to be at or below 0.20.

Summary of Biological Impact Analysis

To the degree that better data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. Non-target species would also benefit if the costs of coverage generally discouraged effort which would reduce interactions.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

The approximate cost for an observer is $800/day. In addition to the costs borne by vessels, NMFS has estimated that it incurs approximately $400/day in administrative costs related to each additional day at sea.

Compared to the approximate sea days provided in 2010, achieving a 0.3 C.V. for both blueback herring and alewife in the Mid-Atlantic for MWT would require 476-232 extra sea days (costing about $0.2-$0.4 million) and achieving a 0.2 C.V. for both blueback herring and alewife in the Mid-Atlantic for MWT would require 686-344 extra sea days (costing about $0.3-$0.5 million), with at sea costs being $800/day. Administrative costs to NMFS would equal an additional 50% of the at-sea costs ($400/day). The range is related to the fact that C.V.s vary from year to year related to variation in the underlying data.

Compared to the approximate sea days provided in 2010, achieving a 0.3 C.V. for both blueback herring and alewife in the SMBT (Mid-Atlantic and New England) would require 1,410-2,478 extra sea days (costing about $1.1-$2.0 million) and achieving a 0.2 C.V. for both blueback herring and alewife in the Mid-Atlantic for MWT would require 2,850-3,757 extra sea days (costing about $2.3-$3.0 million), with at sea costs being $800/day. Administrative costs to NMFS would equal an additional 50% of the at-sea costs ($400/day). The range is related to the fact that C.V.s vary from year to year related to variation in the underlying data.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

5f. Vessels would have to pay for observers to meet any observer coverage goals adopted by the Council that are greater than existing sea day allocations assigned through the sea day allocation process (already implemented in other fisheries). NEFSC would accredit observers and vessels would have to contract and pay observers.

Summary of Biological Impact Analysis

Biological impacts should be independent of who pays for data.

Summary of Socio-Economic Impact Analysis

See 5b-5e above.

5g. Phase-in industry funding over 4 years such that to achieve the target coverage selected in 4b-4e above, NMFS would pay for 100%, 75%, 50%, then 25% of the at-sea portion of the specified observer coverage (NOTE: NMFS has indicated this is not feasible from a funding point of view).

Summary of Biological Impact Analysis

Biological impacts should be independent of who pays for data.

Summary of Socio-Economic Impact Analysis

Alternatives 5b-5e above compare the cost of observer coverage relative to different coverage levels and precision targets. In the short term cost-sharing with NMFS would make the economic impacts less but would not have an impact on the long term. For this alternative, if NMFS paid 100% of the observer coverage there would be minimal socio-economic impacts. For the phase in years, the impacts per trip would be the same as described above, but the number of trips for which industry would have to pay for observers would be less, at least initially.

5h. Require reevaluation of coverage requirement after 2 years to determine if incidental catch rates justify continued expense of continued high coverage rates.

Summary of Biological Impact Analysis

This should not have any impacts other than allowing more rapid future management responses.

Summary of Socio-Economic Impact Analysis

This should not have any impacts other than allowing more rapid future management responses.

2.1.6 Alternative Set 6 - Mortality Caps

<u>Background/Statement of Problem/Need for Action:</u>

There are currently no limits on incidental catch of RH/S in the mackerel and/or longfin squid fisheries other than state landing requirements.

The alternatives would seek to directly limit the mortality of the relevant RH/S species in the mackerel and longfin squid fisheries. While the actual mortality cap quantities would be determined during the specifications process just as annual ACLs/AMs are set, this document explores a range of options so that likely impacts may be evaluated. The range of mortality cap quantities would be evaluated in an environmental assessment during the specifications process (though without comprehensive RH/S assessments it is not possible to determine if any particular quantity of RH/S catch is sustainable). The following values are primarily provided to give the reader a sense of impacts from a range of mortality caps that will be investigated in greater depth during the specifications process. A summary of the key biological and human community impacts (detailed in section 7) follows for each alternative.

NOTE ON COMBINATIONS: All of the action alternatives in this Alternative Set could be implemented singly or in combination with any other alternative(s) in this Alternative Set.

<u>6a</u>. No-action

If this alternative is selected, then no measures from Alternative Set 6 would be implemented and the existing state management measures (as described in section 5.9) would remain in place. Thus there would be no incremental impacts compared to the status quo, but there are relative impacts compared to the action alternatives, as described below.

<u>6b</u>. Implement a mortality cap for <u>river herrings</u> for the <u>mackerel</u> fishery whereby the mackerel fishery would close once it is determined that it created a certain level of river herring mortality (that level would be determined annually by Council in specification process unless RH/S were added as stocks in the fishery in which case SSC would be involved in ABC setting for RH/S).

One way to assign mortality caps for river herring would be to base it on the range of estimated river herring mortality conducted by the science center/FMAT to support Am14. Mid-Atlantic mid-water trawl (MWT) fishing in Quarter 1, which is largely but not completely mackerel fishing, accounted for 35% of total river herring mortality 2005-2010. MWT fishing in Quarter 1 is mixed, with mackerel comprising over 50 % of the landings, but herring making up a large amount of landings in January (see Figure 21A of Appendix 2). The table below describes total ocean and quarter 1 mid-water trawl mortalities in the leftmost columns.

Table 1. Example River Herring Caps For Mackerel

	Total Estimated Ocean Fishing Mortality (mt)	Mid-Water Trawl Quarter 1 mortality (mt) (35% of total) = Mortality Cap Possibility	Mackerel would close at these landings (mt) with high ratio, 0.86%	Mackerel would close at these landings (mt) with mean ratio, 0.45%	Mackerel would close at these landings (mt) with low ratio, 0.02%
2006	245	86	9,975	19,063	428,908
2007	664	232	27,029	51,656	1,162,263
2008	672	235	27,333	52,237	1,175,335
2009	361	126	14,679	28,053	631,190
2010	244	85	9,911	18,940	426,160

Using the separate ratio method described in Wigley et al., 2007 (modified by adding kept in the numerator in addition to discards) developed for the butterfish cap and applying it to observer trips and regular trips that landed at least 50% or at least 100,000 pounds of mackerel (encompasses almost all landings) results in annual river herring mortality ratios from 0.02% in 2007 to .86% in 2009 with a mean of 0.45. If these values were used with the above range of mortality caps, the amount of total fish (the ratio is based on all fish retained) that could be harvested by trips as defined above before the mackerel fishery was shut down by the river herring mortality cap is illustrated in the rightmost 3 columns depending of the ratio of river herring. The main point is that whether mackerel would close because of a cap would depend on how much the Council set the cap at in a given year, what the realized incidental catch of river herring was, and what the mackerel availability was. In the above table the range of caps is just a percentage of the observed catch over the years 2006-2010. Since the realized ratio can vary substantially from year to year, it is not possible to predict impacts other than to acknowledge that in some years a closure could come very early and in some years a closure could not happen at all.

<u>Summary of Biological Impact Analysis</u>

If a cap was set low enough to shut the directed fishery down, there would be some benefits to RH/S. However, since the linkage between incidental catch of RH/S and RH/S stock status and productivity is not known, the impacts are not quantifiable. Smaller caps and earlier closures should lead to relatively higher benefits.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

If a low cap is chosen and a high ratio is observed, the directed fishery would close due to the cap before it reached the directed fishery quota. This would result in revenue losses to fishery participants that would be dependent on the exact level of the cap and bycatch ratio, and prices for the directed species that “is left in the water” because of the cap closure. The ranges described in the above table would suggest potentially forgone revenue as high as about $8 million or as low as zero dollars at 2010 ex-vessel prices depending on the above factors and based on the proposed 2012 quota.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

6c. Implement a mortality cap for shads for the mackerel fishery whereby the mackerel fishery would close once it is determined that it created a certain level of shad mortality (that level would be determined annually by Council in specification process unless RH/S were added as stocks in the fishery in which case SSC would be involved in ABC setting for RH/S).

One way to assign mortality caps for shad would be to base it on the range of estimated shad mortality conducted by the science center/FMAT to support Am14. Mid-Atlantic mid-water trawl fishing in Quarter 1, which is largely but not completely mackerel fishing, accounted for 12% of total shad mortality 2005-2010. The table below describes total ocean and quarter 1 mid-water trawl mortalities in the leftmost columns (2006 omitted because of lack of shad records).

Table 2. Example Shad Caps For Mackerel

	Total Estimated Ocean Fishing Mortality (mt)	Mid-Water Trawl Quarter 1 mortality (mt) (12% of total) = Mortality Cap Possibility	Mackerel would close at these landings (mt) with high ratio, 0.05%	Mackerel would close at these landings (mt) with mean ratio, 0.03%	Mackerel would close at these landings (mt) with low ratio, 0.004%
2007	60	7	14,364	23,940	179,550
2008	60	7	14,450	24,084	180,630
2009	70	8	16,903	28,172	211,290
2010	47	6	11,338	18,896	141,720

Using the separate ratio method described in Wigley et al., 2007 (modified by adding kept in the numerator in addition to discards) developed for the butterfish cap and applying it to observer trips and regular trips that landed at least 50% or at least 100,000 pounds of mackerel (encompasses almost all landings) results in annual shad mortality ratios from 0.004% in 2009 to 0.05% in 2007 with a mean of 0.03. If these values were used with the above range of mortality caps, the amount of total fish (the ratio is based on all fish retained) that could be harvested by trips as defined above before the mackerel fishery was shut down by the shad mortality cap is illustrated in the rightmost 3 columns depending of the ratio of shad. The main point is that whether mackerel would close because of a cap would depend on how much the Council set the cap at in a given year, what the realized incidental catch of shad was, and what the mackerel availability was. In the above table the range of caps is just a percentage of the observed catch over the years 2006-2010. Since the realized ratio can vary substantially from year to year, it is not possible to predict impacts other than to acknowledge that in some years a closure could come very early and in some years a closure could not happen at all.

Summary of Biological Impact Analysis

If a cap was set low enough to shut the directed fishery down, there would be some benefits to RH/S. However, since the linkage between incidental catch of RH/S and RH/S stock status and productivity is not known, the impacts are not quantifiable. Smaller caps and earlier closures should lead to relatively higher benefits.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

If a low cap is chosen and a high ratio is observed, the directed fishery would close due to the cap before it reached the directed fishery quota. This would result in revenue losses to fishery participants that would be dependent on the exact level of the cap and bycatch ratio, and prices for the directed species that "is left in the water" because of the cap closure. The ranges described in the above table would suggest potentially forgone revenue as high as about $7 million or as low as zero dollars at 2010 ex-vessel prices depending on the above factors and based on the proposed 2012 quota.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>6d</u>. Implement a mortality cap for <u>river herrings</u> for the <u>longfin squid</u> fishery whereby the longfin squid fishery would close once it is determined that it created a certain level of river herring mortality (that level would be determined annually by Council in specification process unless RH/S were added as stocks in the fishery in which case SSC would be involved in ABC setting for RH/S).

One way to assign mortality caps for river herring would be to base it on the range of estimated river herring mortality conducted by the science center/FMAT to support Am14. Mid-Atlantic small mesh bottom trawl accounted for 5% of total river herring mortality. While Mid-Atlantic small mesh bottom trawl encompasses a variety of fisheries besides longfin squid (including Atlantic herring), some of the New England small mesh bottom trawl mortality is probably related to longfin squid fishing so using the full Mid-Atlantic value is probably reasonable. The table below describes total ocean and 2.5% of total mortalities in the leftmost columns.

Table 3. Example River Herring Caps For Longfin Squid

	Total Estimated Ocean Fishing Mortality (mt)	Mid-Atlantic Small Mesh Bottom Trawl mortality (mt) (5% of total) = Mortality Cap Possibility	Longfin squid would close at these landings (mt) with high ratio, 0.17%	Longfin squid would close at these landings (mt) with mean ratio, 0.06%
2006	245	12	7,233	20,424
2007	664	33	19,534	55,346
2008	672	34	19,754	55,968
2009	361	18	10,608	30,057
2010	244	12	7,162	20,293

Using the separate ratio method described in Wigley et al., 2007 (modified by adding kept in the numerator in addition to discards) developed for the butterfish cap and applying it to observer trips and regular trips that landed at least 2,500 pounds longfin squid (encompasses almost all landings) results in annual river herring mortality ratios from almost zero in 2007 to .17% in 2009 with a mean of 0.06%. If these values were used with the above range of mortality caps, the amount of total fish (the ratio is based on all fish retained) that could be harvested by trips as defined above before the longfin squid fishery was shut down by the river herring mortality cap is illustrated on the rightmost 2 columns depending of the ratio of river herring. The main point is that whether longfin squid would close because of a cap would depend on how much the Council set the cap at in a given year, what the realized incidental catch of river herring was, and what the longfin squid availability was. In the above table the range of caps is just a percentage of the observed catch over the years 2006-2010. Since the realized ratio can vary substantially from year to year, it is not possible to predict impacts other than to acknowledge that in some years a closure could come very early and in some years a closure could not happen at all.

Summary of Biological Impact Analysis

If a cap was set low enough to shut the directed fishery down, there would be some benefits to RH/S. However, since the linkage between incidental catch of RH/S and RH/S stock status and productivity is not known, the impacts are not quantifiable. Smaller caps and earlier closures should lead to relatively higher benefits.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

If a low cap is chosen and a high ratio is observed, the directed fishery would close due to the cap before it reached the directed fishery quota. This would result in revenue losses to fishery participants that would be dependent on the exact level of the cap and bycatch ratio, and prices for the directed species that "is left in the water" because of the cap closure. The ranges described in the above table would suggest potentially forgone revenue as high as about $35 million or as low as zero dollars at 2010 ex-vessel prices depending on the above factors and based on the proposed 2012 quota.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

6e. Implement a mortality cap for shads for the longfin squid fishery whereby the longfin squid fishery would close once it is determined that it created a certain level of shad mortality (that level would be determined annually by Council in specification process unless RH/S were added as stocks in the fishery in which case SSC would be involved in ABC setting for RH/S).

One way to assign mortality caps for shad would be to base it on the range of estimated shad mortality conducted by the science center/FMAT to support Am14. Mid-Atlantic small mesh bottom trawl accounted for 11.5% of total shad mortality. While Mid-Atlantic small mesh bottom trawl encompasses a variety of fisheries besides longfin squid (including Atlantic herring), some of the New England small mesh bottom trawl mortality is probably related to longfin squid fishing so using the full Mid-Atlantic value is probably reasonable. The table below describes total ocean and 11.5% of total mortalities in the leftmost columns.

Table 4. Example Shad Caps For Longfin Squid

	Total Estimated Ocean Fishing Mortality (mt)	Mid-Atlantic Small Mesh Bottom Trawl mortality (mt) (11.5% of total) = Mortality Cap Possibility	Longfin squid would close at these landings (mt) with high ratio, 0.21%	Longfin squid would close at these landings (mt) with mean ratio, 0.10%	Longfin squid would close at these landings (mt) with low ratio, 0.03%
2006	47	5	2,587	5,433	18,109
2007	60	7	3,278	6,883	22,943
2008	60	7	3,297	6,924	23,081
2009	70	8	3,857	8,099	26,998
2010	47	5	2,587	5,433	18,109

Using the separate ratio method described in Wigley et al., 2007 (modified by adding kept in the numerator in addition to discards) developed for the butterfish cap and applying it to observer trips and regular trips that landed at least 2,500 pounds longfin squid (encompasses almost all landings) results in annual shad mortality ratios from almost 0.03% in 2009 to 0.21% in 2010 with a mean of 0.10%. If these values were used with the above range of mortality caps, the amount of total fish (the ratio is based on all fish retained) that could be harvested by trips as defined above before the longfin squid fishery was shut down by the shad mortality cap is illustrated in the rightmost 2 columns depending of the ratio of shad. The main point is that whether longfin squid would close because of a cap would depend on how much the Council set the cap at in a given year, what the realized incidental catch of shad was, and what the longfin squid availability was. In the above table the range of caps is just a percentage of the observed catch over the years 2006-2010. Since the realized ratio can vary substantially from year to year, it is not possible to predict impacts other than to acknowledge that in some years a closure could come very early and in some years a closure could not happen at all.

Summary of Biological Impact Analysis

If a cap was set low enough to shut the directed fishery down, there would be some benefits to RH/S. However, since the linkage between incidental catch of RH/S and RH/S stock status and productivity is not known, the impacts are not quantifiable. Smaller caps and earlier closures should lead to relatively higher benefits.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

If a low cap is chosen and a high ratio is observed, the directed fishery would close due to the cap before it reached the directed fishery quota. This would result in revenue losses to fishery participants that would be dependent on the exact level of the cap and bycatch ratio, and prices for the directed species that "is left in the water" because of the cap closure. The ranges described in the above table would suggest potentially forgone revenue as high as about $45 million or as low as zero dollars at 2010 ex-vessel prices depending on the above factors and based on the proposed 2012 quota.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

6f. Add mortality caps to list of measures that can be frameworked.

Summary of Biological Impact Analysis

Allowing a cap to be considered via a framework should not have any impacts other than allowing more rapid management responses in the future.

Summary of Socio-Economic Impact Analysis

Allowing a cap to be considered via a framework should not have any impacts other than allowing more rapid management responses in the future.

2.1.7 Alternative Set 7 – Restrictions in areas of high RH/S catch

Background/Statement of Problem/Need for Action:

There are currently no limits on incidental catch of RH/S in the mackerel and/or longfin squid fisheries other than state landing requirements

The Council originally hoped to include some alternatives that would restrict fishing in relatively small areas that appeared to be "hotspots" for RH/S catch. The Amendment's Fishery Management Action Team's found that small-area management is unlikely to be successful (see Appendices 1 & 2). Because the Council instructed the FMAT to generate area-based alternatives that would be likely to provide protection to RH/S, the FMAT generated several alternatives that are area based but the FMAT also acknowledged that such large-scale closures would effectively close the fisheries for many participants.

Council staff attempted to perform additional smaller-scale examinations of the data (for example around Hudson canyon) and while at such small scales there were too few observations to draw conclusions, even at small scales incidental catch events usually exhibited strong spatial-temporal variability.

The FMAT analysis suggests that because of the spatial and temporal variability of observed (Northeast Fishery Observer Program or "NEFOP") RH/S catch, the same kind of variability in mackerel and longfin squid effort and catch, and the same kind of variability in RH/S NEFSC trawl survey catches, that very large areas would be required to ensure that management was not just redistributing effort, possibly in a way that even increased RH/S catch. For this reason Council staff used the FMAT GIS analysis (See appendices 1 and 2) to construct areas for mackerel and longfin squid based on the mid-water and small-mesh bottom trawl fleet effort data and RH/S catch data. The table below is designed to help illustrate how even if you reduce catch rates of one species, for example blueback, but reduce catch rates of the directed species (for example mackerel) even more, it can be possible to do more harm than good if the fleet increases effort to maintain the same amount of harvest. Larger areas would not allow such redistribution of effort however. A summary of the key biological and human community impacts (detailed in section 7) follows for each alternative.

Table 5. Direct-Incidental Impact Schematic

Effects on RH catch of moving effort assuming effort changes to maintain constant mackerel catch if CPUE changes

	Mackerel			
Blueback	CPUE Changes	neutral	a little lower	a lot lower
	neutral	0	bad	bad
	a little lower	good	0	bad
	a lot lower	good	good	0

NOTE ON COMBINATIONS: 7bMack and 7cMack are mutually exclusive – the Council could close the area to directed fishing (7bMack) or require observers (7cMack) but not both. Likewise 7bLong and 7cLong are mutually exclusive – the Council could close the area to directed fishing (7bLong) or require observers (7cLong) but not both. One of the mackerel alternatives (either 7bMack or 7cMack) could be combined with one of the longfin squid alternatives (either 7bLong or 7cLong) however. 7d could be added to any 7b or 7c alternative to make those provisions only applicable after a cap-based trigger was reached. The Council would have to specify in this case that the Alternative Set 6 cap trigger was only a trigger for Alternative Set 7 rather than a stand-alone cap measure. 7e could be chosen in addition to any other alternative in this Alternative Set.

Given the overlapping nature of Alternative Sets 7 and 8, it is not expected that alternatives would be chosen from both Alternative Sets 7 and 8 for one fishery. One could select an alternative for the longfin squid fishery from one set and for the mackerel fishery from another set, but not from both sets for one fishery.

The enforceability of area-based management alternatives could be facilitated by the selection of the vessel monitoring system (VMS) requirement in Alternative Set 1 (alternatives 1eMack or 1eLong).

The selection of alternatives that include observer coverage requirements (7cMack and 7cLong) would require the selection of observer program notification alternatives for limited access mackerel permits in Alternative Set 1(1d48 and 1d72).

7a. No-action

If this alternative is selected, then no measures from Alternative Set 7 would be implemented and the existing state management measures (as described in section 5.9) would remain in place. Thus there would be no incremental impacts compared to the status quo, but there are relative impacts compared to the action alternatives, as described below.

7bMack. Closed Area - Prohibit retention of more than 20,000 pounds of mackerel in RH/S Mackerel Management Area (applies in quarter 1 only – see map below) for vessels with federal mackerel permits.

Summary of Biological Impact Analysis

Given the RH/S Mackerel Management Area encompasses most quarter-one mid-water trawl effort as well as most quarter-one observer data observations of RH/S catch, which are estimated to account for 35% of total RH/S catch, it is likely that effectively closing this area to mackerel fishing would create some positive impacts for mackerel as well as RH/S and other non-target species, but it is not possible to quantify the effect (if any) on RH/S stocks of catching one amount of RH/S versus some other amount due to the paucity of assessment information.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

As described in the table below, about 85% of mackerel revenues with an assigned area (2/3 to ¾ of total landings) from 2006-2010 came from within the RH/S Mackerel Management Area. While vessels would compensate as best they could so impacts are difficult to further quantify, vessels that typically rely on mackerel would likely suffer economically.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

Table 6. Distribution of Mackerel Revenues in and out of RH/S Area

	Outside Mackerel Value ($)	Inside Mackerel Value ($)
2006	3,149,111	17,323,851
2007	946,926	2,666,001
2008	553,705	3,200,344
2009	681,665	6,655,122
2010	471,663	2,920,919
Total	5,803,070	32,766,237
%	15%	85%

Source: Unpublished VTR Data

7bLong. Closed Area - Prohibit retention of more than 2,500 pounds longfin squid in RH/S Longfin Squid Management Area (applies year-round – see maps below) for vessels with federal longfin squid moratorium permits.

Summary of Biological Impact Analysis

Given the RH/S Longfin Squid Management Area encompasses most small mesh bottom trawl effort, which is responsible for 24% of RH/S catch, it is likely that effectively closing this area to longfin squid fishing would create some positive impacts for longfin squid as well as non-target species such as RH/S, but it is not possible to quantify the effect (if any) on RH/S stocks of catching one amount of RH/S versus some other amount due to the paucity of assessment information. However, examination of targeting information in the observer data suggests that RH/S encounters in SMBT fisheries are more associated with targeting of Alt Herring so impacts may not be large from restrictions only on SMBT longfin squid fishing.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

As described in the table below, about 71% of longfin squid kept catch (VTR data) from 2006-2010 came from within the RH/S longfin squid Management Area. While vessels would compensate as best they could so impacts are difficult to further quantify, vessels that typically rely on longfin squid would likely suffer economically.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

Table 7. Distribution of longfin squid VTR catches in and out of RH/S Area.

	Outside Loligo Pounds	Inside Loligo Pounds
2006	7,139,722	30,323,237
2007	16,516,551	12,991,085
2008	6,692,942	20,772,623
2009	4,352,451	17,991,543
2010	4,050,619	12,510,747
Total	38,752,285	94,589,235
%	29%	71%

Source: Unpublished VTR Data

<u>7cMack.</u> Require observers in RH/S Mackerel Management Area (applies in quarter 1 only – see map below) for vessels with federal mackerel permits to retain 20,000 pounds or more of mackerel. Vessels would have to pay for observers to meet any observer coverage goals adopted by the Council that are greater than existing sea day allocations assigned through the sea day allocation process (already implemented in other fisheries). NEFSC would accredit observers and vessels would have to contract and pay observers.

<u>Summary of Biological Impact Analysis</u>

To the degree that better data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. To the degree that fishermen did not fish because of the requirement there could be benefits to the managed species as well as non-target species and protected resources. To the extent that fishermen transferred effort there could be unknown impacts on other managed species, non-target species, habitat, and protected resources.

<u>Summary of Socio-Economic Impact Analysis</u>

Impacts are mixed with an uncertain net impact.

The cost of observers relative to vessel revenues and existing costs is described in Alternative Set 5.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

<u>7cLong.</u> Require observers in RH/S longfin squid Management Area (applies year round) for vessels with federal longfin squid permits to possess 2,500 pounds or more of longfin squid. Vessels would have to pay for observers to meet any observer coverage goals adopted by the Council that are greater than existing sea day allocations assigned through the sea day allocation process (already implemented in other fisheries). NEFSC would accredit observers and vessels would have to contract and pay observers.

<u>Summary of Biological Impact Analysis</u>

To the degree that better data is used to better minimize non-target interactions, there could be positive impacts to non-target species, including RH/S. To the degree that fishermen did not fish because of the requirement there could be benefits to the managed species as well as non-target species, habitat, and protected resources. To the extent that fishermen transferred effort there could be unknown impacts on other managed species, non-target species, habitat, and protected resources.

Summary of Socio-Economic Impact Analysis

Impacts are mixed with an uncertain net impact.

The cost of observers relative to vessel revenues and existing costs is described in Alternative Set 5.

While there are human community costs associated with this alternative, there also could be human community benefits as described in Section 2.1.

7d. Make above requirement(s) in effect only when a mortality cap "trigger" is reached. Operation of a “trigger” would be identical to the operation of a mortality cap (see Alternative Set 6 above) but the consequence of hitting the cap would be implementing 7b and/or 7c above if this alternative is selected in conjunction with 7b and/or 7c above. Trigger levels would be specified annually via specifications.

This option would use a mortality cap but instead of shutting down the fishery either the closed area or 100% observer coverage requirements in this Alternative Set would go into force. This alternative could only be selected in conjunction with 7b and/or 7c above.

Summary of Biological Impact Analysis

To the degree that a mortality cap gave fishermen incentive to avoid RH/S there could be positive impacts to RH/S. Once a cap was reached, then the same impacts as discussed above with 7b and/or 7c would be applicable but to a lesser degree since they would not be in force for the full year.

Summary of Socio-Economic Impact Analysis

To the degree that a mortality cap gave fishermen the opportunity to avoid RH/S and avoid more onerous requirements such as 7b or 7c above, a mortality cap trigger could have a positive impact compared to 7b or 7c alone. Once a cap was reached, then the same impacts as discussed above with 7b and/or 7c would be applicable but to a lesser degree since they would not be in force for the full year.

7e. Stipulate that any areas designated in Amendment 14 would be considered for updating every other year in specifications considering the most recent data available when specifications are developed.

Summary of Biological Impact Analysis

7e should not have any impacts other than facilitating future management responses.

Summary of Socio-Economic Impact Analysis

7e should not have any impacts other than facilitating future management responses.

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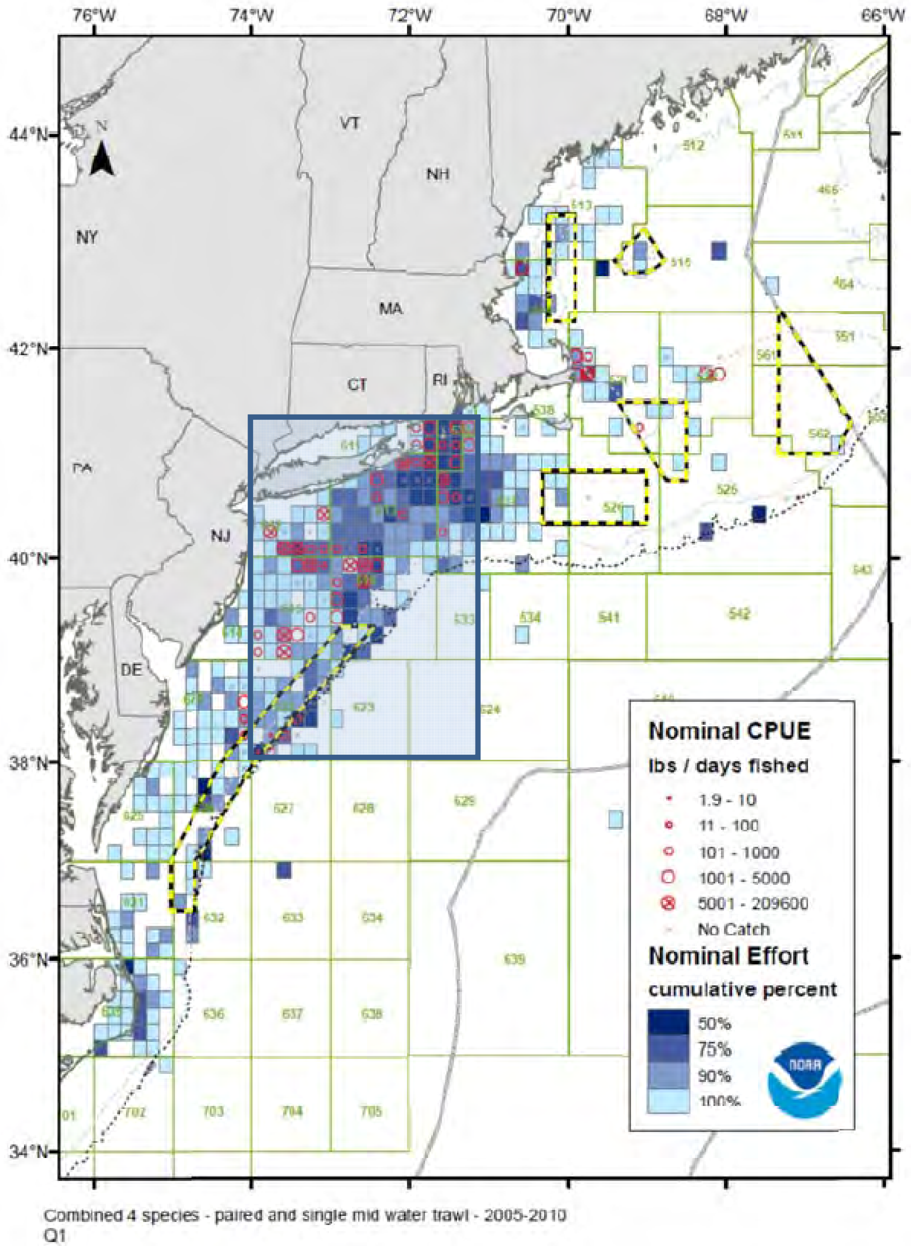
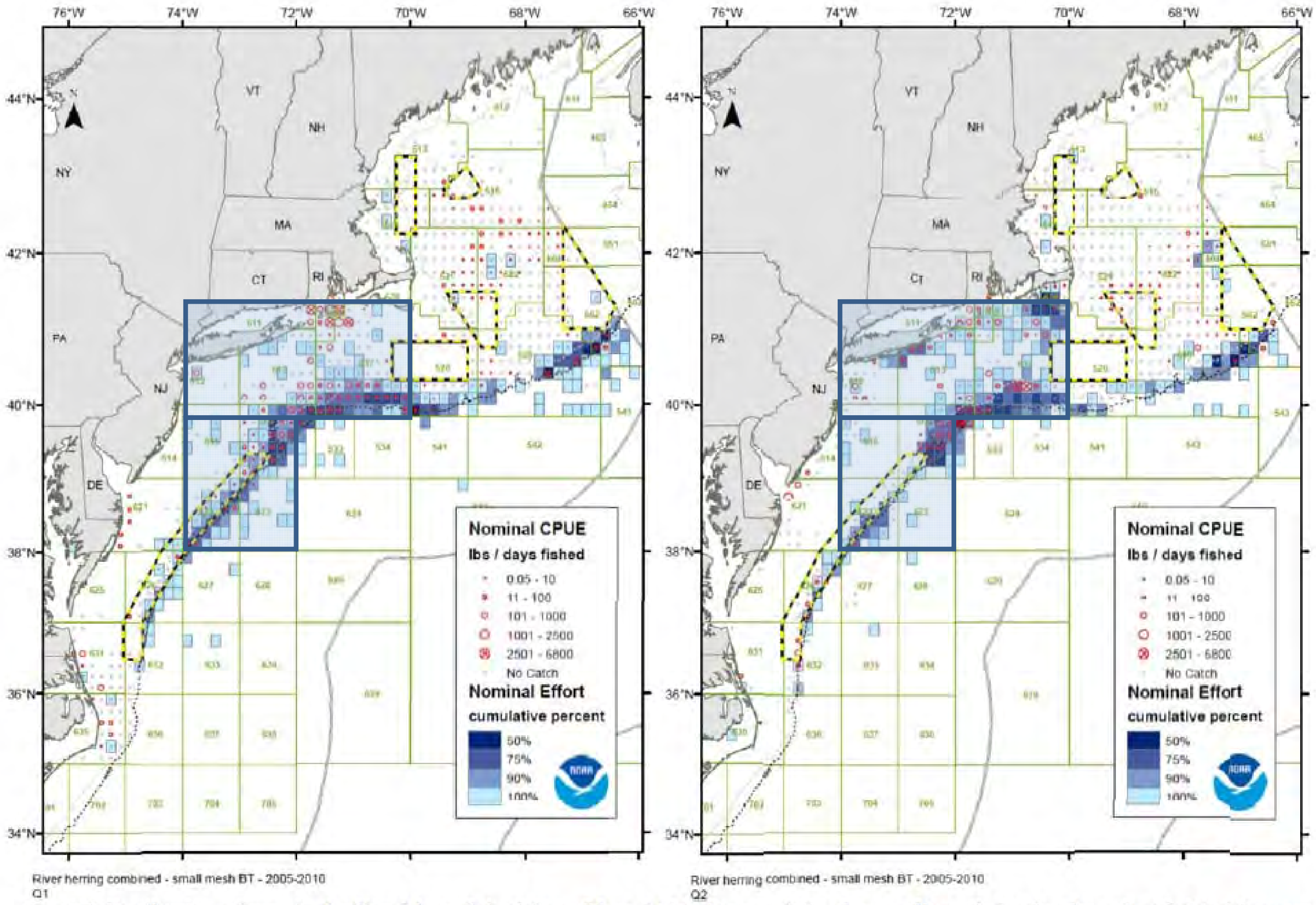
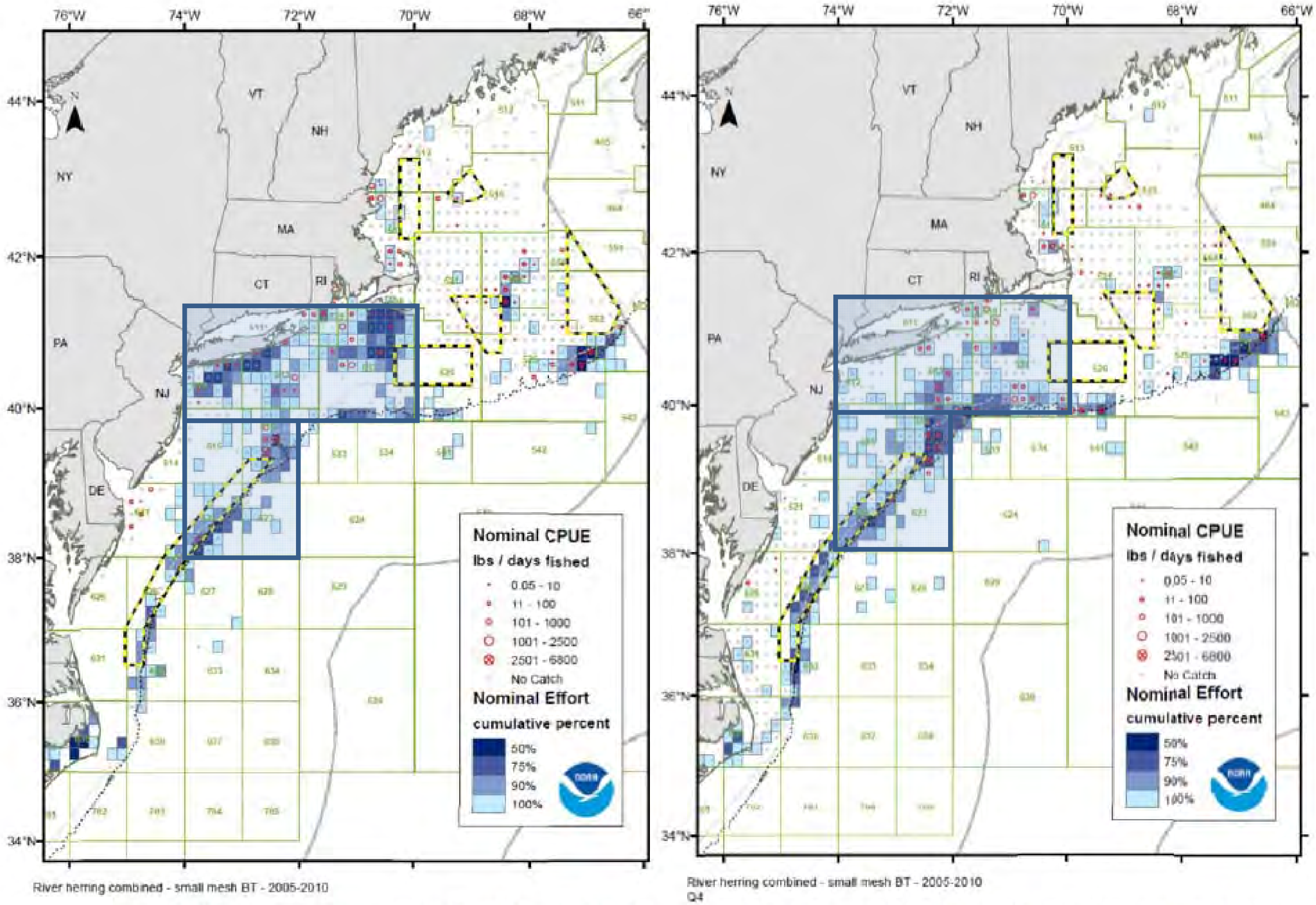


Figure 1. RH/S Mackerel Management Area (would apply in Quarter 1 only) over Quarter 1 MWT effort and RH/S Catch



Spatial distribution of nominal effort (days fished from Vessel Trip Reports) for the small mesh (codend mesh ≤ 3.5 in.) bottom trawl fleet and the fleet's incidental catch rates (kept+discarded weight/days fished from observed NEFOP trips) of alewife, blueback herring, hickory shad, and American shad combined, by ten-minute square, during Quarter 1 (left) and 2 (right) for 2005-2010.

Figure 2. RH/S Longfin squid Management Area over small mesh bottom effort and RH/S Catch (Quarters 1 and 2)



Spatial distribution of nominal effort (days fished from Vessel Trip Reports) for the small mesh (codend mesh ≤ 3.5 in.) bottom trawl fleet and the fleet's incidental catch rates (kept+discarded weight/days fished from observed NEFOP trips) of alewife, blueback herring, hickory shad, and American shad combined, by ten-minute square, during Quarter 3 (left) and 4 (right) for 2005-2010.

Figure 3. RH/S Longfin squid Management Area over small mesh bottom effort and RH/S Catch (Quarters 3 and 4)

2.1.8 Alternative Set 8 – Hotspot Restrictions

Background/Statement of Problem/Need for Action:

There are currently no limits on incidental catch of RH/S in the mackerel and/or longfin squid fisheries other than state landing requirements

The Council originally hoped to include some alternatives that would restrict fishing in relatively small areas that appeared to be "hotspots" for RH/S catch. The Amendment's Fishery Management Action Team's found that small-area management is unlikely to be successful (see Appendices 1 & 2). However, the New England Fishery Management Council's Amendment 5 to the Atlantic Herring FMP is considering small area "hotspot" alternatives. While Amendment 5 concluded that low positive impacts would result from the hotspot alternatives, it also noted that bycatch rates could increase outside of the hotspot areas which would seem to mirror the conclusions of the FMAT for Amendment 14 regarding the problems with small area management.

Regardless, to allow for potential coordination between this Amendment and Amendment 5 to the Atl. Herring FMP, the hotspot alternatives have been included as alternatives that would apply to mackerel and/or longfin squid fishing. Also, Since Atlantic herring and mackerel are often targeted by the same vessels and are sometimes targeted together at the same time, it makes sense to consider these alternatives even though they were based on observer data from "herring trips" as defined below.

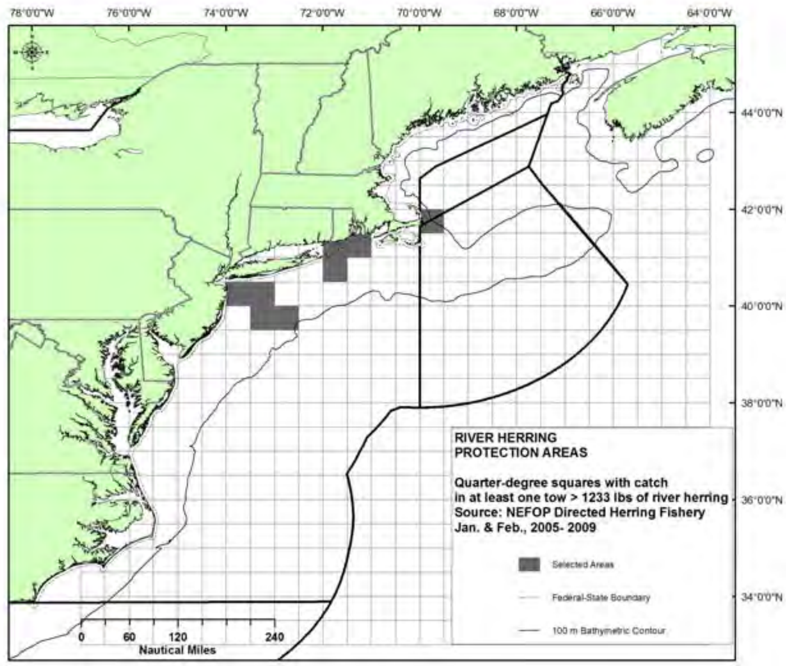
The smallest areas are termed "River Herring Protection Areas." These Protection Areas were identified bimonthly as the quarter degree squares with at least one observed tow of river herring catch greater than 1,233 pounds, using 2005-2009 Northeast Fisheries Observer Program data from trips with greater than 2,000 pounds of kept Atlantic herring during the respective 2-month period. The protection areas include just the portion of the monitoring/avoidance areas (described below) that have the highest river herring catches on Atlantic herring trips as defined above. Since the raw observer data were pooled across years, the threshold was only one tow, and the results are only from Herring Trips, they do not reflect how much total river herring was caught in the Protection Area versus other areas in a given year.

Slightly larger areas are termed "River Herring Monitoring/Avoidance Areas." These Monitoring/Avoidance Areas were identified bimonthly as the quarter degree squares with at least one observed tow of river herring catch greater than 40 pounds, using 2005-2009 Northeast Fisheries Observer Program data from trips with greater than 2,000 pounds of kept Atlantic herring during the respective 2-month period. They include all of the area identified in the protection areas as well is areas where a more modest amount of river herring was caught. Since the raw observer data were pooled across years, the threshold was only one tow, and the results are only from Herring Trips, they do not reflect how much total river herring was caught in the Monitoring/Avoidance Areas versus other areas in a given year.

These protection and monitoring/avoidance areas are mapped below by their respective bi-monthly periods. Since seeing them on the same page clarifies the differences among the areas, they are illustrated together below (where applicable). Management measures that could apply to these areas follow the maps.

Figure 4. <u>January – February Herring Areas</u>

<u>Protection Area (highest catch records from Monitoring/Avoidance Area)</u>



<u>Monitoring/Avoidance Area</u>

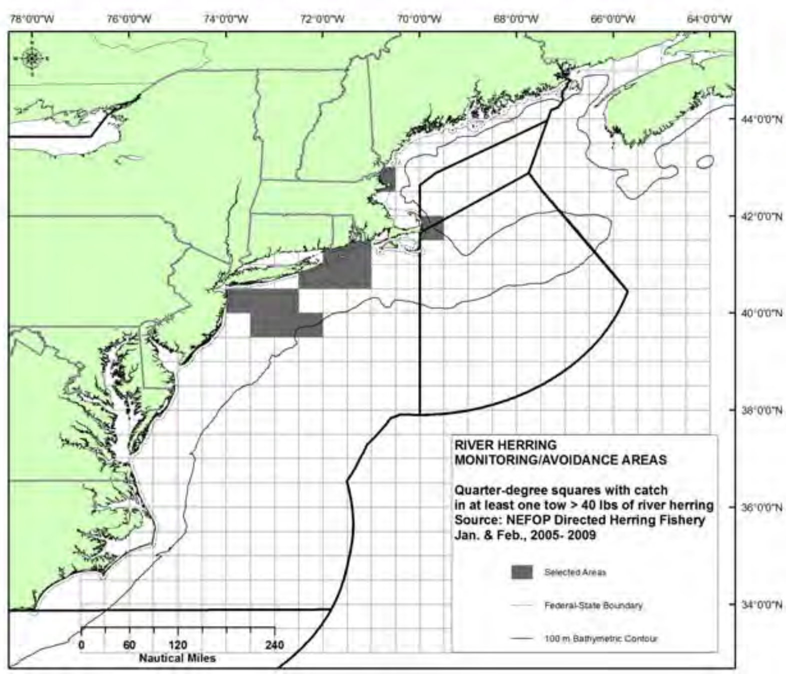
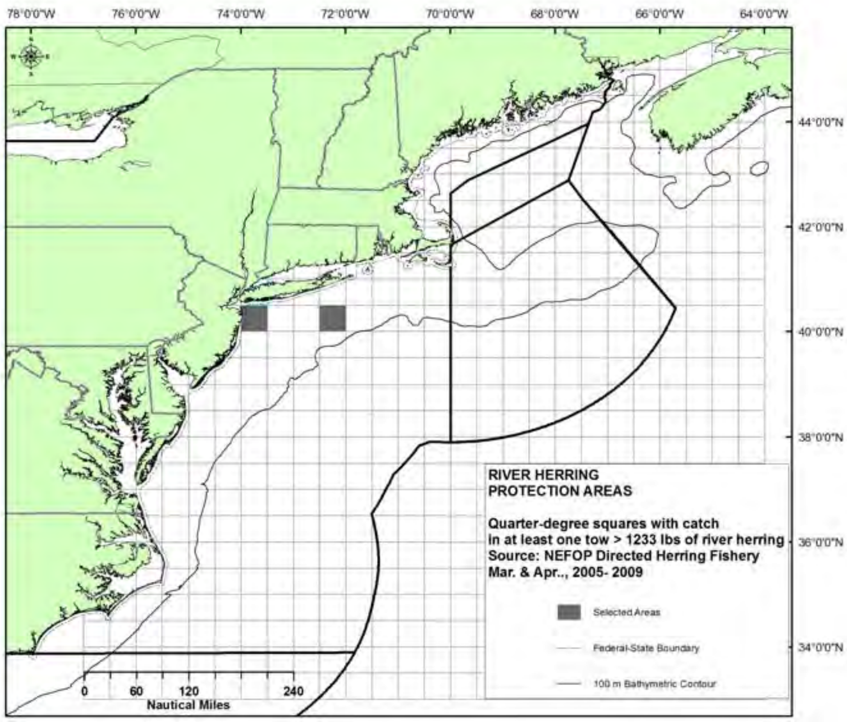


Figure 5. **March – April** Herring Areas

Protection Area (highest catch records from Monitoring/Avoidance Area)



Monitoring/Avoidance Area

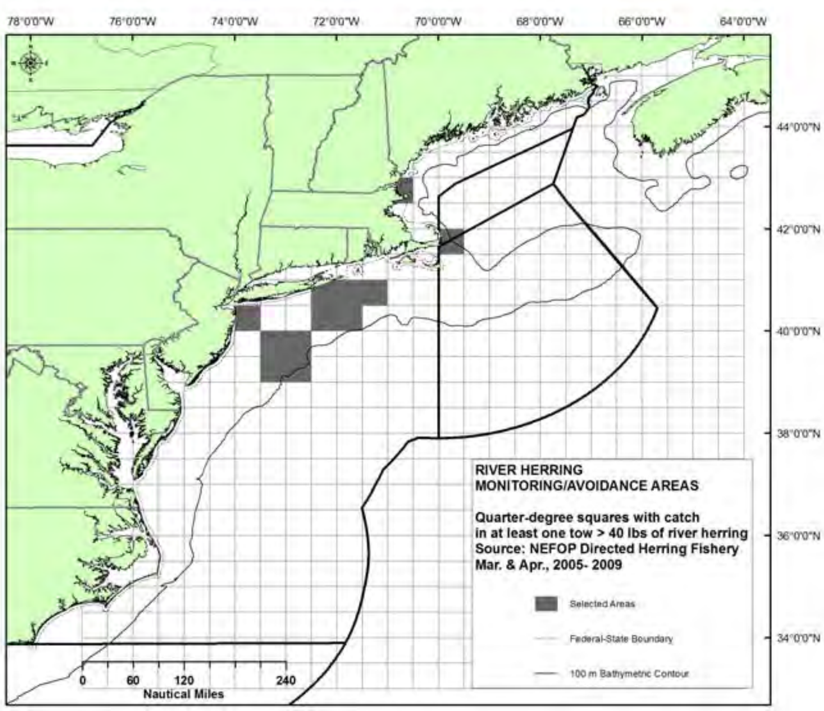


Figure 6.**May – June** Herring Areas

Protection Area

None proposed – there were no qualifying observer records (quarter degree squares with at least one observed tow of river herring catch greater than 1,233 pounds, using 2005-2009 Northeast Fisheries Observer Program data from trips with greater than 2,000 pounds of kept Atlantic herring).

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Monitoring/Avoidance Area

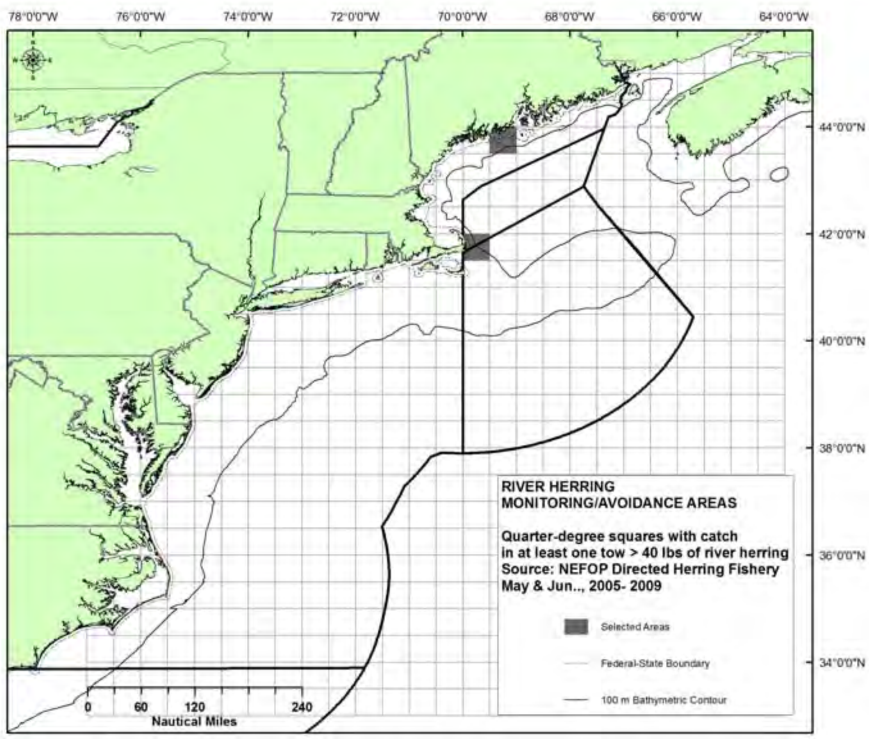

Figure 7.<u>July – August **Herring Areas**</u>

<u>Protection Area</u>

None proposed – there were no qualifying observer records (quarter degree squares with at least one observed tow of river herring catch greater than 1,233 pounds, using 2005-2009 Northeast Fisheries Observer Program data from trips with greater than 2,000 pounds of kept Atlantic herring).

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<u>Monitoring/Avoidance Area</u>

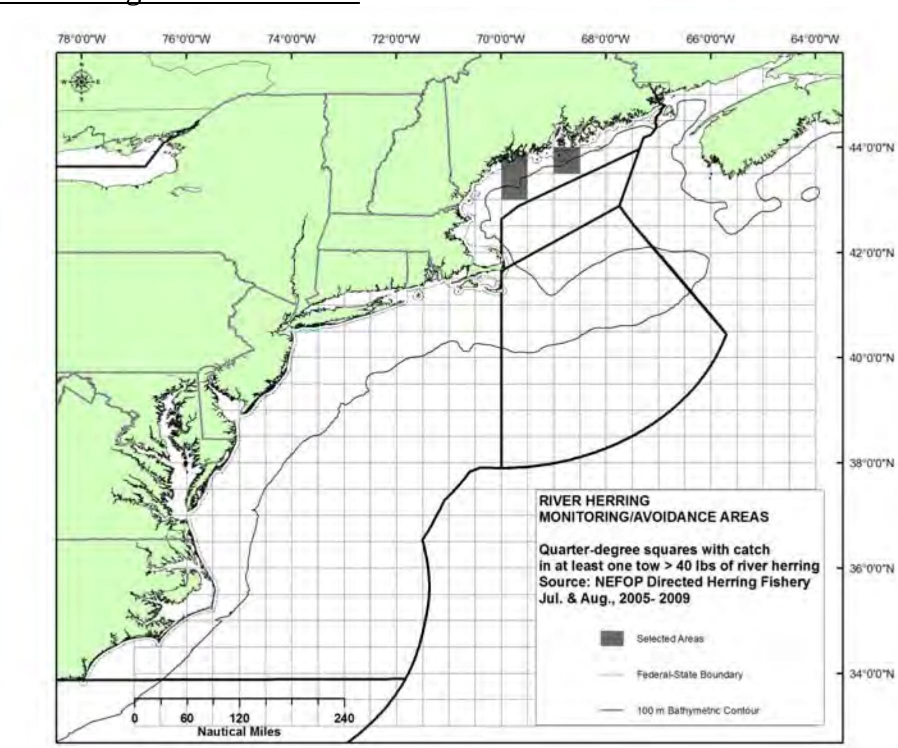
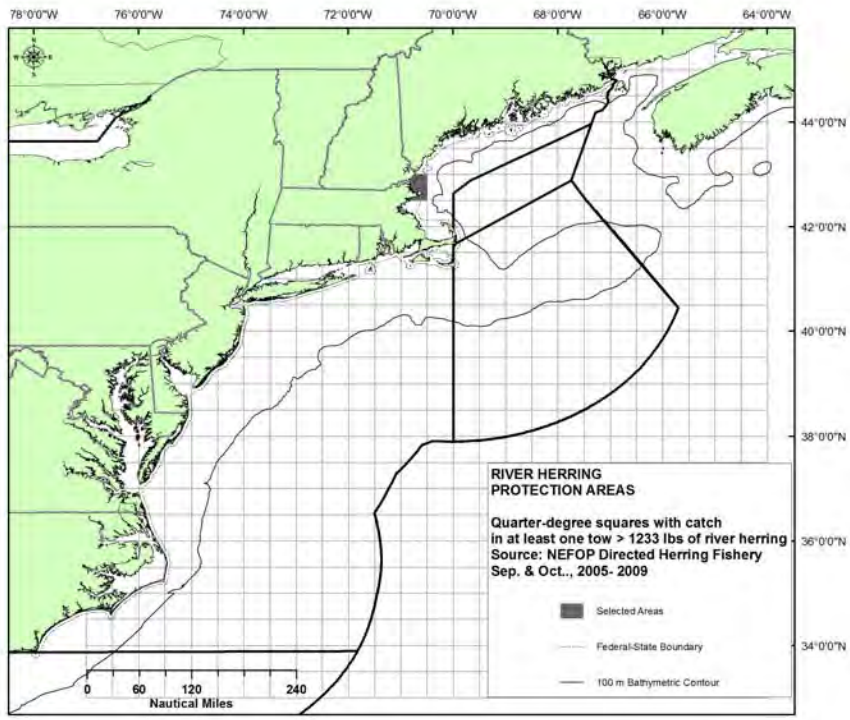


Figure 8.<u>September – October **Herring Areas**</u>

Protection Area (highest catch records from Monitoring/Avoidance Area)



Monitoring/Avoidance Area

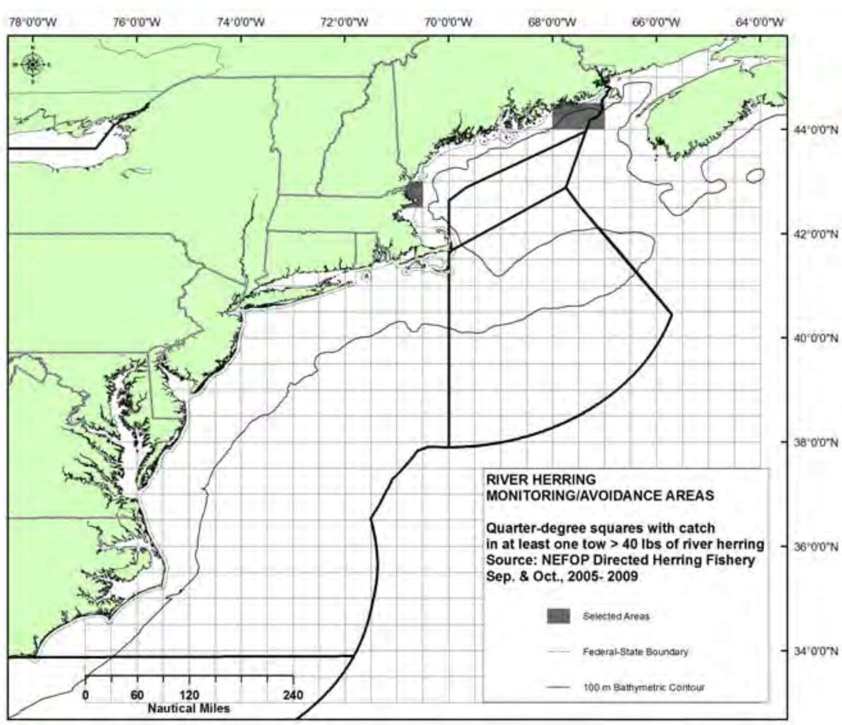
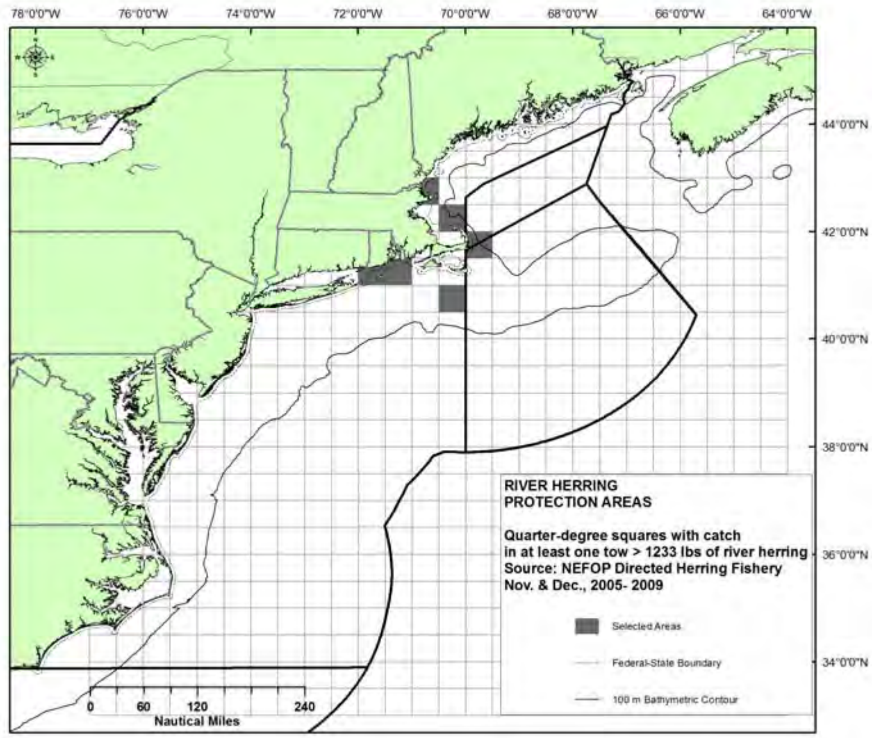
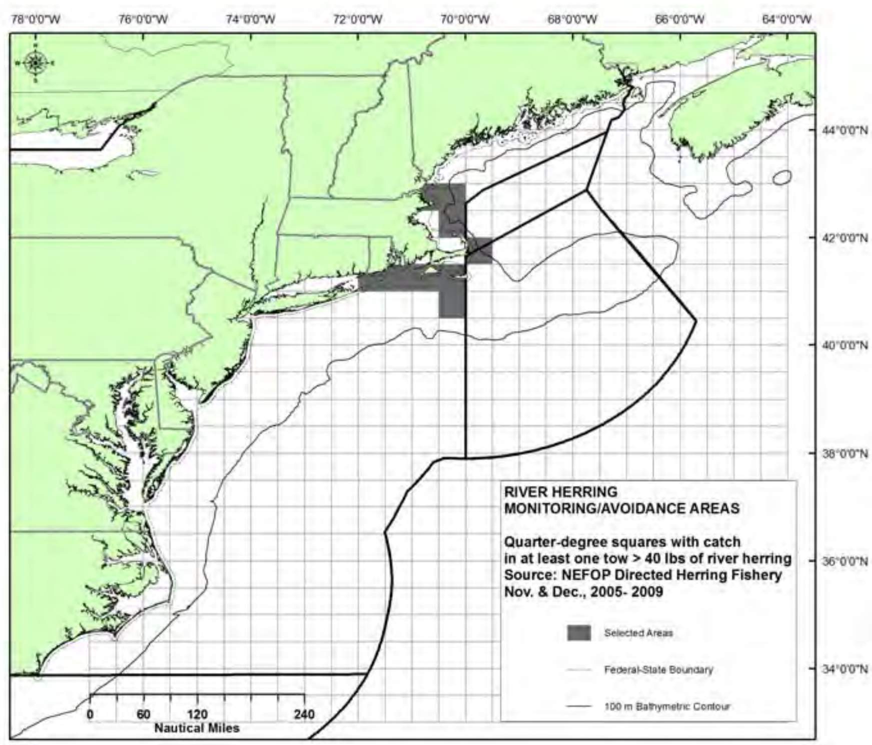


Figure 9. November – December **Herring Areas**

Protection Area (highest catch records from Monitoring/Avoidance Area)



Monitoring/Avoidance Area



Management Measures

For the areas described above a variety of management measures are being considered. A summary of the key biological and human community impacts (detailed in section 7) follows. Related to the FMAT findings that small, inter-annually fixed "hotspot" closures are unlikely to be effective, the impacts for all of the alternatives are the same and are described after all of the potential alternatives are described.

NOTE ON COMBINATIONS: All of the action alternatives in the set could be adopted individually or together. 8f, which would make any of the requirements selected in this Alternative Set only applicable when the same measures were in effect for the Atlantic Herring fishery, would only be chosen if at least one alternative among 8cMack, 8cLong, 8dMack, 8dLong, 8eMack, or 8eLong was also chosen.

Given the overlapping nature of Alternative Sets 7 and 8, it is not expected that alternatives would be chosen from both Alternative Sets 7 and 8 for one fishery. One could select an alternative for the longfin squid fishery from one set and for the mackerel fishery from another set, but not from both sets for one fishery.

The enforceability of area-based management alternatives could be facilitated by the selection of the vessel monitoring system (VMS) requirement in Alternative Set 1 (alternatives 1eMack or 1eLong).

The selection of alternatives that include observer coverage requirements (8cMack and 8cLong) would require the selection of observer program notification alternatives for limited access mackerel permits in Alternative Set 1(1d48 and 1d72).

If an overall observer coverage requirement in Alternative Set 5 was selected but did not result in a trip covered by an alternative in this Alternative Set having an observer, this Alternative Set would effectively require additional coverage.

8a. No-action

If this alternative is selected, then no measures from Alternative Set 8 would be implemented and the existing state management measures (as described in section 5.9) would remain in place. Thus there would be no incremental impacts compared to the status quo, but there are relative impacts compared to the action alternatives, as described below.

NOTE: Due to their similar likely impacts, all impacts for the action alternatives in this Alternative Set are summarized below 8f.

<u>8b</u>. Make implementing the hotspot requirements of NEFMC's Amendment 5 to the Atlantic Herring Plan for Mackerel/longfin squid vessels frameworkable.

The Council would make the hotspot requirements considered below frameworkable under a subsequent action. Biological and Socioeconomic considerations would be reevaluated when the framework was developed.

<u>8cMack</u>. For Atlantic mackerel permitted vessels, more than an incidental level of fish (20,000 pounds mackerel) may not be retained/transferred/ possessed if any fishing occurs in a River Herring Monitoring/Avoidance Area without a NMFS-approved observer at any point during the trip. Vessels would have to pay for observers to meet any observer coverage goals adopted by the Council that are greater than existing sea day allocations assigned through the sea day allocation process (already implemented in other fisheries).

<u>8cLong</u>. For longfin squid permitted vessels, more than an incidental level of fish (2,500 pounds longfin squid) may not be retained/transferred/ possessed if any fishing occurs in a River Herring Monitoring/Avoidance Area without a NMFS-approved observer at any point during the trip. Vessels would have to pay for observers to meet any observer coverage goals adopted by the Council that are greater than existing sea day allocations assigned through the sea day allocation process (already implemented in other fisheries).

<u>8dMack</u>. If a mackerel-permitted vessel is fishing in any River Herring <u>Monitoring/Avoidance</u> Areas identified in this alternative with an observer onboard, vessels would be required to pump/haul aboard all fish from the net for inspection and sampling by the observer. Vessels that do not pump fish would be required to bring all fish aboard the vessel for inspection and sampling by the observer. Unless specific conditions are met (see below), vessels would be prohibited from releasing fish from the net, transferring fish to another vessel that is not carrying a NMFS-approved observer, or otherwise discarding fish at sea, unless the fish have first been brought aboard the vessel and made available for sampling and inspection by the NMFS-approved observer.

• Vessels may make short test tows in the area to check the abundance of target and incidental catch species without pumping the fish on board if the net is reset without releasing the contents of the test tow. In this circumstance, catch from the test tow would remain in the net and would be available to the observer to sample when the subsequent tow is pumped out.

• Fish that have not been pumped aboard may be released if the vessel operator finds that:
1. pumping the catch could compromise the safety of the vessel;
2. mechanical failure precludes bringing some or all of the catch aboard the vessel; or
3. spiny dogfish have clogged the pump and consequently prevent pumping of the rest of the catch.

• If the net is released for any of the reasons stated above, the vessel operator would be required to complete and sign a Released Catch Affidavit providing information about where, when, and why the net was released, as well as a good-faith estimate of the total weight of fish caught on the tow and weight of fish released. The Released Catch Affidavit must be submitted within 48 hours of completion of the fishing trip.

• Following the release of the net for one of the three exemptions specified above, the vessel would be required to exit the River Herring Monitoring/Avoidance Area. The vessel may continue to fish but may not fish in the River Herring Monitoring/Avoidance Areas for the remainder of the trip.

8dLong. If a longfin squid-permitted vessel is fishing in a River Herring Monitoring/Avoidance Areas identified in this alternative with an observer onboard, vessels would be required to pump/haul aboard all fish from the net for inspection and sampling by the observer. Vessels that do not pump fish would be required to bring all fish aboard the vessel for inspection and sampling by the observer. Unless specific conditions are met (see below), vessels would be prohibited from releasing fish from the net, transferring fish to another vessel that is not carrying a NMFS-approved observer, or otherwise discarding fish at sea, unless the fish have first been brought aboard the vessel and made available for sampling and inspection by the NMFS-approved observer.

• Vessels may make short test tows in the area to check the abundance of target and incidental catch species without pumping the fish on board if the net is reset without releasing the contents of the test tow. In this circumstance, catch from the test tow would remain in the net and would be available to the observer to sample when the subsequent tow is pumped out.

• Fish that have not been pumped aboard may be released if the vessel operator finds that:
1. pumping the catch could compromise the safety of the vessel;
2. mechanical failure precludes bringing some or all of the catch aboard the vessel; or
3. spiny dogfish have clogged the pump and consequently prevent pumping of the rest of the catch.

• If the net is released for any of the reasons stated above, the vessel operator would be required to complete and sign a Released Catch Affidavit providing information about where, when, and why the net was released, as well as a good-faith estimate of the total weight of fish caught on the tow and weight of fish released. The Released Catch Affidavit must be submitted within 48 hours of completion of the fishing trip.

• Following the release of the net for one of the three exemptions specified above, the vessel would be required to exit the River Herring Monitoring/Avoidance Area. The vessel may continue to fish but may not fish in the River Herring Monitoring/Avoidance Areas for the remainder of the trip.

<u>8eMack</u>. Vessels possessing a federal mackerel permit would not be able to retain, possess or transfer more than an incidental level of fish (20,000 pounds mackerel) while in a River Herring <u>Protection Area</u> unless no mesh smaller than 5.5 inches is onboard the vessel.

<u>8eLong</u>. Vessels possessing a federal moratorium longfin squid permit would not be able to retain, possess or transfer more than an incidental level of fish (2,500 pounds longfin squid) while in a River Herring <u>Protection Area</u> unless no mesh smaller than 5.5 inches is onboard the vessel.

<u>8f</u>. Make the above measures 8cMack, 8cLong, 8dMack, 8dLong, 8eMack, or 8eLong only effective if/when they are effective for Atlantic Herring vessels, including if they become effective in the middle of a season because a catch-cap based trigger is reached by the Atlantic Herring fleet under a trigger established by Amendment 5 to the Atlantic Herring FMP.

<u>Summary of Biological Impact Analysis</u>

A neutral or minimal impact would be expected compared to the no-action alternative. Vessels may fish elsewhere with the action alternatives but since the areas are relatively small, while there may be some redirection or displacement of fishing effort due to these alternatives, it would not be expected that over time the new areas would be substantially different than the old areas in terms of non-target impacts (including RH/S) given the wide and variable distribution of most non-target species including RH/S. RH/S catch may decreased inside the hotspot but increased outside the hotspot. This is consistent with the findings of the FMAT analyses detailed in Appendices 1 and 2.

<u>Summary of Socio-Economic Impact Analysis</u>

A low negative impact would be expected compared to the no-action alternative. Given the complexity of fishermen's responses to regulations and given the protection areas are relatively small, the effects may not be substantial for most fishermen in most years compared to the no-action alternative (they will fish other areas around the hotspots). However, near-shore fishermen near the closed areas may be disproportionately impacted by closures around their home port.

2.1.9 <u>Alternative Set 9</u> – Addition of RH/S as "Stocks in the Fishery" in the MSB FMP

<u>Background/Statement of Problem/Need for Action:</u>

The current overall framework for RH/S management may be insufficient to address the management needs of RH/S.

The Magnuson Stevens Act describes various "National Standards" for fishery management plans. National Standard One (NS1) states: "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry." NMFS has published detailed guidance for NS1, available at: http://www.nmfs.noaa.gov/msa2007/catchlimits.htm. While Council's are provided considerable flexibility, the guidance describes which stocks should be "in the Fishery" and describes the requirements for those stocks deemed by a Council to be "in the Fishery." The NS1 guidance is described in more detail in Section 5.

The impacts for all of the RH/S species are essentially the same so they are discussed together. While there may be differences of degrees, since these fish occupy similar habitats and trophic niches, and face similar challenges, the differences do not warrant a discussion for each species separately. Thus, when RH/S is used it means one, several, or all four of the relevant species. A summary of the key biological and human community impacts (detailed in section 7) follows for each alternative.

NOTE ON COMBINATIONS: All of the action alternatives in the set could be adopted individually or together.

9a. No-action

Under the no-action alternative, primary RH/S management would continue to rest with the states as coordinated through the ASMFC as described in section 5.9. The states would continue to address catch in state waters and address habitat improvements through collaborative work with NOAA, U.S. F&W Service, and private partners. From the Council perspective, RH/S would continue to be managed as a bycatch species, with bycatch to be minimized to the extent practicable. The Council could also continue to consider discretionary measures designed to reduce retained incidental catch (bycatch is defined as discards in the MSA) as it is doing in Amendment 14.

If this alternative is selected, then no measures from Alternative Set 9 would be implemented and the existing state management measures (as described in section 5.9) would remain in place. Thus there would be no incremental impacts compared to the status quo, but there are relative impacts compared to the action alternatives, as described below.

9b. Add blueback herring as a stock in the MSB FMP.

9c. Add alewife as a stock in the MSB FMP.

9d. Add American shad as a stock in the MSB FMP.

9e. Add hickory shad as a stock in the MSB FMP.

The Council could add none, one, or any combination of these species as "stocks" in the fishery. Selecting any of the action alternatives would result in the Council immediately beginning another amendment to add all of the provisions 1-15 above to the FMP for any species that is added. Such a process would likely take another 1-2 years to complete, with the development of ACLs/AMs (or ACL alternatives) and essential fish habitat designations taking the most time and being the most substantive of those provisions.

If an assessment was available and if it contained accepted reference points, any need for rebuilding that was indicated by those reference points could also lead to major actions.

Since RH/S are already managed by the ASMFC, and since substantial catches of RH/S take place in state waters, the plan would likely have to be a joint plan with the ASMFC. It is possible that the Council could attempt to defer primary management of catches (ACLs) to the ASMFC as discussed below.

Once the species were added through the follow-up amendment, NMFS would begin conducting habitat consultations for any identified EFH for federal and/or federally permitted actions (i.e. non-fishing impacts). An evaluation of fishing activities impacts on RH/S habitat and consideration of measures to minimize such impacts would also take place, possibly in the follow-up amendment or possibly afterward through another action.

In the amendment to implement the MSA provisions for a "stock in the fishery," the Council would have to decide whether to implement standard ACLs with accountability measures or make the case that an alternative equivalent could function as an ACL (this applies to any RH/S species that were added). In the first case, the Council's SSC would have to provide an Acceptable Biological Catch (ABC) (regardless of whether information was available on sustainable catch levels), which would be the ACL, and then all sources of mortality would have to be accounted for and controlled to ensure that the ACL was not exceeded. Such controls could involve RH/S retention limits, retention prohibitions, and or measures to reduce discards from relevant gear types such that ACLs would not be exceeded.

In the second case, the Council would have to make the case that alternative management measures are taking the place of an ACL, in the way that the North Pacific Fishery Management Council has made the case that Salmon moratoria in certain federal waters plus Alaska's escapement-based management measures effectively create a justifiable alternative approach to Council-derived ACLs/AMs. Their argument hinges on the fact that the State of Alaska monitors catch in all of the salmon fisheries and manages salmon holistically by incorporating all the sources of fishing mortality on a particular stock or stock complex in calculating the escapement goal range. As explained above, overfishing is prevented by in-season monitoring and data collection that indicates when an escapement goal is not being met. When the data indicate low run strength due to natural fluctuations in salmon abundance, Alaska Department of Fish & Game closes the fishery to ensure the escapement goal range is reached. Biological escapement goal (BEG) means the escapement that provides the greatest potential for maximum sustained yield. BEG is the primary management objective for escapement (NPFMC 2011).

In order to pursue a similar path a be consistent with the MSA, it would appear that the Council would have to make that argument that the States were pursuing management based on biologically-based escapement goals and that those goals had taken all sources of mortality into account, including ocean-intercept fishing mortality. This may be problematic especially in states with moratoriums because they do not know the status of their runs (most) – if they do not know the status of their runs it would seem to be difficult to make the case that whatever at-sea mortality occurs has been accounted for and that taking everything into consideration a sustainable outcome would result.

The two ACL/AM approaches described above would be options for the Council to explore if it decided to move forward with adding any RH/S species as stocks in the MSB FMP.

Note: Due to the difficulty in identifying the two river herrings and the two shads in landings data it is assumed that for ACL/AM purposes that they could be addressed together (i.e. a river herring ACL and a shad ACL).

Summary of Biological Impact Analysis (9b-9e)

Impacts to RH/S would be expected to be positive for all relevant RH/S species and in approximately the same fashion. It is not possible to develop all of the measures (especially EFH and ACLs) that would be necessary for the FMP not to be deficient if any RH/S species were officially added as stocks in the fishery in this document. Instead, selection of an Alternative Set 9 action alternative would “kick off” another Amendment to fully add stocks to the MSB FMP in a manner that would keep the plan in compliance with the Magnuson Stevens Act. The only substantial negative impact would be costs for management and whether those costs could be justified by the potential benefits. Accordingly, the focus here is on the potential benefits so that managers can weigh the trade-offs between potential benefits and the additional costs of adding stocks as managed resources in the MSB FMP.

Impacts Specific for RH/S if They Were Added as Stocks in the Fishery, Compared to the No-Action Alternative

Impacts to RH/S would be expected to be positive for all relevant RH/S species and in approximately the same fashion given their similar life histories and place in the ecosystem. However, quantification is very difficult given the myriad challenges facing RH/S stocks. The only substantial negative impact would be costs for management and whether those costs could be justified by the potential benefits. Accordingly, the focus here is on the potential benefits so that managers can weigh the trade-offs between potential benefits and the additional costs of adding stocks as managed resources in the MSB FMP.

1. There would be additional federal support of RH/S management (assessments, FMP and specifications review, etc.) and additional coordination of conservation activities.

Right now there is some federal involvement by U.S. Fish and Wildlife Service, NMFS Northeast Region Protected Resource Branch staff, NMFS Northeast Fisheries Science Center staff, and Council staff (quasi-federal) in RH/S management. However, these staffers do not have RH/S as a primary responsibility or focus. For example, there is no RH/S coordinator at the NMFS Northeast Regional Office or a fishery management council RH/S coordinator, as there is for directly managed resources. There is direct involvement by a lead Atlantic States Marine Fisheries Commission (ASMFC) staffer but without dedicated leads at other agencies coordination can be difficult (and the ASMFC staffer also coordinates American Eel, Atlantic Striped Bass, and Sturgeon). If RH/S were added as managed species into the MSB FMP, it may add staff with RH/S responsibilities (at NMFS or at the Council) or at the least existing staff would have RH/S responsibilities added to their primary activities. So for example, there would be a NMFS Northeast Region plan coordinator for RH/S, a Council plan coordinator for RH/S, a NMFS Northeast Fisheries Science Center assessment lead, etc., even if it primarily involves a reassignment of duties among current staff. As part of coordination responsibilities the Council coordinator and NMFS coordinator would each likely become more involved in a wide range of RH/S conservation activities especially in terms of how fishing interacts with the variety of challenges facing RH/S stocks.

These staffers would also become responsible for several annual/cyclic activities. First, they would conduct annual fishery descriptions and fishery reviews as part of specifications. Second, they would become more directly involved in assessments since NMFS strives to complete successful assessments for managed species in order to improve is Fish Stock Sustainability Index score, the primary measure of how well NMFS is performing it's duties (http://www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm). Adding these stocks into the FMP would not guarantee that reference points/stock determination criteria would be available (reference points are generally not available for even the existing species in this plan due to high levels of scientific uncertainty) but at least additional resources would likely be expended on RH/S assessment (though they may just be diverted from other species due to the current budget environment). If an assessment successfully generated reference points and status determination criteria then rebuilding requirements would be instituted if a stock was found to be overfished.

As part of specifications the Council's SSC would also review RH/S status and make Acceptable Biological Catch recommendations. If ACLs were instituted (see below) they would provide ACL recommendations but even if ACLs were not instituted (see additional discussion below) the Council would need a functional equivalent for incidental catch in its other managed fisheries and the SSC would likely provide relevant recommendations. Related to incidental catch management, another annual activity would be integrating RH/S considerations into bycatch reporting and observer prioritization. While NMFS has been diverting resources from other small mesh fisheries to mackerel in the last year to better characterize RH/S interactions, as a stock in the fishery NMFS would have to directly describe its plans for RH/S bycatch monitoring, and the Council would presumably have a stronger case arguing for more coverage for a managed species than it currently can make in terms of making a case for more resources about a non-target species.

Adding RH/S as stocks in the fishery would also change the nature of management actions that are available to the Council. Currently the Council is limited to addressing catch in its other managed fisheries. If RH/S were stocks in the fishery, as managed stocks the Council could implement restrictions on other fisheries that interact with RH/S. As an example, currently the Summer Flounder-Scup-Black Sea Bass FMP restricts all bottom trawling in areas where survey data has shown scup to aggregate. If RH/S were managed species the Council could implement broader restrictions on fishing activities beyond its other managed species if necessary and/or appropriate to conserve RH/S.

2. EFH would be designated for RH/S.

Designating EFH for RH/S would increase NMFS's ability to conserve habitats used by these anadromous species, especially freshwater habitats used for spawning and as juvenile nursery areas that are most affected by a wide range of human activities.

Currently, acting under the authority of the MSA, there is a mandatory requirement that NMFS must issue EFH conservation recommendations to federal agencies for activities proposed, funded, permitted, or undertaken by those agencies. Designation of EFH for RH/S would greatly expand the geographic boundaries where mandatory consultations would be required including most coastal rivers and their watersheds on the Atlantic coast. With such designation comes the authority to more aggressively regulate the adverse impacts of non-fishing activities on riverine and estuarine habitats for these species. However, the agency may lack the resources to effectively implement the necessary actions, similar to the Agency's funding issues with Atlantic salmon (see below).

Since A) states are already independently acting to improve riverine habitats B) NOAA has ongoing consultations with upstream dam removal/riverine habitat improvement projects, and C) NMFS has already been successful mitigating impacts to some habitats (tidal riverine waters) used by RH/S because they are forage species for other federally-managed fish species (e.g., bluefish), and are, therefore, considered a component of EFH for these predatory species, it is unclear exactly what the marginal added function of NOAA EFH efforts would be.

NMFS also already prescribes mandatory measures necessary to provide safe, timely and effective passage around hydropower facilities (upstream and downstream) under Section 18 of the Federal Power Act. However, this authority is only applicable to those hydropower facilities licensed by the Federal Energy Regulatory Commission and most FERC licenses are issued for a period of 30 + years.

Freshwater habitats used by RH/S also already benefit indirectly from EFH conservation measures that are proposed for Atlantic salmon because salmon and RH/S share many of the same habitats. However, the indirect benefits of Atlantic salmon EFH conservation are limited to those areas within New England where Atlantic salmon EFH rivers are located and are greatly constrained by funding limitations. The U.S. Fish and Wildlife Service is also engaged in riverine habitat issues but their focus is primarily on dam passage issues.

In summary, designation of EFH for RH/S would greatly expand the geographic boundaries where mandatory consultations would be required for activities that may impact RH/S habitat but it is unclear what tangible benefits would accrue beyond those already being pursued by the states, NMFS, and other federal agencies.

3. ACLs and AMs would likely be implemented.

Compared to the no-action alternative, if ACLs/AMs were established there would be better accounting of RH/S catch. If overfishing limits are identified (none exist now) then high quality catch data can be used to prevent overfishing, which would be a positive impact for any RH/S species that had ACLs/AMs. Adding ACLs/AMs also has some costs, primarily the costs of reporting and monitoring. However, regardless of the ACL/AM question additional reporting and monitoring provisions are being considered for RH/S.

One question that has surfaced repeatedly has been "Could the Council add river herring or shad as stocks in the fishery but use the ACL/AM flexibility provisions of the NS1 guidance to defer to ASMFC for primary management?" The NPFMC is considering such a path for salmon and deferring to Alaska. This could theoretically allow the designation of EFH and result in greater federal resources without having to deal with ACLs for the currently data-poor RH/S stocks. There are several key issues however, which become evident when reviewing analysis for updating the NPFMC's salmon plan (http://www.fakr.noaa.gov/npfmc/), where Alaska has primary authority even though it is a federally managed species. First, Alaska has a long history of well-documented successful/sustainable management with salmon. Second, the salmon situation is different in that RH/S landings, and certainly discards, appear not nearly as well documented (especially at the species level) as salmon landings and discards. Existing or pending ASMFC moratoriums will likely address most of the landings control but not discards and some states may still allow relatively uncontrolled landings of RH/S that are caught incidentally in federal waters. For these reasons it currently seems likely that ACLs and AMs would be needed, i.e. it would be difficult to argue that the state management would effectively account for all catch. This is at least the viewpoint of the Amendment 14 FMAT and NOAA GC, though the Council looks forward to getting additional perspectives on this topic during the public input process.

The ACL flexibility guidelines also still require consistency with Magnuson (alternatives to ACLs/AMs would have to essentially achieve the same results). So even if primary management could be ceded to the ASMFC, the Council's suite of management measures would still have to function as ACLs/AMs. Thus the Council would still have to implement hard caps on its other managed species to control overall catch (this is the case with Salmon in the North Pacific's groundfish fishery).

Also if ASMFC had primary responsibility, the Council would have to limit incidental catch in its directed fisheries based on the best available science about what catch level is consistent with sustainability and/or rebuilding as well as accounting upfront for whatever catch (landings and/or discards) occurs in state waters. Thus while there might not be ACLs/AMs on paper, the caps on incidental catch in Council-managed fisheries would need to have the same function as ACLs/AMs in order to be consistent with the Magnuson Act and the National Standard One final rule guidelines. Again however, this is the viewpoint of the Amendment 14 FMAT and NOAA GC and the Council looks forward to getting additional perspectives on this topic during the public input process.

If the Council added RH/S as a stock in the fishery and just the provisions deferring primary management to the ASMFC were disapproved by NMFS or struck down in subsequent legal action then the standard ACL provisions would presumably apply. If such events took place, or if the Council decided to just outright add one or more RH/S stocks into the fishery then ACLs and AMs would be required, along with all the other requirements of fishery management plans (EFH, rebuilding when appropriate, etc.) as detailed in section 5.9.

While ASMFC/Council coordination for RH/S issues has been extensive in the last 2 years the ramifications of ACLs would likely lead to additional collaboration. The Council would either have a joint or complementary plan with the Commission and ACLs or other catch quotas for federal management would be based on ABCs provided by its SSC and would have to account for any state fishing mortality beyond the control of the Council. While the Council would not be able to totally control all mortality because of state fisheries and discards in state waters, mortality in federal waters would be limited. If an Acceptable Biological Catch (ABC) provided by the Council’s SSC was greater than anticipated state mortality then the difference could be utilized as federal water mortality.

Alternative Set 9 Summary and Conclusion

The two key questions that will have to be answered by the Council are: 1) Is the current management framework is sufficient to conserve RH/S stocks; **<u>and</u>** 2) Can federal management by the Council improve management of RH/S enough to justify the management cost burden. It is not clear that Council involvement would be sufficient to conserve RH/S stocks given the varied challenges faced by RH/S stocks. It also may be true that the Council could achieve much of what it would do for RH/S informally outside of federal FMP management. However, adding RH/S stocks into an FMP would likely bring additional resources to bear and at least result in additional efforts and coordination between ASMFC, NMFS, the Council, the states, and other management partners for whichever stocks were chosen if any. The future efforts of these organizations are difficult to predict, but it is reasonable to conclude that there would be some gains for RH/S species through future actions if they are listed as stocks in the MSB fishery, as described above. However, the uncertainty regarding the current factors causing RH/S populations to remain in a depressed state means that it is difficult to identify specific causes and link remedies to specific outcomes. Given this, the extent of benefits from adding RH/S as stocks in the fishery is very difficult to quantify even though impacts are likely to be positive.

Given RH/S share similar life histories each would benefit to some degree if any were chosen, but each species would benefit most if it itself was chosen due to the catch control, EFH conservation, and general management coordination that would result.

Summary of Socio-Economic Impact Analysis (9b-9e)

Impacts are mixed with an uncertain net impact.

On one hand, if additional incidental catch reduction was required as a result of adding this species as a stock in the fishery there could be negative economic impacts to the MSB or other fisheries. Such actions and their impacts would be analyzed separately in other specifications, frameworks, or amendments. This document considers a number of different measures to reduce incidental catch of RH/S, and the reader can look to Sections 7.6-7.8 for analyses of how some types of RH/S catch reduction measures can impact human communities. Revenue losses (or potentially forgone revenue) from such measures range from very low in the case of a cap that does not constrain the fishery to near elimination of the mackerel and longfin squid fisheries in the case of the broadest area closures (they have had a combined value in the $18-$36 million dollar range in the last 5 years). It is also possible that the Council could select some of these measures to reduce incidental catch in mackerel/longfin squid fisheries, but may still have to implement further measures to reduce RH/S catch through this or its other FMPs for other fisheries.

On the other hand, it is also possible that benefits could accrue in the future if adding these species as federally managed species assisted in conserving these stocks and potentially redeveloping directed fisheries (which is uncertain). While historical high levels of landings may have been unsustainably high , RH/S fisheries had combined landings in the 20,000 mt to 30,000 mt range throughout the 1950s and 1960s ranging from Maine to South Carolina. While there are some issues (climate, stream flow, non-point run-off, etc.) that the Council may have minimal impact upon, to the degree that enhanced conservation efforts can assist recovery, then positive human community impacts are possible in terms of both additional commercial and additional recreational fishing opportunities that could result from rebuilt RH/S stocks. Recreational benefits could be direct (catching RH/S) or indirect in that RH/S are forage species for higher trophic level predators such as striped bass so higher RH/S populations could indirectly help striped bass populations.

River Herring and Shad runs also are or have been important culturally for communities (just Google “Shad Festival” or “Herring Festival”) and even recently have supported some subsistence fishing (e.g. Mashpee Wampanoag Indian Tribe on Cape Cod, Massachusetts (ASMFC 2011). There also are other non-market existence values (i.e. value gained by the public related to the knowledge that these species are being conserved successfully) that could increase in value from successful management. Public interest in this amendment demonstrates that that the general public holds a certain value for the knowledge that these fisheries are being sustainably managed, and even if each individual's value is small the total public value may be quite large.

If limiting RH/S catch, EFH designation and protection, and increased federal-state cooperation through this alternative set led to rebuilding then the benefits of the action alternatives would be large. If limiting RH/S catch through this alternative set did not substantially lead to rebuilding (i.e. other factors are primarily to cause for RH/S declines - see sections 6.2.5 and 6.2.6) then the benefits of the action alternatives would be minor. Future research may provide information on what factors are primarily responsible to RH/S declines but currently that information is not available.

2.2 Summary Tables

Overview of Measures Table: Table 8 provides a concise general summary of the measures and their anticipated effects. An initial cumulative effects assessment (CEA) was conducted for this draft document in Section 8. Once final preferred measures are selected a table will be added to this executive summary with a cumulative effects summary.

For all Alternative Sets (1-9) and all valued ecosystem components (VECs), the first alternative ("a") equals no-action, which is what is predicted to happen with the status quo management measures. Subsequent alternatives are the action alternatives and diverge from the status quo management measures as described in Section 5. The impact analysis focuses on the valued ecosystem components (VECs) that were identified for Amendment 14 and described in detail in Section 6.0 of this document. These VECs include:

1. Managed Resources
   - Atlantic mackerel stock
   - *Illex* stock
   - Longfin squid stock
   - Atlantic butterfish stock
2. Non-target species
   -Non-Target species include river herrings (blueback and alewife) and shads (American and hickory), collectively referred to as RH/S. Given the lack of information on how these species travel and mix in the ocean, different impacts are generally not discernible between these species but are noted where appropriate (for example in caps that are placed on particular species)
3. Habitat including EFH for the managed resources and non-target species
4. Endangered and other protected resources
5. Human Communities

While in previous MSB FMP EISs the impacts from all alternatives are grouped together for each VEC, with the large number of alternatives in this amendment (more than 80), the result would that one would start with managed resources, have 80+ associated impacts, then have 80+ impacts for non-target species, and so on with the other VECs. This format seemed to lead to a disconnect in evaluating each alternative in terms of its overall positive and negative impacts across different VECs. As a result, the impact analysis in this EIS proceeds alternative by alternative with impacts for each VEC described for a given alternative before moving on to the next alternative's impacts.

Subsequently summarizing impacts by VEC was stymied by the number of possible action alternative combinations that could result from final Council action (more than millions). Any summary would hinge on the particular combination of alternatives selected by the Council, and no preferred alternatives have been identified by the Council at this point. The Final EIS will have that information however and will detail the combined effects of the Council's preferred alternatives. This will also facilitate creation of a summary by VEC for the preferred alternatives chosen by the Council.

In these tables, a variety of terms (e.g. positive or negative) have specific meanings for each VEC and are described below. These are the same as are used in the impact analysis section, Section 7.

Managed Species, Non-Target Species, Protected Species:

Note: Often impacts are indirect in that an action may change overall effort, which would decrease impacts if effort goes down or increase impacts if effort goes up.

Neutral/minimal: actions that are expected to have no discernible impact on stock/population size. The table below uses just "minimal" to save space.
Positive: actions that increase stock/population size
Negative: actions that decrease stock/population size

Habitat:

Note: Often impacts are indirect in that an action may change overall effort, which would decrease impacts if effort goes down or increase impacts if effort goes up.

Neutral/minimal: actions that are expected to have no discernible impact on habitat. The table below uses just "minimal" to save space.
Positive: actions that improve the quality or reduce disturbance of habitat
Negative: actions that degrade the quality or increase disturbance of habitat

Human Communities:

Neutral/minimal: actions that are expected to have no discernible impact on human communities. The table below uses just "minimal" to save space.
Positive: actions that increase revenue and well-being of fishermen and/or associated businesses
Negative: actions that decrease revenue and well-being of fishermen, associated businesses, or other interested parties.
Mixed: The action would create benefits for some and costs for others. Generally there are costs to MSB fishery participants but potential benefits to other fishermen (commercial or recreational) or other interested parties who value MSB or RH/S resources. Since the linkages between catches in MSB fisheries and RH/S resources is not known, it is generally uncertain regarding which would be greater, costs to current MSB participants or benefits to other interested parties.

Impact Qualifiers:

The following qualifiers are also used in the impact analysis:

Low (as in *low* positive or *low* negative): to a lesser or small degree
High (as in *high* positive or *high* negative) to a greater or large degree
Potentially: A relatively higher degree of uncertainty is associated with the impact. Often this qualifier is used when an action may lead to better data, but future actions would have to actually use that data in decision making in order for there to be a concrete benefit.

If impacts are expected to be isolated to a particular species, usually either mackerel, longfin squid, *Illex* squid, butterfish, or river herrings and shads (RH/S) then this fact will be noted as well.

To some the extent the operation of the MSB fisheries may currently be negatively affecting the directed fisheries, RH/S stocks, other non-target species, habitat, and protected resources compared to if there was no fishery. However the fisheries exist currently, so their continued operation under "no-action" would result in similar impacts as occur presently. As such, all comparisons in Table 8 are in reference to changes from the no-action alternative but Section 7 also discusses how the no-action alternative may compare to the action alternatives.

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Table 8. Alternative Impact Summary Table

Management Measures	Valued Ecosystem Component (VEC) Impacts				
	Managed resource	Non-target species Esp. RH/S	Habitat including EFH	Protected Resources	Human Communities
1a No Action	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo
1bMack mackerel weekly VTRs	Potentially Low Positive - better monitoring	Potentially Low Positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
1bLong longfin weekly VTRs	Potentially Low Positive - better monitoring	Potentially Low Positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
1c MSB weekly VTRs	Potentially Low Positive - better monitoring	Potentially Low Positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
1d48 48hr notice for mackerel trips	Potentially Low Positive - better observer placement	Positive - better observer placement	Minimal - no substantial change in effort expected	Potentially Positive - better observer placement	Mixed (positive and negative impacts for different interests)
1d72 72hr notice for mackerel trips	Potentially Low Positive - better observer placement	Positive - better observer placement	Minimal - no substantial change in effort expected	Potentially Positive - better observer placement	Mixed (positive and negative impacts for different interests)
1eMack VMS for mackerel vessels	Potentially Low Positive - better monitoring	Potentially Positive - better monitoring	Minimal - no substantial change in effort expected	Potentially Positive - supports area closures	Mixed (positive and negative impacts for different interests)
1eLong VMS for longfin vessels	Potentially Low Positive - better monitoring	Potentially Positive - better monitoring	Minimal - no substantial change in effort expected	Potentially Positive - supports area closures	Mixed (positive and negative impacts for different interests)
1fMack VMS reporting for mackerel	Potentially Low Positive - better monitoring	Potentially Low Positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
1fLong VMS reporting for longfin	Potentially Low Positive - better monitoring	Potentially Low Positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
1gMack 6hr pre-land VMS for mackerel	Potentially Low Positive - better monitoring	Potentially Positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
1gLong 6hr pre-land VMS for longfin	Potentially Low Positive - better monitoring	Potentially Positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)

(continued)

Management Measures	Valued Ecosystem Component (VEC) Impacts				
	Managed resource	Non-target species Esp. RH/S	Habitat including EFH	Protected Resources	Human Communities
2a No Action	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo
2b Vessel SAFIS Confirmation	Low positive - better record keeping	Low positive - better record keeping	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Potentially Low Positive - better record keeping
2c mackerel catch weighing with annual sorting documentation	Low positive - better monitoring	Low positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
2d mackerel catch weighing with sort doc for each transaction	Low positive - better monitoring	Low positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
2e longfin catch weighing with annual sort doc	Low positive - better monitoring	Low positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
2f longfin catch weighing with sort doc for each transaction	Low positive - better monitoring	Low positive - better monitoring	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
2g Allow volume to weight conversions	Neutral - equivalent to status quo	Neutral - equivalent to status quo	Neutral - equivalent to status quo	Neutral - equivalent to status quo	Neutral - equivalent to status quo

(continued)

Management Measures	Valued Ecosystem Component (VEC) Impacts				
	Managed resource	Non-target species Esp. RH/S	Habitat including EFH	Protected Resources	Human Communities
3a No action	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo
3B reasonable assistance	Low Positive - improves observer data	Low Positive - improves observer data	Minimal - no substantial change in effort expected	Low Positive - improves observer data	Minimal
3c pump/haul notice	Low Positive - improves observer data	Low Positive - improves observer data	Minimal - no substantial change in effort expected	Low Positive - improves observer data	Minimal
3d paired observers	Low Positive - improves observer data	Low Positive - improves observer data	Minimal - no substantial change in effort expected	Low Positive - improves observer data	Minimal
3e slippage reports	Low Positive - improves observer data	Low Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Minimal
3f no discards before sampling mackerel	Low Positive - improves observer data	Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
3g no discards before sampling longfin	Positive - improves observer data	Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
3h 1 slip termination	Positive - improves observer data	Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
3i 2 slip termination	Positive - improves observer data	Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
3j Closed Area 1 Rules	Positive - improves observer data	Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
3k 5 annual mackerel slips then trip termination for if more	Low Positive - improves observer data	Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
3l 10 annual mackerel slips then trip termination for if more	Low Positive - improves observer data	Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)

(continued)

Management Measures	Valued Ecosystem Component (VEC) Impacts (cont)				
	Managed resource	Non-target species Esp. RH/S	Habitat including EFH	Protected Resources	Human Communities
3m 5 trimester longfin slips then trip termination for if more	Positive - improves observer data	Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
3n 10 trimester longfin slips then trip termination for if more	Positive - improves observer data	Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
3o repeat observers for canceled trips	Low Positive - improves observer data	Low Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
3p individual vessel slippage quota	Potential Positive - improves observer data	Potential Positive - improves observer data	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)

(continued)

Management Measures	Valued Ecosystem Component (VEC) Impacts				
	Managed resource	Non-target species Esp. RH/S	Habitat including EFH	Protected Resources	Human Communities
4a No Action	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo
4b port-side sampling for mackerel landings	Minimal - landings already well monitored	Positive - better landings data for non-targets	Minimal - fishery mostly uses MWT	Potentially positive - may lower effort.	Mixed (positive and negative impacts for different interests)
4c portside sampling for longfin landings	Minimal - landings already well monitored	Minimal - much non-target catch is discarded at set	Potentially positive - may lower effort.	Potentially positive - may lower effort.	Mixed (positive and negative impacts for different interests)
4d Tier 3 mackerel hold certification	Minimal - landings already well monitored	Potentially low Positive - better data for non-targets	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
4e longfin hold certification	Minimal - landings already well monitored	Potentially positive - better data for non-targets	Minimal - no substantial change in effort expected	Minimal - no substantial change in effort expected	Mixed (positive and negative impacts for different interests)
4f Sust. Fish. Coalition frameworkable	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action

(continued)

Management Measures	Valued Ecosystem Component (VEC) Impacts				
	Managed resource	Non-target species Esp. RH/S	Habitat including EFH	Protected Resources	Human Communities
5a No action	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo
5b Observer coverage for mackerel MWT	Potentially low positive - better discard data	Positive - better incidental catch data	Minimal - fishery mostly uses MWT	Minimal (positive if industry has to pay which would decrease effort)	Mixed (positive and negative impacts for different interests)
5c Observer coverage for mackerel SMBT	Potentially low positive - better discard data	Positive - better incidental catch data	Minimal (positive if industry has to pay which would decrease effort)	Minimal (positive if industry has to pay which would decrease effort)	Mixed (positive and negative impacts for different interests)
5d Observer coverage for longfin SMBT	Positive - better discard catch data	Positive - better incidental catch data	Minimal (positive if industry has to pay which would decrease effort)	Minimal (positive if industry has to pay which would decrease effort)	Mixed (positive and negative impacts for different interests)
5e Strata-Fleet-Based Alternatives	Positive - better discard catch data	Positive - better incidental catch data	Minimal (positive if industry has to pay which would decrease effort)	Minimal (positive if industry has to pay which would decrease effort)	Mixed (positive and negative impacts for different interests)
5f Industry Funding	Minimal but tied to 5b-5e above.	Minimal but tied to 5b-5e above.	Minimal but tied to 5b-5e above.	Minimal but tied to 5b-5e above.	Mixed (positive and negative impacts for different interests)
5g phased industry funding	Minimal but tied to 5b-5e above.	Minimal but tied to 5b-5e above.	Minimal but tied to 5b-5e above.	Minimal but tied to 5b-5e above.	Mixed (positive and negative impacts for different interests)
5h 2-year coverage re-evaluation	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action

(continued)

Management Measures	Valued Ecosystem Component (VEC) Impacts				
	Managed resource	Non-target species Esp. RH/S	Habitat including EFH	Protected Resources	Human Communities
6a No Action	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo
6b Mackerel River Herring Cap	Potentially low positive - lower catch	Potentially positive - lower catch depending on cap amount	Minimal - fishery mostly uses MWT	Potentially positive - lower effort depending on cap amount	Mixed (positive and negative impacts for different interests)
6c Mackerel Shad Cap	Potentially low positive - lower catch	Potentially positive - lower catch depending on cap amount	Minimal - fishery mostly uses MWT	Potentially positive - lower effort depending on cap amount	Mixed (positive and negative impacts for different interests)
6d Longfin River Herring Cap	Potentially positive - lower catch (butterfish)	Potentially positive - lower catch depending on cap amount	Potentially positive - lower effort depending on cap amount	Potentially positive - lower effort depending on cap amount	Mixed (positive and negative impacts for different interests)
6e longfin shad cap	Potentially positive - lower catch (butterfish)	Potentially positive - lower catch depending on cap amount	Potentially positive - lower effort depending on cap amount	Potentially positive - lower effort depending on cap amount	Mixed (positive and negative impacts for different interests)
6f Make Caps Frame-workable	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action

(continued)

Management Measures	Valued Ecosystem Component (VEC) Impacts				
	Managed resource	Non-target species Esp. RH/S	Habitat including EFH	Protected Resources	Human Communities
7a No Action	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo
7bMack Closed Area Mackerel	Potentially low positive - lower catch	Positive - lower effort/catch	Minimal - fishery mostly uses MWT	Positive - would reduce effort	Mixed (positive and negative impacts for different interests)
7bLong Closed Area Longfin	Potentially low positive - lower catch	Low Positive - lower effort/catch	Positive - would reduce effort	Positive - would reduce effort	Mixed (positive and negative impacts for different interests)
7cMack observer area mackerel	Potentially low positive - lower catch	Potentially positive (better observer data and/or lower effort)	Minimal - fishery mostly uses MWT	Positive - would reduce effort	Mixed (positive and negative impacts for different interests)
7cLong observer area longfin	Potentially low positive - lower catch	Potentially low positive (better observer data and/or lower effort)	Positive - would reduce effort	Positive - would reduce effort	Mixed (positive and negative impacts for different interests)
7d trigger option	Tied to 7b-7c. Would reduce impacts (positive or negative) because those measures would only be in place for part of year after trigger was reached.	Tied to 7b-7c. Would reduce impacts (positive or negative) because those measures would only be in place for part of year after trigger was reached.	Tied to 7b-7c. Would reduce impacts (positive or negative) because those measures would only be in place for part of year after trigger was reached.	Tied to 7b-7c. Would reduce impacts (positive or negative) because those measures would only be in place for part of year after trigger was reached.	Tied to 7b-7c. Would reduce impacts (positive or negative) because those measures would only be in place for part of year after trigger was reached.
7e Area Updating	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action

(continued)

Management Measures	Valued Ecosystem Component (VEC) Impacts				
	Managed resource	Non-target species Esp. RH/S	Habitat including EFH	Protected Resources	Human Communities
8a No action	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo
8b make hotspots frame- workable	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action	Minimal - allows future action
8cMack Observers in Monitoring/ Avoidance Area	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Low negative - possible costs to fishery without any conservation benefits
8cLong Observers in Monitoring/ Avoidance Area	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Low negative - possible costs to fishery without any conservation benefits
8dMack Closed Area 1 rules w/exit for slipping	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Low negative - possible costs to fishery without any conservation benefits
8dLong Closed Area 1 rules w/exit for slipping	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Low negative - possible costs to fishery without any conservation benefits
8eMack closure in protection area	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Low negative - possible costs to fishery without any conservation benefits
8eLong closure in protection area	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Low negative - possible costs to fishery without any conservation benefits
8f Tie alternative implemen-tation to Atl Herring	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Minimal - hotspots are too small given geo-temporal variability of fish and fishing	Low negative - possible costs to fishery without any conservation benefits

Note: The FMAT analysis (see Appendices 1 & 2) found that the small-area based “hotspot” alternatives considered in this Alternative Set are likely to just redistribute effort and that given the widespread distribution of RH/S the end result could be to increase impacts on RH/S just as easily as reducing impacts on RH/S and that one would not be able to predict the actual outcome.

(continued)

Management Measures	Valued Ecosystem Component (VEC) Impacts					
	Currently Managed resources	RH/S	Other non-target species	Habitat including EFH	Other (non-RH) Protected Resources	Human Communities
9a No Action	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo	Neutral - Status Quo
9b Add blueback herring as a managed stock in the MSB FMP	Minimal	Positive related to a variety of related conservation measures	Minimal but if future effort reductions were needed related to RH/S closures could be positive	Positive because EFH would be designated and conserved.	Minimal but if future effort reductions were needed related to RH/S closures could be positive	Mixed (positive and negative impacts for different interests)
9c Add alewife as a managed stock in the MSB FMP	Minimal	Positive related to a variety of related conservation measures	Minimal but if future effort reductions were needed related to RH/S closures could be positive	Positive because EFH would be designated and conserved.	Minimal but if future effort reductions were needed related to RH/S closures could be positive	Mixed (positive and negative impacts for different interests)
9d Add American Shad as a managed stock in the MSB FMP	Minimal	Positive related to a variety of related conservation measures	Minimal but if future effort reductions were needed related to RH/S closures could be positive	Positive because EFH would be designated and conserved.	Minimal but if future effort reductions were needed related to RH/S closures could be positive	Mixed (positive and negative impacts for different interests)
9e Add hickory shad as a managed stock in the MSB FMP	Minimal	Positive related to a variety of related conservation measures	Minimal but if future effort reductions were needed related to RH/S closures could be positive	Positive because EFH would be designated and conserved.	Minimal but if future effort reductions were needed related to RH/S closures could be positive	Mixed (positive and negative impacts for different interests)

2.3 Initial Areas of Controversy

Many measures considered in this document have been controversial at least at some point in the development of the Amendment. The controversy generally hinges on three primary factors. They are: 1) the relatively high potential cost of some of the alternatives (especially industry-funded observer coverage [Set 5], mortality caps [Set 6] and large-scale area-based restrictions [Set 7]); 2) the concern by some segments of the public about the impacts of large scale trawling on river herring and shad populations; and 3) the lack of firm science (i.e. high uncertainty) about either the coast-wide populations of river herring and shad or about the impact on those populations from at-sea trawling versus other sources of mortality (natural or human-caused).

2.4 Considered but Rejected Management Actions

1. The Council decided not to add a provision for annual forage set-asides for mackerel, squids, and butterfish. Instead, the Council noted that the recent Omnibus Annual Catch Limit Amendment already allows harvest reductions due to forage concerns and concluded that formal set-asides would be better considered after the Council develops ecosystem level goals and objectives that are informed by the ongoing work of the ecosystem subcommittee of the Scientific and Statistical Committee.

2. The Council considered including consideration of catch shares for the squid fisheries during the scoping process but concluded that it would be more effective to focus Amendment 14 on river herring and shad issues. Also, there was strong public comment against including squid catch shares at the current time.

3. The Council considered requiring 6 hour pre-landing notification via phone to land more than 20,000 pounds of mackerel so as to facilitate quota monitoring. This was removed because NMFS is trying to phase out phone notifications of this kind.

4. The Council considered requiring 6 hour pre-landing notification via phone to land more than 2,500 pounds of longfin squid so as to facilitate quota monitoring. This was removed because NMFS is trying to phase out phone notifications of this kind.

5. The Council considered requiring daily electronic reporting by MSB-permitted dealers so as to facilitate quota monitoring (directed and/or incidental catch) and cross checking with other data sources. This was removed because other options seemed equally effective and the infrastructure for 24hr reporting is burdensome for both NMFS and dealers.

6. The Council considered requiring 48 hour electronic reporting by MSB-permitted dealers so as to facilitate quota monitoring (directed and/or incidental catch) and cross checking with other data sources. This was removed because other options seemed equally effective and the infrastructure for 48hr reporting is burdensome for both NMFS and dealers.

7. The Council considered requiring 72 hour electronic reporting by MSB-permitted dealers so as to facilitate quota monitoring (directed and/or incidental catch) and cross checking with other data sources. This was removed because other options seemed equally effective and the infrastructure for 42hr reporting is burdensome for both NMFS and dealers.

8. The Council considered requiring trip termination following 3 slipped hauls on an observed trip so as to minimize slippage events. The goal is to minimize slippage events. This was removed because other options seemed equally effective (termination after 1 or 2 hauls) and having 3 slipped hauls on one trip would be a rare event.

9. The Council considered using mesh changes to reduce the incidental catch of river herrings and shads but concluded such measures were not feasible due to the lack of trawl mesh selectivity for mackerel, river herrings, and shads. Selectivity information would be necessary to evaluate both potential benefits to river herrings and shads and potential costs to the relevant directed fisheries.

10. Some measures under consideration address slippage where the contents of a net on an observed haul on an observed trip are released in the water. In these cases the observer cannot sample the released catch. Some alternatives considered requiring ¼ of the catch to be pumped on board but these were rejected because a) catch may be patchy and only sampling ¼ of the net

11. To obtain information on fish that may remain in the net, the Council conserved alternatives that would require nets to be periodically brought aboard after pumping for sampling. These alternatives were rejected because the observer program had already begun such sampling at higher rates than those considered in the document. An alternative was also added to prohibit any discarding of un-sampled fish, even operational discards.

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2.5 Regulatory Basis for the Amendment

Amendment 14 was developed in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the National Environmental Policy Act (NEPA), the former being the primary domestic legislation governing fisheries management in the U.S. Exclusive Economic Zone (EEZ). The MSA requires Councils to minimize bycatch to the extent practicable (Section 301 – National Standard 9) and provides discretionary authority to "include management measures in the plan to conserve…non-target species…considering the variety of ecological factors affecting fishery populations" (Section 303(b)(12). How these provisions apply to RH/S catch in the mackerel and Longfin Squid fisheries is the primary concern of Am14 (see purposes A and B above). The MSA also provides for Councils to submit new fishery management plans for fish stocks, including anadromous species (see purpose C above).

NEPA requires federal agencies to incorporate environmental considerations in their planning and decision-making through a systematic interdisciplinary approach. Specifically, all federal agencies are to prepare detailed statements assessing the environmental impact of and alternatives to major federal actions significantly affecting the environment. These statements are commonly referred to as environmental impact statements (EISs). This document constitutes the EIS for the management measures currently under consideration and was prepared by the Council in consultation with the National Marine Fisheries Service (NMFS).

This document also addresses the requirements of the Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA), the Regulatory Flexibility Act (RFA), the Administrative Procedure Act (APA), the Paperwork Reduction Act (PRA), the Coastal Zone Management Act (CZMA), the Information Quality Act (IQA), and Executive Orders 13132 (Federalism), 12898 (Environmental Justice), 12866 (Regulatory Planning), and 13158 (Marine Protected Areas). These other applicable laws and Executive Orders help ensure that in developing an FMP and/or FMP amendment, the Council considers the full range of alternatives and their expected impacts on the marine environment, living marine resources, and the affected human environment. This integrated document contains all required elements for these laws and executive orders including MSA and NEPA, and the information to ensure consistency with the applicable laws and executive orders.

The TC requests **(responses in bold)**:

- Add age and length data analysis from Laura Lee as an appendix or some part of the report
    - **This report is included as Appendix 1.**

- Include more detailed summary of caveats in age data and why data wasn't included
    - **A paragraph has been added (yellow highlight) on page 4 within the Request for Fisheries section addressing concerns regarding age data and referring to Appendix 1 for additional detail.**

- Include information on why Z benchmark for Albemarle Sound from 2007 assessment was not used
    - **Additional text (yellow highlight) has been included on page 5 within the Sustainability Parameters sub-section of the Albemarle Sound section.**

- Extension of time series pre sex-specific data collection
    - **As noted at the January 2012 TC meeting, shad were not sexed prior to 2000. The pre-sexing extended time series can be found in Appendix 1, Figs. 41 and 42 (pages A1-56 and A1-57). The draft reviewed by TC in January already contained a full explanation in the Ancillary Information section regarding why female CPUE and female relative F were chosen as parameters, rather than both sexes combined. This has been highlighted in blue and is located near the top of page 15 of the main document.**

- Requests most current (2011) data
    - **All figures have been updated with 2011 data (Cape Fear Figs. 13, 14, 15 had years incorrectly labeled as 2000-2010, when they should have been labeled 2001-2011).**

- Add table of most current restrictions (area specific)
    - **This information was already included in the text within the Existing Management section (Seasonal Restrictions, Commercial Gear Restrictions, Recreational Restrictions), therefore a table is redundant. Area headings have been added (see yellow highlighted text beginning on page 2 within Existing Management section.)**

- Cape Fear system is currently not sustainable. TC recommends that 1) closure or 2) allow restricted fishery along with continued monitoring and reporting.
    - **Please see yellow highlighted information (beginning at top of page 14) in the Proposed Management Measures for 2013 section, as well as Appendix 2.**
    - **Please also review existing text in Future Considerations subsection within the Cape Fear section (blue highlighted text at bottom of page 12) regarding changes to this system**

- TC recommends approval of SFMP for Albemarle Sound, Neuse, Roanoke, Tar-Pamlico Rivers

North Carolina American Shad Sustainable Fishery Plan

Prepared by

North Carolina Division of Marine Fisheries
and
North Carolina Wildlife Resources Commission

December 2011
Updated March 2012

INTRODUCTION

American shad (*Alosa sapidissima*) are currently managed under Amendment 3 to the Atlantic States Marine Fisheries Commission (ASMFC) Interstate Fishery Management Plan for Shad and River Herring. Amendment 3 requires all states and jurisdictions without an approved sustainable fishery plan to close their fisheries (with the exception of catch and release fisheries) for American shad by January 1, 2013 (ASMFC 2010). A sustainable fishery is defined in Amendment 3 as one that "demonstrates their stock could support a commercial and/or recreational fishery that will not diminish future stock reproduction and recruitment". The purpose of this plan is to identify and implement sustainable management measures that will allow for maintenance and rebuilding of American shad populations in North Carolina.

The most recent stock assessment of American shad stated that populations in the Albemarle Sound and Roanoke River are stable and low, whereas a determination of stock status could not definitively be assigned for the Tar-Pamlico, Neuse and Cape Fear rivers due to limited information (ASMFC 2007a). It should be noted that areas south of Albemarle Sound form a zone where stocks transition from iteroparity to semelparity, which can also impact the ability to determine stock status.

Sustainable fishery parameters are being submitted for consideration for the following areas: Albemarle Sound/Roanoke River, Tar-Pamlico River, Neuse River, and Cape Fear River.

EXISTING MANAGEMENT

American shad are jointly managed by the North Carolina Marine Fisheries Commission (MFC) and the North Carolina Wildlife Resources Commission (WRC). The Division of Marine Fisheries (DMF) implements MFC rules for American shad in the Atlantic Ocean as well as the Coastal and Joint waters of North Carolina, while the WRC manages American shad in the state's recreational fishery in Inland Waters. The known extent of American shad in North Carolina river systems is shown in Figure 1.

Commercial Seasonal Restrictions (statewide)

From the 1950s to 1965, a January 1 through May 1 commercial season existed in Coastal Waters, while a January 1 through June 1 season existed in Inland Waters throughout the state. From 1966 through 1994, no seasonal restrictions existed for the commercial fishery. Since 1995, a commercial season of January 1 through April 15 has been in place in Coastal and Joint waters although the fishery is rarely opened prior to February 1 each year. Implementation of this seasonal restriction greatly reduced harvest, as historically a large portion of the commercial American shad harvest occurred after April 15 and into May.

Commercial Gear Restrictions

Albemarle Sound

Beginning in 1988, western Albemarle Sound (also referred to as Batchelor Bay) has been closed to the use of gill nets from February through mid-November. While the purpose of the closure is striped bass (*Morone saxatilis*) conservation, this measure has also afforded protection for American shad. From 1988 through 1990, limits of 1,000 to 2,000 yards were implemented for 5.25-inch stretched mesh and larger gill nets in Albemarle Sound, and nets could only be set 5 days per week. Again, these measures were implemented for striped bass conservation, but it is likely they had positive impacts on American shad.

Since 1998, commercial restrictions in Albemarle Sound have been consistent and include a prohibition on the use of gill nets with a mesh size of 3.5–5.0 inches stretched mesh and a limit of 1,000 yards on the use of 5.25-inch stretched mesh during the open shad season (generally mid-February through April 15). When the season closes, these nets are removed from the water. The Albemarle Sound is the only system for which mesh size restrictions and yardage limits exist during the shad season.

Tar-Pamlico River, Neuse River

There is a statewide rule limiting the amount of large mesh (5.0-inch and greater) gill net set in internal coastal waters to no more than 3,000 yards per vessel. However, this rule has been suspended in the majority of internal coastal waters as a result of sea turtle conservation measures that allow no more than 2,000 yards per vessel of 4.0–6.5-inch gill net in the Tar-Pamlico and Neuse systems. Nets can be set in lengths no greater than 100 yards and must have at least a 25-yard space between each individual length of net. Only single overnight sets are allowed; nets can be set one hour prior to sunset and must be retrieved within one hour of sunrise, with no sets allowed Friday, Saturday or Sunday evenings. Additionally, in certain sections of the Tar-Pamlico and Neuse rivers, gill nets with a mesh size less than five inches must be attended at all times.

Interim management measures implemented in November 2011 for spotted seatrout (*Cynoscion nebulosus*) conservation make it unlawful to use gill nets of any mesh size in Joint Waters on weekends. These measures will reduce American shad harvest since they will likely remain in effect throughout the spring 2012 fishing season.

Cape Fear River

The same statewide rule limiting the amount of large mesh gill net in internal coastal waters that has been suspended in the Tar-Pamlico and Neuse systems has also been suspended in the Cape Fear as a result of sea turtle conservation measures. All the same restrictions described above for the Tar-Pamlico and Neuse systems (i.e. mesh lengths, spacing, set/retrieval days and times) apply in the Cape Fear system with the exception of the maximum yardage allowed; a 1,000-yard limit per vessel has been imposed in the Cape Fear.

The same interim management measures implemented in November 2011 for spotted seatrout conservation in the Joint Waters of the Tar-Pamlico and Neuse systems are also in place in the Cape Fear, making it unlawful to use gill nets of any mesh size on weekends.

Recreational Restrictions

Prior to 1995, no recreational restrictions existed. Beginning in 1995, it became unlawful to take American shad and hickory shad (*Alosa mediocris*) by any method except hook-and-line from April 15–December 31 in Coastal Waters. Additionally, from 1995 through 1998, there was a recreational season during January 1 through April 14. Beginning in 1999, it became unlawful to possess more than 10 American shad and hickory shad in the aggregate in both Coastal and Inland Waters.

Albemarle Sound/Roanoke River

In 2010, the WRC implemented a 1-fish American shad limit within the 10-fish aggregate creel limit for American and hickory shad in the Inland Waters of the Roanoke River.

Neuse River

A rule implementing a 1-fish limit for American shad in the Inland Waters of the Neuse River will become effective in August 2012 and applicable to the spring 2013 fishing season.

Tar-Pamlico River, Cape Fear River

The 10 American and hickory shad aggregate creel limit applies throughout the waters of the Tar-Pamlico and Cape Fear rivers.

REQUEST FOR FISHERIES

A sustainable fishery is defined in Amendment 3 as one that demonstrates shad stocks could support a commercial and/or recreational fishery that will not diminish future stock reproduction and recruitment. A suite of potential sustainability parameters were considered for North Carolina and it was decided to develop sustainability parameters for each river system based on relative abundance and relative fishing mortality rate. Relative abundance was calculated using available fisheries-independent survey data that were considered appropriate for measuring the abundance of American shad and were expressed in terms of catch-per-unit-effort (CPUE). The standard deviations of the annual CPUE index values were also calculated to demonstrate the variability of these values. Environmental conditions on the spawning grounds, especially flow rates, are a major source of the variability associated with these indices.

Relative fishing mortality rate is calculated by dividing catch by a fisheries-independent index of relative abundance. Imprecision in the survey index can cause estimates of relative *F* to be noisy. The noise can be dampened by using an average of the survey index over adjacent years in place of point estimates in the denominator. Here, relative *F* was computed by dividing commercial landings by a centered 3-year average of a survey index. Note that relative *F* in the first and last year of the time series will be based on only two years of data. In each system, the survey data used in the calculations of relative *F* were subset to reflect conditions in the commercial fishery.

Indices of relative abundance and estimates of relative *F* were calculated for each system using available data. The objective was to select a minimum of one abundance index and one series of relative *F* estimates to serve as sustainability parameters in each system. Where multiple data sources were available in a system to calculate relative abundance or relative *F*, a tiered approach was taken to select the most appropriate data source for deriving the sustainability parameter. Sources of data that were not considered reflective of conditions in the system of interest were eliminated from consideration. Data sources that were available for a minimum of ten years were preferred. Also, data sources associated with extreme variability or a large amount of imprecision were not considered reliable for deriving sustainability parameters. Finally, sustainability parameters based on the female segment of the stock were preferred because the commercial fishery targets roe shad; roe landings can account for as much as 90% of the total American shad landings in a year.

While scales have been collected for aging from both fisheries-dependent and fisheries-independent programs since 1972, there was concern regarding the reliability of scales for determining age for the following reasons: first, the scouring that allows for identification of spawning marks could result in loss of annuli and therefore inconsistent scale readings; and second, although increases in average age and percent of older individuals were observed, these were also associated with decreases in average length and weight. Because of these concerns and continued discrepancies between NCDMF and NCWRC in the determination of age and spawning marks, age data were not considered for sustainability parameters in any of the systems (See Appendix 1 for additional detail).

The sustainability parameters evaluated and selected are described below for each system. The selected sustainability parameters will be reported in annual compliance reports and any management actions will be noted. Potential management actions are included in a separate section to eliminate repetition within each of the river system sections, although any action or suite of actions could be specific to and independent of each system.

Albemarle Sound

Stock Status

The 2007 ASMFC stock assessment stated that American shad stocks in the Albemarle Sound and Roanoke River were low but stable and suggested a benchmark total mortality rate (Z_{30}) of 1.01 (ASMFC 2007b). Annual estimates of *Z* from the assessment indicate that values have fluctuated around the benchmark since 2000.

Commercial Fisheries

The Albemarle Sound area has traditionally accounted for the largest proportion of the state's commercial harvest (Figure 2). The 2010 American shad landings in North Carolina totaled 233,267 pounds, and the

Albemarle Sound area accounted for 79.3% of those landings. Landings from gill nets comprised 97.3% of the overall harvest.

Recreational Fisheries

A recreational fishery for striped bass and hickory shad has existed on the Roanoke River for many years, with little effort, catch or harvest of American shad in annual creel surveys. However, creel surveys conducted by the WRC have traditionally focused on striped bass effort and harvest; therefore, estimates of American shad harvest could be inherently biased. The spring 2006 Roanoke River creel report estimated a directed harvest of 103 American shad and release of 541 fish (McCargo et al. 2007). As noted in the previous section, a 1-fish limit on American shad within the aggregate 10-fish creel for American and hickory shad became effective July 1, 2008 on the Roanoke River. This regulation was implemented to provide additional protection for American shad on the Roanoke River and to complement restoration and stocking efforts (see "Future Considerations" section,).

Sustainability Parameters

Data used in the development of sustainability parameters include independent gill net survey (IGNS) data collected by DMF, electrofishing data collected on the spawning grounds by WRC, and commercial landings data collected through the DMF Trip Ticket Program (see the "Stock Monitoring Programs" section for complete descriptions of these surveys).

Although DMF has conducted a fixed-station alosine seine survey since 1972 for calculation of a juvenile abundance index (JAI), the survey was specifically developed for river herring and is not a reliable indicator of shad juvenile abundance. Further analysis determined that the survey lacked the persistence needed to provide an unbiased index of abundance. For these reasons, the JAI is not being used as a sustainability parameter even though this information is updated annually in compliance reports.

Although a Z benchmark of 1.01 was calculated for the Albemarle Sound from the 2007 stock assessment, there was concern that the total mortality estimate for a population in which the age distribution is contracting will not necessarily show an increase if there is no change in the slope that the Z estimate is based upon. In addition, continued concerns regarding the reliability of scales for determining age highly influenced the workgroup's decision not to use age data for sustainability parameters. Because of this, the Z benchmark was not considered for a sustainability parameter.

The following sustainability parameters and thresholds were evaluated for the Albemarle Sound area:

Female CPUE (DMF IGNS): The female CPUE index based on the DMF IGNS was calculated as the number of fish per haul using data collected during January through May (Figure 3).

- Time series: 2000–2011. Although the IGNS has been conducted since 1991, use of the 2000–2011 time series will allow for more consistent comparison with the female CPUE index from the Roanoke River electrofishing survey, which has been conducted annually since 2000.
- Threshold: Three consecutive years of values below the 25th percentile (where 75% of all values are greater).

Female CPUE (WRC electrofishing survey): The female CPUE index based on the WRC electrofishing survey was calculated as the number of fish per minute (Figure 3). Data from the 2000 electrofishing survey were unavailable for analysis due to database construction but will be included when parameters are updated for the annual compliance report.

- Time series: 2001–2011.
- Threshold: Three consecutive years of values below the 25th percentile (where 75% of all values are greater).

Female Relative F (DMF IGNS): Female relative *F* based on the DMF IGNS was calculated using commercial gill net landings of roes in Albemarle Sound (February through April) and a female index derived from data collected in the 5.0, 5.5 and 6.0-inch mesh sizes of the IGNS (February through April; Figure 4). The February through April timeframe was used to reflect the period during which the commercial fishery is prosecuted. The mesh sizes selected most accurately reflect those used by the commercial fleet.

- Time series: 2000–2011. See description of time series for female CPUE based on the DMF IGNS.
- Threshold: Three consecutive years of values above the 75th percentile (where 25% of all values are greater).

Female Relative F (WRC electrofishing survey): Female relative *F* based on the WRC electrofishing survey was calculated using commercial landings of roes by all gear types in Albemarle Sound and the female CPUE index from the Roanoke River electrofishing survey (Figure 5). Because the survey occurs during the months of March through May, landings data from only those months were used in the calculations. As noted above, data from the 2000 electrofishing survey were unavailable for analysis.

- Time series: 2001–2011.
- Threshold: Three consecutive years of values above the 75th percentile (where 25% of all values are greater).

Total Relative F (DMF IGNS): Total relative *F* based on the DMF IGNS was calculated the same way that female relative *F* based on the DMF IGNS was calculated except that all sexes were included (male, female, unknown) in computing relative abundance, and commercial landings included both bucks and roes (Figure 6).

- Time series: 1998–2011. This time period was chosen because commercial regulations in the Albemarle Sound have been consistent during these years.
- Threshold: Three consecutive years of values above the 75th percentile (where 25% of all values are greater).

The sustainability parameters selected for Albemarle Sound were female CPUE based on the IGNS, female CPUE based on the electrofishing survey and female relative *F* based on the IGNS. Relative *F* based on the IGNS was chosen over relative *F* based on the electrofishing survey because the electrofishing survey is limited to the Roanoke River and so was not considered representative of Albemarle Sound as a whole. The majority of the commercial fishery occurs in Albemarle Sound and because a reliable IGNS exists for this area, use of relative *F* based on the IGNS rather than the electrofishing index was determined to be a more appropriate sustainability parameter. Exceeding the threshold for any of the selected parameters will trigger management action (see "Potential Management Measures").

The IGNS index of female relative abundance for Albemarle Sound showed little variation over time (Figure 3). This index has been above the threshold from 2005-2010, and fell below the threshold in 2011. The female abundance index derived from the electrofishing survey was above the threshold throughout most of the time series (Figure 3). This index demonstrated an increase from 2006 to 2008 but decreased in 2009 and dropped below the threshold in 2010. The index increased slightly above the threshold in 2011.

Estimates of female relative *F* derived from the IGNS also varied with time and exceeded the threshold in 2010 and 2011 (Figure 4). Relative *F* estimates for female American shad derived from the electrofishing survey demonstrated a decline from 2003 to 2008 followed by an increase through 2011. (Figure 5). Trends in total relative *F* derived from the IGNS (Figure 6) were similar to trends in female relative *F* derived from the same survey (Figure 4).

Future Considerations

Since 1998, American shad fry have been stocked in the Roanoke River downstream of Kerr (US Army Corps of Engineers), Gaston (Dominion Power) and Roanoke Rapids (Dominion Power) reservoirs at Weldon, NC as well as upstream of these reservoirs at Altavista and Clover Landing, VA. These stocking activities serve as migratory obstruction mitigation required by Federal Energy Regulatory Commission (FERC) relicensing of the Gaston and Roanoke Rapids hydropower dams. This restoration effort is coordinated by a Diadromous Fish Restoration Technical Advisory Committee (DFRTAC; includes representatives from U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Virginia Department of Game and Inland Fisheries (VDGIF), WRC, DMF and Dominion Power) and has a target of two annual population estimates of 20,000 adult American shad present below the base of the Roanoke Rapids Dam. The two population estimates do not have to occur in consecutive years. The target was developed based on a combination of 1/10th of the projected run size (using the 50 shad per acre rule of thumb for riverine habitat between the dam and the river mouth (St. Pierre 1979)) and very limited historic landings information.

The contribution of these enhancement efforts to the overall population in the Albemarle Sound system, as well as the potential impact of fishery removals on these efforts, are issues that need to be resolved for possible inclusion in future revisions to this plan. Additional efforts in the Albemarle region include prioritization of roadway culvert replacements. DMF is pursuing a grant opportunity to restore river herring habitat through removal of priority culverts within the region. While this is specifically focused on river herring habitat, there may likely be benefits to shad habitat as well should the grant be awarded.

With regard to the Roanoke River creel survey, additional effort will be made in the future to target locations closer to the spawning grounds near Gaston, where there may be a higher encounter rate of American shad by anglers. This creel survey occurs annually, and collection of effort data related to American shad is somewhat dependent on location. Also, existing methods do not capture effort, harvest and catch from bank anglers although efforts are underway to do so in upcoming surveys.

Finally, DMF just completed a research prioritization process for all managed species. A top priority was expansion of existing surveys to meet the need for more accurate JAIs for species of importance. Depending on funding and staff resources, expansion of the alosine seine survey may be able to meet this need.

Tar-Pamlico River

Stock Status

Stock status could not be determined for the Tar-Pamlico River based on the 2007 ASFMC stock assessment (ASMFC 2007b). There were no definitive trends in abundance, although it was noted that the electrofishing CPUE for the Tar River was higher than in other North Carolina rivers since 2000. A total mortality benchmark (Z_{30}) of 1.01 was suggested.

Commercial Fisheries

Commercial landings of American shad have declined significantly since the mid-1980s and have remained low and variable without trend since 1994 (Figure 2). Almost all harvest occurs in gill nets. There has been sporadic harvest by pound nets over the years.

Recreational Fisheries

A recreational fishery does exist, and estimates of angler effort and catch are calculated through the use of a creel survey that rotates among the Tar, Neuse, and Cape Fear rivers. The most recent creel survey on the Tar River was conducted in 2005 and determined recreational harvest to be 1,212 American shad out of a total estimated catch of 7,575 American and hickory shad combined (Homan et al. 2006). The recreational creel limit is 10 American and hickory shad in the aggregate. While DMF has recently expanded creel surveys further upstream in the central region (Pamlico Sound area) of the state, estimates of harvest are highly variable and inherently have a large error associated with them, similar to creel surveys conducted by WRC in Inland Waters.

Sustainability Parameters

Data used in the development of sustainability parameters for the Tar-Pamlico system include electrofishing data collected by WRC and commercial landings data collected through the DMF Trip Ticket Program (see the "Stock Monitoring Programs" section for complete descriptions of these surveys). There is no directed JAI survey for the Tar-Pamlico system. An IGNS has been conducted consistently in the Neuse, Pamlico, and Pungo river tributaries of Pamlico Sound since 2004, but the survey has an average annual catch of only 24 American shad in the Tar-Pamlico River. American shad captured in this IGNS are not sexed; therefore, an independent estimate of female relative abundance could not be calculated from this survey.

The following sustainability parameters and thresholds were evaluated for the Tar-Pamlico River system:

Female CPUE (WRC electrofishing survey): The female CPUE index based on the WRC electrofishing survey was calculated as the number of fish per minute (Figure 7).

- Time series: 2000–2011. The electrofishing survey has been conducted annually since 2000 on the Tar River.
- Threshold: Three consecutive years of values below the 25th percentile (where 75% of all values are greater).

Female Relative F (WRC electrofishing survey): Female relative *F* based on the WRC electrofishing survey was calculated using commercial landings of roes by all gear types from the Pamlico River and the female CPUE index from the Tar River electrofishing survey (Figure 8). Because the electrofishing survey primarily occurs during March through April, only commercial landings from those months were used in the calculations.

- Time series: 2000–2011. The electrofishing survey has been conducted on the Tar River annually during these years.
- Threshold: Three consecutive years of values above the 75th percentile (where 25% of all values are greater).

Total Relative F (DMF IGNS): Total relative *F* based on the DMF IGNS was calculated using commercial gill net landings (February through April) from the Pamlico River and an abundance index derived from data collected in the 4.5, 5.0, 5.5, 6.0, and 6.5-inch mesh sizes of the IGNS in the Pamlico River (February through April; Figure 9). Because the IGNS occurs during February through April in the Pamlico River, only commercial landings from those months were used in the calculations. The mesh sizes selected most accurately reflect those used by the commercial fleet in this system.

- Time series: 2004–2011. This time period reflects the years that the IGNS has been conducted in the Pamlico Sound and its tributary rivers (Neuse, Pamlico).
- Threshold: Three consecutive years of values above the 75th percentile (where 25% of all values are greater).

The sustainability parameters selected for the Tar-Pamlico River were the female CPUE index and female relative *F*, both derived from the WRC electrofishing survey. Although the IGNS is generally considered to be more representative of conditions in the commercial shad fishery, there are currently only 8 years of data available from the IGNS in the Pamlico River while 12 years are currently available from the Tar River electrofishing survey. Exceeding the threshold for any of the selected parameters will trigger management action (see "Potential Management Measures").

Female relative abundance of American shad derived from the electrofishing survey in the Tar River was above the threshold in most years of the time series (Figure 7). The index fell just below the threshold in 2009 but increased to a level slightly above the threshold in 2010 and 2011. Estimates of relative *F* for female American shad derived from the electrofishing survey were below the threshold during 2000 to 2006 (Figure 8). These estimates of female relative *F* exceeded the threshold from 2007-2009 and were only slightly below the threshold in 2010. The 2011 estimate is well below the threshold. The estimates of total relative *F* based on the IGNS were variable over time but were generally similar to the female relative *F* estimates derived from the electrofishing survey (Figure 9).

Future Considerations

There is potential to improve upstream passage in this system. The WRC, FWS and the Pamlico-Tar River Foundation have engaged in conversations with the Rocky Mount Mills Dam owner and hydroelectric operator. In addition to interest in providing American shad access to potential spawning habitat upstream of Rocky Mount Mills Dam, concern exists that periodic downward spikes in flow below Rocky Mount Mills Dam compromise the quality of existing spawning habitat.

With regard to creel surveys, DMF and WRC have engaged in a cooperative effort to improve the frequency and design of surveys on the Tar and Neuse rivers beginning in spring 2012. Creel surveys will occur annually and include increased coverage on both rivers, which should improve estimates of recreational harvest. These efforts will continue for at least the next five years.

As noted previously, DMF recently completed a research prioritization exercise for all managed species. One of the top priorities was expansion of existing surveys to provide accurate JAIs for all commercially and recreationally important species. Depending on future funding and protected resources concerns, expansion of the IGNS in the rivers may be able to serve this need.

Neuse River

Status of Stocks

Stock status could not be determined for the Neuse River based on the 2007 ASFMC stock assessment (ASMFC 2007b). There were no definitive trends in abundance over the most recent five to ten years of the assessment. A total mortality benchmark (Z_{30}) of 1.01 was suggested (ASMFC 2007a).

Commercial Fisheries

Commercial landings of American shad have declined since 1972. There have been several peaks throughout the time series, but landings have remained low and variable without trend since the early 2000s (Figure 2). Harvest occurs almost entirely from gill nets. There have been minimal contributions from pound nets over the years.

Recreational Fisheries

Estimates of angler effort and catch are calculated through the rotating creel survey noted in previous systems. A confounding factor in the creel survey is that American and hickory shad co-occur in the Neuse and responses to creel clerks indicated only that anglers were fishing for “shad”. The most recent survey occurred in 2003. An estimated 318 American shad were caught during the month of April, 274 of which were harvested (Rundle et al. 2004). A 1-fish limit on American shad within the aggregate 10-fish recreational creel limit for American and hickory shad has been proposed for the Inland Waters of the Neuse River. Unlike the 1-fish limit for American shad on the Roanoke River, this measure is being implemented in response to recent declines in electrofishing indices and creel data and will become effective in 2012.

Sustainability Parameters

Data used in the development of sustainability parameters for the Neuse River system include electrofishing data collected by WRC and commercial landings data collected through the DMF Trip Ticket Program (see the "Stock Monitoring Programs" section for complete descriptions of these surveys). There is no directed JAI survey for the Neuse River. As noted previously, there is an IGNS in the tributaries of Pamlico Sound. However, the IGNS for the Neuse River area of the survey has an average annual catch of only 17 American shad. Because American shad captured by this IGNS are not sexed, an independent estimate of female relative abundance could not be calculated from this survey.

The following sustainability parameters and thresholds were evaluated for the Neuse River system:

Female CPUE (WRC electrofishing survey): The female CPUE index based on the WRC electrofishing survey was calculated as the number of fish per minute (Figure 10).

- Time series: 2000–2011. The electrofishing survey has been conducted consistently since 2000 on the Neuse River.
- Threshold: Three consecutive years of values below the 25th percentile (where 75% of all values are greater).

Female Relative F (WRC electrofishing survey): Female relative *F* based on the WRC electrofishing survey was calculated using commercial landings of roes by all gear types from the Neuse River and the female CPUE index from the Neuse River electrofishing survey (Figure 11). Because the electrofishing survey primarily occurs during March through April, only commercial landings from those months were used in the calculations.

- Time series: 2000–2011. This time period reflects the years the electrofishing survey has been conducted on the Neuse River.
- Threshold: Three consecutive years of values above the 75th percentile (where 25% of all values are greater).

Total Relative F (DMF IGNS): Total relative *F* based on the DMF IGNS was calculated using commercial gill net landings (February through April) from the Neuse River and an index derived from data collected in the 4.5, 5.0, 5.5, 6.0, and 6.5-inch mesh sizes of the IGNS (February through April) in the Neuse River (Figure 12). Because the IGNS in the Neuse River occurs during February through April, only commercial landings from those months were used in the calculations. The mesh sizes selected most accurately reflect those used by the commercial fleet.

- Time series: 2004–2011. This time period reflects the years that the IGNS has been conducted in the Pamlico Sound and its tributary rivers (Neuse, Pamlico).
- Threshold: Three consecutive years of values above the 75th percentile (where 25% of all values are greater).

The sustainability parameters selected for the Neuse River were the female CPUE index and female relative *F*, both derived from the WRC electrofishing survey. Although the IGNS is generally considered to be more representative of conditions in the commercial shad fishery, there are currently only 7 years of data are available from the IGNS in the Neuse River while 11 years are currently available from the Neuse River electrofishing survey. Exceeding the threshold for any of the selected parameters will trigger management action (see "Potential Management Measures").

The electrofishing index of relative abundance for female American shad in the Neuse River has been variable and remained above the threshold throughout most of the time series, but did fall below the threshold in 2010 (Figure 10) and increased above the threshold again in 2011. Relative *F* estimates for female shad derived from the electrofishing survey have been variable but were below the threshold from

2008 to 2011 (Figure 11). The estimates of total relative *F* based on the IGNS demonstrate a similar trend to female relative *F* estimates derived from the electrofishing survey during 2007 through 2011 (Figure 12).

Future Considerations

Lack of adequate flow during the spring spawning season is a major concern on the Neuse River. The largest dam on this river is the Falls Lake Dam, which forms the drinking water supply for the city of Raleigh and other municipalities. While flow regimes have been negotiated on the Roanoke River for spawning and ecological needs, similar considerations do not formally exist on the Neuse River. The variability in timing and strength of flows can impact restoration efforts, particularly spawning success and subsequent recruitment (e.g., there may be sufficient numbers of spawning adults but flows are insufficient for successful spawning activity or downstream transport of larvae and juveniles to favorable nursery habitat). Periodically limited stream flow and associated navigability issues also impact the ability to conduct electrofishing surveys.

As noted in the previous section, a more frequent creel survey rotation as well as efforts by DMF to expand creel surveys upstream should hopefully provide improvements in future recreational effort and catch/harvest estimates. Similarly, a representative JAI for American shad may be a future possibility depending on resources available to expand or reconfigure existing independent surveys.

Cape Fear River

Stock Status

Similar to the Tar-Pamlico and Neuse rivers, the stock status on the Cape Fear River is unknown, although a total mortality benchmark (Z_{30}) of 1.01 was recommended in the latest assessment (ASMFC 2007a, 2007b). Of all the river systems in North Carolina, the Cape Fear is likely to have the highest proportion of fish that are semelparous.

Commercial Fishery

Commercial landings have displayed several cyclical peaks since 1972, although each successive peak has been slightly lower than the previous. Landings have been somewhat low throughout the 2000s. As with the other river systems, the vast majority of landings are from gill nets. There has been very little harvest from other gears.

Recreational Fishery

The rotating creel survey used in the river systems took place during the spring of 2011 on the Cape Fear River, from mid-March through mid-May. Estimates of total catch and harvest were 22,312 and 14,888 American shad respectively. The creel limit remains at 10 American and hickory shad in the aggregate.

Sustainability Parameters

Data used in the development of sustainability parameters for the Cape Fear system include electrofishing data collected by WRC and commercial landings data collected through the DMF Trip Ticket Program (see the "Stock Monitoring Programs" section for complete descriptions of these surveys). There is no directed JAI survey for the Cape Fear River. While there was an IGNS from 2003–2007, it was a fixed-station survey rather than a stratified random design and was therefore not used in any sustainability parameter calculations.

The following sustainability parameters and thresholds were evaluated for the Cape Fear River system:

Female CPUE (WRC electrofishing survey): The female CPUE index based on the WRC electrofishing survey was calculated as the number of fish per minute (Figure 13).

- Time series: 2001–2011. The electrofishing survey has been conducted annually since 2001 on the Cape Fear River.
- Threshold: Three consecutive years of values below the 25th percentile (where 75% of all values are greater).

Female Relative F (WRC electrofishing survey): Female relative *F* based on the WRC electrofishing survey was calculated using commercial landings of roes by all gear types from the Cape Fear River and the female index from the WRC Cape Fear River electrofishing survey (Figure 14). Because the electrofishing survey primarily occurs during March through May, only commercial landings from those months were used in the calculations.

- Time series: 2001–2011. This time period reflects the years the electrofishing survey has been conducted on the Cape Fear River.
- Threshold: Three consecutive years of values above the 75th percentile (where 25% of all values are greater).

Total Relative F (WRC electrofishing survey): Total relative *F* based on the WRC electrofishing survey was calculated using commercial landings by all gear types from the Cape Fear River and an index of total abundance from the WRC Cape Fear electrofishing survey (Figure 15). Because the electrofishing survey is conducted during March through May, only commercial landings from those months were used in the calculations.

- Time series: 2001–2011. The electrofishing survey has been conducted annually on the Cape Fear River since 2001.
- Threshold: Three consecutive years of values above the 75th percentile (where 25% of all values are greater).

The sustainability parameters selected for the Cape Fear River were the female CPUE index and female relative *F*, both derived from the WRC electrofishing survey. Although the IGNS is generally considered to be more representative of conditions in the commercial shad fishery, the IGNS conducted on the Cape Fear River consisted of a fixed-station design and data are currently available for a limited number of years (2003–2007); therefore, it was not considered appropriate for developing abundance indices or calculating relative *F* estimates. Exceeding the threshold for any of the selected parameters will trigger management action (see "Potential Management Measures").

Relative abundance of female American shad in the Cape Fear River has been low since 2004 as compared to the early 2000s, based on the electrofishing survey (Figure 13). The index values have remained near the threshold since 2004 and were below the threshold in 2010 and 2011. Estimates of female relative *F* gradually increased from the beginning of the time series in 2001 to a peak in 2007 (Figure 14). These estimates then decreased in 2008 and increased to levels above the threshold in 2010 and 2011. Total relative *F* estimates show a nearly identical pattern (Figure 15).

Future Considerations

The Cape Fear River is currently the site of a major reconstruction effort for fish passage (Lock and Dam #1 rock arch ramp). This is scheduled for completion by the 2013 spawning season. Based on the construction efforts and changing conditions, DMF and WRC recommend a two-year review of the 75th percentile threshold for female relative *F*. Calculation of this parameter is likely to be heavily influenced by drought, floods, and changes in fish passage and may require revision sooner than other systems. Restoration efforts may also influence electrofishing catch rates because fish passage may improve with completion of the rock arch ramp.

Potential Management Measures

The environmental circumstances under which a sustainability threshold may be reached can vary among systems. Therefore, different management measures may be used for each system in addressing the triggers. A suite of potential measures to be implemented is presented here and may be used singly or in conjunction with one another:

- Restrictions on length of season to reduce effort (e.g., March 1–April 15)—not to extend beyond the estuarine striped bass quotas being filled (avoids waste of striped bass and shad)
- Trip limits (this may result in discards)
- Reduce allowable amount of yards (the 1,000-yard limit in Albemarle Sound could be considered in other areas)
- Area/season closure (e.g., area closure at mouth of Roanoke River from February–mid-November since 1988)
- Only allow fishing certain days of the week (lift days)
- Creel reduction—complement WRC rules in the Roanoke and Neuse Rivers in Coastal Waters
- Commercial harvest quota (although possible, this could be difficult to implement given existing resources)
- If two years of sustainability parameters exceeding thresholds are observed, a suite of management measures could be proactively developed and presented to Finfish and Regional Advisory Committees

Proposed Management Measures for 2013

<u>Albemarle Sound, Tar-Pamlico River, Neuse River</u>

As noted in the "Commercial Gear Restrictions" section, management measures implemented in November 2011 for spotted seatrout conservation (prohibition on the use of gill nets in Joint Waters on weekends) are likely to reduce commercial harvest of American shad during the upcoming 2012 fishing season. The following management measures are proposed to be effective January 1, 2013:

- Commercial season of March 1, 2013 through April 15, 2013
- Recreational creel limits of 1-fish for American shad in the Joint and Coastal Waters of the Roanoke and Neuse rivers to complement the WRC 1-fish limit in the Inland Waters of these rivers

While none of the selected sustainability parameters for any of the river systems have exceeded the triggers for management, the above measures are considered prudent given the results of the 2007 stock assessment as they pertain to North Carolina. Future changes to creel limits for American shad in the Inland Waters of the other river systems will also be complemented by DMF for Joint and Coastal Waters.

Although harvest is an obvious potential contributor to population declines, significant habitat degradation has also occurred in all of the river systems. It is unlikely that American shad populations in North Carolina will recover and expand without considerable resources being dedicated to habitat restoration for this species. Our management goals, however, are intended to sustain population levels as additional habitat is protected or improved through aquatic habitat conservation measures and increased passage opportunities of American shad beyond impediments that block migration to historic spawning grounds.

Cape Fear River

At the request of the ASMFC Shad and River Herring Technical Committee, additional analysis was conducted for the Cape Fear River. This was based on the female relative *F* parameter being over the 75th percentile threshold for two consecutive years, as well as the female CPUE from the electrofishing survey being very close to the threshold for the past six years. First, the percent reduction in commercial harvest required to bring female relative *F* down to the threshold was calculated. This reduction (commercial harvest only) was determined to be 11.2%. Again, this reduction would only result in female relative *F* decreasing to the threshold, not below it.

Additional analyses were conducted to determine the commercial and recreational reductions in harvest that would provide an additional conservation buffer. Recall that the relative *F* parameter is based on the ratio of commercial roe harvest *only* to the female index from the electrofishing survey; it does not include recreational harvest. It should be noted that commercial harvest and estimated recreational harvest for 2011 are roughly equivalent, and in several years, recreational harvest is greater (note that recreational harvest is listed in numbers of fish). It was determined that equivalent reductions in harvest for both commercial and recreational sectors would provide the greatest benefit.

For the commercial sector, it was determined that a shortened season would provide the greatest benefit to the resource rather than a trip limit. Seasonal reductions will result in fewer discards, as well as additional protection for protected species such as Atlantic sturgeon. Reductions were calculated from the beginning of the season (January 1) and the end of the season (April 15) for both 25% and 35% reductions in commercial harvest (Table 1). Calculations included the weekend lift days for gill nets in Joint Waters that were implemented in November 2011 and noted above. See Appendix 2 for more information.

Table 1. Opening date and closing date to reduce American shad commercial harvest in the Cape Fear River by 25% and 35%. Calculations were based on average commercial harvest from 2001 through 2011.

Reduction	Opening Date	Closing Date
25%	20-Feb	11-Apr
35%	5-Mar	4-Apr

For the recreational sector, a series of bag limit reductions and associated percent reductions in harvest were calculated based on the 2011 Cape Fear creel survey (see Appendix 2). A 3% catch-and-release mortality was applied based on Hillard (2003). The reductions to a 5-fish and 4-fish bag limit were most closely associated with 25% and 35% reductions in recreational harvest, respectively (Table 2).

Table 2. Percent reductions in recreational harvest based on 2011 Cape Fear creel survey. Estimates include 3% catch-and-release mortality.

Bag Limit	Estimated Harvest (numbers of fish)	Reduction
5	11,621	23%
4	10,085	33%

Based on the minimum required reduction in *commercial harvest only* to reach the female relative threshold of 11.2%, reductions of 25% for both commercial and recreational harvest are proposed for 2013. Given that the minimum required reduction is based only on commercial harvest and that commercial and estimated recreational harvest are roughly equivalent, a 25% reduction in both sectors should provide a conservation buffer. As noted in the "Future Considerations" subsection of the Cape Fear section on page 12, construction on the Cape Fear to remove impediments to upstream passage at Lock & Dam 1 will be completed for the 2013 spawning season and are expected to result in 80% upstream passage. Construction activities resulted in the closure of the boat launch at Lock & Dam 1 in late 2011, which is the most popular launch for both commercial and recreational fishermen. It is anticipated that this closure will displace effort further upstream on the Cape Fear.

Ancillary Information

The focus on female indices for the sustainability parameters in all systems is based on the conclusion that changes in female abundance combined with impacts from various environmental parameters could prove challenging to stock improvement given that the commercial fishery targets roe shad. Major fluctuations in female abundance could potentially impact future recruitment and landings. The use of sex ratios as a sustainability parameter was considered, but it was determined that the sex ratios from both the IGNS (in the Albemarle system and potentially the other systems) and the electrofishing surveys were more suitable for use as long-term trends rather than short-term (i.e., three year) indicators of stock health due to the impact of environmental variability on the data. The intent of the agencies is to monitor the sex ratios from each of the surveys for trends and use this information to help inform future management.

The use of repeat spawning data was also considered as a potential sustainability parameter. However, inconsistencies in determination of repeat spawning marks made it difficult to set a target or threshold. Because repeat spawning continues to be tracked annually as part of the required monitoring program, it will also be used as ancillary information for determining future management. Should greater confidence in repeat spawning data be attained in the future, they may be considered for developing a formal sustainability parameter.

Finally, while sustainability parameters will be updated annually in compliance reports, DMF and WRC will conduct a review of this plan once every five years as new data and information become available and may elect to change or update sustainability parameters at that time.

STOCK MONITORING PROGRAMS

The following descriptions represent the entirety of stock monitoring programs used to assess the health of American shad in North Carolina. All programs are included in annual compliance reports and as noted in the program descriptions, specific details can be found in past compliance reports.

Fishery-Independent Monitoring

Juvenile Abundance

A juvenile abundance index is calculated for Albemarle Sound area using data from the alosine seine survey that has been conducted annually since 1972. Eleven core seine stations are sampled monthly in the western Albemarle Sound area during June–October of each year. During September, thirteen additional seine samples are taken to determine distribution and annual variations of alosines in the nursery area. All stations are sampled with an 18.5-m (60-ft) bag seine. Relative abundance data are collected for blueback herring, alewife, American shad and hickory shad from the 11 core stations.

Samples are sorted by species and 30 randomly selected individuals of each alosine species present are measured. Other species present are also noted. Water temperature, salinity, and other environmental characteristics are counted, measured, and recorded. As noted previously, this survey was designed specifically for blueback herring and is not considered a reliable indicator of juvenile American shad abundance.

No juvenile abundance indices exist for the Tar-Pamlico, Neuse and Cape Fear river systems.

Adult Stock Monitoring

Spawning Area Survey

An annual spawning stock survey and representative sampling for biological data is required from Albemarle Sound and its tributaries, Tar-Pamlico, Neuse, and Cape Fear rivers for American shad. Sampling in these areas was initiated in 2000.

WRC personnel collect American shad from the Roanoke, Tar, Neuse and Cape Fear systems annually during March–May. A boat-mounted electrofishing unit (Smith-Root 7.5 GPP) is used (1 or 2 dip netters) to capture fish during daylight hours and electrofishing times are recorded. To minimize size selection during sampling, shad are picked up as they are encountered regardless of size. Relative abundance of each year-class is indexed by CPUE expressed as the number of fish captured per hour of electrofishing. American shad broodstock collections are not included in calculations of CPUE. Size, age and sex data are collected for all captured fish.

Independent Gill Net Survey (IGNS)

Since 1991, DMF has been conducting an independent gill net survey throughout the Albemarle Sound area. The survey was designed for striped bass data collection and occurs November through May each year. However, American shad are captured during the survey and size, age and sex data are collected. Forty-yard segments of gill net from 2.5- through 7.0-inch stretched mesh, in half-inch increments, as well as 8.0, and 10.0-inch stretched mesh are utilized. The sound is divided into zones and grids and random sites are selected within these areas. Lines of float and sink nets are set in both shallow and deep strata if they are present in the grid.

The IGNS in the Pamlico Sound area (including Pamlico, Pungo and Neuse rivers) began in 2000. The survey runs from February through mid-December and utilizes a slightly different methodology than that conducted in the Albemarle Sound. Thirty-yard segments of gill net are used, ranging from 3.0-inch stretched mesh through 6.5-inch stretched mesh in half-inch increments. Similar to the Albemarle Sound, each set of nets is fished in both shallow and deep strata, and sites are selected at random from within a set of zones and grids.

An IGNS was conducted in the Cape Fear River from 2003–2007 but used a fixed-station design rather than a stratified random design.

Size, Age and Sex Determination

Spawning Area Survey

Sex is determined for each captured fish by applying directional pressure to the abdomen toward the vent and observing the presence of milt or eggs. Each fish is measured for total length in millimeters. Scales are removed from the left side of each fish between the lateral line and the dorsal fin. To estimate age, scales are examined at 33X magnification on a microfiche reader and annuli are counted. Spawning marks are recorded separately. Shad that cannot be aged are assigned ages based on the gender specific age-length key developed for each river and included in CPUE and size-distribution analyses. Beginning in 2011, American shad will be aged using otoliths. Up to 10 fish per 10-mm size bin (by sex) will be sacrificed for otolith extraction.

Independent Gill Net Survey

Each fish is measured for fork length and total length. Sex is determined only for fish captured in the Albemarle Sound IGNS. Each fish is sexed by applying directional pressure to the abdomen toward the vent and observing the presence of milt or eggs. Scales are collected from the left side of each fish between the lateral line and the dorsal fin. Scales are prepared and aged according to the DMF/WRC American Shad Ageing Guidelines.

Total Mortality Estimates

Survival estimates are calculated using the Robson and Chapman (1961) method. Robson and Chapman showed that estimates of annual rates of survival can be made from the catch curve of a single season if the population is exposed to unbiased fishing gear beyond the age of recruitment and if year-class strength and survival rate remain constant from year to year. Annual mortality rates are calculated based on observed samples of individuals at age. Only age groups that are fully recruited to the gear are included in the calculations and the resulting estimates only apply to the fully recruited individuals.

Hatchery Evaluation

Roanoke River American Shad Restoration Project

American shad fry reared at the FWS Edenton National Fish Hatchery and at the WRC Watha State Fish Hatchery have been stocked annually into the Roanoke River since 1998. This restoration project was initiated by the WRC and funded by the North Carolina Department of Transportation as mitigation for aquatic habitat damages resulting from highway bridge construction on the Roanoke River (see North Carolina's 1999 Shad and River Herring Report for full details). The project has since evolved into a cooperatively managed restoration partnership (see earlier text in the Albemarle Sound section under "Future Considerations") as required by FERC relicensing of the Gaston and Roanoke Rapids hydropower projects.

Initial attempts in 1998 at field collection and fertilization of American shad eggs met with limited success. In 1999, both hatcheries began developing hormone injection/tank spawning techniques in efforts to increase fry production. Also in 1999, WRC began coordination of marking fry with oxytetracycline (OTC) marking and stocking activities with the ad hoc interstate OTC Marking Task Force.

Following protocols of other states involved in American shad restoration efforts, brood stock for fry production are obtained from nearby rivers having adequate shad stocks. American shad brood fish are collected by electrofishing from the Tar, Neuse, Cape Fear, and Roanoke rivers. Upon collection, brood fish are placed in circular tanks with oxygen and continuously circulating water onboard the electrofishing boats and are then transferred to large circular, trailer-mounted tanks for transport to the hatcheries. In 2009, for the first time, no brood fish were injected with hormone (LHRHa or sGnRHa pellets) upon arrival at the hatcheries and prior to being transferred to circular spawning tanks. In 2011, broodstock endemic to the system intended for fry stockings were utilized for production. Broodstock will be genotyped for future genetic analysis of returning adults to identify hatchery contribution.

For additional detail and information regarding OTC marking, please refer to the 2009 North Carolina Shad and River Herring Compliance Report.

Evaluation of Hatchery Contribution

Since 2000, the annual contribution of returning adult American shad to the Roanoke River spawning stock collected in independent sampling gears has ranged between 0% and 3.1%. Because Roanoke River American shad return to the spawning grounds 3 to 6 years after hatching or stocking, recent American shad fry stockings since 2007 are likely still at-large. The WRC will continue stocking and recovery efforts of the Roanoke River American shad restoration program to assess the contribution of hatchery-origin American shad. Please see previous compliance reports for data (e.g., number of fry stocked, number of hatchery origin fish recovered) and additional details regarding hatchery contribution.

Fishery-Dependent Monitoring

Commercial Fishery

Total Catch, Landings and Effort

American shad landings data are collected through the North Carolina Trip Ticket Program. The number of participants by gear utilized and the total number of positive trips can be determined. For the Albemarle Sound area, the following assumptions are made: (1) trips landing over 100 pounds of shad are considered directed trips, and (2) the maximum yardage used in directed trips is 1,000 yards. The total yardage for each area is determined by multiplying the number of participants by the maximum yardage per area. The catch-per-yard (CPY) is determined by dividing the number of pounds harvested by the total yardage estimate of gill nets fished and multiplied by 1,000 yards. This will result in the pounds landed per 1,000 yards. Catch estimates for other areas are determined similarly.

Size, Age and Sex Composition of Catch

Commercial landings from all four systems (Albemarle Sound, Tar-Pamlico River, Neuse River and Cape Fear River) are sampled to obtain size, age, sex and repeat spawning information. A target of 200 samples from each system has been in place since 1999. For specific information regarding exact number of samples collected per area, please see previous compliance reports.

Recreational Fishery

Total Catch, Landings and Effort

The North Carolina Fisheries Reform Act of 1997 required the MFC to establish limits on recreational use of commercial fishing gear. An individual holding a Recreational Commercial Gear License (RCGL) is allowed to use limited amounts of specified commercial gear to catch seafood for personal consumption or recreational purposes. The holder of the RCGL must comply with the recreational size and creel limits, and RCGL catch cannot be sold. During 2002, DMF began a RCGL survey to estimate the harvest by these license holders. The survey was discontinued in 2009 due to budget reductions.

In the Coastal, Joint, and Inland Waters of North Carolina the American shad and hickory shad hook-and-line creel limits are 10 fish per person per day in the aggregate. In the Inland Waters of the Roanoke River—effective July 1, 2008—the limit for American shad was reduced to one fish per person per day. In the Inland Waters of the Neuse River, the limit for American shad will be reduced to one fish per person per day effective August 1, 2012.

An annual creel survey occurs on the Roanoke River each year. The survey targets striped bass catch and effort but also collects information on American shad and other species. A rotating creel survey occurs on the Tar, Neuse and Cape Fear rivers. For specific information regarding catch and harvest of American shad, please see previous compliance reports.

Bycatch and Discards

Bycatch and discard information are not currently collected on commercial trip tickets. The only mechanism that exists to capture commercial bycatch and discards of American shad in other fisheries is an observer program conducted by DMF to monitor sea turtle interactions in gill nets. Because there are very few encounters with sea turtles in the areas and times of year where and when directed American shad fishing occurs (i.e., western Albemarle Sound and the rivers), these areas have little observer coverage. However, current gill net restrictions in the Albemarle Sound and tributaries allows for the use of floating gill net webbing only during the open shad season. Once the shad season closes, the gill net webbing used to target shad is removed from the water.

The creel surveys conducted by the WRC in Inland Waters do capture discard and release information of non-target species. Please see previous compliance reports for this information.

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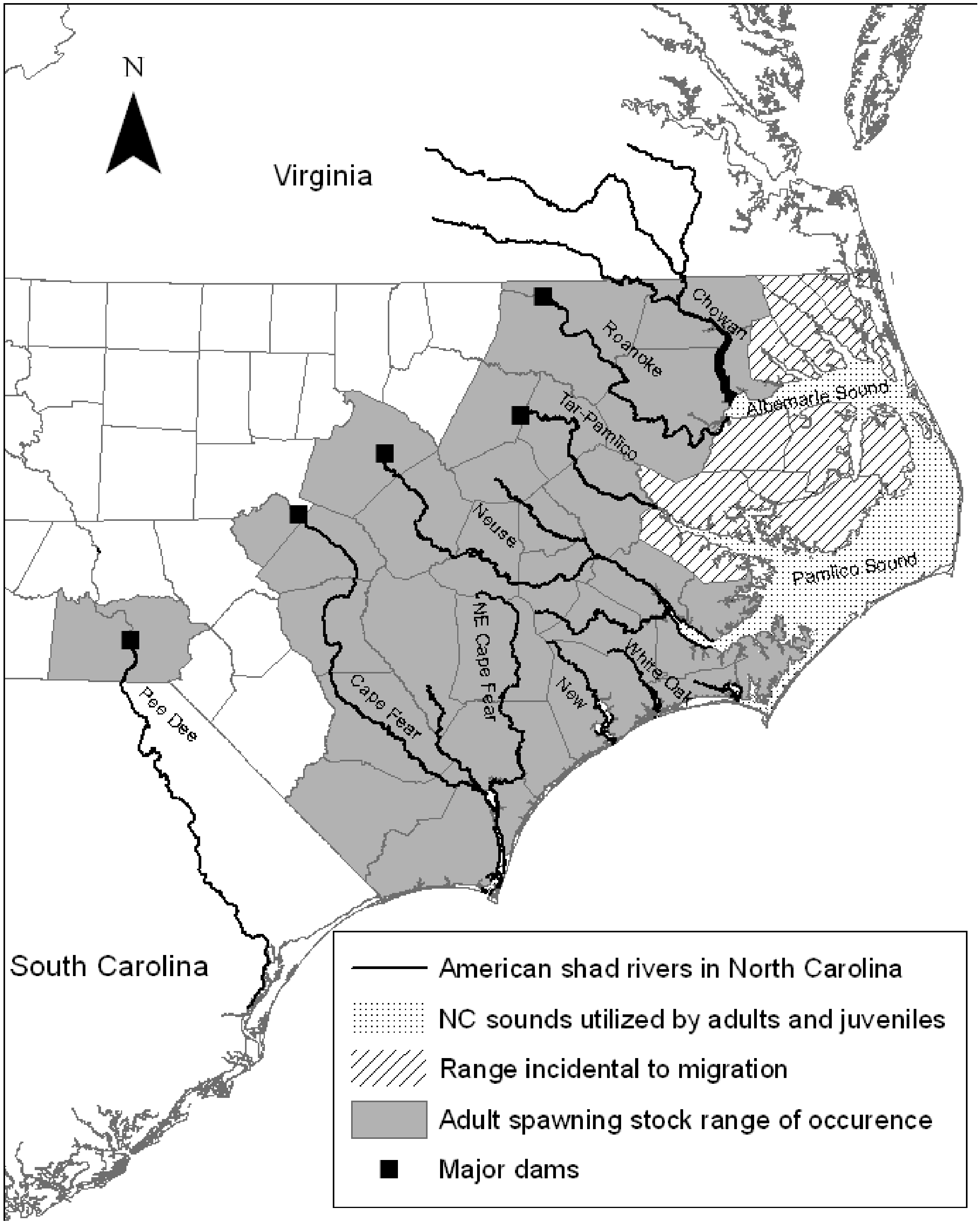


Figure 1. North Carolina river systems depicting the extent of American shad occurrence and habitat use.

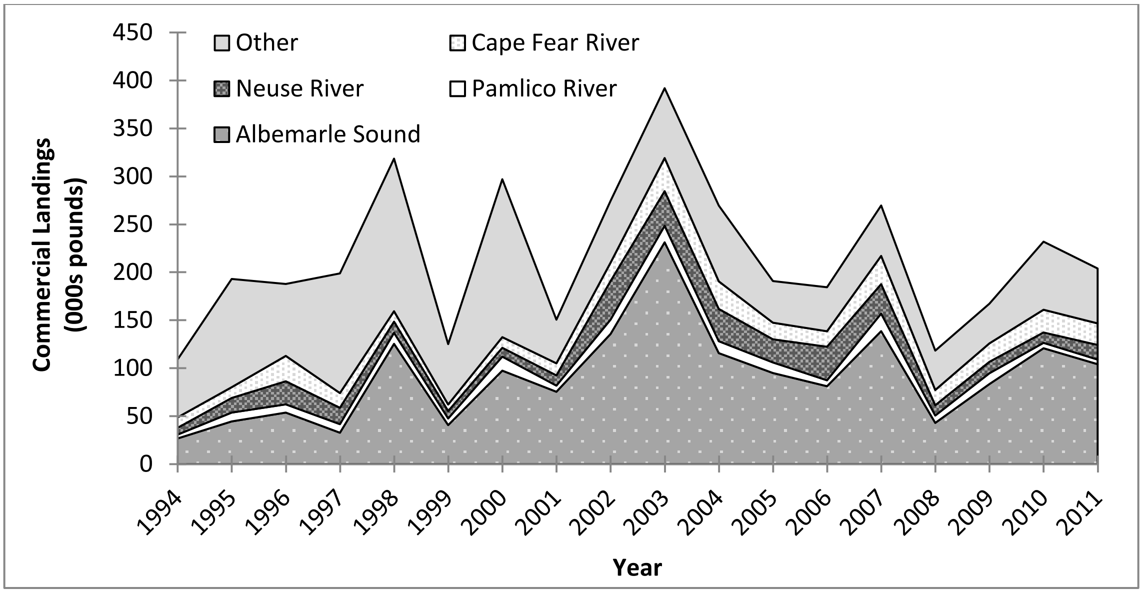


Figure 2. Commercial landings of American shad in North Carolina by water body, 1994–2011.

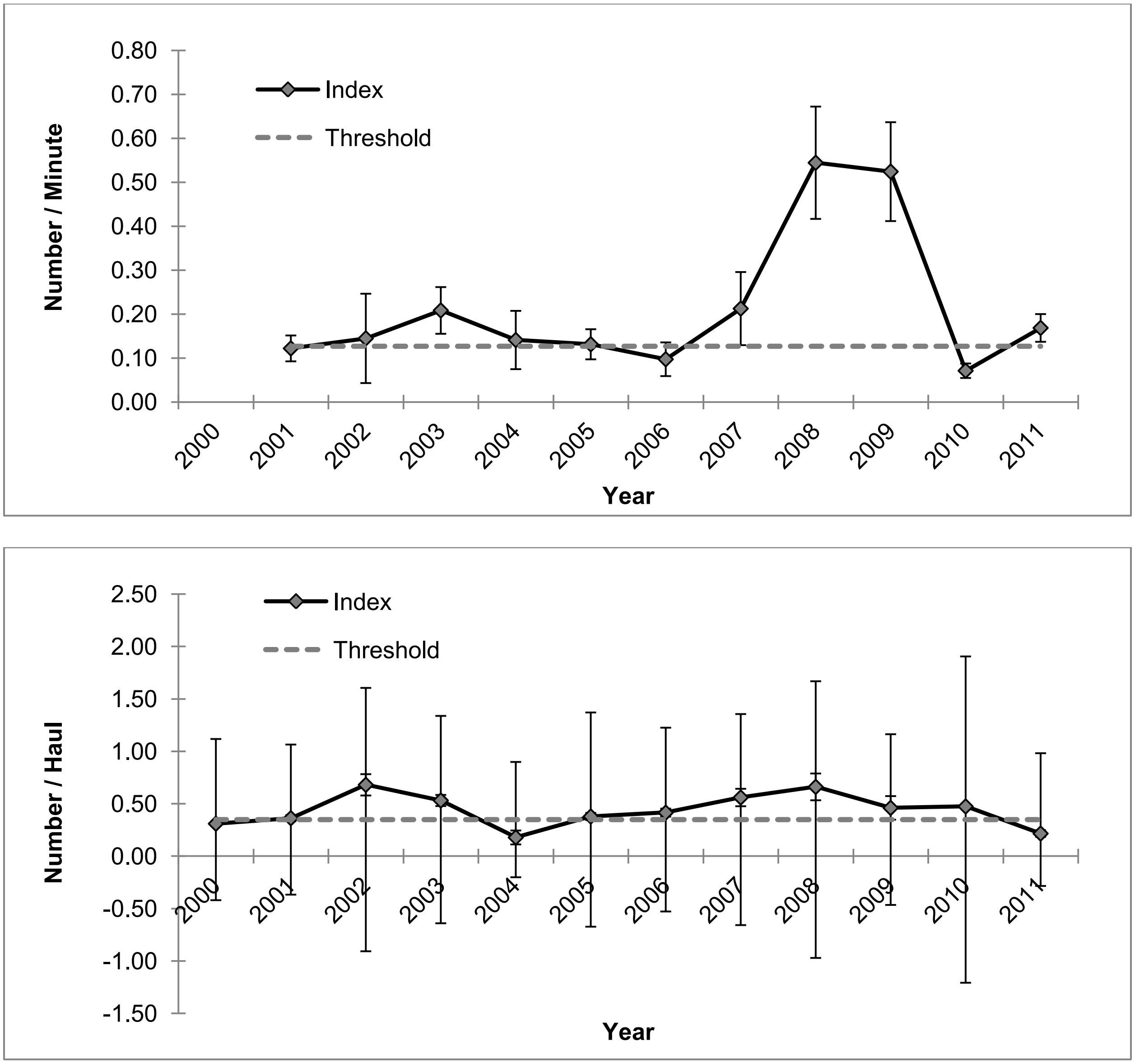


Figure 3. Female index from electrofishing survey (March–May; top graph) and female index from IGNS (January–May; bottom graph) for Albemarle Sound, 2000–2011. The error bars represent ±1 standard deviation. Threshold represents 25^{th} percentile (where 75% of all values are greater).

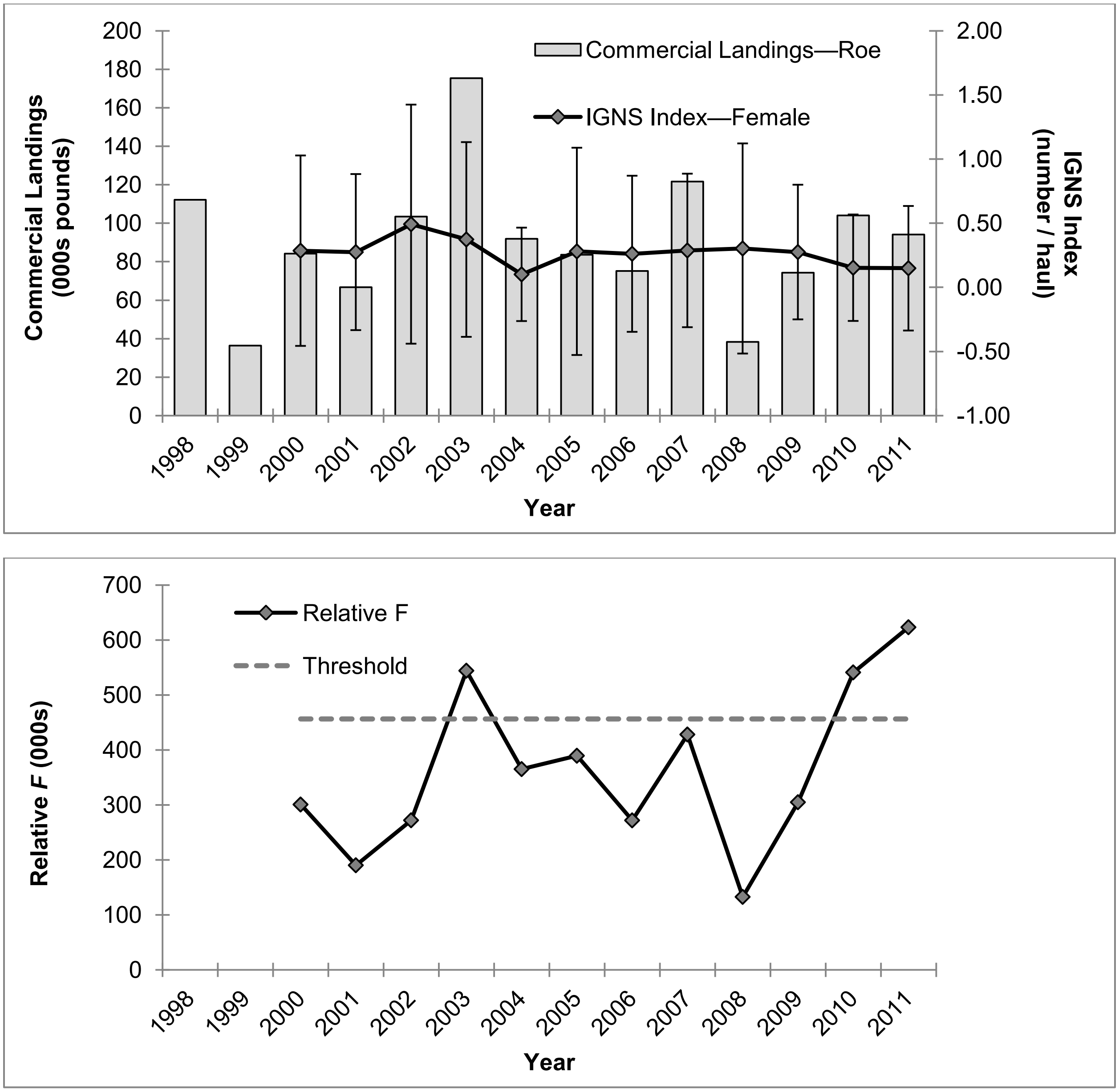
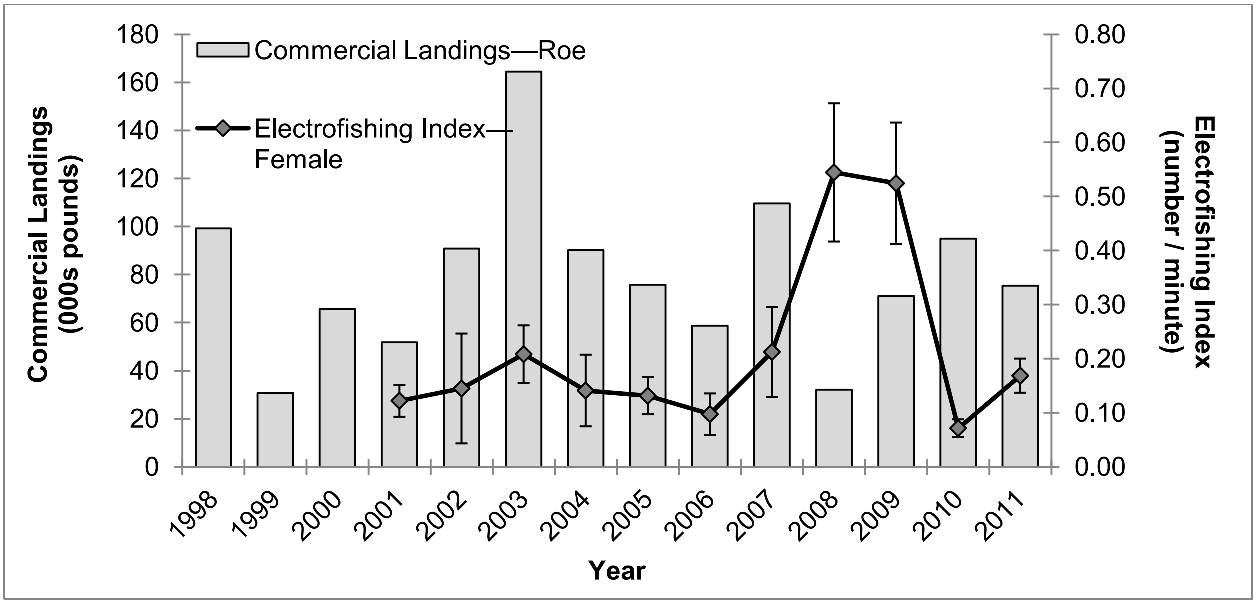


Figure 4. Commercial gill net landings of roes (February–April) compared to the female IGNS index (5.0, 5.5 and 6.0-inch mesh sizes, February–April; top graph) and annual estimates of female relative *F* based on these data (bottom graph) for Albemarle Sound, 2000–2011. The error bars in the top graph represent ±1 standard deviation. The threshold represents the 75Th percentile (where 25% of all values are greater).



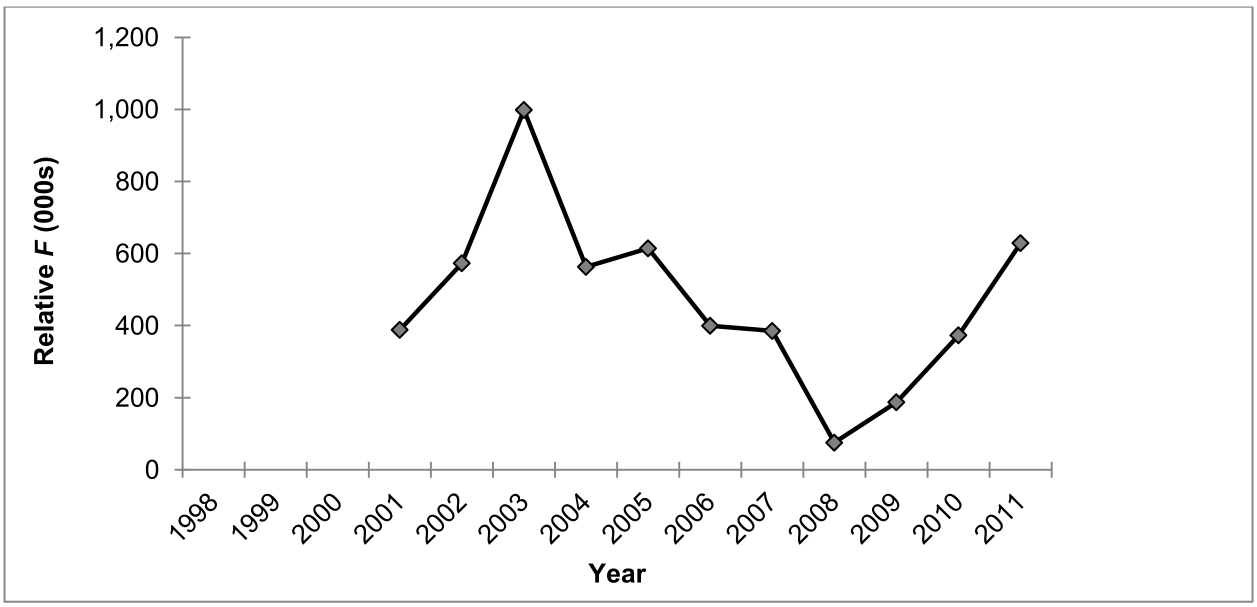
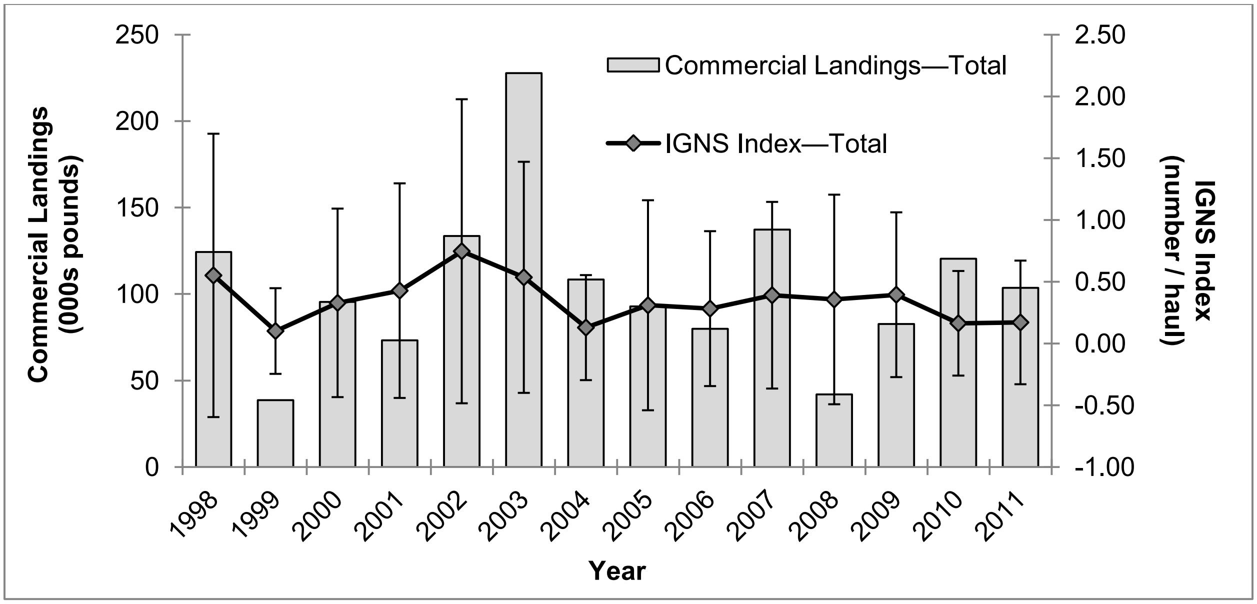


Figure 5. Commercial landings of roes by all gear types (March–May) compared to the female electrofishing index (March–May; top graph) and annual estimates of female relative *F* based on these data (bottom graph) for Albemarle Sound, 2000–2011. The error bars in the top graph represent ±1 standard deviation.



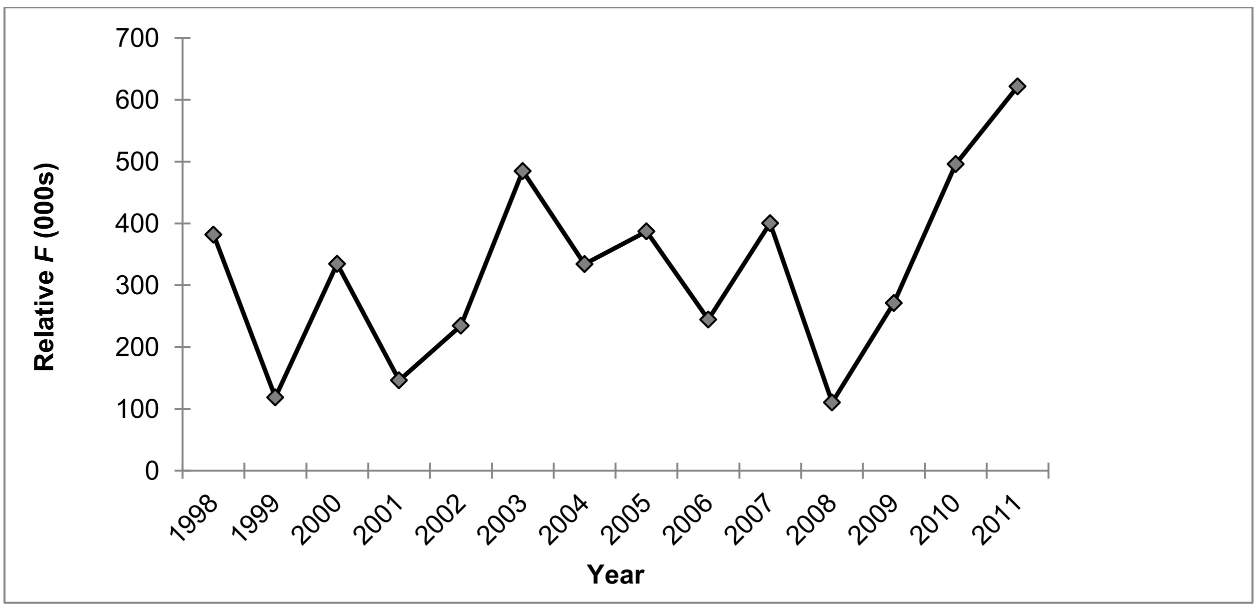


Figure 6. Commercial gill net landings (February–April) compared to the total IGNS index (5.0, 5.5 and 6.0-inch mesh sizes, February–April; top graph) and annual estimates of total relative *F* based on these data (bottom graph) for Albemarle Sound, 1998–2011. The error bars in the top graph represent ±1 standard deviation.

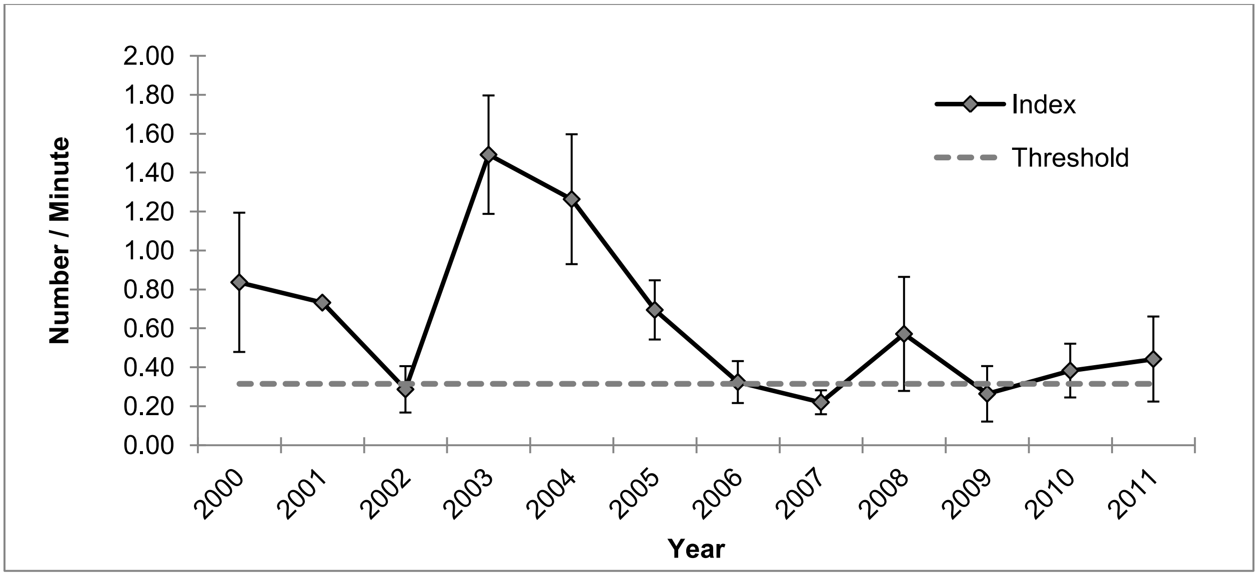


Figure 7. Female electrofishing index (March–May) for the Tar-Pamlico River, 2000–2011. The error bars represent ±1 standard deviation. The threshold represents the 25th percentile (where 75% of all values are greater).

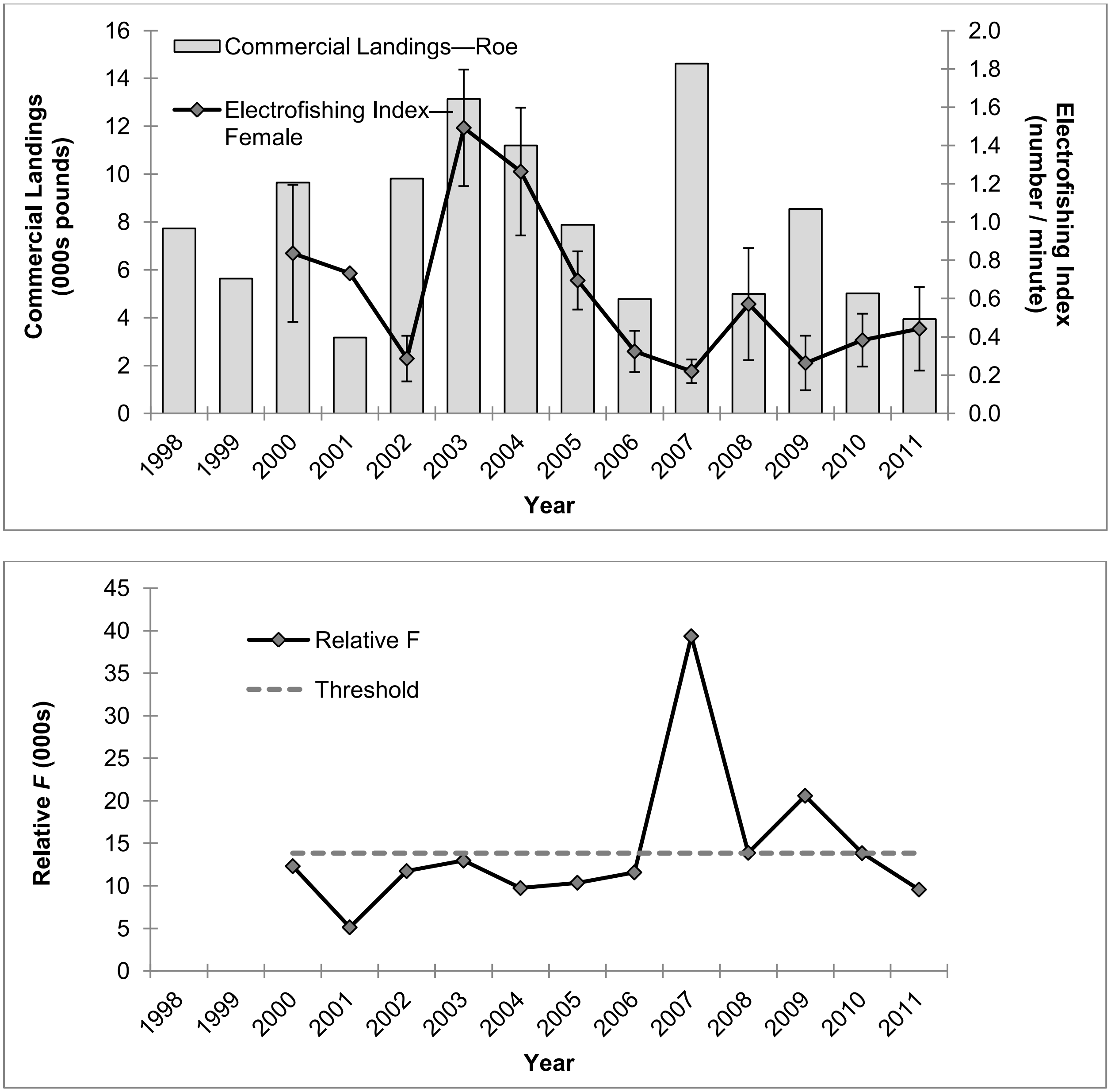
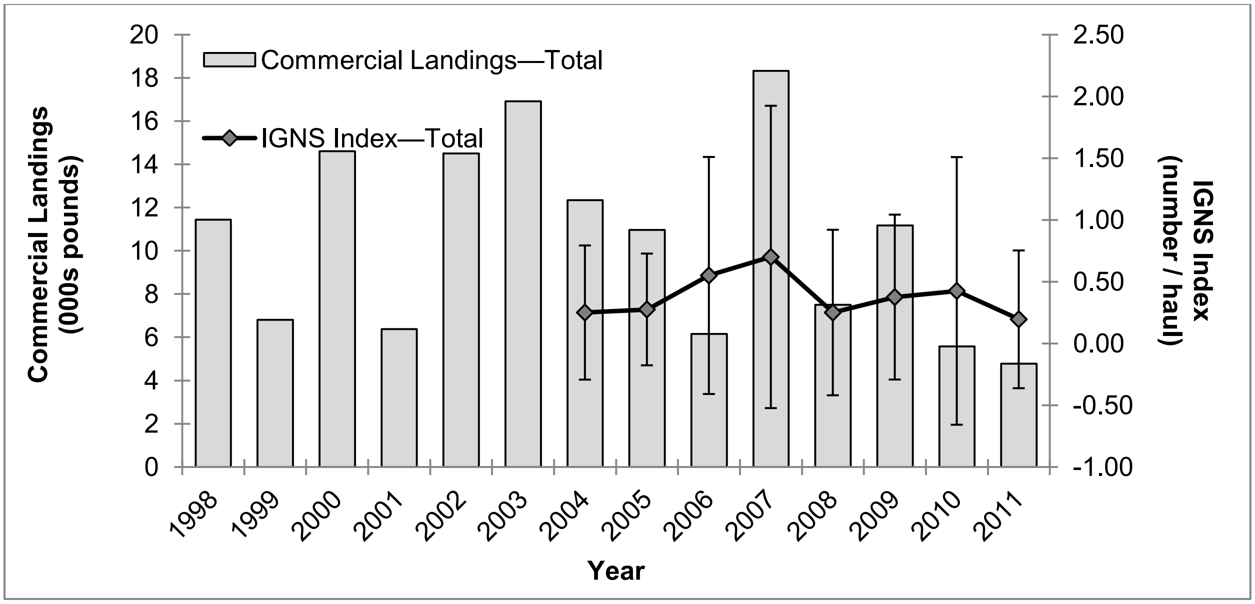


Figure 8. Commercial landings of roes by all gear types (March–April) compared to the female electrofishing index (March–May; top graph) and annual estimates of female relative *F* based on these data (bottom graph) for the Tar-Pamlico River, 2000–2011. The error bars in the top graph represent ±1 standard deviation. The threshold represents the 75th percentile (where 25% of all values are greater).



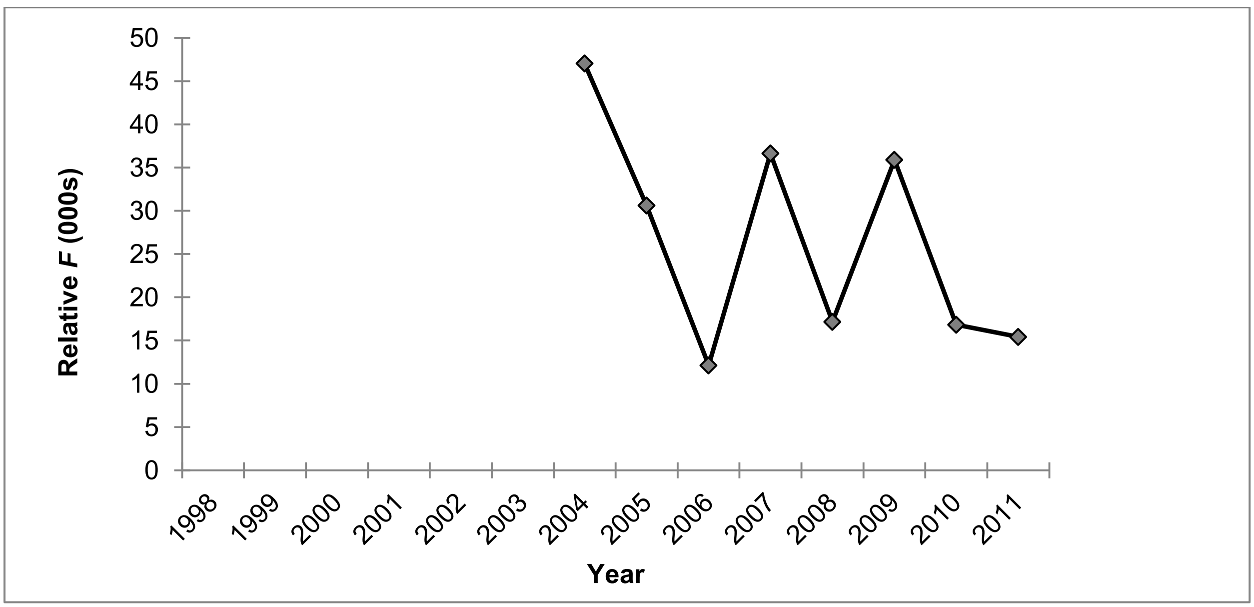


Figure 9. Commercial gill net landings (February–April) compared to the total IGNS index (4.5, 5.0, 5.5, 6.0, and 6.5-inch mesh sizes, February–April; top graph) and annual estimates of total relative *F* based on these data (bottom graph) for the Tar-Pamlico River, 2004–2011. The error bars in the top graph represent ±1 standard deviation.

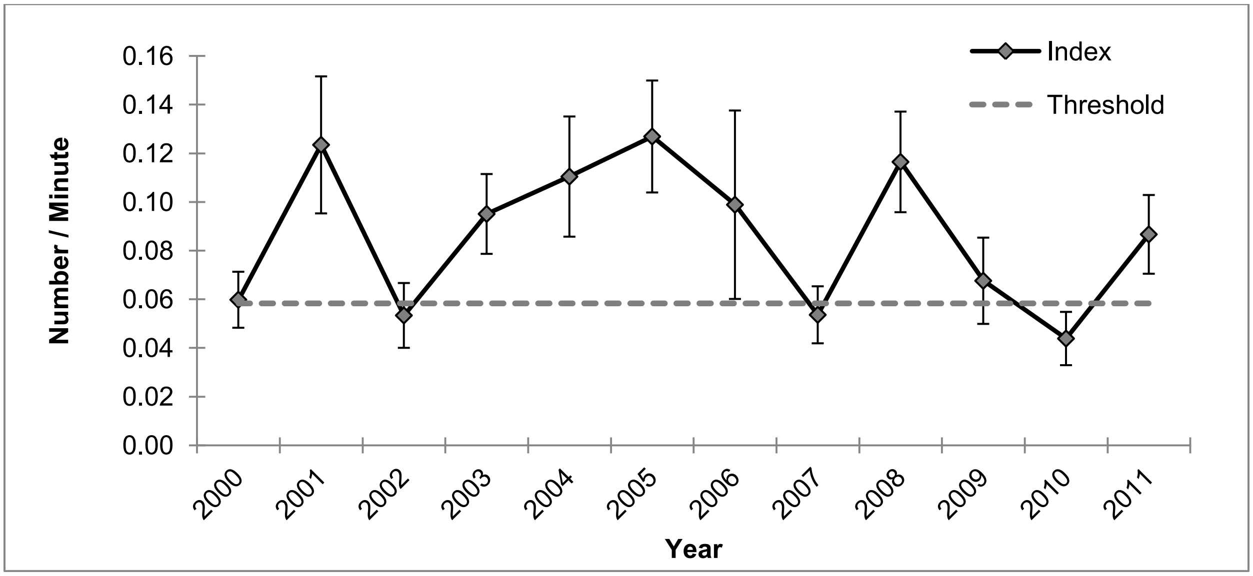
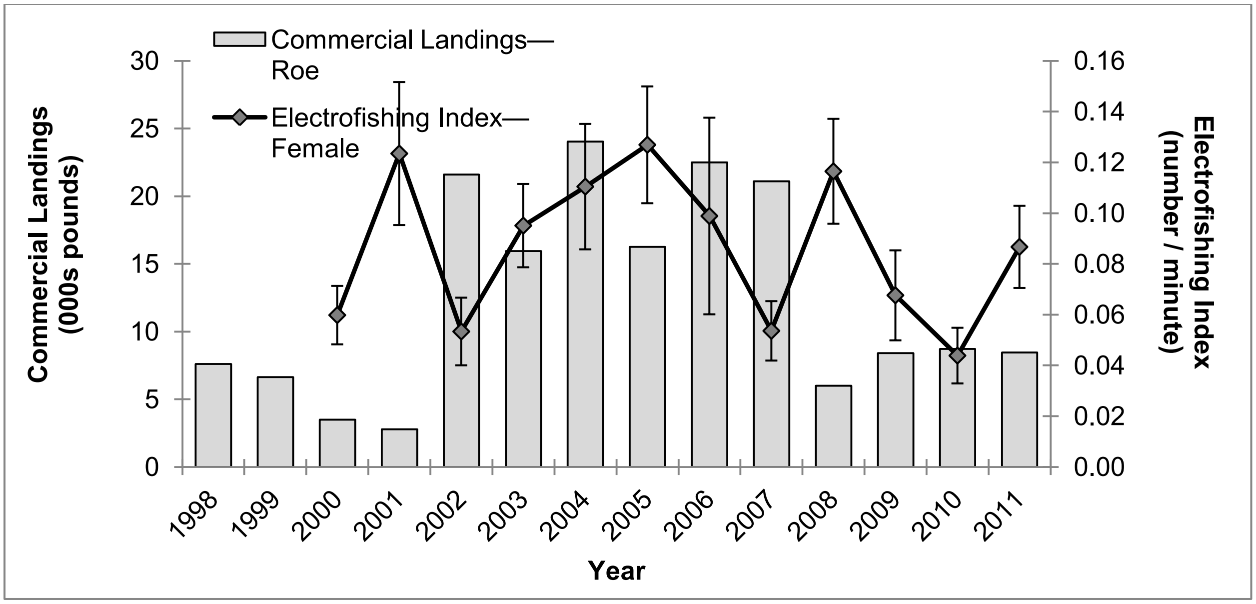


Figure 10. Female electrofishing index (March–May) for the Neuse River, 2000–2011. The error bars represent ±1 standard deviation. The threshold represents the 25th percentile (where 75% of all values are greater).



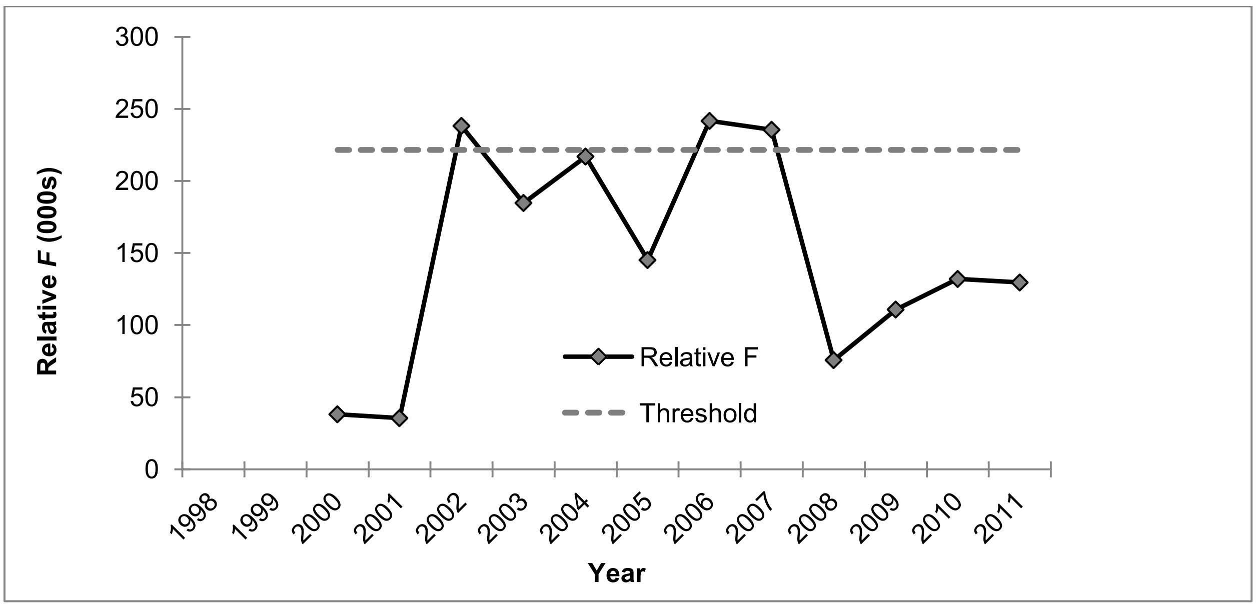


Figure 11. Commercial landings of roes by all gear types (March–May) compared to the female electrofishing index (March–May; top graph) and annual estimates of female relative *F* based on these data (bottom graph) for the Neuse River, 2000–2011. The error bars in the top graph represent ±1 standard deviation. The threshold represents the 75th percentile (where 25% of all values are greater).

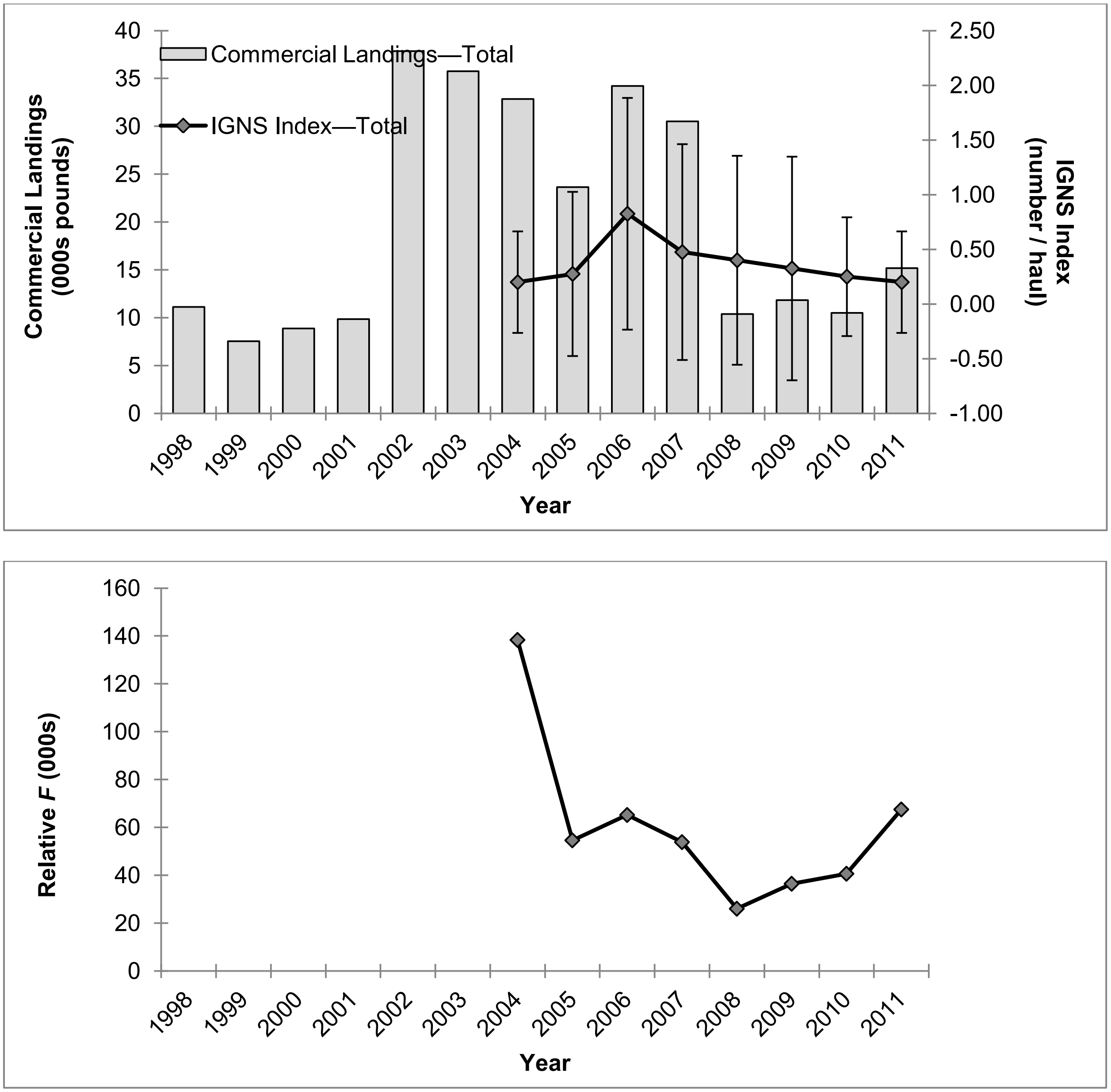


Figure 12. Commercial gill net landings (February–April) compared to the total IGNS index (4.5, 5.0, 5.5, 6.0, and 6.5-inch mesh sizes, February–April; top graph) and annual estimates of total relative *F* based on these data (bottom graph) for the Neuse River, 2004–2011. The error bars in the top graph represent ±1 standard deviation.

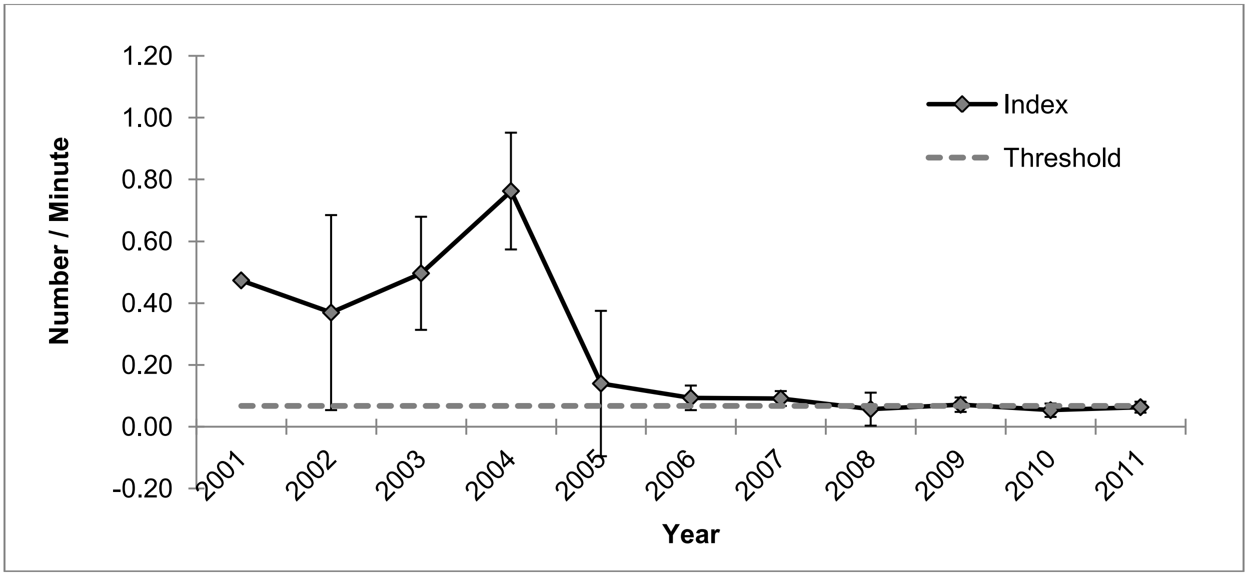
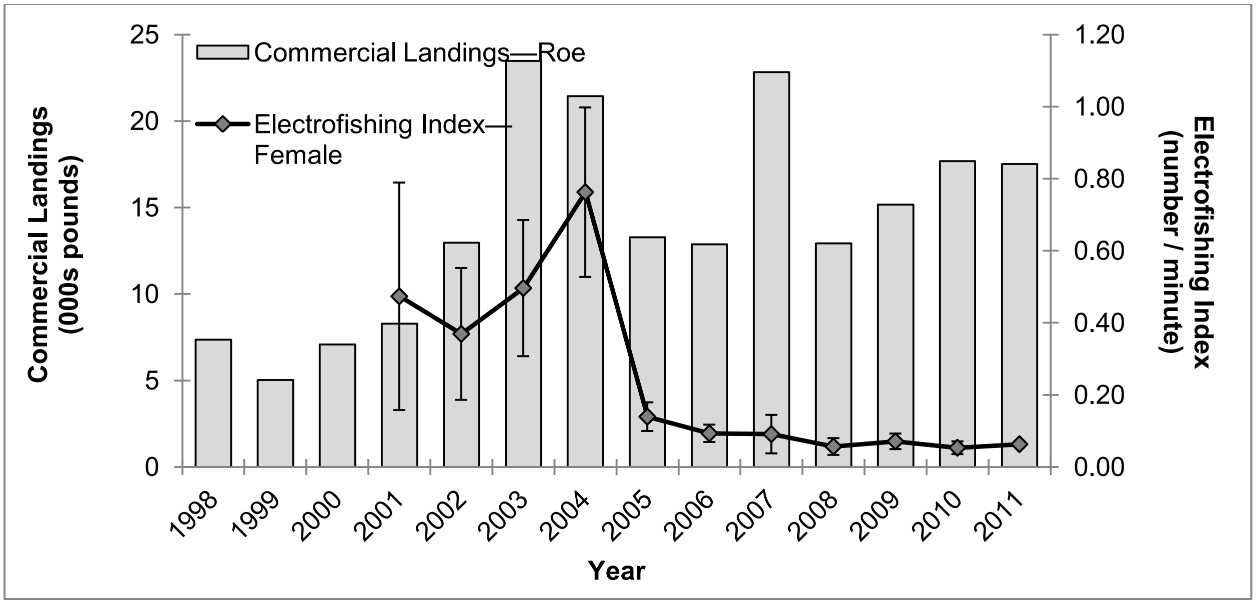


Figure 13. Female electrofishing index (March–May) for the Cape Fear River, 2001–2011. The error bars represent ±1 standard deviation. The threshold represents the 25th percentile (where 75% of all values are greater).



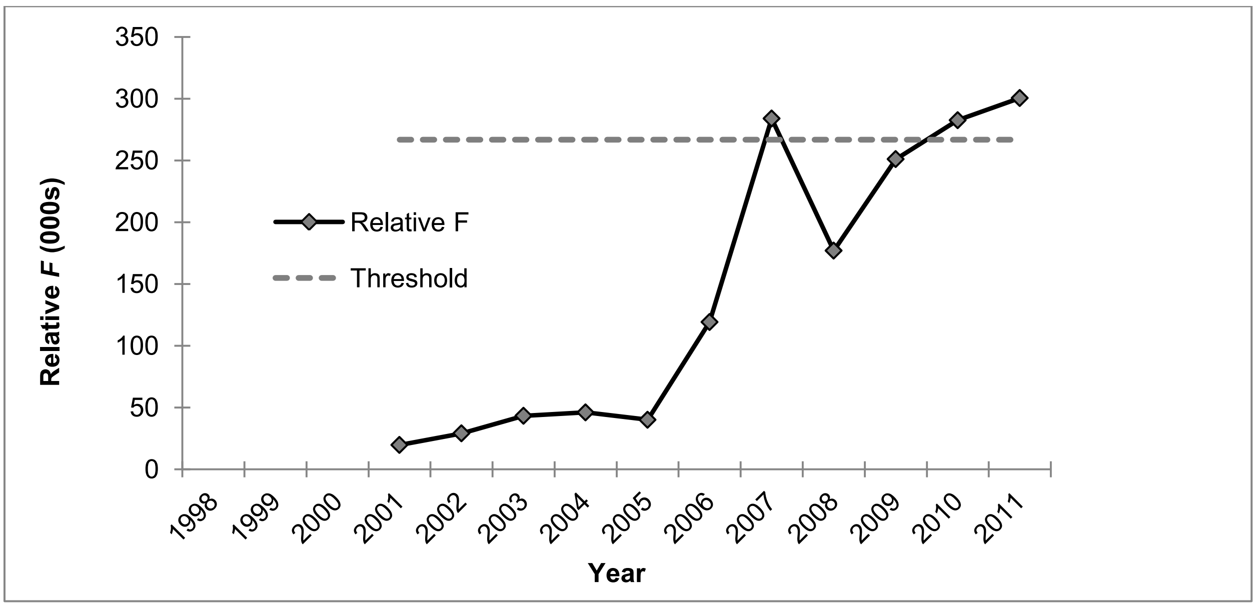


Figure 14. Commercial landings of roes by all gear types (March–May) compared to the female electrofishing index (March–May; top graph) and annual estimates of female relative *F* based on these data (bottom graph) for the Cape Fear River, 2001–2011. The error bars in the top graph represent ±1 standard deviation. The threshold represents the 75th percentile (where 25% of all values are greater).

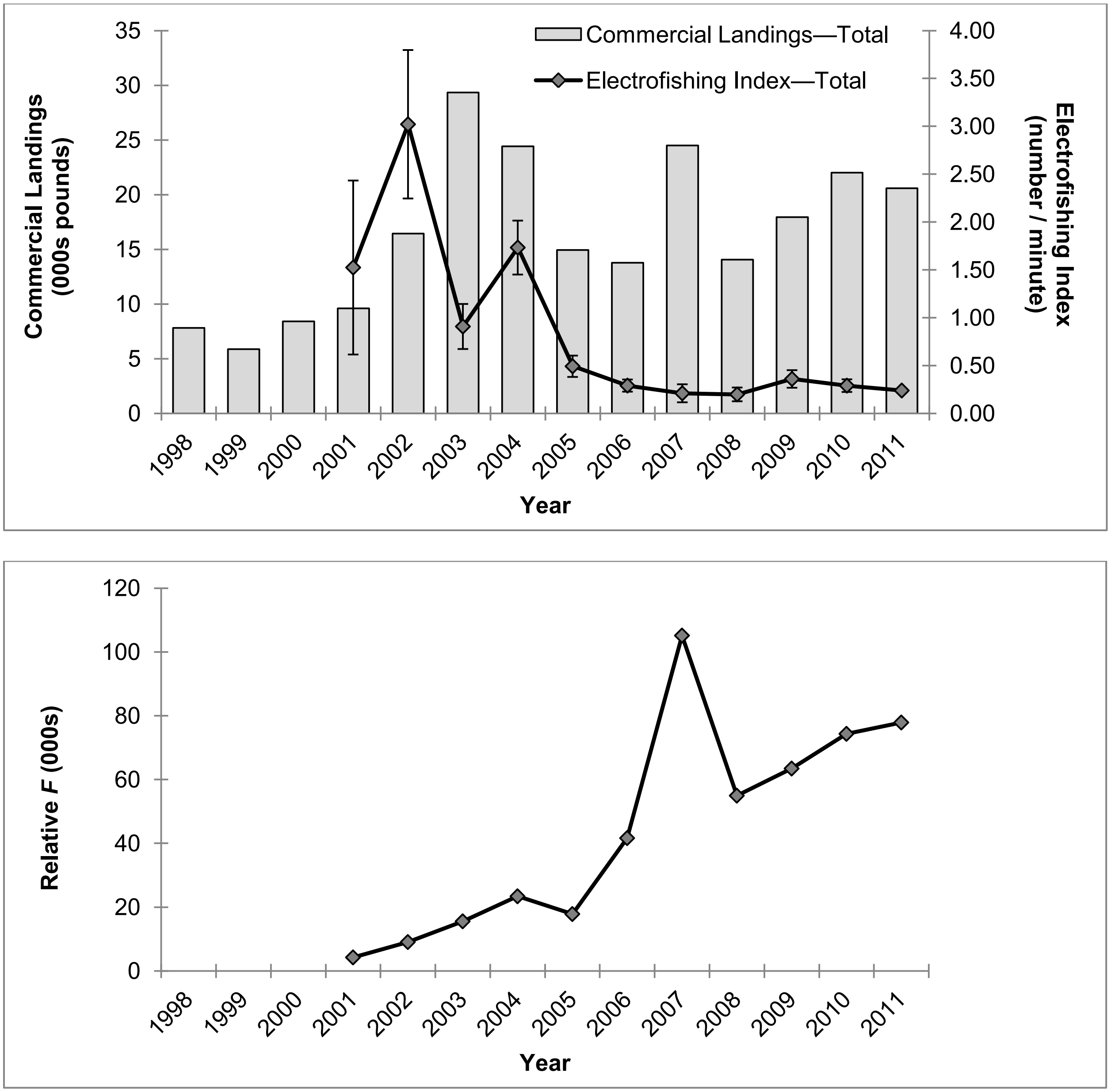


Figure 15. Commercial landings by all gear types (March–May) compared to the total electrofishing index (March–May; top graph) and annual estimates of total relative *F* based on these data (bottom graph) for the Cape Fear River, 2001–2011. The error bars in the top graph represent ±1 standard deviation.

Appendix I:

Evaluation of Available Data for Determining Sustainability of American Shad Fisheries in North Carolina

November 2011

Prepared by:

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INTRODUCTION

In February 2010, the Atlantic States Marine Fisheries Commission (ASMFC) approved Amendment 3 to the Interstate Fishery Management Plan (FMP) for Shad and River Herring (ASMFC 2010). The amendment calls for a moratorium on commercial and recreational fishing for river herring in state waters beginning January 1, 2013, unless a state develops and submits for approval a sustainable management plan. Amendment 3 defines sustainable fisheries as "those that demonstrate their stock could support a commercial and/or recreational fishery that will not diminish the future stock reproduction and recruitment."

A working group comprised of NCDMF staff began meeting in the summer of 2011 to discuss the development of an American shad sustainability plan for North Carolina. An initial evaluation of the available data looked into the usefulness of Program 100 for deriving a juvenile abundance index for American shad and examined annual trends in commercial landings and stock characteristics derived from fisheries-dependent sampling. In addition to fisheries-dependent biological sample sizes, the percent of samples greater than or equal to 5 and 6 years in age, percent repeat spawners, average length, average weight, and average age were considered. Preliminary estimates of total mortality (*Z*) for Albemarle Sound based on the Chapman-Robson method were also briefly reviewed.

Analysis of the Program 100 data found that the survey lacked the persistence needed for a fixed-station survey to provide an unbiased index of abundance. Note that Program 100 was not designed to capture American shad. Increases in average age and the percentages of older individuals based on the fisheries-dependent sampling observed in some areas were not considered evidence of rebuilding because of observed decreases in average length and weight in these same areas. The working group felt the interpretation of fisheries-dependent biological samples could be confounded by the shift from pound nets to gill nets that occurred in the commercial fishery during the 1980s. There was also concern regarding the reliability of scales for determining age; as fish move to the spawning grounds, scales could be losing annuli due to the erosion that allows for the identification of spawning marks. One concern with the estimates of *Z* is that the total mortality estimate for a population in which the age distribution is contracting will not necessarily show an increase if there is no change in the slope that the *Z* estimate is based upon.

This report expands on the evaluation of the data to improve the characterization of the North Carolina stocks and attempts to address issues and requests brought up by the working group. Specifically, length and age frequencies and trends in average size, age, and percent of repeat spawners were calculated using both fisheries-dependent and fisheries-independent data. The percentage of individuals greater than or equal to the length at 50% maturity was calculated because members of the working group suggested that evaluating the proportion of individuals relative to some defined reference length may be more reliable than using a reference age. Sex ratios were computed based on both fisheries-independent data and fisheries-dependent data. The working group felt that sex ratios based on fisheries-independent samples would be more reflective of the sex ratio in the populations because sampling of the fish houses is based on culled catches and so would provide biased estimates. Sex ratios were computed using the fisheries-dependent data to determine whether the ratio of males to females observed in the fish house samples has been consistent with the reporting of bucks and roes on the commercial trip tickets. Finally, relative fishing mortality rates were computed to provide estimates of the trends in actual fishing mortality rates.

DATA

Biological Samples

Biological data for American shad were retrieved from the NCDMF Biological Database. The database was queried for all fisheries-dependent and fisheries-independent records of American shad available through 2010 (M. Loeffler, NCDMF, pers. comm.). A new field named River was created based on the Location field. The field Gear was created based on the Gear1 field. Most of the samples could be identified as fisheries-dependent or fisheries-independent based on the program that collected the sample, which is indicated by the field Program. However, Programs 930 and 400 can include fisheries-dependent and fisheries-independent samples. For samples associated with Program 930, the type (i.e., fisheries-dependent or fisheries-independent) of program that originally collected the data was determined based on the field Var2. Typically, Var2 indicates the program that originally collected the data. If Var2 was blank or equal to 930, the sample was assumed to originate from a fisheries-dependent program. For samples associated with Program 400, the type of program was determined based on the field Station. If Station contained a code, the sample was collected at a fish house and identified as fisheries-dependent. If the field Station was blank, the sample was assumed to be fisheries-independent.

A preliminary evaluation of the data collected from the water bodies of interest—Albemarle Sound, Cape Fear River, Neuse River, and Pamlico River—indicated the majority of both fisheries-dependent and fisheries-independent samples were collected from gill nets during January through May. In order to reduce bias in the analyses performed, only biological data collected from gill nets during January through May were considered in all analyses except where otherwise noted. The numbers of biological samples meeting these criteria are summarized in Table 1.

Trip Tickets

Commercial landings of American shad were available from the NCDMF Trip Ticket Program (S. McInerny, NCDMF, pers. comm.), which was instituted in 1994. Commercial landings in pounds were provided by water body, year, and market grade for all gears and months, gill nets only during all months, and gill nets only during January through May.

METHODS

Commercial Landings

Annual commercial landings of American shad landed by gill nets during January through May were summarized by water body and market grade.

Size and Age Characteristics

Annual length and age frequencies as well as annual average lengths, weights, and ages were calculated by program type and sex for each water body.

Growth

Alternative age-length models were fit to the available data to determine the best model for characterizing the relation of length to age in American shad. Data were pooled across program types and years (by decade) to increase the number of data points and the range of lengths and ages included in the model fits. Each of the models described below were applied to estimate age-length parameters by water body, sex, and decade. Any obvious outliers were excluded.

One of the most commonly used models to describe the age-length relationship is the von Bertalanffy model, which is given by:

$$L_t = L_\infty\left[1 - e^{-K(t-t_0)}\right]$$

where L_t is length at age t, L_∞ is the theoretical asymptotic average length (if $K > 0$), K is the growth rate at which the asymptote is approached, and t_0 is the hypothetical age at which length is zero.

The Gompertz growth model is a three-parameter sigmoid function and is calculated as:

$$L_t = L_\infty e^{-\frac{1}{K}e^{-K(t-t_0)}}$$

The Richards model is a generalization of the von Bertalanffy model to allow for greater flexibility:

$$L_t = L_\infty\left[1 - \delta e^{-K(t-t_0)}\right]^{\frac{1}{\delta}} \quad \delta \neq 0$$

where δ is an additional parameter estimated by the model.

The logistic age-length model is equivalent to the Richards model when δ = -1 and is given by:

$$L_t = L_\infty\left[1 + e^{-K(t-t_0)}\right]^{-1}$$

Schnute provides a general four-parameter model describing a relative, rather than instantaneous, rate of change in growth that contains most of the preceding models as special cases. The model is given by:

$$L_t = \left[L_1^b + \left(L_2^b - L_1^b\right)\frac{1 - e^{-a(t-t_1)}}{1 - e^{-a(t_2-t_1)}}\right]^{\frac{1}{b}}$$

for case 1 (see Schnute 1981) where t_1 and t_2 were specified as the youngest and oldest ages observed, L_1 is length at age t_1, L_2 is length at age t_2, and the parameters a and b define the shape of the curve and are not equal to zero for case 1.

Model fits were first evaluated based on convergence status; models that did not successfully converge were removed from consideration for the associated dataset. The fits of models that successfully converged were compared within each water body/sex/decade combination using the Akaike Information Criterion (AIC) for use with sum of squares (Hongzhi 1989; Hilborn and Mangel 1997). This method takes into account both the goodness-of-fit and the number of parameters estimated. The model fit associated with the smallest AIC value is considered the most likely to be correct among the models considered, given the data. One age-length model was selected for characterizing the age-length relation for American shad based on the results of the AIC analysis. The water body/sex/decade-specific parameter estimates from the "best" model were used in the calculation of lengths at 50% maturity (see below). The selected model was also used to estimate age-length parameters by water body and sex (decades pooled) to provide substitute estimates in case the model failed to converge on a particular water body/sex/decade combination.

Maturity

The annual percentage of repeat spawners was calculated for each water body, program type, and sex. Records where the age and number of spawning marks indicated that the individual fish's age at first spawning was younger than 3 years were excluded from the calculation.

The annual percent of individuals greater than or equal to length at 50% maturity (L_{50}) was computed for each water body, program type, and sex. In order to determine estimates of L_{50}, a maturity schedule was needed. Maki et al. (2001) provide a method for estimating the proportion mature at age when samples are only available from the mature segment of the population. The method was used to estimate the proportion mature at age by water body, sex, and decade. Data were pooled across program types and years (by decade) to increase the number of data points and the range of ages included in the model fits. Records where the age and number of spawning marks indicated that the individual fish's age at first spawning was younger than 3 years were excluded before estimating the maturity schedules. The age at 50% maturity (A_{50}) was determined for each water body, sex, and decade based on the estimated maturity schedules. The A_{50} estimates were converted to L_{50} estimates by applying the age-length parameters predicted for the associated water body, sex, and decade. If the age-length model failed to converge for a particular water body/sex/decade combination, the age-length parameters estimated for the same water body and sex (pooled over decades) were applied to the A_{50} estimate to estimate the L_{50} value. If the maturity schedule for a particular water body/sex/decade combination could not be estimated, the maturity schedule for the same water body and sex (pooled over decades) was estimated to derive A_{50} and the age-length parameters for the particular water body/sex/decade combination were applied to estimate L_{50}. If neither a maturity schedule or age-length parameters were available for a particular water body/sex/decade combination, then the estimated maturity schedule and age-length parameters for the same water body and sex (pooled over decades) were used to estimate A_{50} and then L_{50}.

The lengths for each water body, program type, and sex observed in each year were compared to the L_{50} value for the associated water body and sex estimated for the decade of the observation year. The annual percentage of observed lengths greater than or equal to L_{50} was computed by water body, program type, and sex.

Sex Ratio

The annual ratio of the number of males to the number of females was computed by water body and sex based on fisheries-independent data only.

Sex ratios were also calculated to evaluate whether the reporting of buck and roe landings on trip tickets has been consistent with the sex ratios estimated from the fisheries-dependent samples. Commercial gill-net landings that occurred during January through May were converted to numbers by dividing the landed weights by the average individual weight of American shad, which was calculated from the fisheries-dependent biological sampling data. The average individual weights were calculated by water body and sex and applied to landings for the same water body and sex to estimate the number landed. The estimated number of male American shad landed was divided by the estimated number of female American shad landed by water body for each year. Sex ratios were also calculated based on the fisheries-dependent samples as the ratio of the number of males to the number of females. Data were available to compute the fisheries-dependent sex ratios for 2000 through 2010.

Relative *F*

The calculation of relative fishing mortality rate (*F*) requires catch data and a fisheries-independent index of relative abundance. The length and age composition of individuals encountered in the fisheries-independent survey should be similar to the length and age composition of individuals landed by the commercial fishery because this approach assumes the survey index adequately represents the fishable portion of the stock.

Annual estimates of relative *F* were calculated using three methods. For the first method, relative *F* in year *t* was calculated by dividing commercial gill-net landings (*L*) by an index of relative abundance (*I*) derived from a fisheries-independent survey:

$$\text{rel}F_t = \frac{L_t}{I_t}$$

Imprecision in the survey index can cause estimates of relative *F* to be noisy. The noise can be dampened by using an average of the survey index over adjacent years in place of point estimates in the denominator. Two methods of averaging the survey index, or smoothing, were considered. For the first smoothing method considered, relative *F* was computed by dividing commercial gill-net landings by a lagged 3-year average of the survey index:

$$\text{rel}F_t = \frac{L_t}{\left(\frac{I_t + I_{t-1} + I_{t-2}}{3}\right)}$$

In this method, note that relative *F* in the first and last year of the time series is based on only 1 year of data. Also, relative *F* in the second and second-to-last year is based on only 2 years of data using this calculation method.

For the second smoothing method, relative *F* was computed by dividing commercial gill-net landings by a centered 3-year average of the survey index:

$$\text{rel}F_t = \frac{L_t}{\left(\frac{I_{t+1} + I_t + I_{t-1}}{3}\right)}$$

In this method, note that relative *F* in the first and last year of the time series is based on only 2 years of data.

For the Albemarle Sound, relative *F* was calculated based on commercial landings and the NCDMF fisheries-independent gill-net survey (IGNS). The NCDMF IGNS operates January through May and the mesh size of the gear ranges from 2.5- to 7.0-inch square mesh at 0.5-inch intervals. In order to reduce bias in the relative *F* estimates, only commercial gill-net landings that occurred during January through May were used. Additionally, an alternative survey index was calculated using only data observed in 5.0-, 5.5-, and 6.0-sized meshes in order to more closely mimic the mesh sizes used in the commercial fishery. Estimates of relative *F* for Albemarle Sound were calculated based on both the original survey index and the alternative survey index using the three methods described above.

Because the IGNS began in 1991 and the Trip Ticket program was initiated in 1994, it was necessary to obtain commercial landings for 1991 to 1993 in order to compute relative *F* for the 1991 to 2010 time period for Albemarle Sound. Commercial gill-net landings that occurred during January through May in 1991 to 1993 were available from voluntary reporting by seafood dealers that occurred during that time (S. McInerney, pers. comm.).

Estimates of relative *F* were also calculated for the Cape Fear, Neuse, and Pamlico rivers using the three methods described. Fisheries-independent survey data were available from the NCWRC fisheries-independent electroshocking survey for the Cape Fear, Neuse, and Tar rivers. The NCWRC electroshocking survey operates from mid-March to the end of April and can possibly extend into May in some years. Indices of relative abundance derived from the electroshocking survey were available for 2003 through 2010. For the calculation of relative *F* in the Cape Fear, Neuse, and Pamlico rivers, commercial landings that occurred during March through April in 2003 to 2010 for all gears were obtained from the NCDMF Trip Ticket program. Computations of relative *F* for the Pamlico River used the electroshocking index from the Tar River because commercial landings specific to the Tar River were not available.

RESULTS

Commercial Landings

Annual commercial gill-net landings of American shad that occurred during January through May are shown for each water body in Figure 1–Figure 4. Roes have comprised the majority of these commercial landings in each water body.

Size and Age Characteristics

The size and age characteristics of American shad derived from the available biological sampling data are depicted in Figure 5–Figure 28. The length and age compositions of American shad sampled from fisheries-dependent and fisheries-independent sampling were generally similar. Annual trends in average length, weight, and age are also generally similar between program types. During the most recent 10 years (2000–2010), the biological data suggest declining trends in average length and weight and increasing trends in average age.

Growth

Five models relating length to age were compared based on ranking of AIC values among candidate models within each water body/sex/decade combination. Only models that successfully converged and produced realistic parameter estimates were considered. There was no one model that was found to consistently result in the lowest AIC among all dataset combinations (Table 2). Both the Richards and Schnute models failed to converge for most dataset combinations. Most of the datasets were best fit by either the von Bertalanffy or logistic model; however, the comparisons of model fits indicated all models (that converged) were nearly equally as likely in predicting growth in length with age for each dataset configuration (very small differences in AIC values among models within datasets). The model selected for use in the calculations of lengths at 50% maturity was the von Bertalanffy age-length model because it is well-known and resulted in the lowest AIC values for many model fits. The von Bertalanffy parameters estimated for each water body/sex/decade combination are presented in Table 3. Parameter estimates for each water body and sex (pooled over decades) are presented in Table 4. Many of the parameter estimates are associated with large standard errors (≥30% of parameter estimate; Table 3, Table 4). This is partly due to the broad overlap in lengths of adjacent age classes observed in the data, which suggests the relationship between age and length for American shad is not well-defined.

Maturity

Temporal trends in percent repeat spawners derived from fisheries-dependent and fisheries-independent samples were not always consistent within water body and sex (Table 5–Table 8). This may be partly due to large variations in samples sizes among years.

Maturity schedules were estimated by water body, sex, and decade (Table 9) and by water body and sex (Table 10) in order to derive estimates of A_{50}. Estimates of A_{50} were converted to L_{50} by applying the appropriate age-length parameters predicted by the von Bertalanffy model (Table 3, Table 4). Observed lengths in each year were compared to the L_{50} value estimated for the matching water body, program type, sex, and decade in order to calculate the percentage of individual lengths that were greater than or equal to the associated L_{50}.

Annual estimates of the percent of lengths greater than or equal to L_{50} were variable among years and some trends were observed (Figure 29–Figure 32). Declining trends in this percentage were demonstrated from 2004 to 2009 for all female American shad sampled from the Albemarle Sound (Figure 29), males sampled by fisheries-independent programs from the Cape Fear River (Figure 30), all females sampled from the Cape Fear River (Figure 30), and all females sampled from the Pamlico River (Figure 32). Males sampled by fisheries-dependent programs in the Cape Fear (Figure 30), Neuse (Figure 31), and Pamlico (Figure 32) rivers exhibited improving trends in the percent of lengths greater than or equal to L_{50} during the early to mid-2000s.

Sex Ratio

The fisheries-independent sex ratios were variable among years in all water bodies (Figure 33–Figure 36). These sex ratios suggest an overall higher proportion of females in the 2000s compared to the proportion of females observed in the 1970s and 1980s.

Sex ratios calculated using fisheries-dependent sources of information were compared to determine if the reporting of bucks and roes on the commercial trip tickets has been consistent with sex ratios based on the fisheries-dependent biological samples. The annual sex ratios derived from both fisheries-dependent sources show that the majority of commercial gill-net landings have been roes (Figure 37–Figure 40). The fisheries-dependent biological sampling data from the Albemarle Sound (Figure 37) and Neuse River (Figure 39) tended to overestimate the sex ratio of the reported landings while the fisheries-dependent biological sampling data from the Cape Fear River (Figure 38) tended to underestimate the sex ratio of the reported commercial landings. Annual trends in sex ratios based on the fisheries-dependent biological sampling data generally exhibited the same trends as sex ratios derived from the trip ticket data for the Albemarle Sound (Figure 37), Cape Fear River (Figure 38), and Pamlico River (Figure 40).

Relative *F*

Annual estimates of relative *F* were calculated using three different calculation methods. For the Albemarle Sound, the calculations were made using commercial landings and both the original IGNS index (all mesh sizes; Figure 41) and a modified IGNS index (mesh sizes 5.0, 5.5, and 6.0 inches; Figure 42). Annual estimates of relative *F* were variable among years regardless of the calculation method or source data. Albemarle Sound's commercial landings in 1993 were 0 so the estimate of relative *F* in 1993 was 0 for all methods and source data. Estimates of relative *F* were highest in 2003 when based on the original IGNS index for all calculation methods used (Figure 41). Relative *F* estimates were highest in 2010 when based on the modified IGNS index (Figure 42). The lowest estimates of relative *F* occurred in the first three years of the time series (1991 to 1993) for all methods and source data (Figure 41, Figure 42).

For the Cape Fear, Neuse, and Pamlico rivers, relative *F* was estimated based on commercial landings and indices of relative abundance derived from the NCWRC electroshocking survey. For the Cape Fear River, estimates of relative *F* were higher in the late 2000s than the early 2000s and the highest values occurred in 2007 regardless of the calculation method (Figure 43). Estimates of relative *F* for the Neuse River exhibited an overall decline over the time series for all calculation methods (Figure 44). Relative *F* for the Pamlico River remained fairly steady from 2003 to 2006, then alternated between highs in lows through 2010 (Figure 45).

SUMMARY

The identification of suitable sustainability targets for American shad is complicated by biases associated with the available biological sampling data. Variability in the number and availability of samples over time makes it difficult to interpret and compare trends in characteristics derived from these data. Fisheries-dependent biological data may be further confounded by changes in gear selectivity and fishing power over time.

Apparent increases in average age in recent years are likely not evidence of rebuilding since decreases in average length and weight have occurred over the same time period. A change in growth rates over time is one explanation for these observations.

The parameter L_{50} was selected as a reference length for evaluating the composition of the different stocks over time. Use of a reference length was considered to be more reliable than using a reference age; however, the L_{50} values were directly converted from estimates of A_{50}, which were, in turn, derived from a weak age-length relation.

Sex ratios for American shad derived from the fisheries-dependent biological samples reflect the dominance of roes that have occurred in the commercial landings. Also, the fisheries-dependent samples from most water bodies[1] appear adequate for detecting trends in the ratio of bucks to roes reported in the landings but tended to overestimate or underestimate the magnitude of this ratio depending on the water body. Sex ratios for American shad derived from fisheries-dependent data sources should not be assumed to represent the sex ratio of the population because the fishery targets roes and sampling of the fish houses is based on culled catches.

Calculation of relative *F* is a useful approach for estimating trends in actual *F* when data required by more complicated estimation methods are not available (Sinclair 1998). The approach is not confounded by normality assumptions and relative *F* can be directly estimated from catch and fisheries-independent survey data. The approach works well as long as fishing power hasn't changed over the time period of interest. One potential drawback is that the approach doesn't consider temporal and spatial shifts in the age structure of the population. Also, relative *F* is sensitive to recruitment variability and changes in selectivity, average weight, age structure, and other factors over time (NEFSC 2002). Another factor that should be considered is the degree of

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[1] For the Neuse River, sex ratios derived from fisheries-dependent biological samples were not consistent with the reporting of bucks and roes on the commercial trip tickets

smoothing, if a smoothing method is used in the calculation. Smoothing methods can reduce the noise associated with imprecision in the survey index. They are meant to provide a balance between the signal and the noise. If the degree of smoothing eliminates the noise but results in a loss of the true signal, then a lesser degree or no smoothing should be considered.

Comparison of relative *F* estimates for Albemarle Sound before 1994 to estimates for 1994 and after may be confounded by the differences in the way in which commercial landings data were collected (pre-1994: voluntary, 1994–present: mandatory reporting). Also, the use of the Tar River electroshocking index in the calculation of relative *F* for the Pamlico River may not be appropriate and should be discussed by the working group.

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TABLES

Table 1. Summary of the number of biological samples available for American shad through 2010 sampled from gill nets in Albemarle Sound, the Cape Fear River, the Neuse River, and the Pamlico River during January through May, by program type.

Program Type	Program No.	Years w/Samples		Lengths		Weights		Ages		Spawning Marks	
		Earliest	Latest	Male	Female	Male	Female	Male	Female	Male	Female
Fisheries-Dependent	400	1972	2010	7,647	10,687	5,243	9,007	4,746	6,071	3,970	5,508
	410	1978	1981	32	50	4	12	32	48	32	48
	460	1996	2010	48	61	18	20	0	0	0	0
	461	1991	2010	1,235	8,943	63	369	0	0	0	0
	462	1996	2004	54	470	42	441	0	0	0	0
	930	1995	2010	565	1,298	559	1,262	301	733	301	733
Fisheries-Independent	127	2003	2007	15	377	15	376	0	0	0	0
	135	1991	2010	753	692	558	514	0	0	0	0
	150	1973	2010	138	100	11	3	99	77	99	77
	300	1975	1981	132	66	0	0	128	64	127	64
	400	1973	2010	1,980	4,436	1,283	2,789	1,326	2,974	772	2,149
	915	2000	2010	0	2	0	0	0	0	0	0
	930	1995	2010	745	1,052	738	1,018	409	638	409	638

Table 2. Calculated AIC values for age-length models fit to available data for American shad by water body, sex, and decade. Values in **bold** indicate the model with the smallest AIC value for the associated water body, sex, and decade.

Water Body	Sex	Decade	von Bertalanffy	Gompertz	Richards	Logistic	Schnute
Albemarle Sound	Male	1970	13.9939	13.9937	13.9945	**13.9936**	13.9945
		1980	13.9506	13.9505	13.9515	**13.9504**	13.9515
		1990	12.7825	12.7824	12.7857	**12.7823**	12.7857
		2000	13.0703	13.0697	*failed*	**13.0692**	*failed*
		2010	*failed*	**10.8105**	*failed*	10.8106	*failed*
	Female	1970	13.9438	13.9433	*failed*	**13.9428**	*failed*
		1980	13.8058	13.8057	13.8069	**13.8055**	13.8069
		1990	**12.9940**	12.9941	*failed*	12.9942	12.9967
		2000	13.1874	13.1876	*failed*	13.1878	**13.1872**
		2010	**9.2560**	9.2572	*failed*	9.2584	*failed*
Cape Fear River	Male	1980	**11.3101**	11.3105	*failed*	11.3108	*failed*
		2000	**11.5435**	11.5435	11.5543	11.5436	11.5543
		2010	**8.1404**	8.1412	*failed*	8.1422	8.2712
	Female	1980	**12.1388**	12.1389	*failed*	12.1390	*failed*
		2000	12.6962	12.6961	12.6979	**12.6960**	12.6979
		2010	10.3199	10.3198	*failed*	**10.3197**	*failed*
Neuse River	Male	1970	**11.8122**	11.8126	*failed*	11.8130	*failed*
		1980	**12.0216**	12.0216	*failed*	12.0216	*failed*
		2000	11.8320	11.8319	11.8343	**11.8317**	*failed*
		2010	**9.8118**	**9.8118**	*failed*	**9.8118**	*failed*
	Female	1970	**12.3750**	12.3752	*failed*	12.3754	*failed*
		1980	*failed*	*failed*	*failed*	*failed*	*failed*
		2000	**12.8599**	12.8601	*failed*	12.8604	12.8600
		2010	**9.6270**	9.6271	*failed*	9.6272	*failed*
Pamlico River	Male	1970	11.8064	11.8073	*failed*	11.8082	**11.7994**
		1980	12.0599	12.0591	*failed*	**12.0583**	*failed*
		2000	11.4770	11.4768	11.4838	**11.4766**	*failed*
		2010	**8.2893**	**8.2893**	*failed*	**8.2893**	*failed*
	Female	1970	**12.3441**	12.3441	*failed*	12.3442	*failed*
		1980	**12.7076**	12.7076	*failed*	12.7077	12.7111
		2000	**13.0253**	13.0256	*failed*	13.0259	*failed*
		2010	*failed*	*failed*	*failed*	*failed*	*failed*

Table 3. Parameter estimates (standard errors in parentheses) of the von Bertalanffy age-length model fits to available data for American shad by water body, sex, and decade. Values of L_∞ represent length in millimeters. Asterisks (*) denote standard errors that are ≥ 30% of the parameter estimate.

Water Body	Sex	Decade	n	L_∞	K	t_0
Albemarle Sound	Male	1970	1,781	443 (4.05)	0.564 (0.0704)	-0.0635 (0.369*)
		1980	1,748	499 (18.1)	0.234 (0.0534)	-2.37 (0.960*)
		1990	496	576 (140)	0.124 (0.105*)	-4.36 (3.61*)
		2000	811	552 (53.6)	0.142 (0.0514*)	-4.46 (1.48*)
		2010	91	*failed to converge*		
	Female	1970	1,476	491 (2.27)	1.04 (0.108)	2.00 (0.198*)
		1980	1,262	533 (15.0)	0.258 (0.0711)	-2.62 (1.47*)
		1990	574	526 (36.0)	0.235 (0.136*)	-2.88 (3.05*)
		2000	1,120	572 (45.3)	0.127 (0.0456*)	-6.59 (2.04*)
		2010	95	603 (124)	0.0898 (0.0633*)	-7.96 (4.11*)
Cape Fear River	Male	1980	150	487 (65.2)	0.322 (0.341*)	-1.89 (3.91*)
		2000	183	456 (23.2)	0.368 (0.164*)	-1.26 (1.52*)
		2010	15	426 (9.13)	1.30 (0.434*)	2.81 (0.418)
	Female	1980	324	504 (5.81)	1.08 (0.312)	1.81 (0.569*)
		2000	941	512 (13.1)	0.265 (0.0605)	-2.73 (1.10*)
		2010	166	490 (27.4)	0.293 (0.170*)	-2.24 (2.83*)
Neuse River	Male	1970	331	494 (51.7)	0.247 (0.158*)	-2.71 (2.53*)
		1980	343	503 (89.8)	0.215 (0.260*)	-3.95 (5.93*)
		2000	251	650 (503*)	0.0660 (0.132*)	-9.74 (10.2*)
		2010	30	401 (9.94)	1.77 (3.11*)	2.44 (2.60*)
	Female	1970	771	600 (71.3)	0.182 (0.0978*)	-2.97 (2.14*)
		1980	413	*failed to converge*		
		2000	1,118	490 (7.72)	0.298 (0.0566)	-3.14 (0.987*)
		2010	97	769 (1,751*)	0.0416 (0.223*)	-14.0 (36.3*)
Pamlico River	Male	1970	323	457 (11.7)	0.611 (0.190*)	0.250 (0.802*)
		1980	293	461 (9.99)	0.676 (0.228*)	0.724 (0.882*)
		2000	180	524 (112)	0.133 (0.144*)	-6.93 (6.63*)
		2010	9	439 (161*)	0.405 (1.36*)	-0.459 (10.6*)
	Female	1970	504	515 (13.5)	0.538 (0.167*)	0.305 (0.886*)
		1980	508	688 (382*)	0.0972 (0.178*)	-6.79 (9.30*)
		2000	1,125	552 (53.7)	0.123 (0.0671*)	-8.26 (4.00*)
		2010	119	*failed to converge*		

Table 4. Parameter estimates (standard errors in parentheses) of the von Bertalanffy age-length model fits to available data for American shad by water body and sex (pooled over decades). Values of L_∞ represent length in millimeters. Asterisks (*) denote standard errors that are ≥ 30% of the parameter estimate.

Water Body	Sex	Decade	n	L_∞	K	t_0
Albemarle Sound	Male	all	4,927	476 (7.03)	0.276 (0.0303)	-2.24 (0.448)
	Female	all	4,527	504 (3.15)	0.400 (0.0304)	-0.872 (0.294*)
Cape Fear River	Male	all	348	435 (5.63)	0.815 (0.189)	0.773 (0.523*)
	Female	all	1,431	475 (2.31)	0.771 (0.108)	0.622 (0.416*)
Neuse River	Male	all	955	456 (8.91)	0.444 (0.0870)	-0.736 (0.609*)
	Female	all	2,399	478 (2.03)	0.666 (0.0602)	0.227 (0.277*)
Pamlico River	Male	all	805	456 (6.14)	0.550 (0.105)	-0.169 (0.591*)
	Female	all	2,256	473 (1.26)	1.05 (0.0955)	1.44 (0.209)

Table 5. Annual percent of repeat spawners (RS) and sample size for American shad sampled from gill nets in Albemarle Sound during January through May, by sex and program type, 1972–1993 and 2000–2010.

	Male				Female			
	Fishery-Dependent		Fishery-Independent		Fishery-Dependent		Fishery-Independent	
Year	% RS	n	% RS	n	% RS	n	% RS	n
1972	44.1	188			44.5	191		
1973	17.3	300	60.0	5	14.8	284	14.3	7
1974	5.58	215			7.56	172		
1975	25.7	148			21.8	188		
1976	24.3	280			24.0	175		
1977	10.0	120			5.15	97		
1978	6.28	239			4.17	168		
1979	18.2	269			6.45	155		
1980	59.5	296			74.5	137		
1981	97.6	125			99.1	106		
1982	57.1	189			87.8	131		
1983	100	103			99.0	100		
1984	100	113			99.3	135		
1985	100	69			100	74		
1986	100	42	100	13	100	29	100	4
1987	100	6			100	1		
1988	100	100			100	99		
1989	52.6	95			78.1	96		
1990	100	79	100	3	100	79	100	1
1991	100	66			100	78		
1992	100	91			100	121		
1993	100	66			100	93		
2000	13.6	81	25.0	4	50.0	110	0	1
2001	42.9	63			13.9	115		
2002	25.6	78			22.8	101	0	1
2003	38.3	94			43.3	134		
2004	40.5	42	11.8	34	44.9	78	40.0	40
2005	23.4	64	12.8	47	31.3	96	36.5	52
2006	60.7	28	10.2	59	48.8	41	27.3	55
2007	76.2	42	37.0	54	42.4	33	66.0	53
2008	100	4	38.0	50	59.6	57	34.0	53
2009	76.9	26	28.6	42	46.6	58	32.6	43
2010	56.9	58	45.5	33	34.6	52	25.6	43

Table 6. Annual percent of repeat spawners (RS) and sample size for American shad sampled from gill nets in the Cape Fear River during January through May, by sex and program type, 1983–1988 and 2001–2010.

	Male				Female			
	Fishery-Dependent		Fishery-Independent		Fishery-Dependent		Fishery-Independent	
Year	% RS	n	% RS	n	% RS	n	% RS	n
1983			100	6			100	5
1984			100	3			100	9
1985			100	4			100	8
1986			100	1			100	4
1987								
1988			100	3			100	15
2001	25.0	20			18.4	98		
2002	5.00	20			12.2	49		
2003	17.9	28			20.0	75		
2004	5.00	40			21.7	106		
2005	0	2	5.88	17	24.6	69	24.7	166
2006			0	4			20.2	89
2007			22.2	18			18.8	85
2008	0	1	25.0	4	17.6	34	19.7	76
2009	37.5	8	19.0	21	45.0	20	21.3	80
2010	0	7	0	8	9.91	111	7.27	55

Table 7. Annual percent of repeat spawners (RS) and sample size for American shad sampled from gill nets in the Neuse River during January through May, by sex and program type, 1977–1988 and 2000–2010.

	Male				Female			
	Fishery-Dependent		Fishery-Independent		Fishery-Dependent		Fishery-Independent	
Year	% RS	n	% RS	n	% RS	n	% RS	n
1977			29.6	81			12.3	366
1978	0	13	4.72	127	0	16	1.47	136
1979			0.877	114			1.17	257
1980			0	26	0	12	0	40
1981	5.56	18	15.8	38	6.25	16	4.65	43
1982								
1983			100	30			100	18
1984			100	23			100	25
1985			100	6			100	3
1986			100	13			100	5
1987								
1988			100	3			100	13
2000	8.33	12			42.9	49		
2001	0	2			37.3	102		
2002	8.11	37			18.9	122		
2003	10.3	29			15.5	58		
2004	16.0	25	0	2	40.4	203	66.7	3
2005	0	10	0	4	35.0	80	41.7	36
2006	25.5	47	30.0	10	37.5	136	32.1	28
2007	93.8	16	33.3	12	52.9	34	45.6	57
2008	100	2	23.1	26	44.1	59	37.8	45
2009	22.2	9	62.5	8	52.5	59	46.8	47
2010	25.0	28	0	2	39.8	83	28.6	14

Table 8. Annual percent of repeat spawners (RS) and sample size for American shad sampled from gill nets in the Pamlico River during January through May, by sex and program type, 1978–1988 and 2000–2010.

	Male				Female			
	Fishery-Dependent		Fishery-Independent		Fishery-Dependent		Fishery-Independent	
Year	% RS	n	% RS	n	% RS	n	% RS	n
1975			20.4	226			10.2	325
1976			30.3	33			41.4	29
1977								
1978			11.1	45			0	52
1979			0	18			4.04	99
1980			0	8			0	64
1981	0	1	8.33	24	0	4	3.23	62
1982								
1983			100	24			100	21
1984			100	8			100	9
1985			100	8			100	13
1986			100	6			100	6
1987								
1988			100	9			100	32
2000	29.4	17			48.0	25		
2001	0	1			21.8	110		
2002	33.3	12	100	1	23.1	91	34.8	23
2003	21.7	46	15.4	13	25.0	120	17.9	28
2004	18.8	16	33.3	3	47.5	160	100	3
2005	16.7	6			29.9	77	28.6	7
2006	44.4	9	33.3	3	46.2	119	50	22
2007	70.0	20	50.0	6	59.6	94	52.9	17
2008	36.4	11	0.0	2	38.7	111	50.0	12
2009	62.5	8	33.3	6	35.4	96	54.5	11
2010	0	3	16.7	6	43.0	107	25.0	12

Table 9. Predicted maturity schedule and derived estimates of A_{50} and L_{50} for American shad by water body, sex, and decade. Values of L_{50} represent length in millimeters.

Water Body	Sex	Decade	n	Proportion Mature at Age								A_{50}	L_{50}
				3	4	5	6	7	8	9	10		
Albemarle Sound	Male	1970	1,766	0.000150	0.00273	0.0110	0.0280	0.0741	0.333	1.00		8.9	439
		1980	1,151	0.00380	0.413	0.933	1.00					4.1	390
		1990	305	0.00632	0.307	0.898	1.00					4.2	379
		2000	812	0.00883	0.194	0.573	0.932	1.00				4.6	404
		2010	91		0.0295	0.452	0.889	1.00				5.1	413 [2]
	Female	1970	1,472								1.00	5.4 [3]	477
		1980	912		0.157	0.723	0.987	1.00				4.7	451
		1990	372		0.0745	0.588	0.959	1.00				4.9	441
		2000	1,121	0.00147	0.0698	0.275	0.690	0.973	1.00			5.2	449
		2010	95		0.00142	0.0198	0.575	1.00				5.7	430
Cape Fear River	Male	1980	17		0.765	1.00						3.1	412
		2000	183	0.000450	0.0117	0.0936	0.400	1.00				5.8	425
		2010	15					1.00				6.2 [3]	420
	Female	1980	41		0.228	0.774	1.00					4.5	476
		2000	947	0.0000880	0.00464	0.0443	0.245	0.667	1.00			6.2	469
		2010	166			0.00767	0.155	0.800	1.00			6.4	452
Neuse River	Male	1970	335	0.00199	0.0358	0.289	1.00					4.9	423
		1980	157		0.273	0.745	1.00					4.5	420
		2000	251	0.0111	0.103	0.376	0.833	1.00				4.9	408
		2010	30		0.0765	0.357	1.00					5.0	398
	Female	1970	775						1.00			6.0 [3]	482
		1980	175		0.0490	0.260	0.800	1.00				5.3	463 [2]
		2000	1,118	0.00111	0.0442	0.193	0.519	0.813	1.00			5.6	457
		2010	97			0.0515	0.478	1.00				5.9	435
Pamlico River	Male	1970	322					1.00				5.6 [3]	440
		1980	88		0.158	0.726	0.875	1.00				4.7	429
		2000	180	0.00100	0.0462	0.244	0.519	1.00				5.4	428
		2010	9			0.250	1.00					5.3	393
	Female	1970	505	0.000263	0.00913	0.0897	0.667	1.00				5.4	488
		1980	211		0.0597	0.207	0.652	1.00				5.4	483
		2000	1,126	0.000294	0.0266	0.145	0.398	0.785	1.00			5.8	458
		2010	119		0.00496	0.178	0.737	1.00				5.4	467 [2]

[2] Computed using age-length parameters estimated for same water body and sex (pooled over decades)
[3] Value borrowed from maturity schedule estimated for same water body and sex (pooled over decades)

Table 10. Predicted maturity schedule and derived estimates of A_{50} and L_{50} for American shad by water body and sex (pooled over decades). Values of L_{50} represent length in millimeters.

Water Body	Sex	Decade	Maturity Schedule									A_{50}	L_{50}
			n	3	4	5	6	7	8	9	10		
Albemarle Sound	Male	all	4,125	0.00443	0.119	0.345	0.456	0.511	0.600	1.00		6.6	434
	Female	all	3,972	0.00234	0.0718	0.370	0.709	0.855	0.92	1.00		5.4	464
Cape Fear River	Male	all	215	0.000580	0.0191	0.0893	0.333	1.00				6.2	430
	Female	all	1,154	0.0000879	0.00523	0.0474	0.249	0.686	1.00			6.6	470
Neuse River	Male	all	773	0.00640	0.106	0.453	0.895	1.00				5.1	421
	Female	all	2,165	0.000448	0.0207	0.147	0.529	0.846	1.00			6.0	468
Pamlico River	Male	all	599	0.00664	0.0771	0.330	0.568	1.00				5.6	437
	Female	all	1,961	0.000342	0.0217	0.136	0.427	0.794	1.00			6.2	470

FIGURES

Figure 1. Annual commercial landings of American shad harvested by gill nets from Albemarle Sound during January through May, by market grade, 1994–2010.

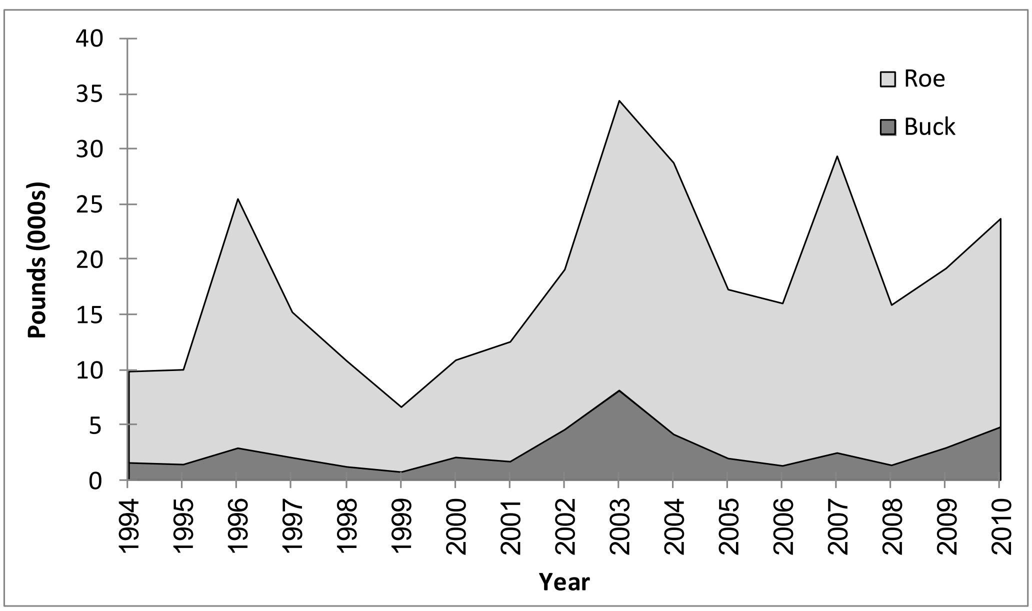


Figure 2. Annual commercial landings of American shad harvested by gill nets from the Cape Fear River during January through May, by market grade, 1994–2010.

Figure 3. Annual commercial landings of American shad harvested by gill nets from the Neuse River during January through May, by market grade, 1994–2010.

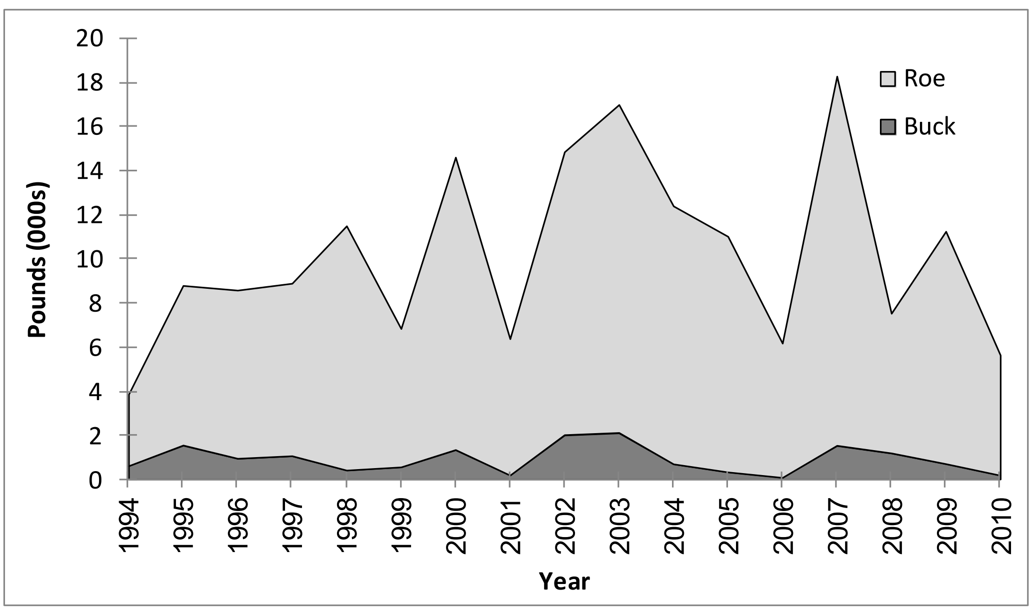


Figure 4. Annual commercial landings of American shad harvested by gill nets from the Pamlico River during January through May, by market grade, 1994–2010.

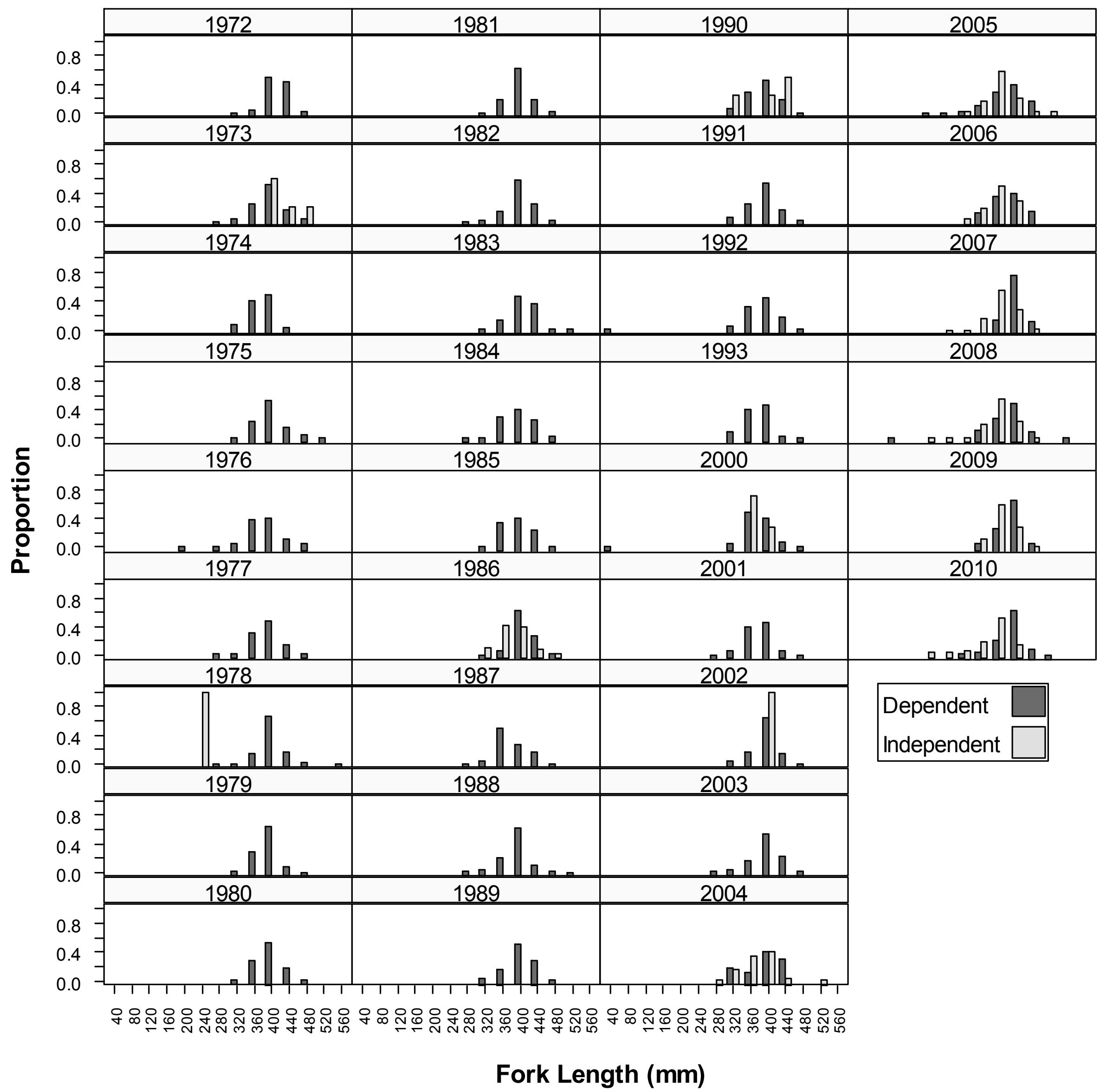


Figure 5. Annual length frequencies of male American shad sampled from gill nets in Albemarle Sound during January through May, by program type, 1972–1993 and 2000–2010.

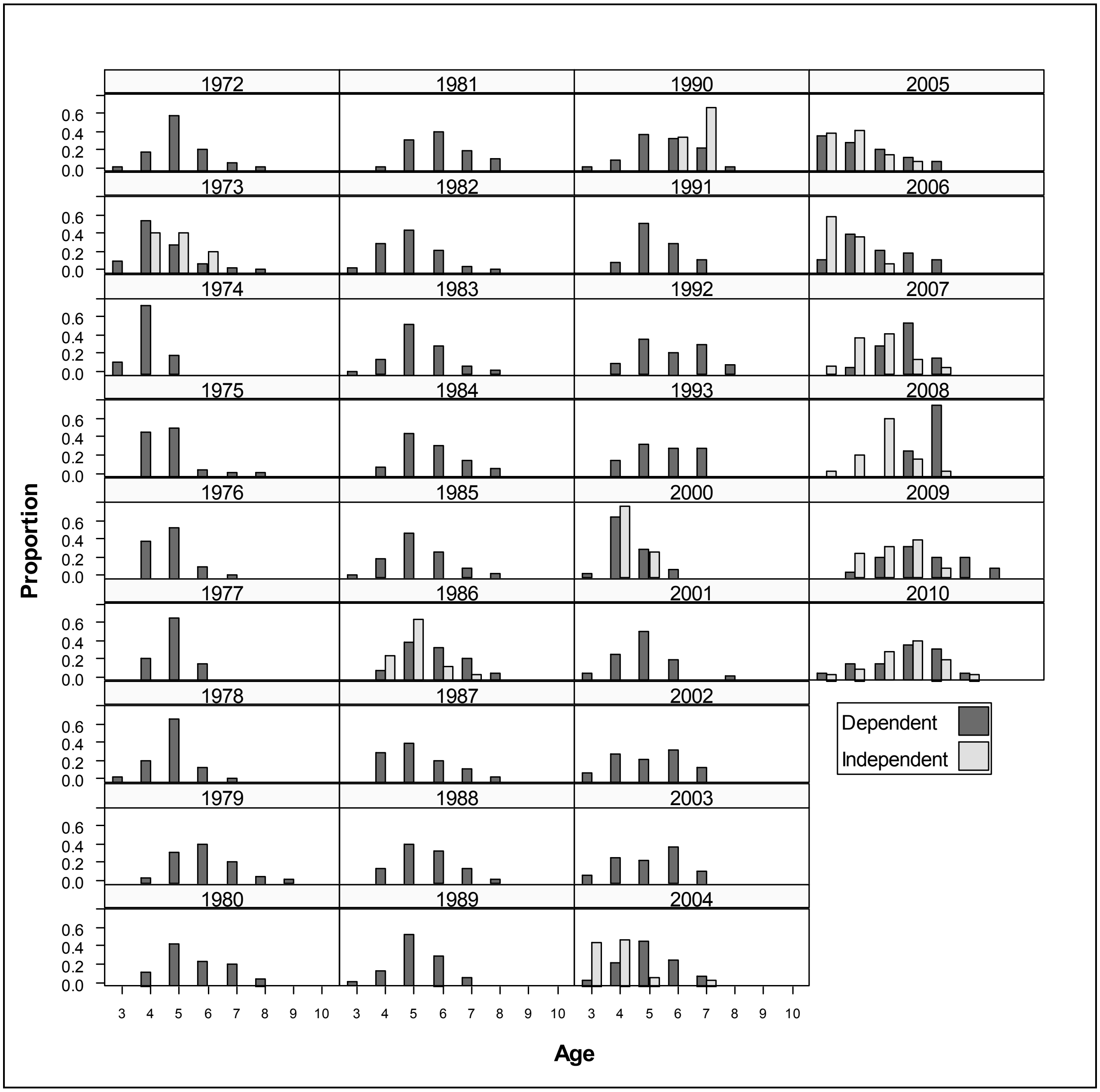


Figure 6. Annual age frequencies of male American shad sampled from gill nets in Albemarle Sound during January through May, by program type, 1972–1993 and 2000–2010.

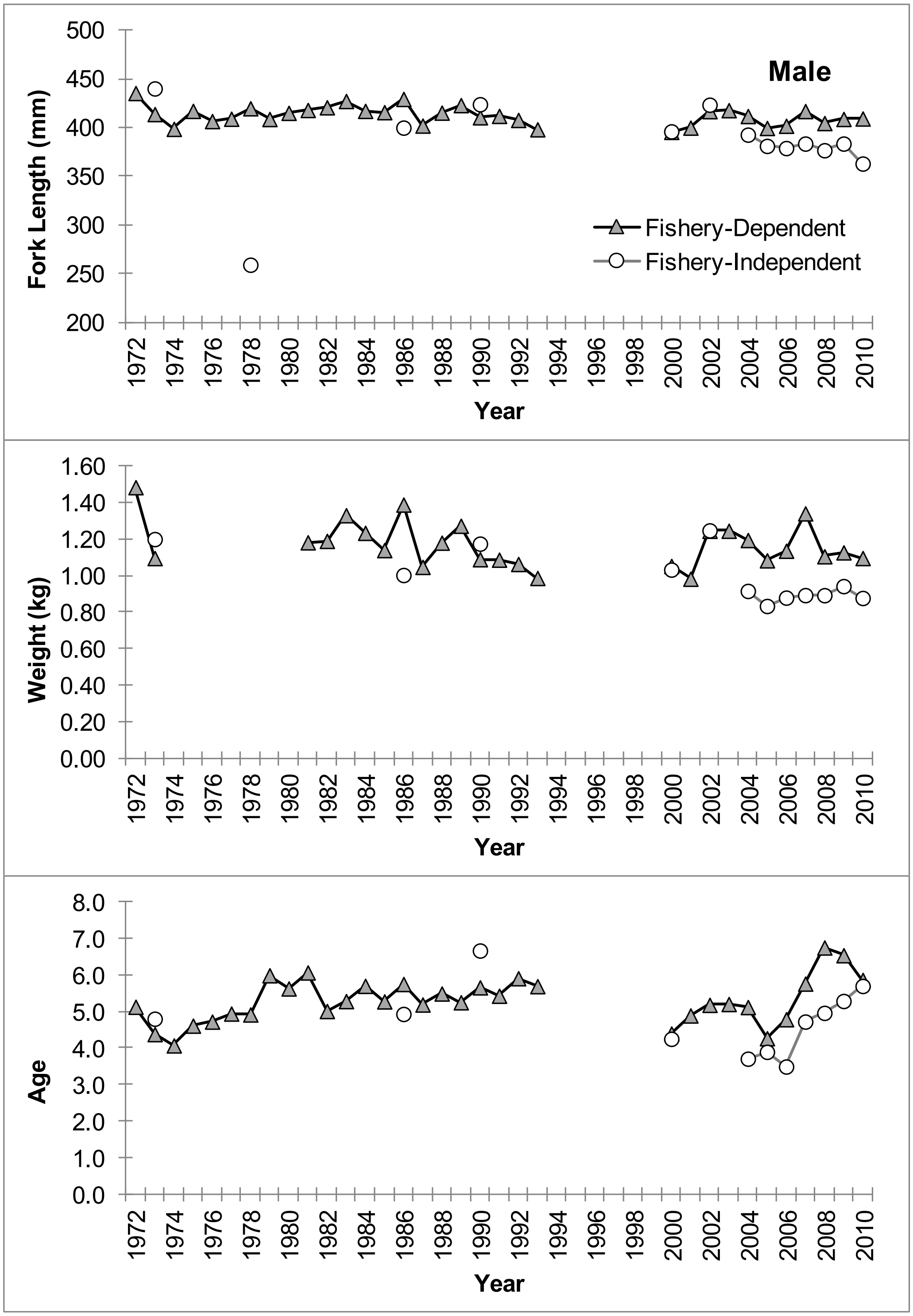


Figure 7. Annual average fork length (top graph), weight (middle graph), and age (bottom graph) of male American shad sampled from gill nets in Albemarle Sound during January through May, by program type, 1972–2010.

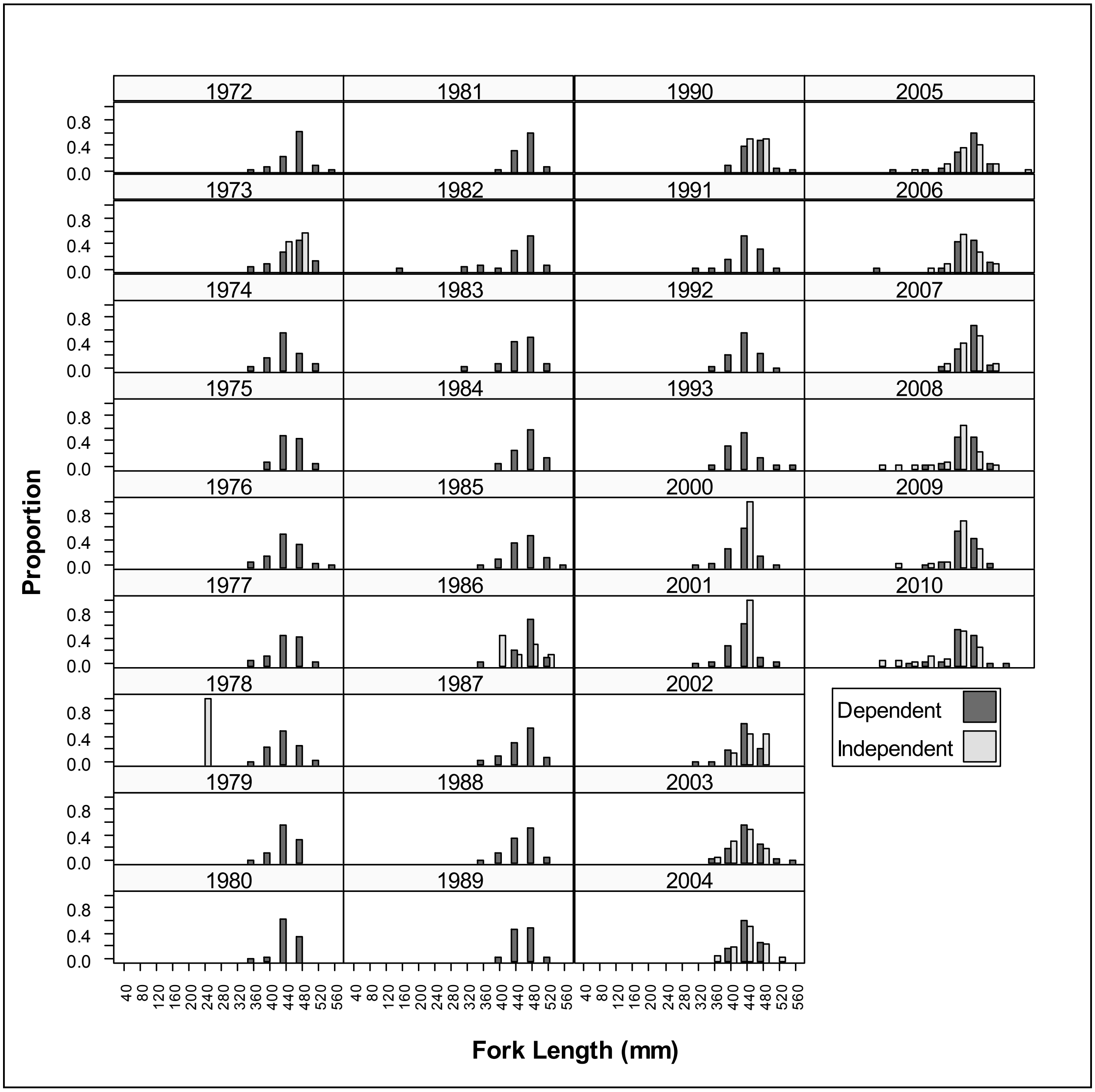


Figure 8. Annual length frequencies of female American shad sampled from gill nets in Albemarle Sound during January through May, by program type, 1972–1993 and 2000–2010.

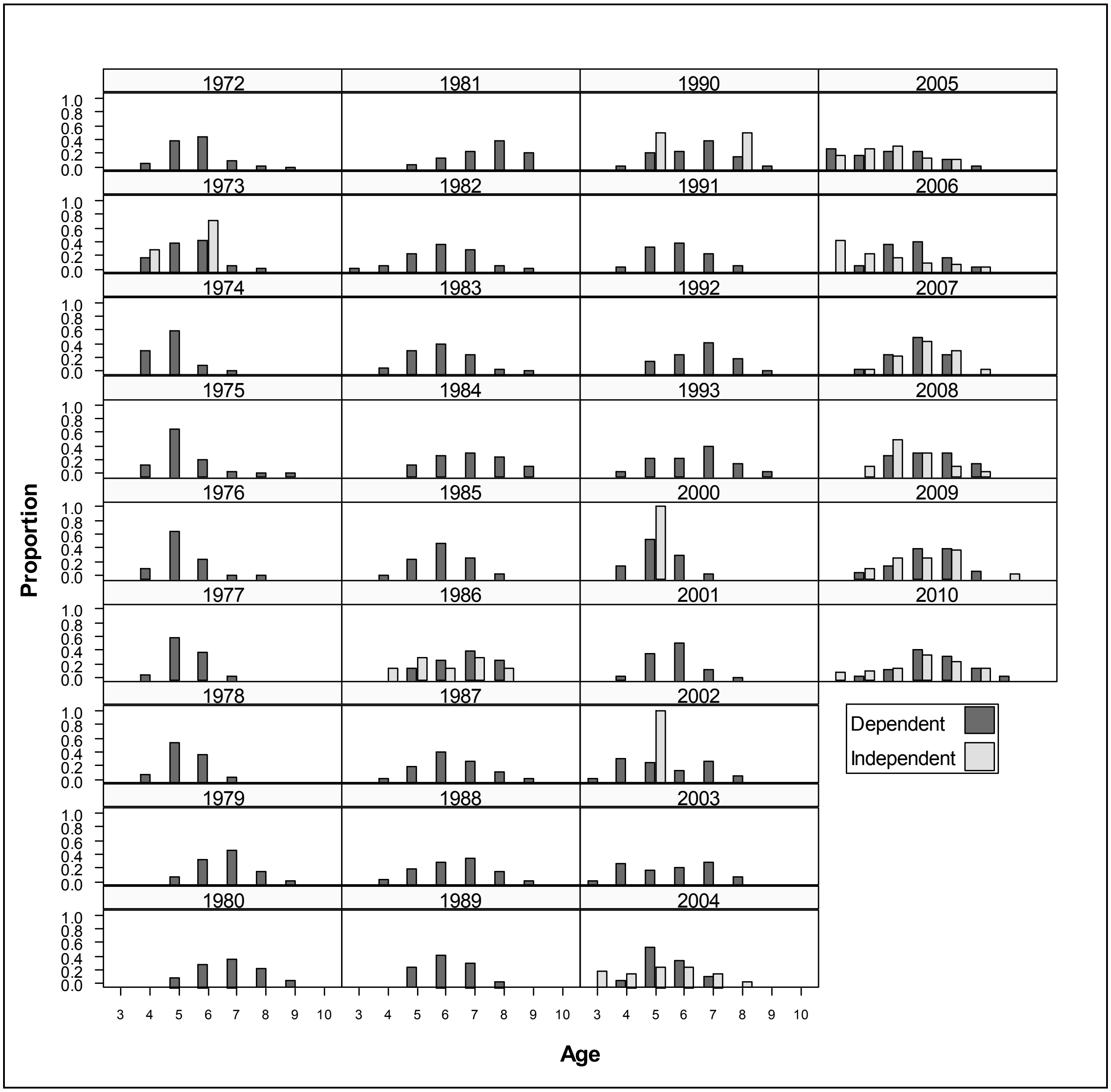


Figure 9. Annual age frequencies of female American shad sampled from gill nets in Albemarle Sound during January through May, by program type, 1972–1993 and 2000–2010.

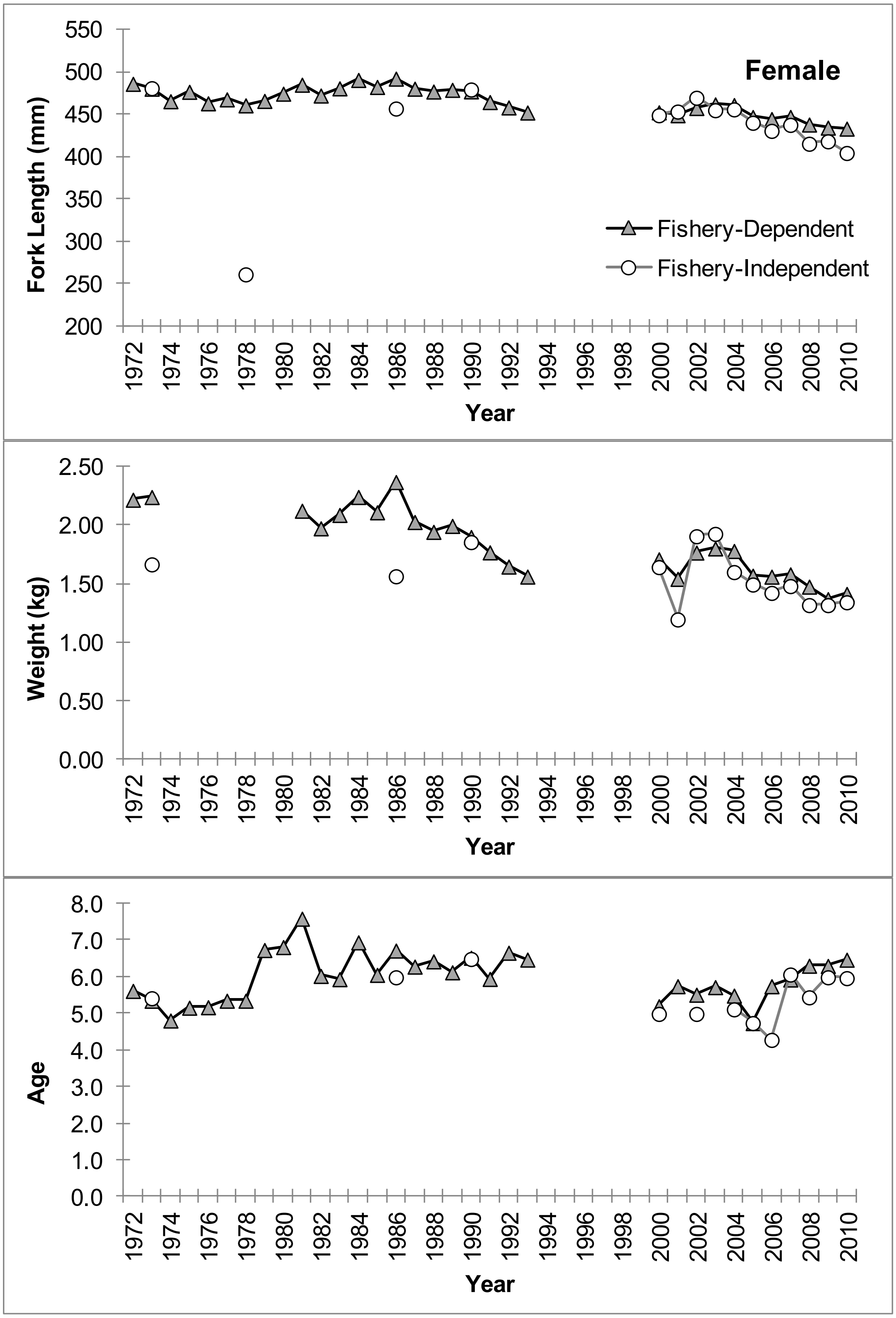


Figure 10. Annual average fork length (top graph), weight (middle graph), and age (bottom graph) of female American shad sampled from gill nets in Albemarle Sound during January through May, by program type, 1972–2010.

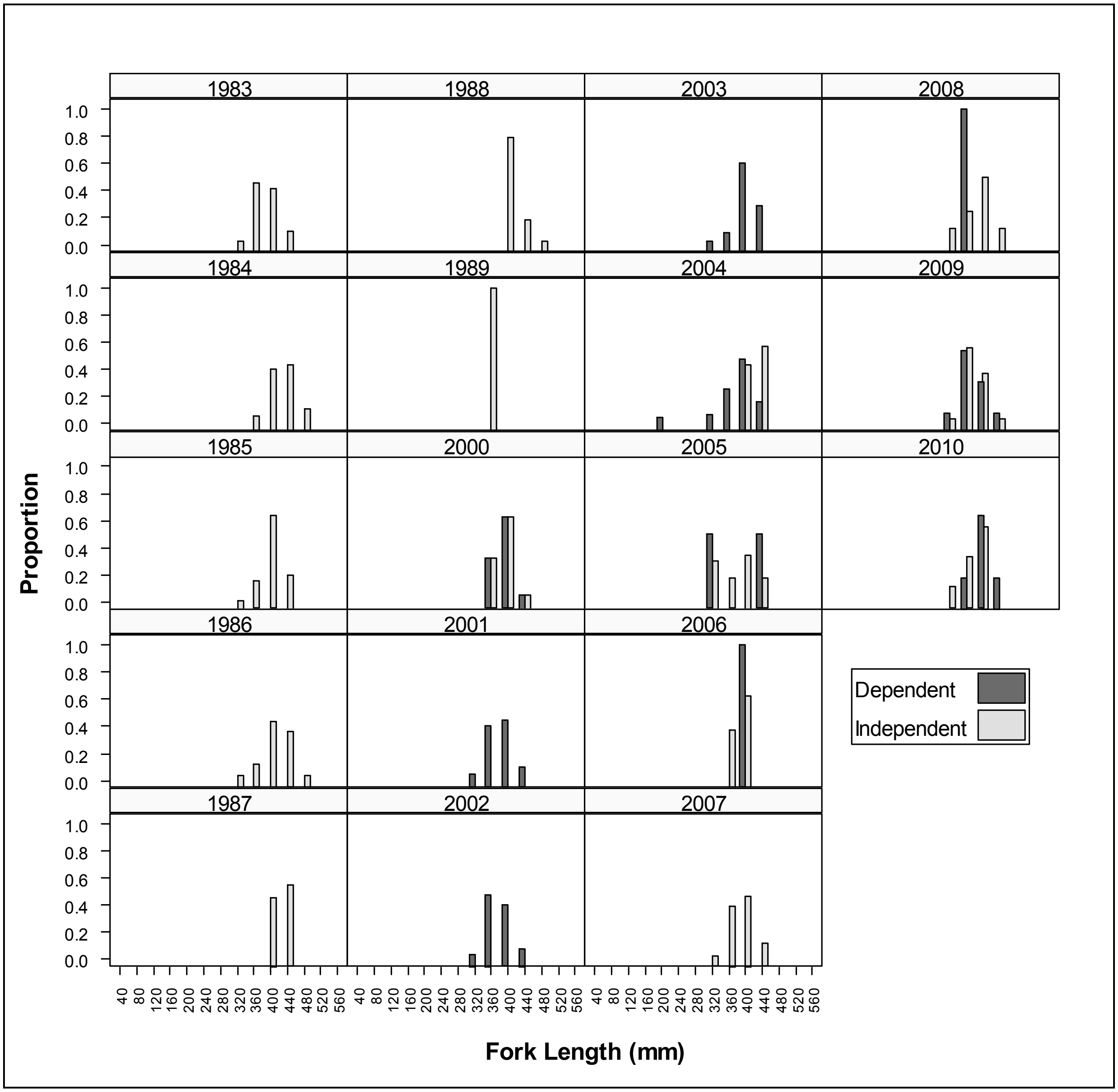


Figure 11. Annual length frequencies of male American shad sampled from gill nets in the Cape Fear River during January through May, by program type, 1983–1989 and 2000–2010.

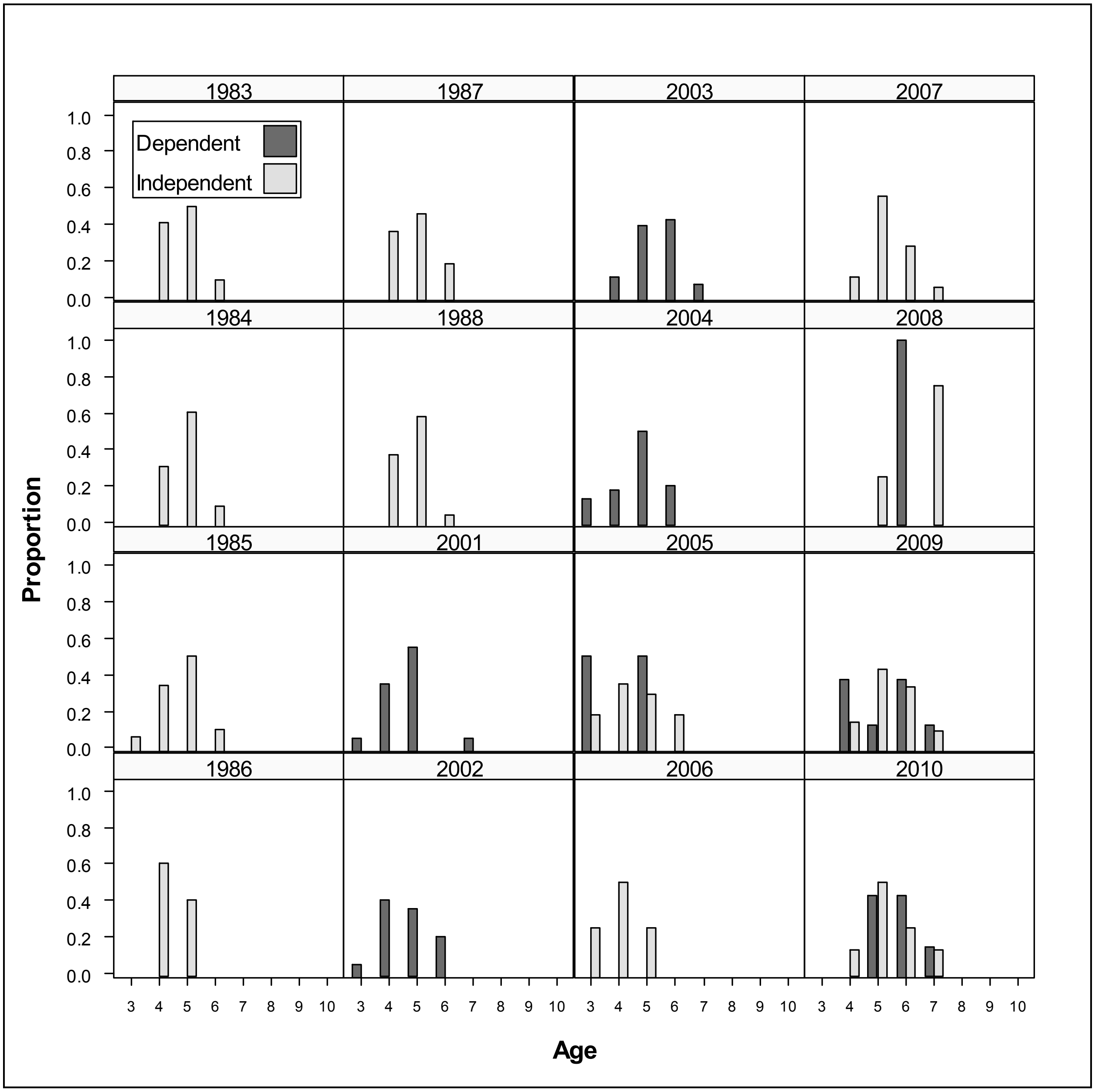


Figure 12. Annual age frequencies of male American shad sampled from gill nets in the Cape Fear River during January through May, by program type, 1983–1988 and 2001–2010.

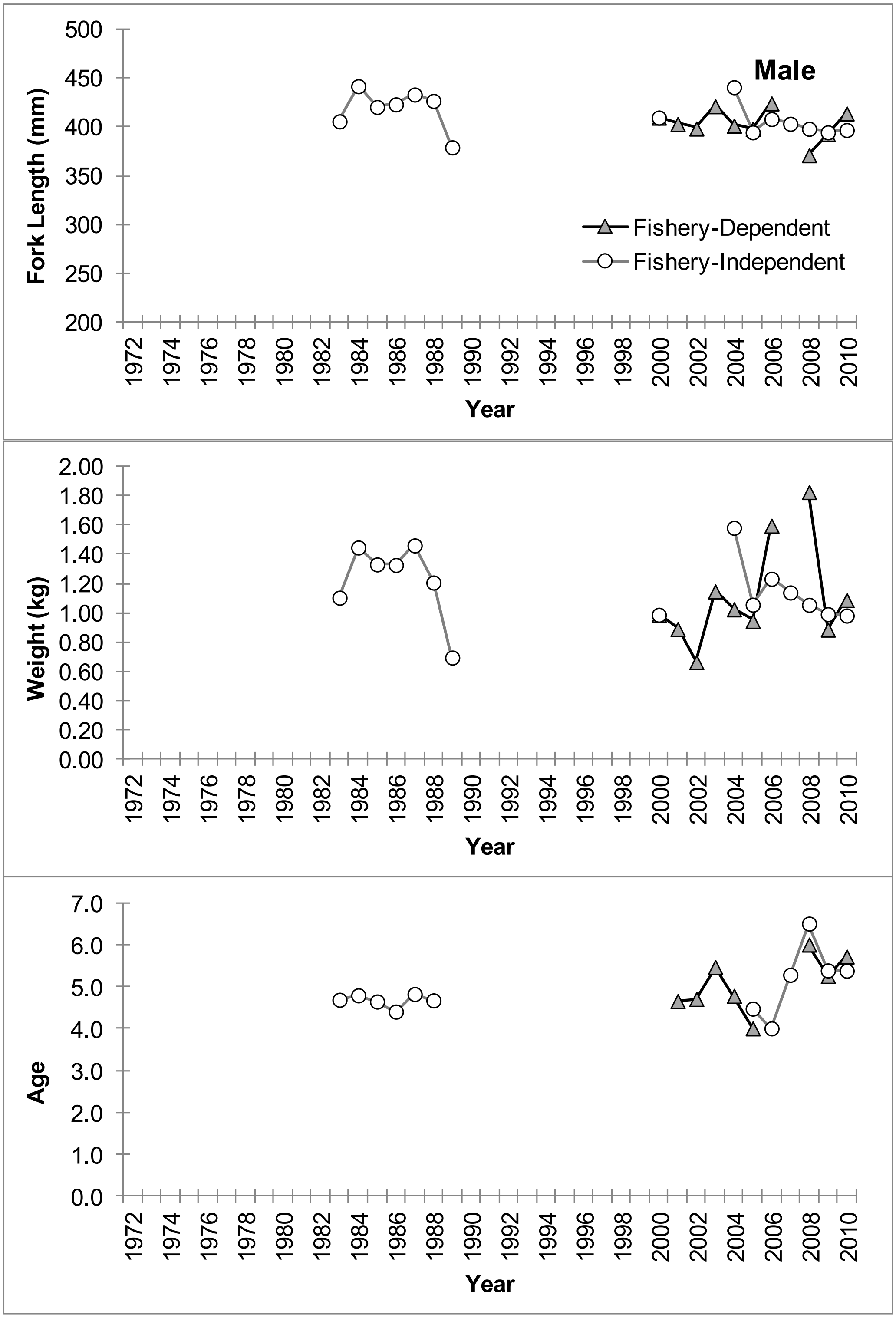


Figure 13. Annual average fork length (top graph), weight (middle graph), and age (bottom graph) of male American shad sampled from gill nets in the Cape Fear River during January through May, by program type, 1972–2010.

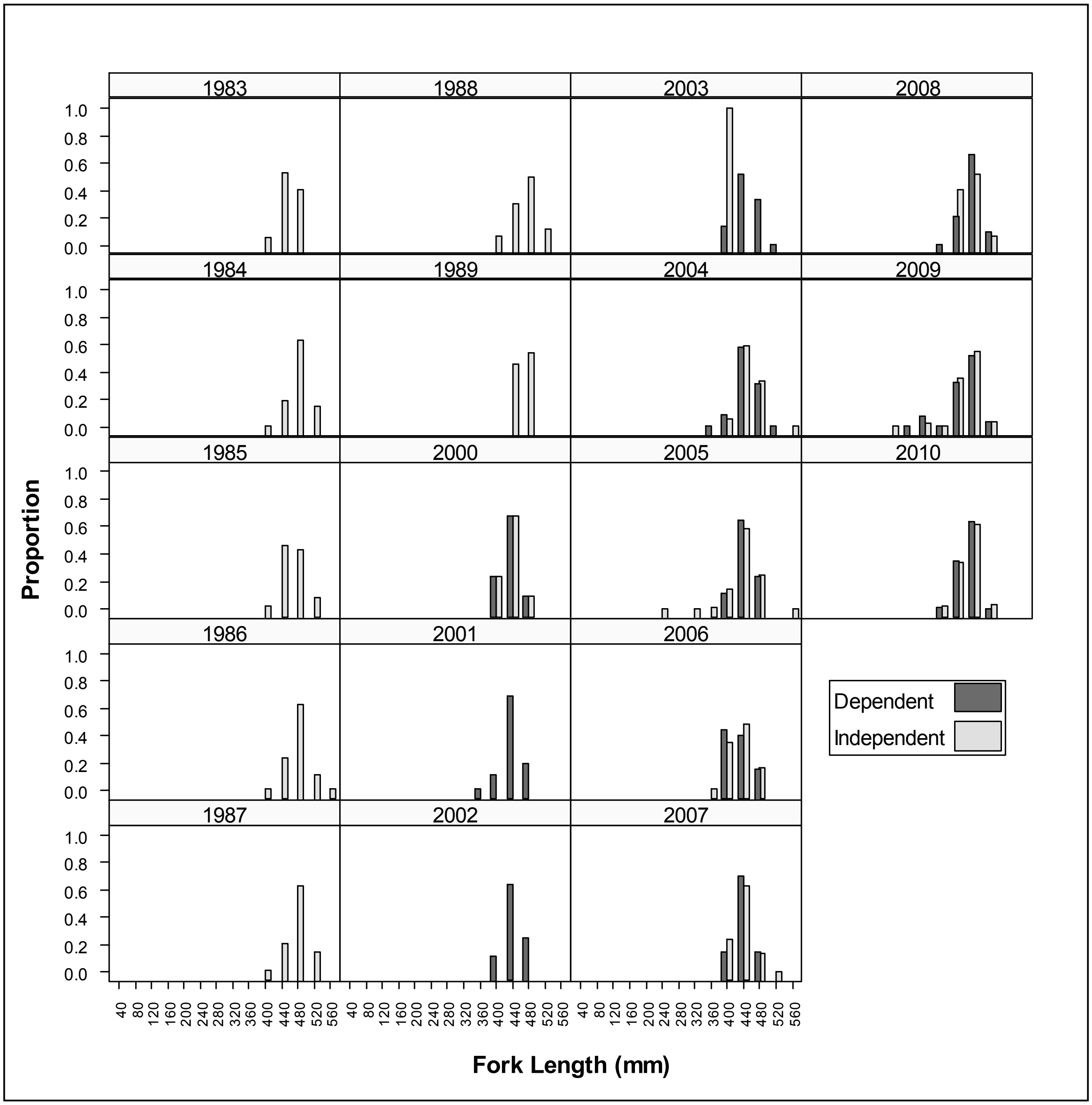


Figure 14. Annual length frequencies of female American shad sampled from gill nets in the Cape Fear River during January through May, by program type, 1983–1989 and 2000–2010.

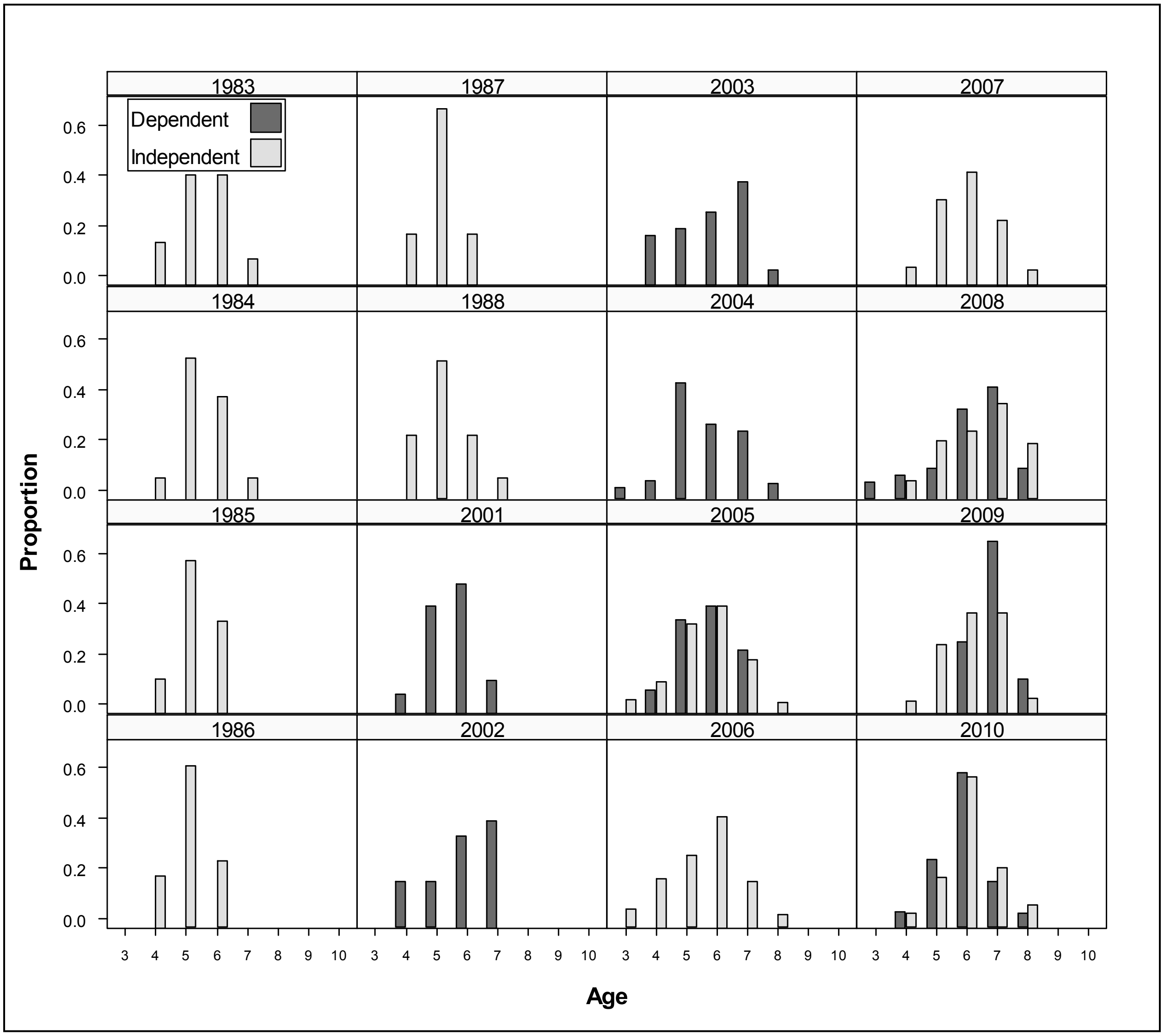


Figure 15. Annual age frequencies of female American shad sampled from gill nets in the Cape Fear River during January through May, by program type, 1983–1988 and 2001–2010.

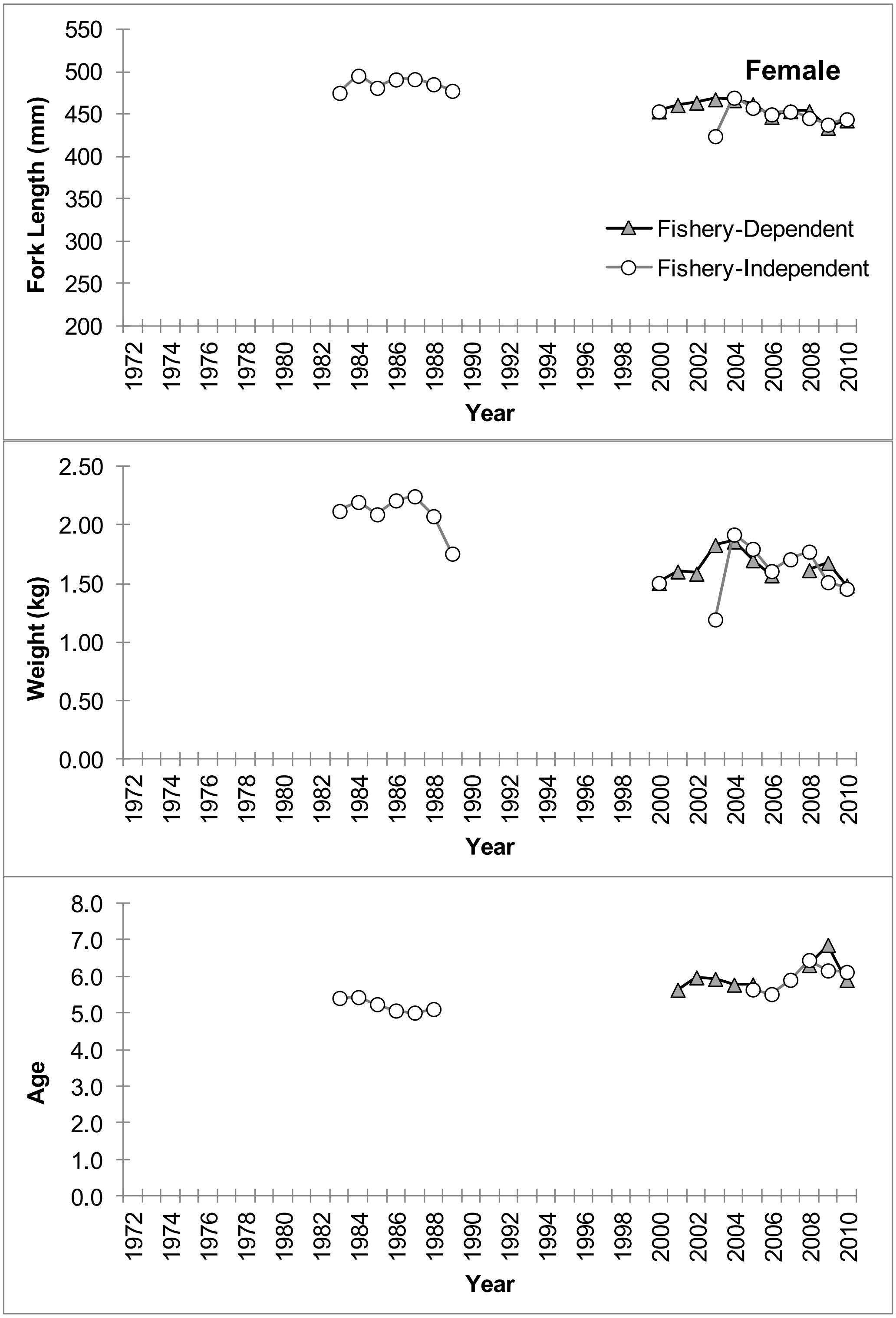


Figure 16. Annual average fork length (top graph), weight (middle graph), and age (bottom graph) of female American shad sampled from gill nets in the Cape Fear River during January through May, by program type, 1972–2010.

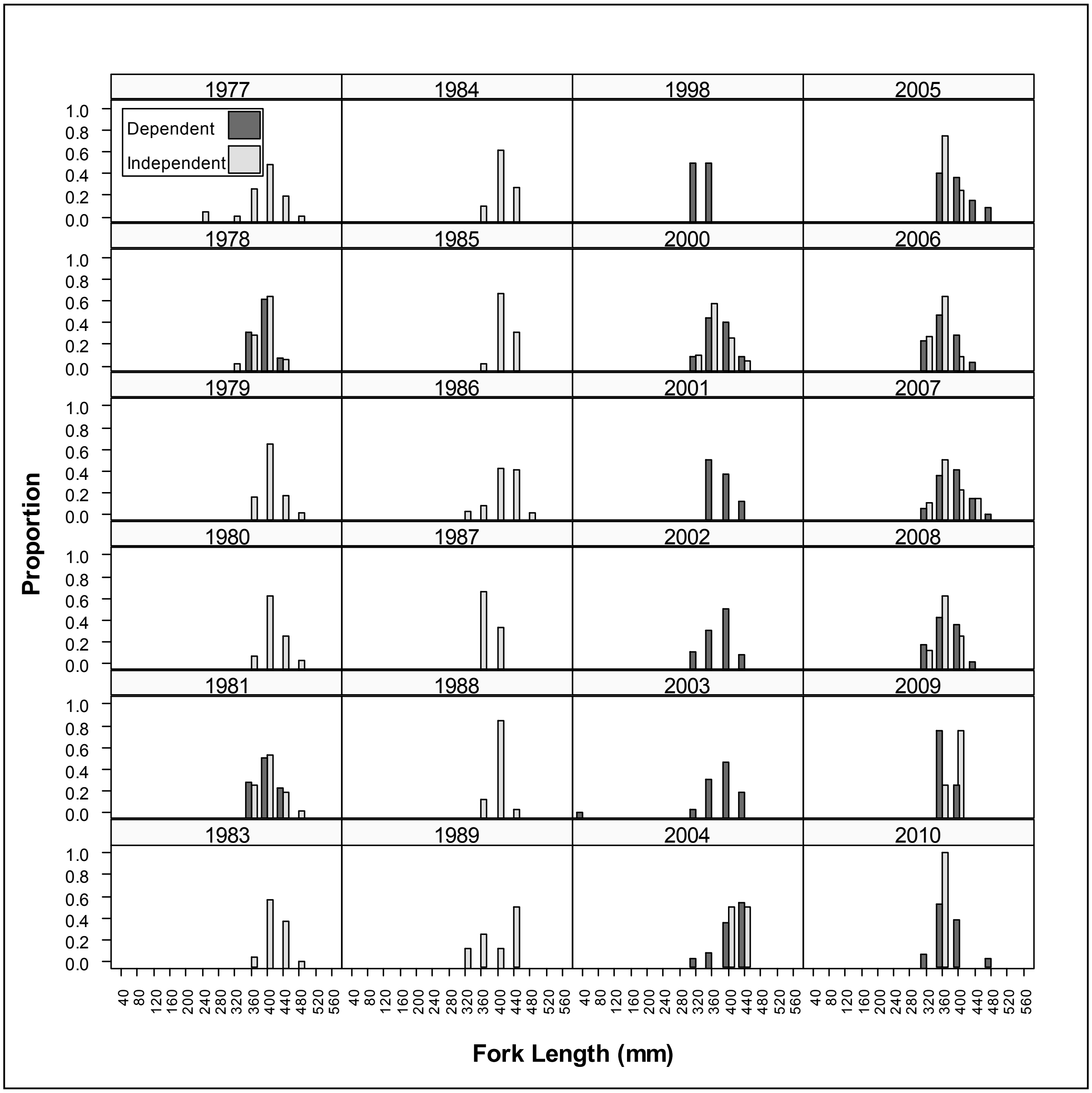


Figure 17. Annual length frequencies of male American shad sampled from gill nets in the Neuse River during January through May, by program type, 1977–1989, 1998, and 2000–2010.

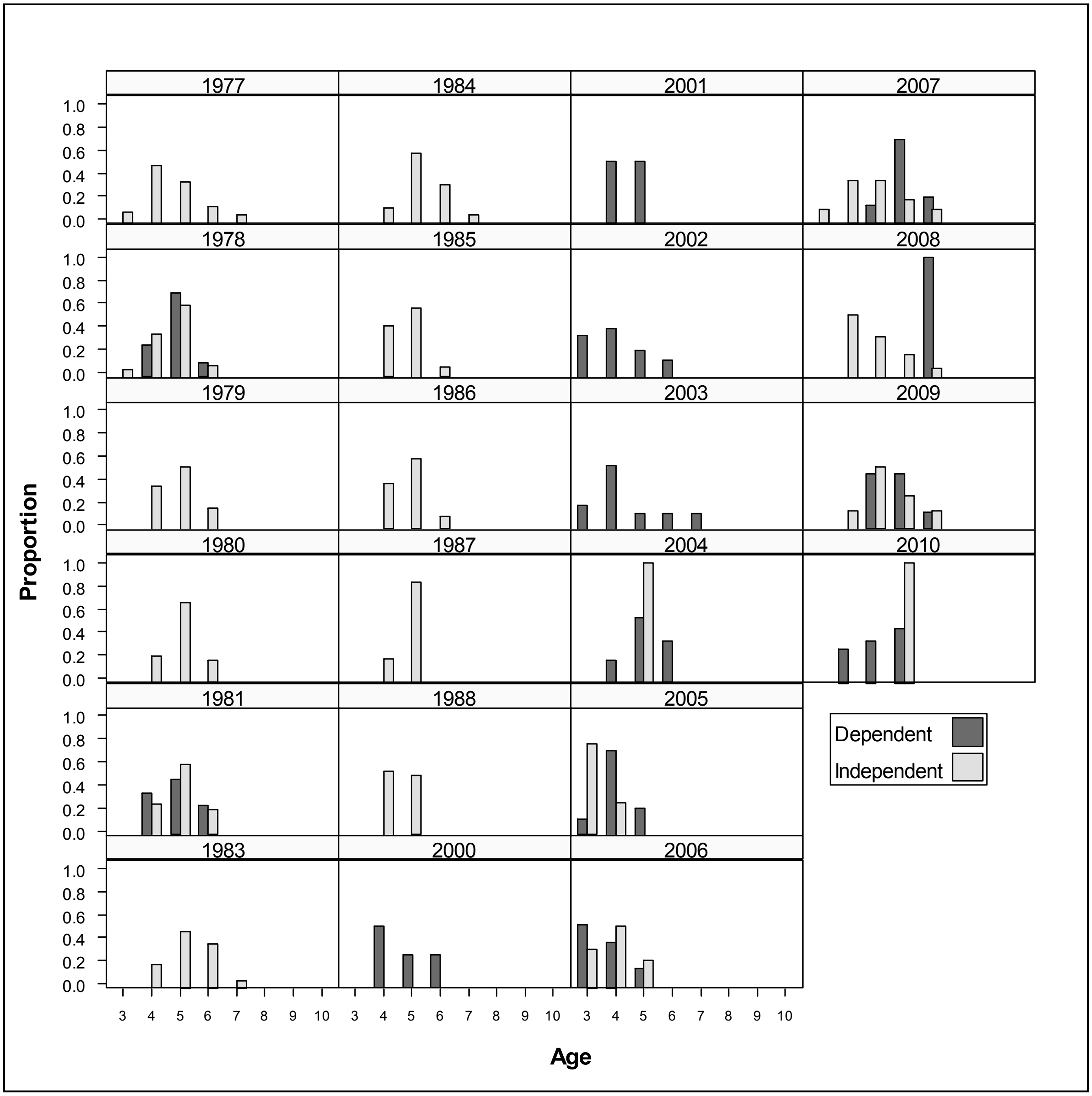


Figure 18. Annual age frequencies of male American shad sampled from gill nets in the Neuse River during January through May, by program type, 1977–1988 and 2000–2010.

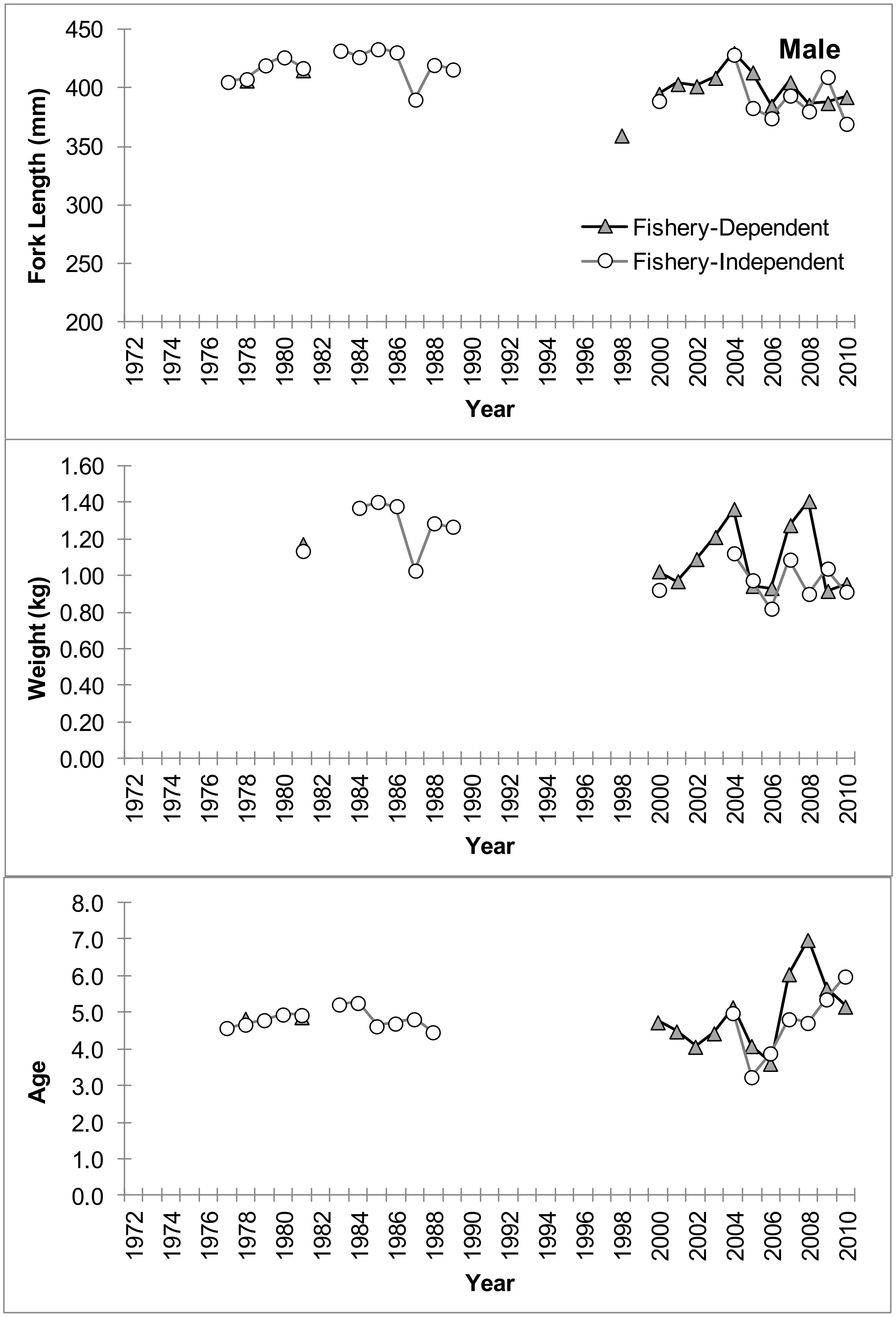


Figure 19. Annual average fork length (top graph), weight (middle graph), and age (bottom graph) of male American shad sampled from gill nets in the Neuse River during January through May, by program type, 1972–2010.

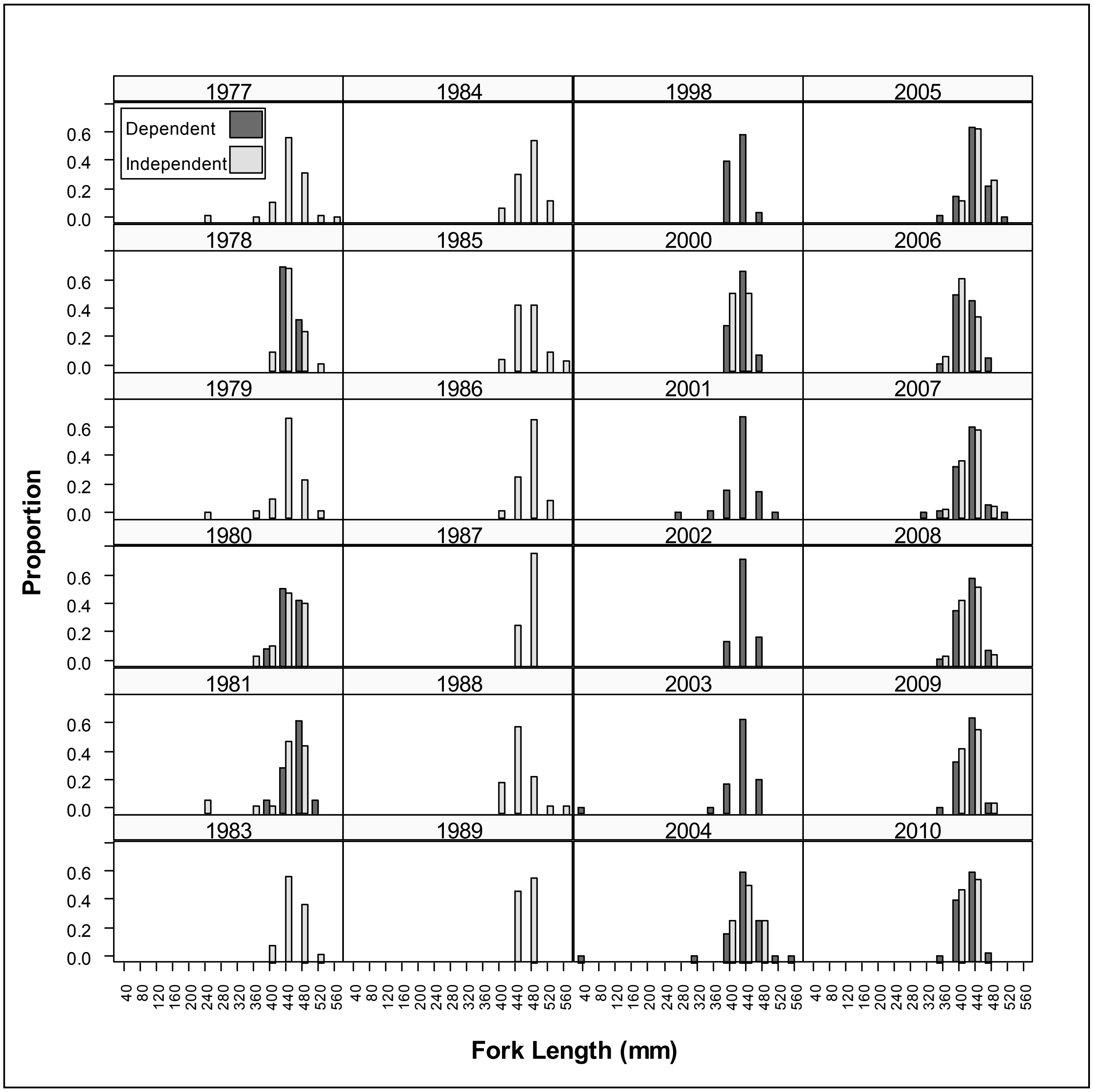


Figure 20. Annual length frequencies of female American shad sampled from gill nets in the Neuse River during January through May, by program type, 1977–1989, 1998, and 2000–2010.

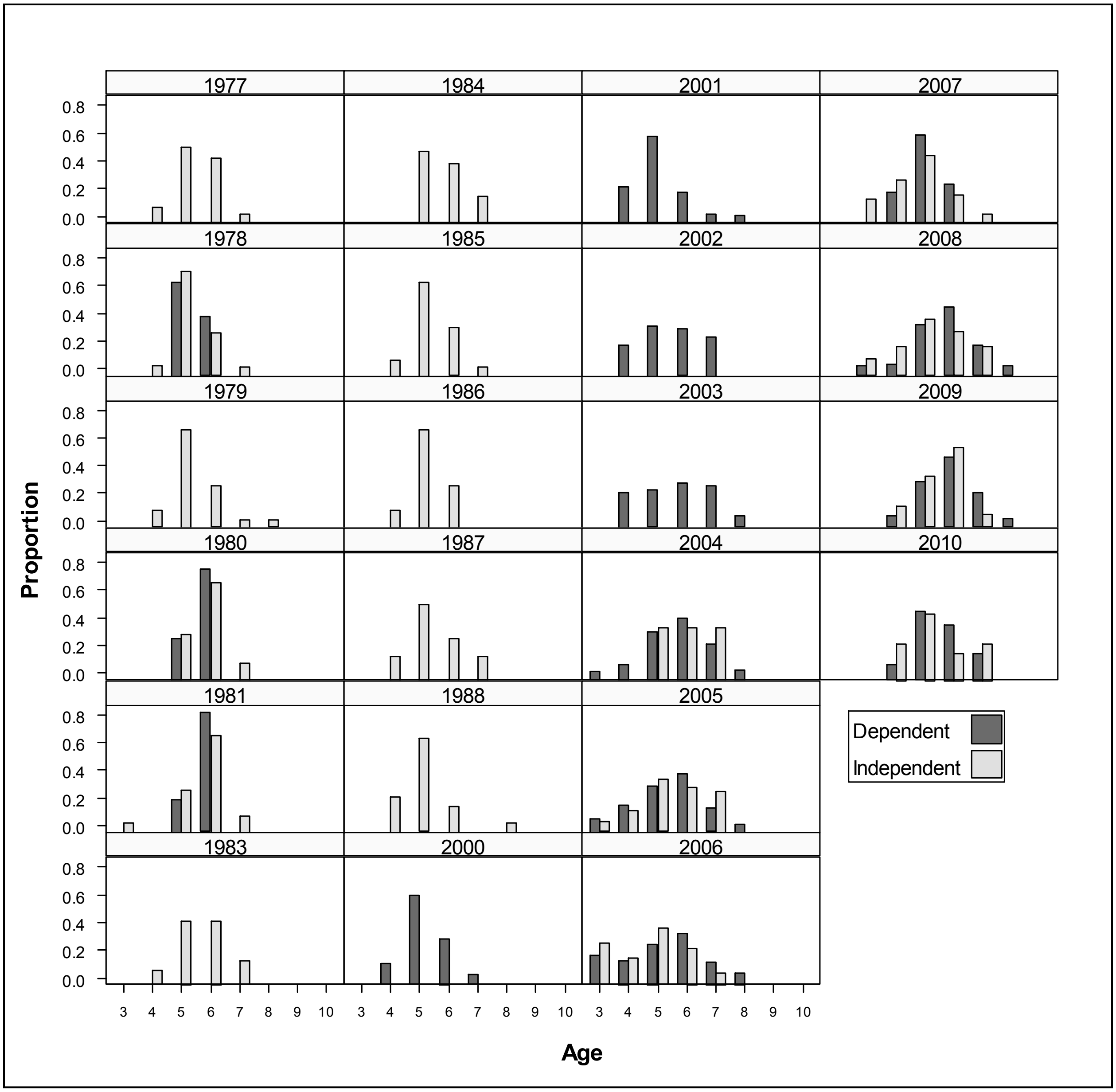


Figure 21. Annual age frequencies of female American shad sampled from gill nets in the Neuse River during January through May, by program type, 1977–1988 and 2000–2010.

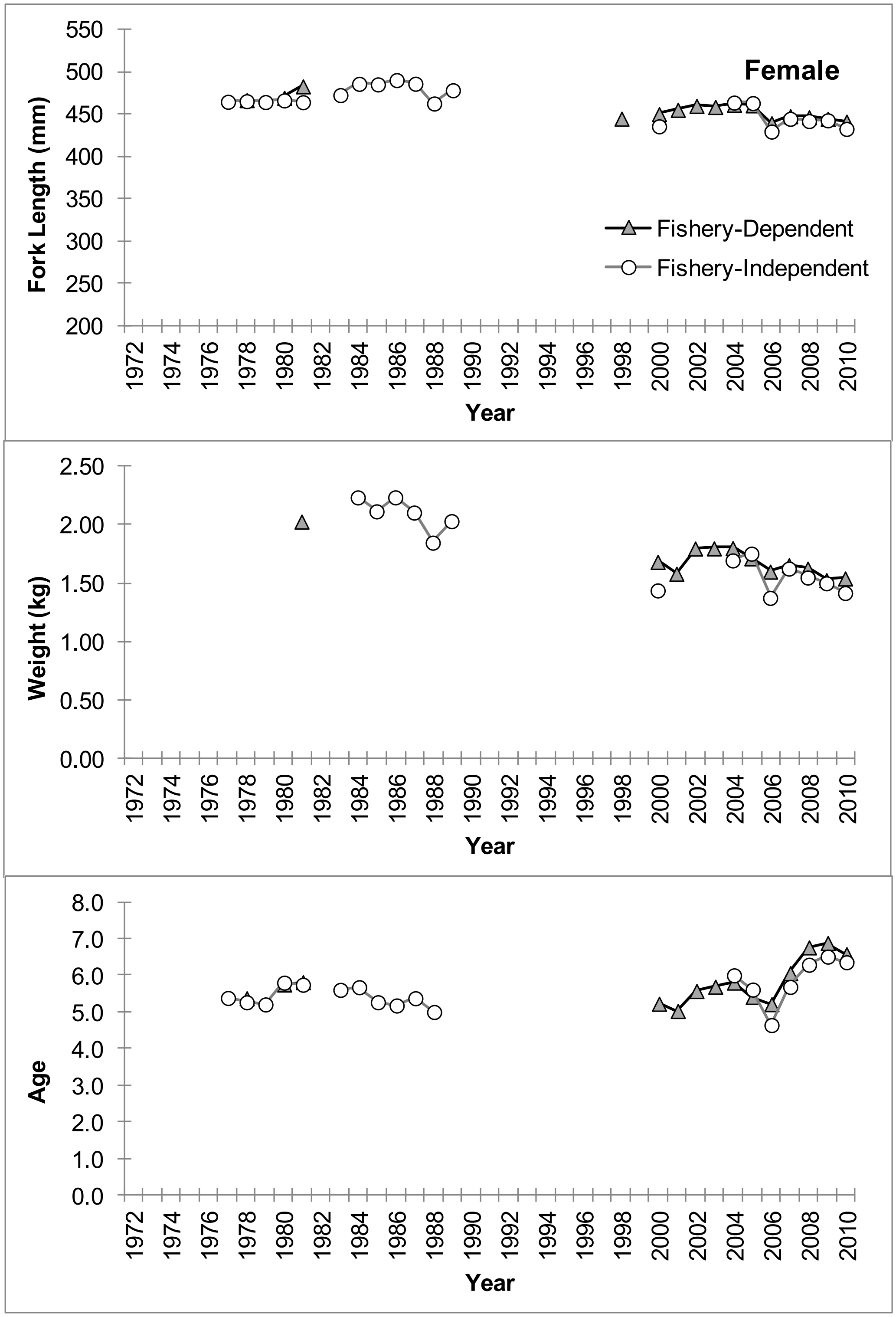


Figure 22. Annual average fork length (top graph), weight (middle graph), and age (bottom graph) of female American shad sampled from gill nets in the Neuse River during January through May, by program type, 1972–2010.

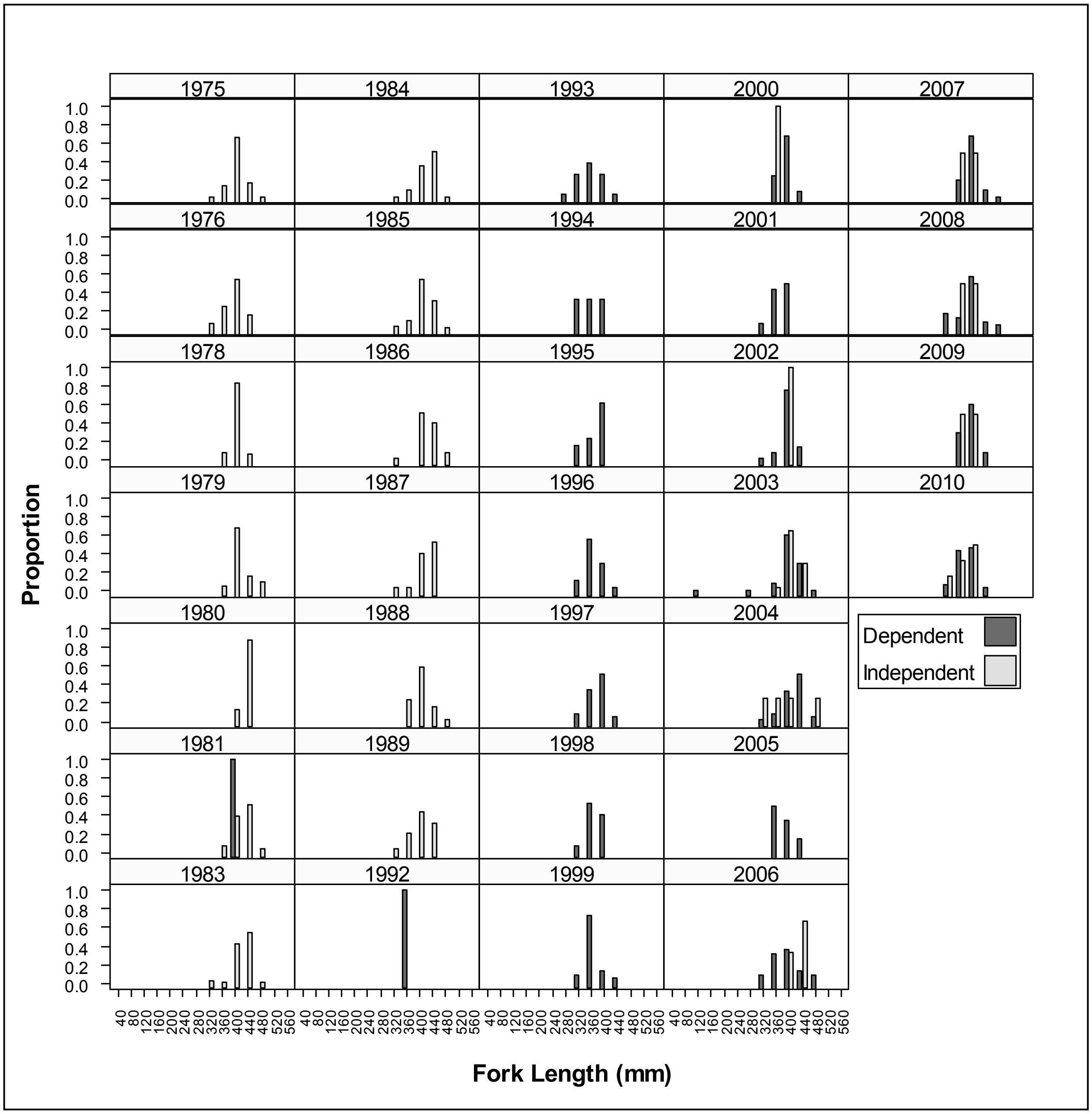


Figure 23. Annual length frequencies of male American shad sampled from gill nets in the Pamlico River during January through May, by program type, 1975–2010.

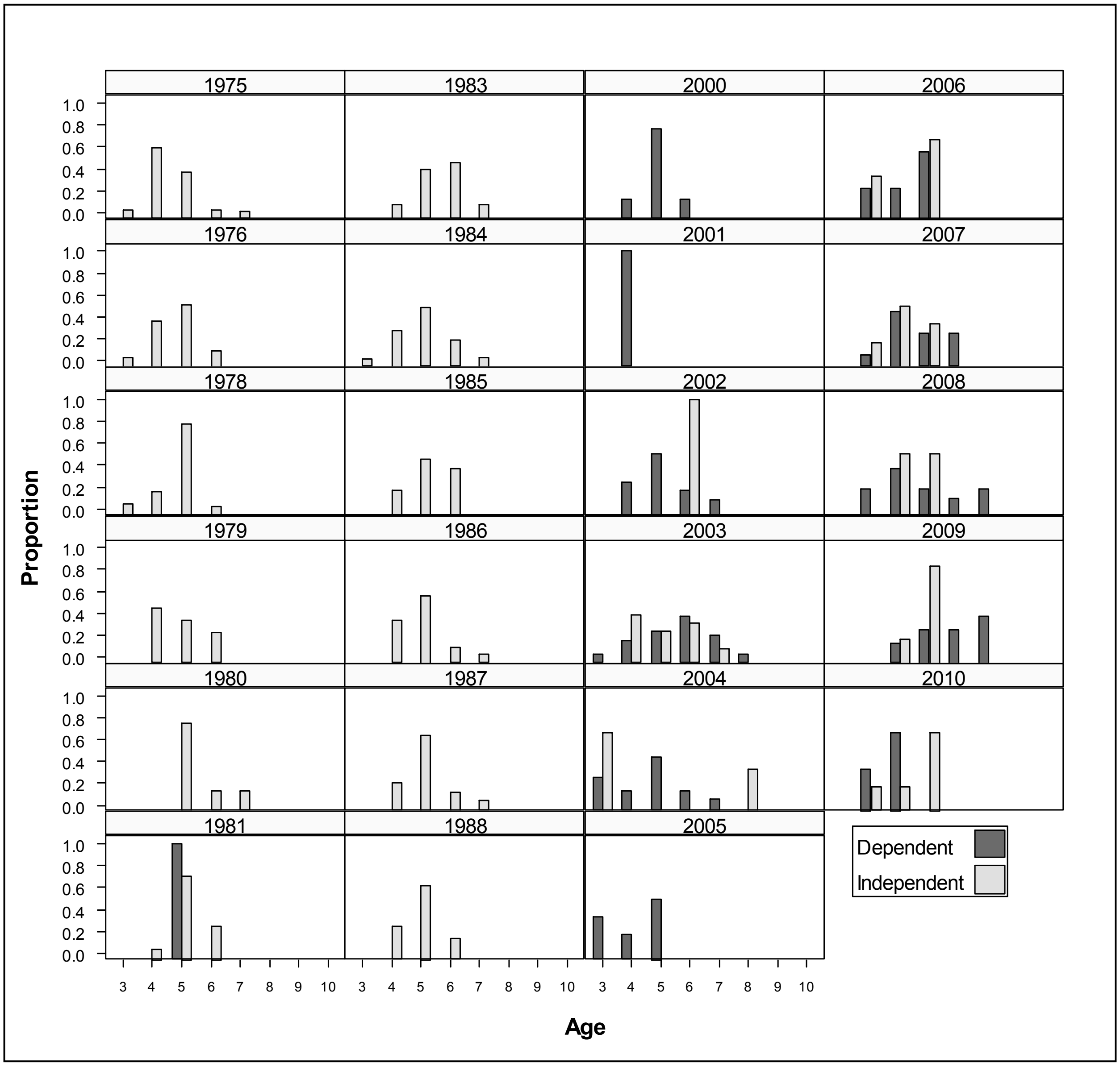


Figure 24. Annual age frequencies of male American shad sampled from gill nets in the Pamlico River during January through May, by program type, 1975–1988 and 2000–2010.

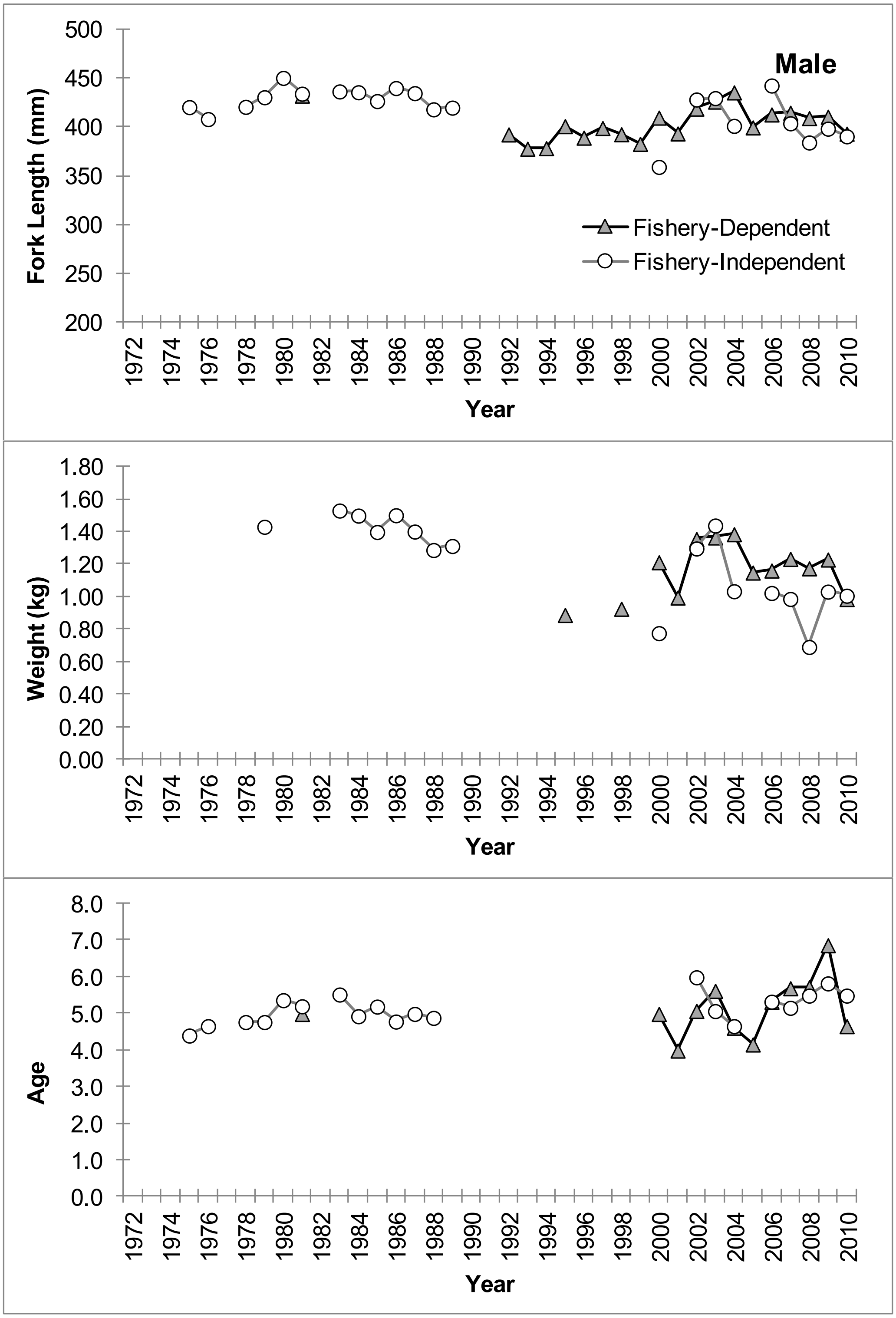


Figure 25. Annual average fork length (top graph), weight (middle graph), and age (bottom graph) of male American shad sampled from gill nets in the Pamlico River during January through May, by program type, 1972–2010.

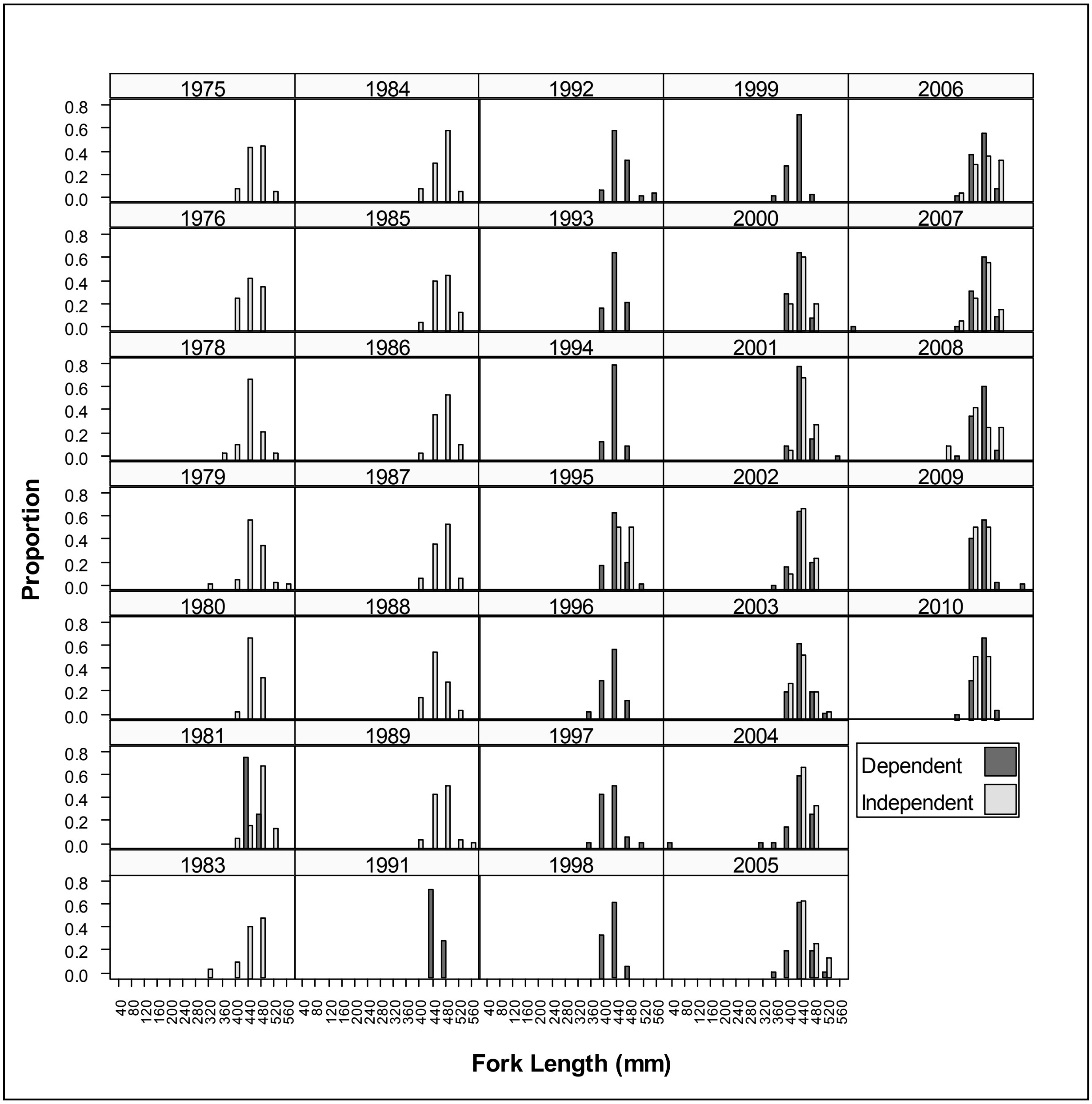


Figure 26. Annual length frequencies of female American shad sampled from gill nets in the Pamlico River during January through May, by program type, 1975–2010.

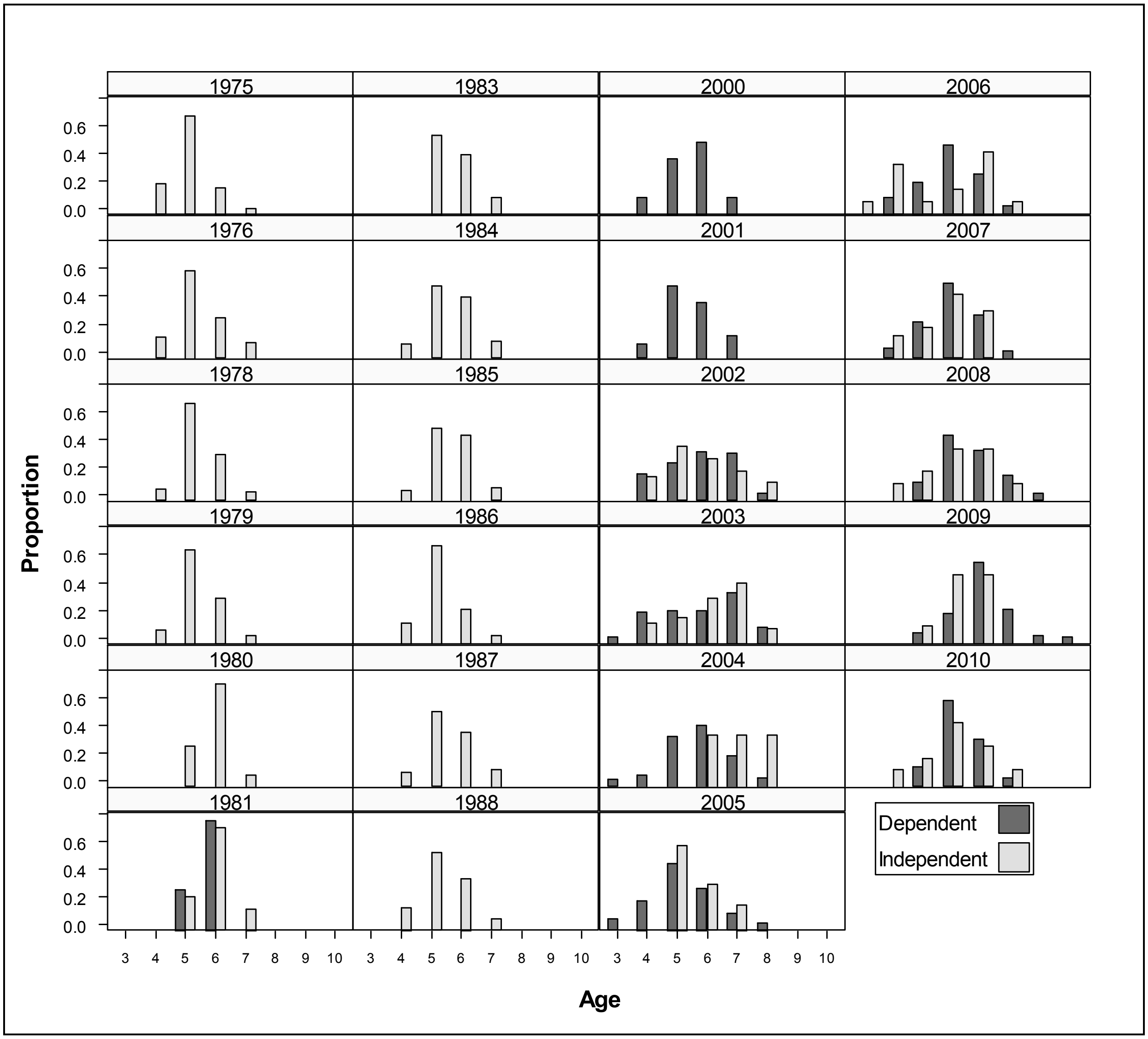


Figure 27. Annual age frequencies of female American shad sampled from gill nets in the Pamlico River during January through May, by program type, 1975–1988 and 2000–2010.

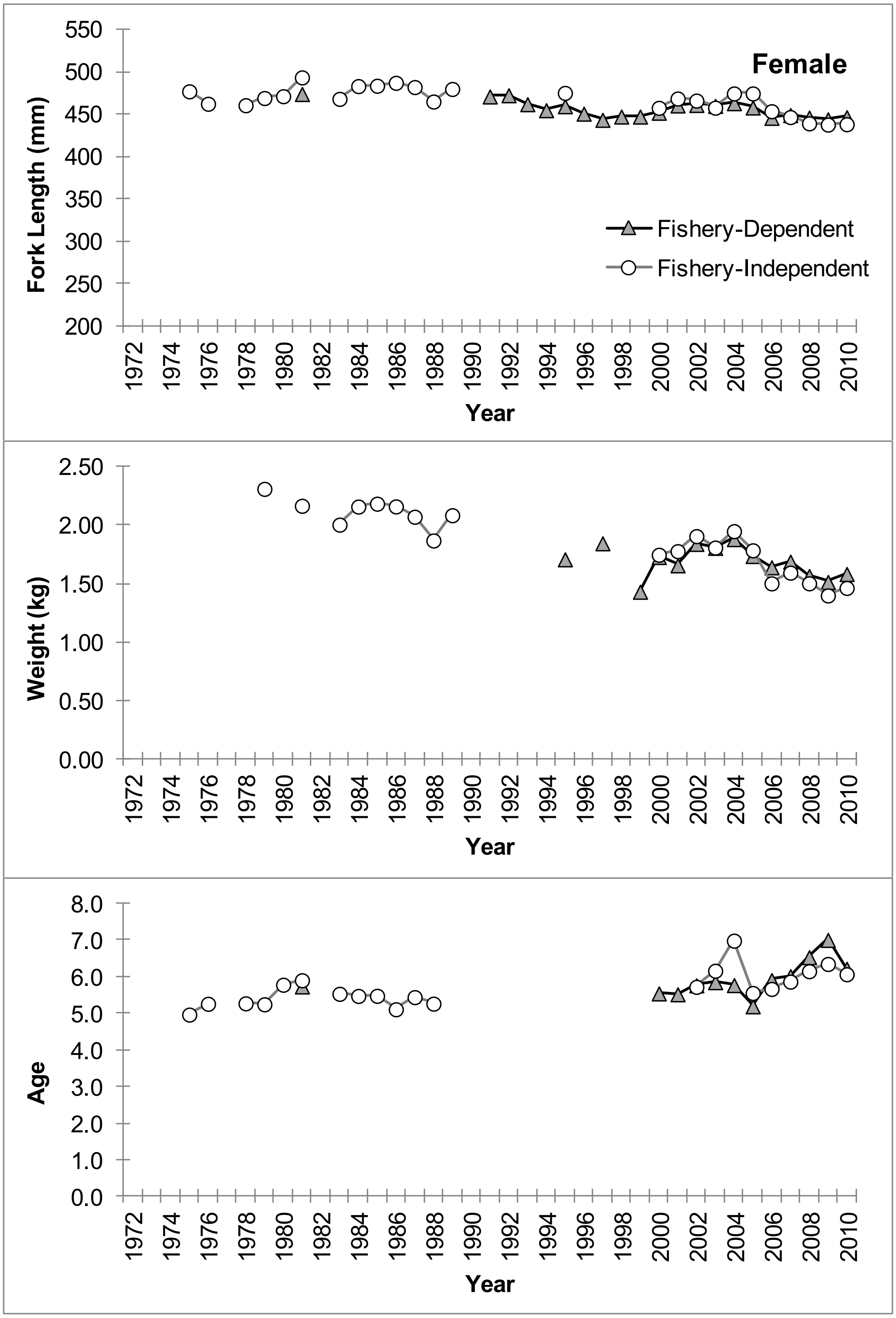


Figure 28. Annual average fork length (top graph), weight (middle graph), and age (bottom graph) of female American shad sampled from gill nets in the Pamlico River during January through May, by program type, 1972–2010.

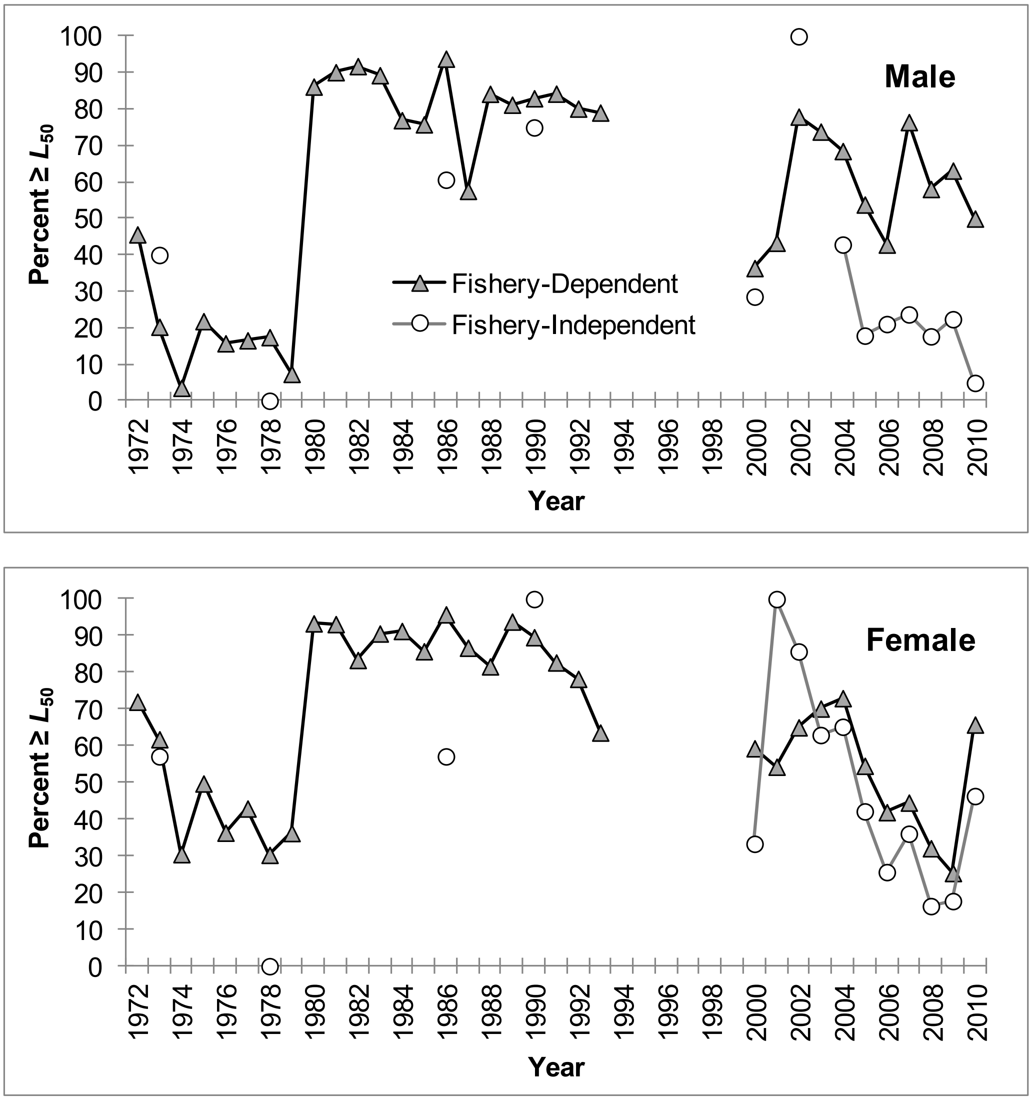
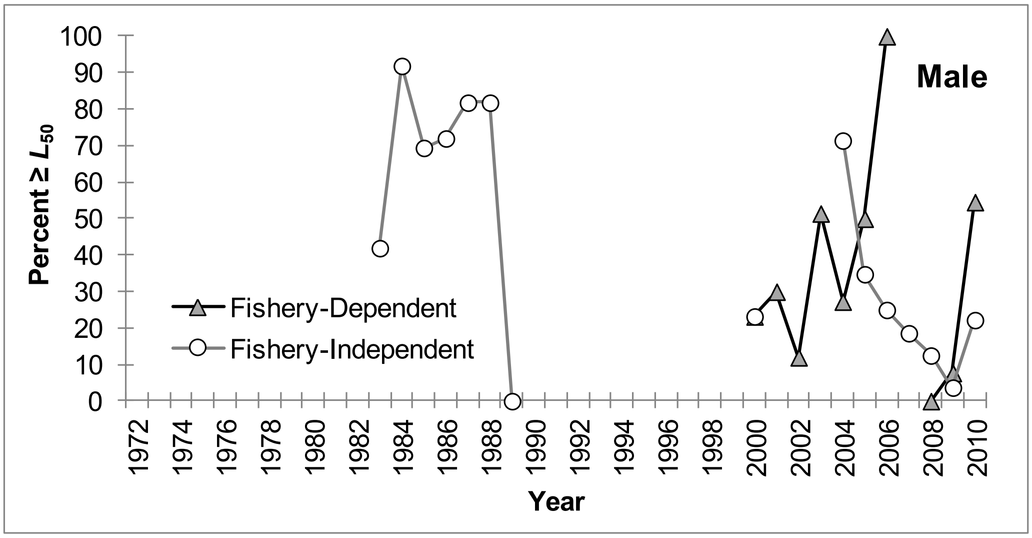


Figure 29. Annual percent of individual lengths ≥ L_{50} for male (top graph) and female (bottom graph) American shad sampled from gill nets in Albemarle Sound during January through May, by program type, 1972–2010.



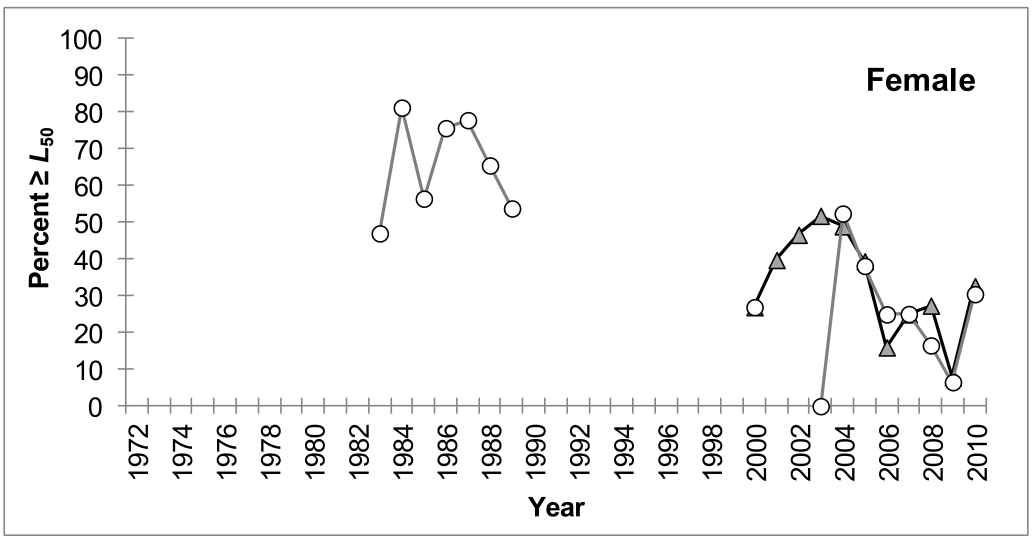


Figure 30. Annual percent of individual lengths ≥ L_{50} for male (top graph) and female (bottom graph) American shad sampled from gill nets in the Cape Fear River during January through May, by program type, 1972–2010.

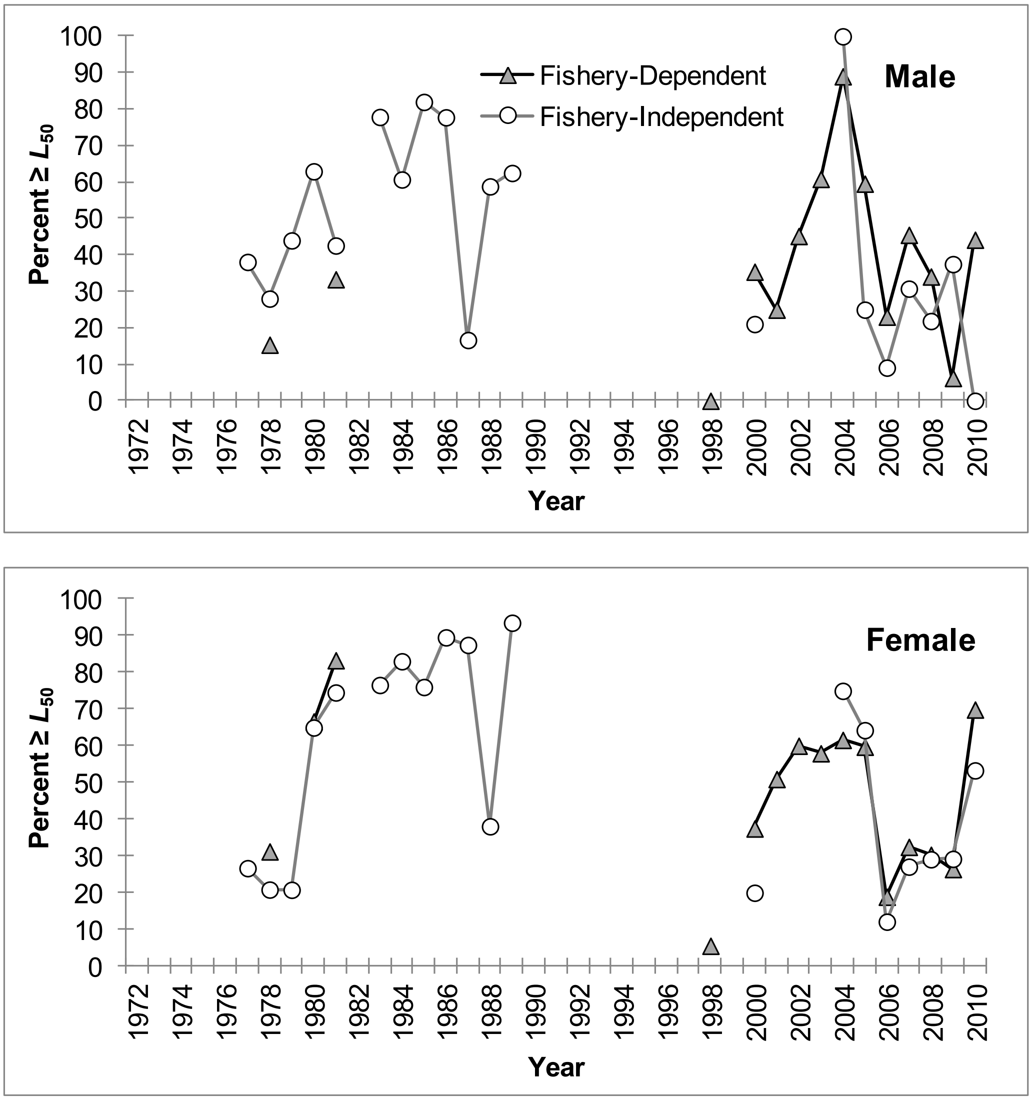


Figure 31. Annual percent of individual lengths ≥ L_{50} for male (top graph) and female (bottom graph) American shad sampled from gill nets in the Neuse River during January through May, by program type, 1972–2010.

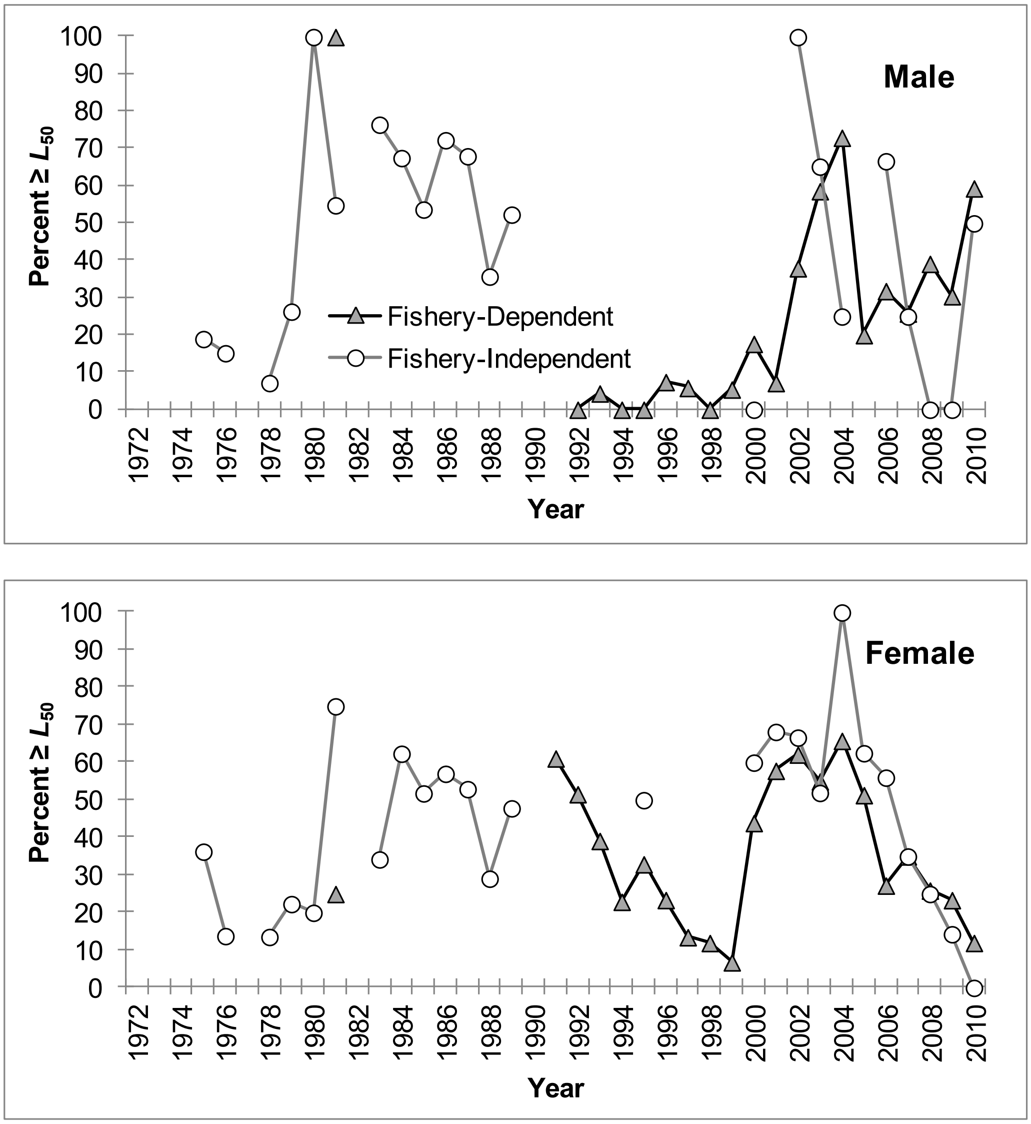


Figure 32. Annual percent of individual lengths ≥ L_{50} for male (top graph) and female (bottom graph) American shad sampled from gill nets in the Pamlico River during January through May, by program type, 1972–2010.

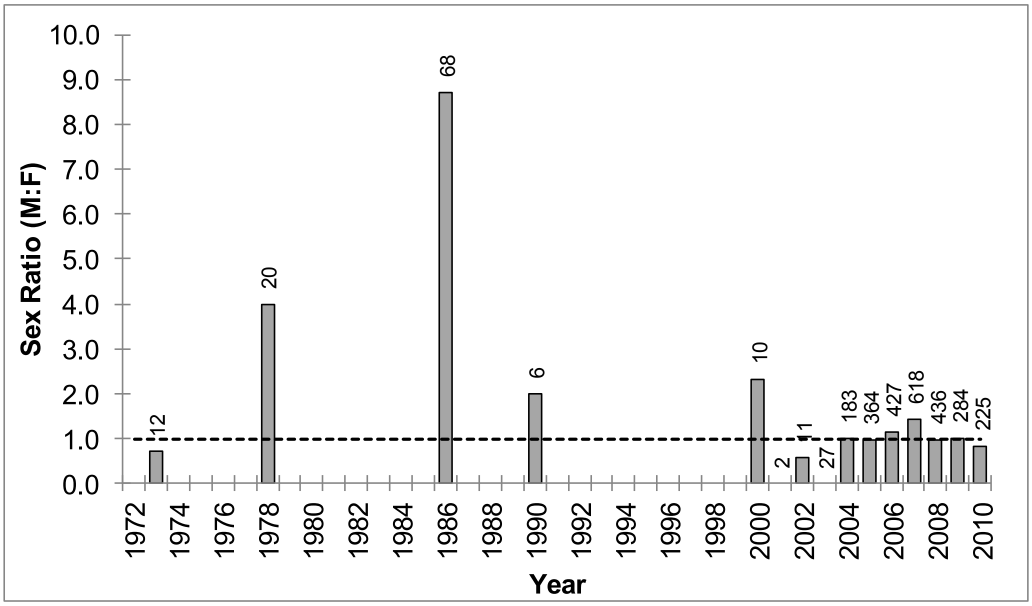


Figure 33. Annual sex ratio (M: F) of American shad sampled from fishery-independent gill nets in Albemarle Sound during January through May, 1972–2010. The horizontal dashed line indicates where the sex ratio is equal to 1.0. Sample sizes are shown above each bar.

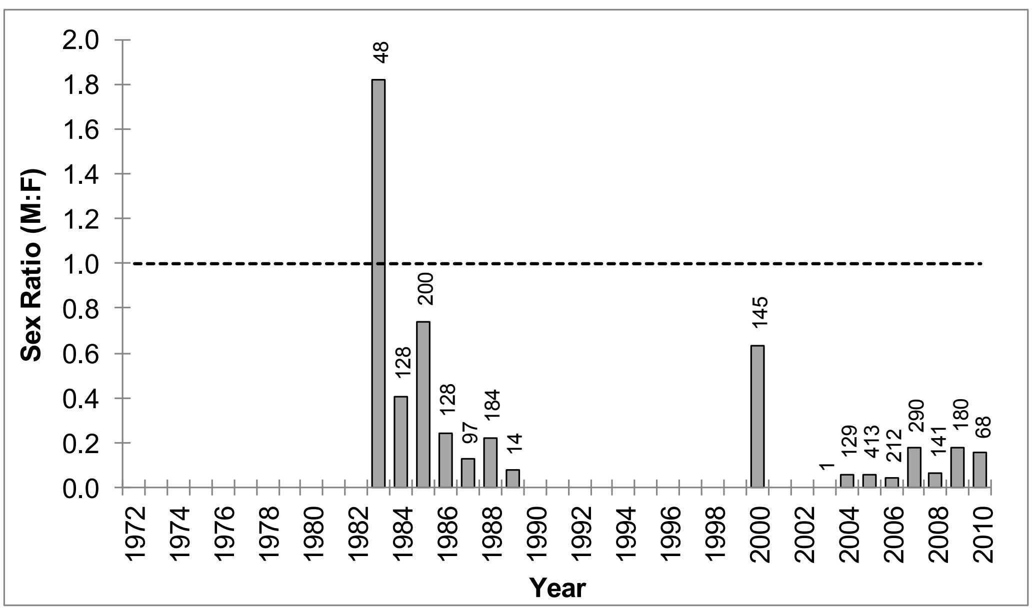


Figure 34. Annual sex ratio (M: F) of American shad sampled from fishery-independent gill nets in the Cape Fear River during January through May, 1972–2010. The horizontal dashed line indicates where the sex ratio is equal to 1.0. Sample sizes are shown above each bar.

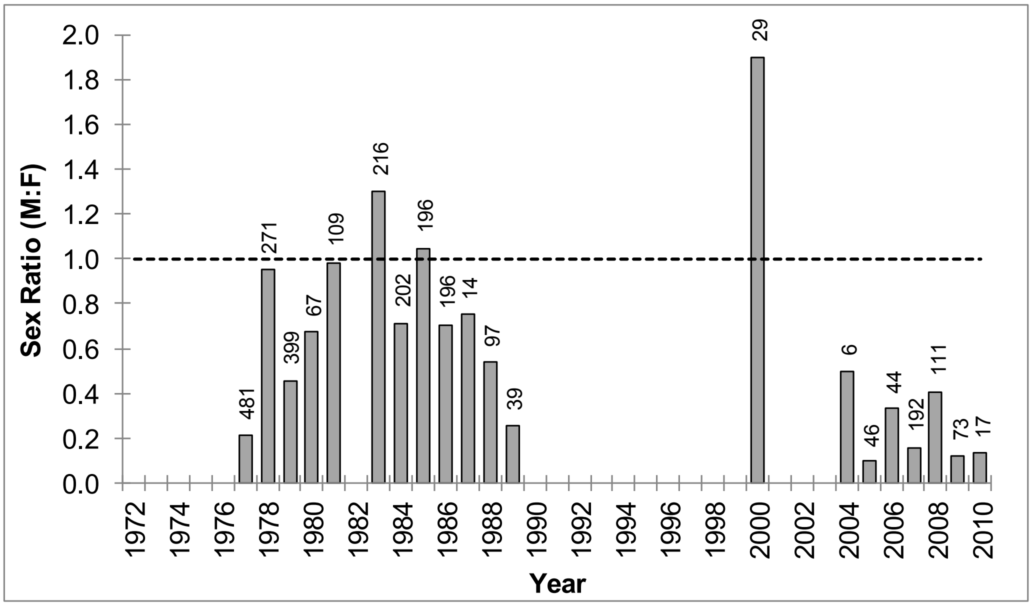


Figure 35. Annual sex ratio (M: F) of American shad sampled from fishery-independent gill nets in the Neuse River during January through May, 1972–2010. The horizontal dashed line indicates where the sex ratio is equal to 1.0. Sample sizes are shown above each bar.

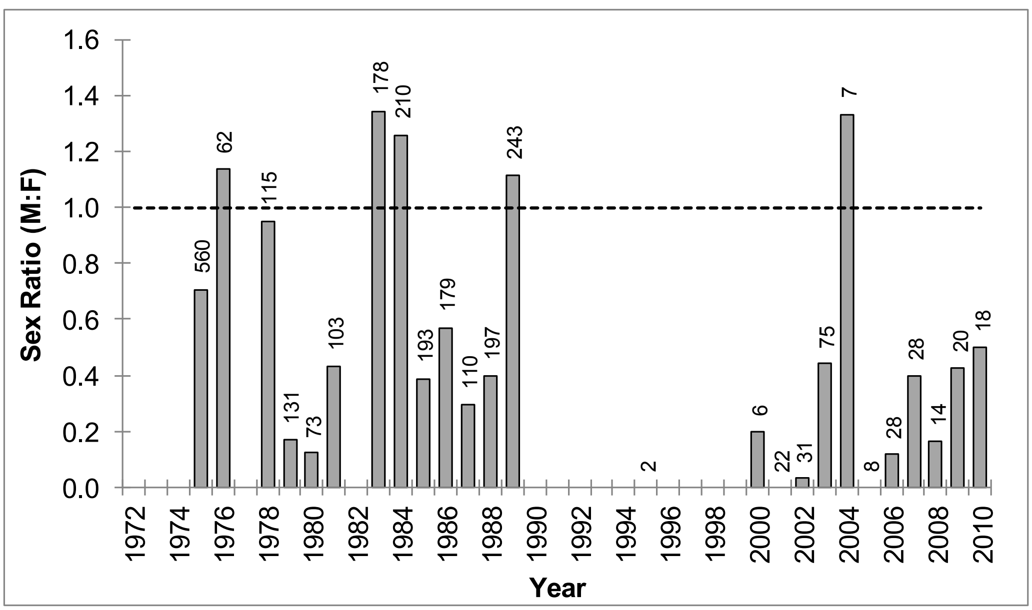


Figure 36. Annual sex ratio (M: F) of American shad sampled from fishery-independent gill nets in the Pamlico River during January through May, 1972–2010. The horizontal dashed line indicates where the sex ratio is equal to 1.0. Sample sizes are shown above each bar.

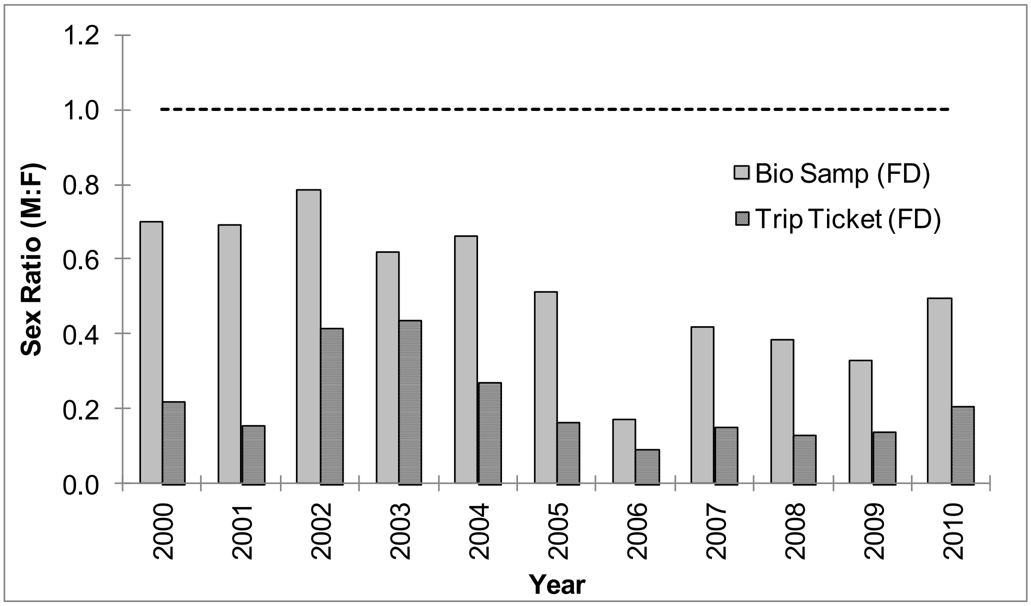


Figure 37. Comparison of annual sex ratios (M: F) of American shad derived from fisheries-dependent biological sampling and trip ticket data for gill nets in Albemarle Sound during January through May, 2000–2010. The horizontal dashed line indicates where the sex ratio is equal to 1.0.

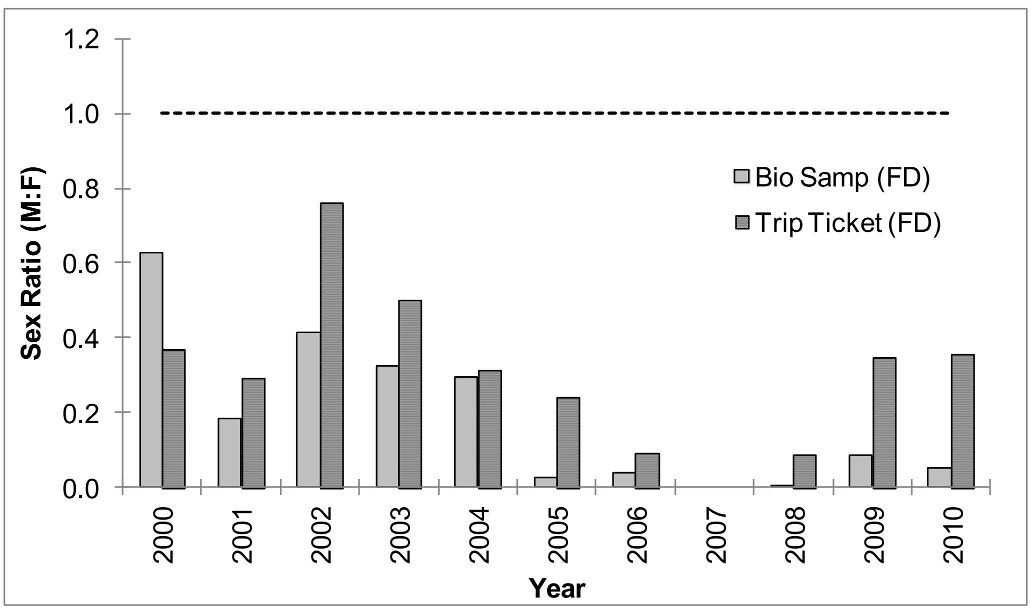


Figure 38. Comparison of annual sex ratios (M: F) of American shad derived from fisheries-dependent biological sampling and trip ticket data for gill nets in the Cape Fear River during January through May, 2000–2010. The horizontal dashed line indicates where the sex ratio is equal to 1.0.

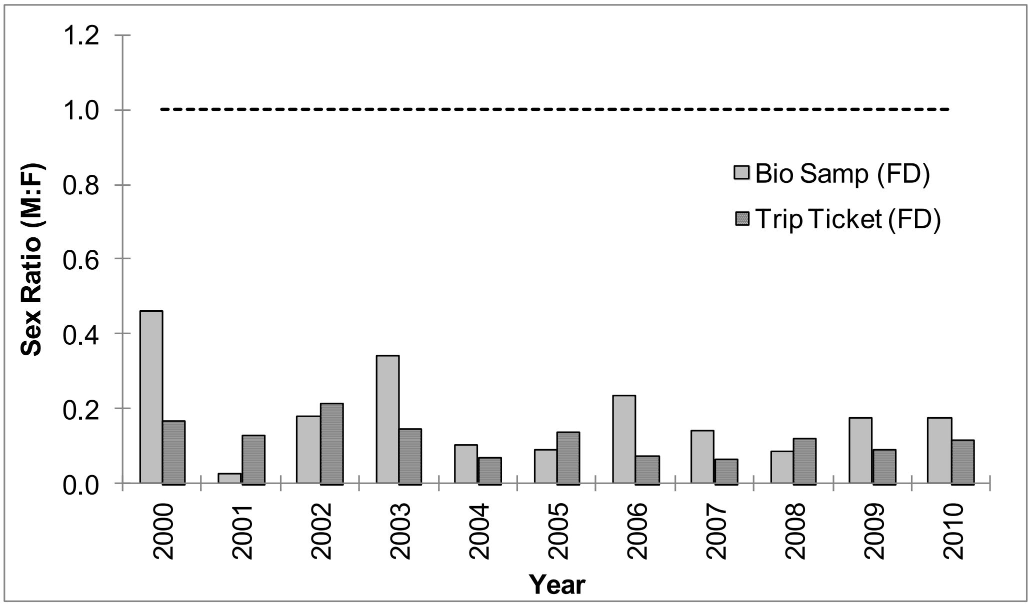


Figure 39. Comparison of annual sex ratios (M: F) of American shad derived from fisheries-dependent biological sampling and trip ticket data for gill nets in the Neuse River during January through May, 2000–2010. The horizontal dashed line indicates where the sex ratio is equal to 1.0.

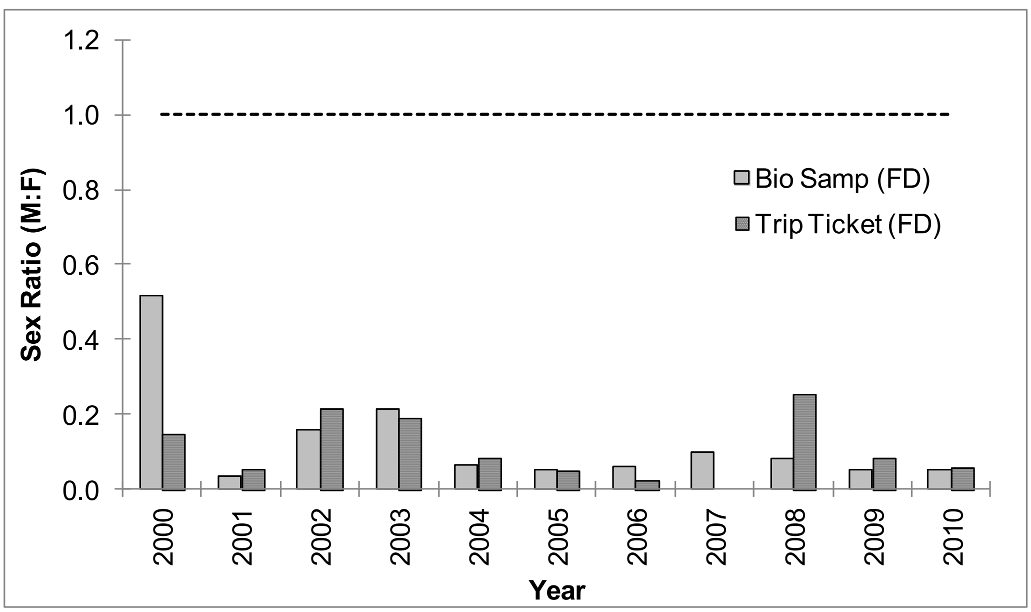
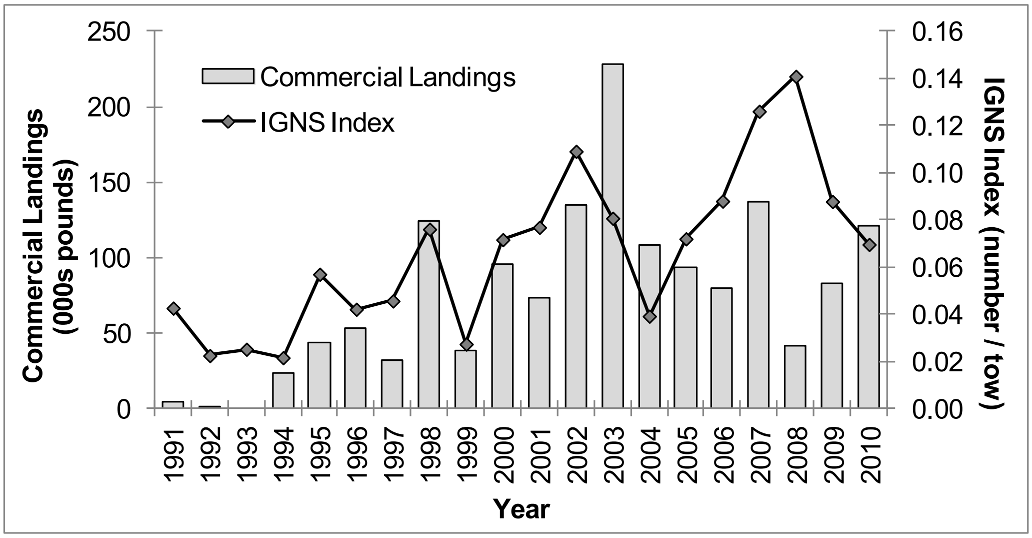


Figure 40. Comparison of annual sex ratios (M: F) of American shad derived from fisheries-dependent biological sampling and trip ticket data for gill nets in the Neuse River during January through May, 2000–2010. The horizontal dashed line indicates where the sex ratio is equal to 1.0.



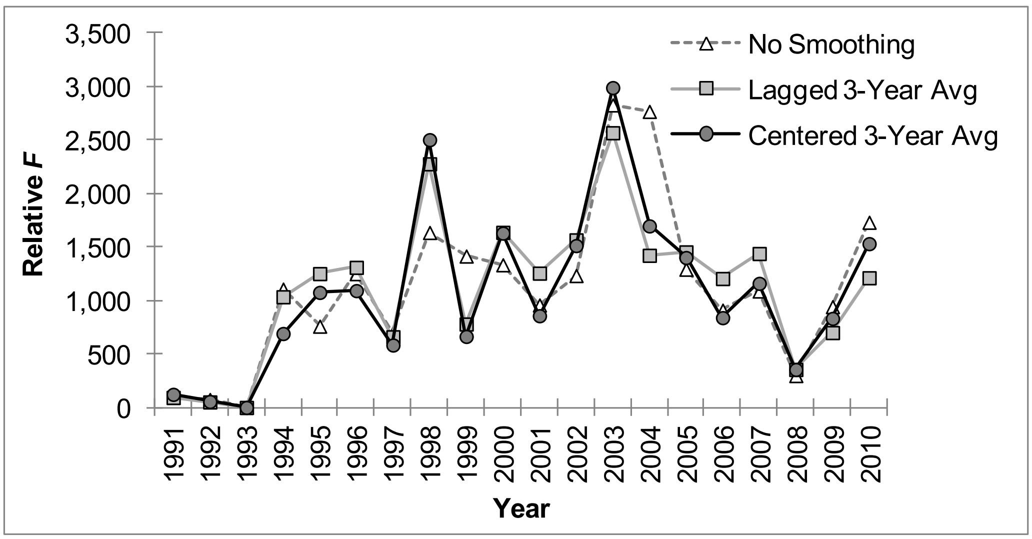


Figure 41. Commercial gill-net landings (January–May) compared to the IGNS index (all mesh sizes; top graph) and annual estimates of relative *F* using three different calculation methods (bottom graph) for Albemarle Sound, 1991–2010.

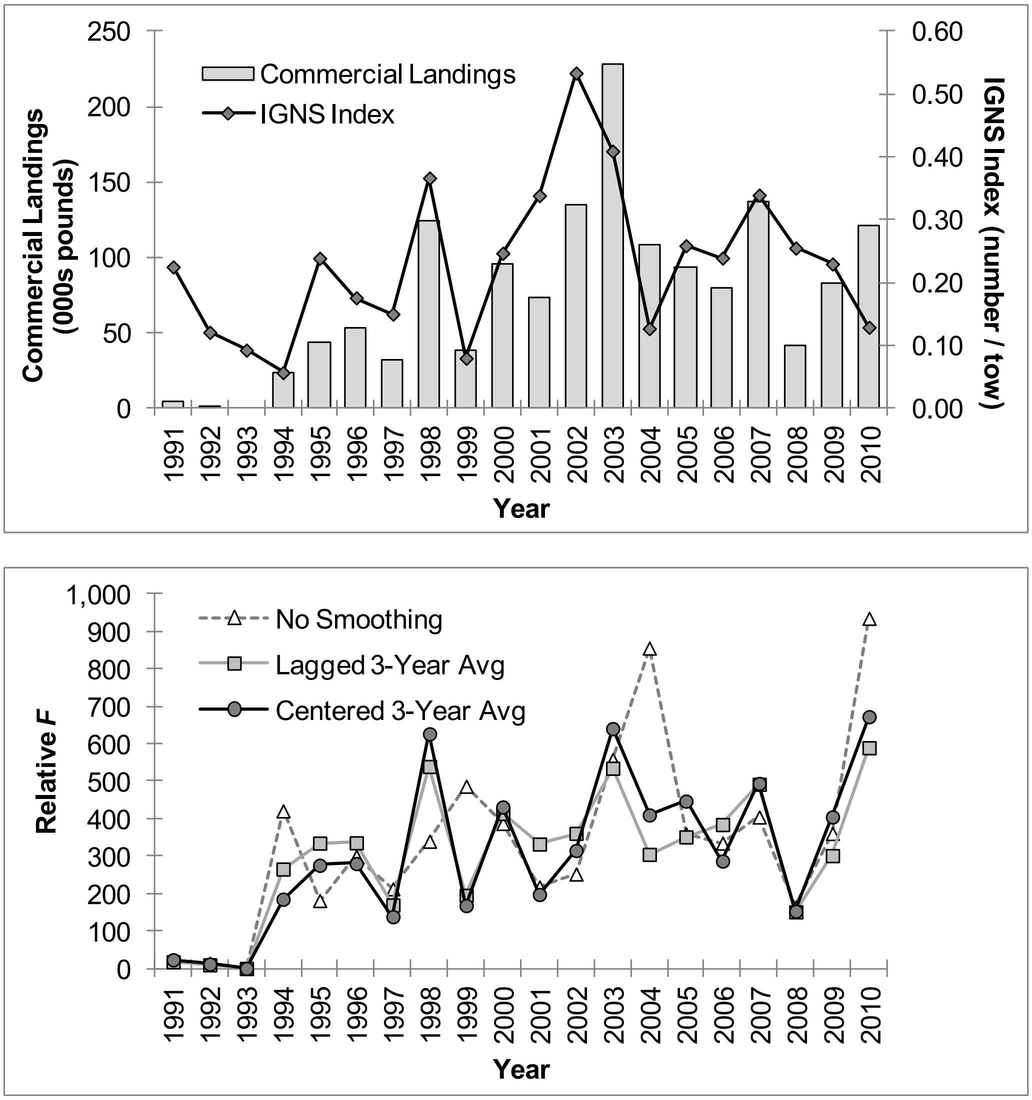
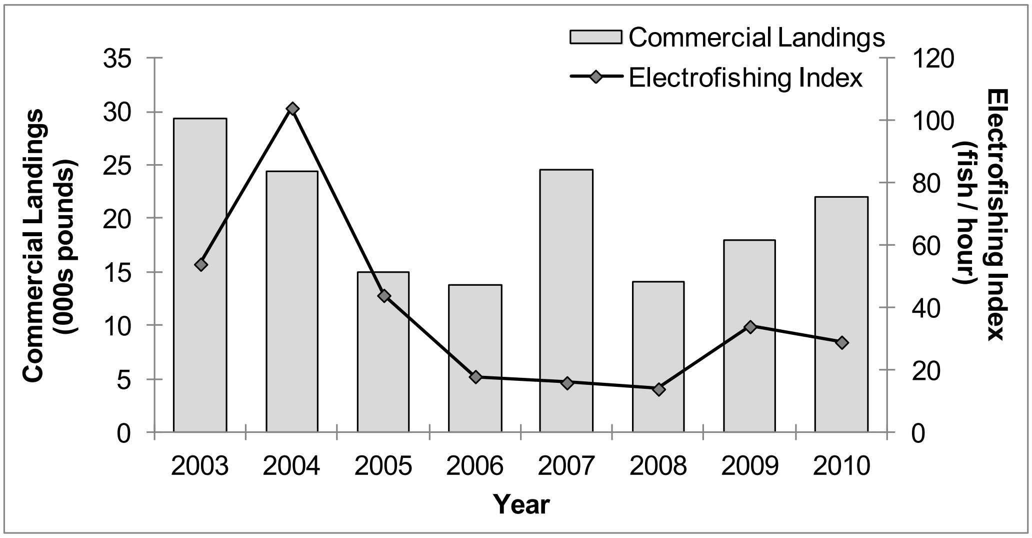


Figure 42. Commercial gill-net landings (January–May) compared to the IGNS index (mesh sizes 5.0, 5.5, and 6.0 inches; top graph) and annual estimates of relative *F* using three different calculation methods (bottom graph) for Albemarle Sound, 1991–2010.



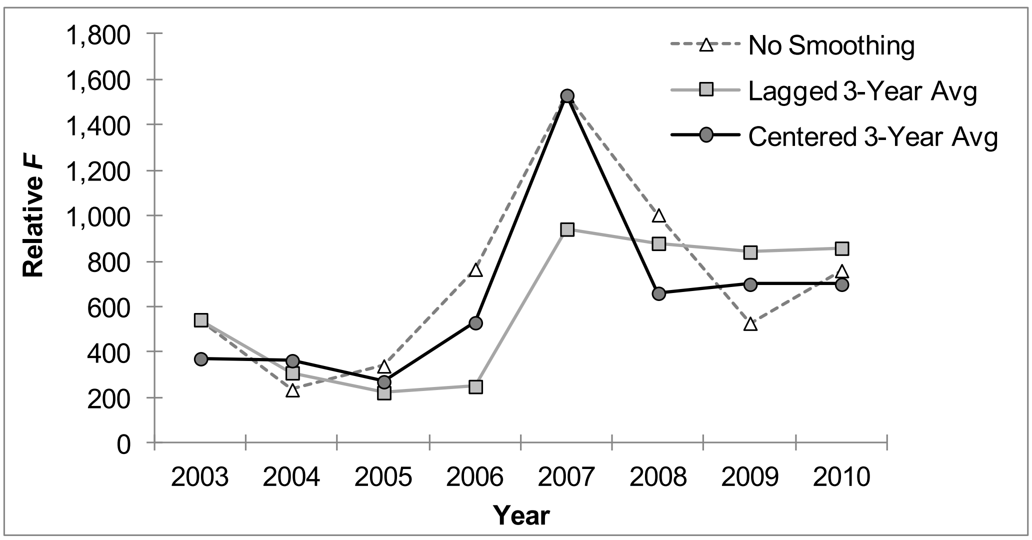


Figure 43. Commercial landings (March–April) compared to the NCWRC electroshocking index (top graph) and annual estimates of relative *F* using three different calculation methods (bottom graph) for the Cape Fear River, 2003–2010.

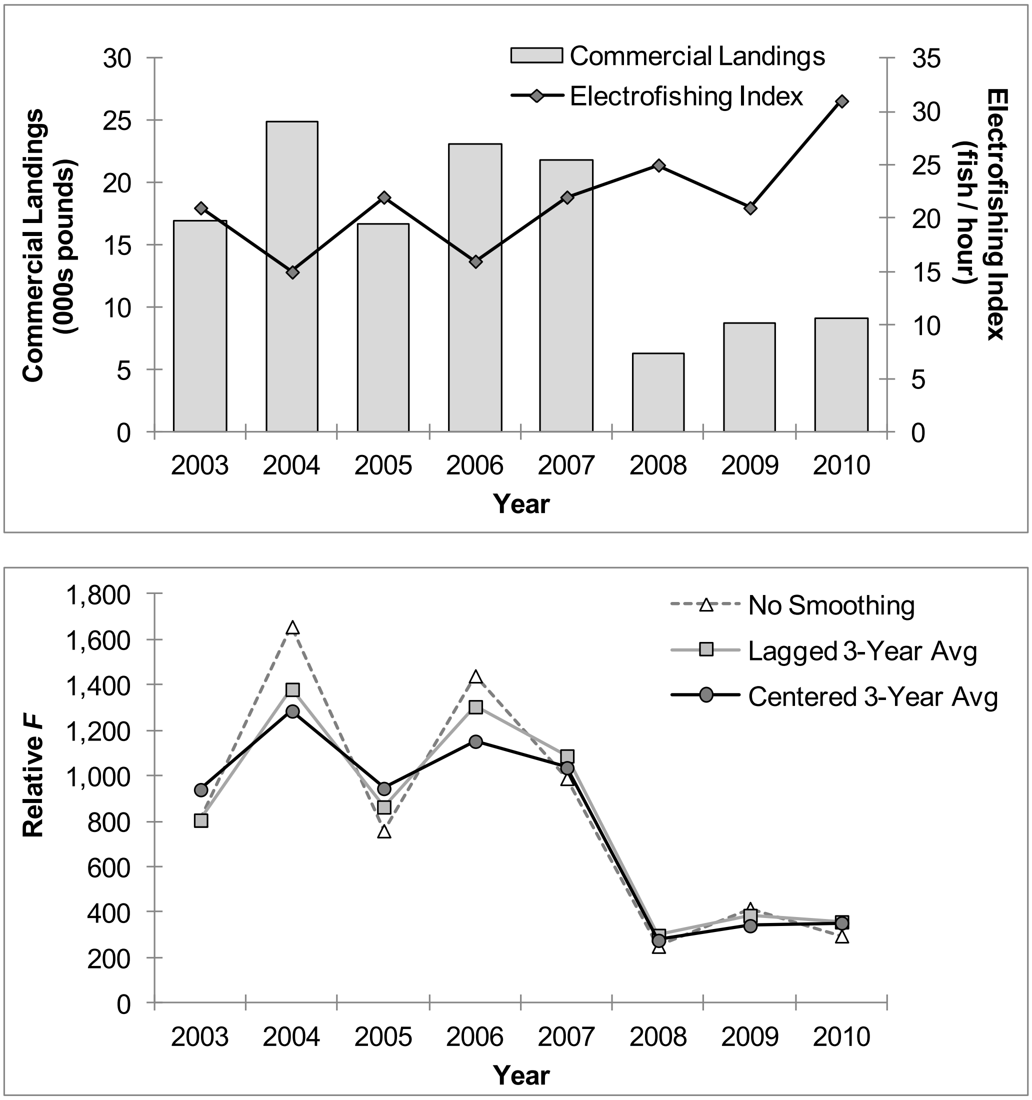


Figure 44. Commercial landings (March–April) compared to the NCWRC electroshocking index (top graph) and annual estimates of relative *F* using three different calculation methods (bottom graph) for the Neuse River, 2003–2010.

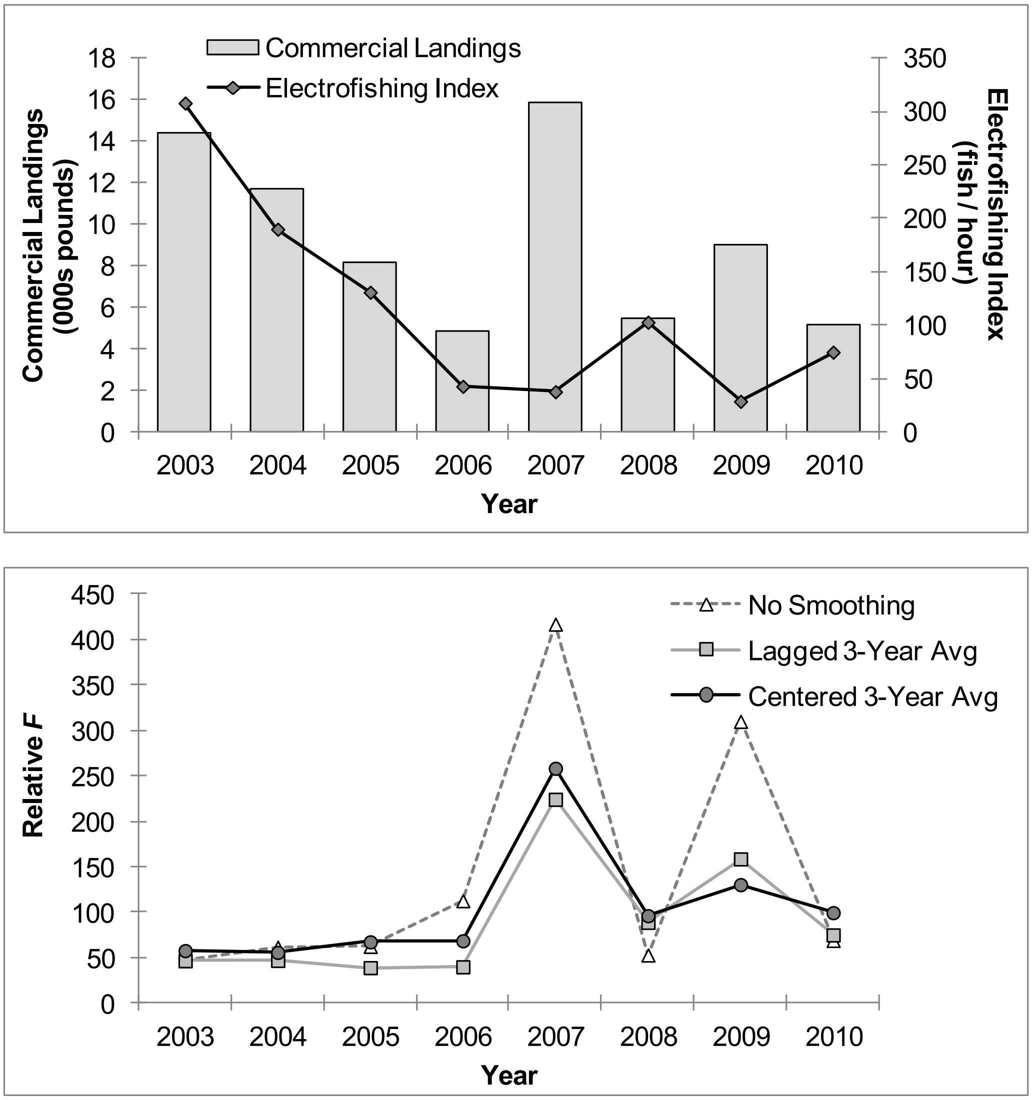


Figure 45. Commercial landings (March–April) for the Pamlico River compared to the NCWRC electroshocking index (top graph) for the Tar River and annual estimates of relative *F* using three different calculation methods (bottom graph), 2003–2010.

COMMERCIAL HARVEST REDUCTIONS

Introduction

Shad reductions were requested by the ASMFC to ensure a sustainable stock of American shad in the Cape Fear River since the sustainability estimates did not show positive trends relative to the thresholds. The commercial harvest reductions were based on Trip Ticket data from the NCDMF Trip Ticket Program (TTP) Database. Since 1994, all commercial fishermen are required to fill out a trip ticket upon landing fish. The data obtained from the TTP collects information on species landed, pounds landed, type of gear, number of fishermen, days fished, and waterbody fished. The two most common gears used to catch American shad are drift nets and set nets. The two gears vary in the way they are fished and the length of the net.

More refined data have been taken in port side sampling of commercial fishermen to get dimensions of the net fished, mesh size, length of gear, and more specific areas fished from 2008 through 2011 for both drift nets and set nets in the Cape Fear River. The Cape Fear drift net fishermen usually fish a net 50 to 75' in length with 5 ½" stretched mesh being the most common mesh size. Some fishermen fish two nets at one time. The nets are generally drifted down the middle of the channel for a couple miles and actively fished when a shad (or other fish) becomes entangled in the net. The time fished (recorded in minutes) varies depending on the flow rates of the river ranging from 30 minutes up to eight hours.

A detailed description of the all set net fishermen is lacking but data are available from a few fishermen. These fishermen fished between 200 and 700 yards of net. The stretched mesh size fished was usually 5 ½" stretched mesh. Nets were usually fished for 24 hours.

Methods

The TTP data were limited to trips from 2001 through 2011 to match the sustainability analysis and limited to trips that caught American shad. Trips where no fish were sold could not be included in the analysis. Reductions of 25 and 35% were calculated by iteratively recalculating harvest based on defined trip limits or seasons and compared to the total annual landings. Although the landings were grouped into varying weight bins for presentation, the iterative calculations were based on raw weights of fish. The targeted trip reduction was calculated as the average reduction based on landings from 2001 to 2011 given different management strategies. If a trip limit was met or exceeded in the model, it was assumed all fishing mortality on shad ended once that trip limit was reached. This assumes 100% compliance which may or may not be the case. The presented trip limits on average met or exceeded the defined criteria in approximately half the years in the times series. The other years the criteria would not limit harvest to the below defined criteria. The reduction included a reduction (19% for entire season) for the lift days established through proclamation which restricts gillnet fishing to weekdays (Proclamation FF-13-2012) in the Cape Fear River where shad are primarily caught in a targeted fishery (Note: This weekend gillnet restriction was implemented in November 2011 and applies to Joint Waters tributaries throughout the state, with the exception of those in the Albemarle Sound area). Weekend lift days were defined as trips with Saturday or Sunday as the trip day.

Seasonal calculations

Weekend harvest was defined and removed as described above due to the current regulations. The percent reduction due to the weekend lift days varied because the number of weekends and amount of harvest on the weekends varied through the season. Harvest included weekday harvest and the designated time period of the seasonal closure. Both early and late season closures were investigated to determine the time frame which met 25 and 35% reductions. The reductions were averaged across years from 2001 through 2011. Because the relative *F* parameter is calculated using the abundance index from the Cape

Fear electrofishing survey (which only occurs in March and April), seasonal reductions were calculated in two ways: 1) using commercial landings only from March and April to match the electrofishing survey; and 2) using commercial landings occurring throughout the season (January through April).

If a seasonal closure is the preferred management option for shad in the Cape Fear River, very little bycatch is expected in other commercial fisheries. Only commercial catfish and spotted seatrout fisheries operate in the vicinity of where shad are typically harvested. The catfish fishery is very small and is executed with either gillnets or hooks. The commercial spotted seatrout fishery typically occurs around the Wilmington Harbor and Brunswick River in the fall and early winter prior to the main migration of shad. The spotted seatrout fishery generally does not exist upstream of these locations.

Results

Total landings have varied overtime time with no consistent trend (Figure 1). The average commercial landings of American shad was low from 1994 to 2011 (18,500 lbs/year). The highest landings occurred in 2003 with 34,545 lbs of American shad harvested. The lowest occurred in 1999 with 6,815 lbs harvested. The catch per trip also had no consistent trend through time (Figure 1). Although catch per trip has not had a noticeable trend, the number of trips catching American shad increased in 2002 and has remained near or above the average of the time series.

The distribution of the weight of the catch varied through time but usually the pounds per trip was less than 100 lbs (Figure 2). From 2001 to 2011, 40 to 70 percent of the trips catching shad caught 100 lbs or less. Extremely high catches (>300 lbs) of American shad were observed in 2002, 2003, and 2004 when these years had greater than 5% of the trips exceeding 300 lbs.

Reductions could be met by developing trip limits or seasonal closures. Trip limits that were able to meet on average a 25 and 35% reduction with the weekend lift days included were 184 lb/trip and 103 lb/trip, respectively (Table 2). Similar to the seasonal reductions, trip limits were calculated using commercial landings from the entire season, as well as only using landings data from the months of March and April.

The seasonal closure reductions were calculated from the beginning of the fishing season (January 1) or from the end of the season (April 15). Closures were calculated for both scenarios at different reduction levels. If the season was shortened at the end of the fishing year, then closing the season on April 12 with a weekend closure would average a 25% reduction. A 35% reduction in landings on average could be achieved by closing the season on March 26. If the season was closed at the beginning of the fishing year and remained opened until April 15, then reductions of 25% and 35% could be achieved by opening the season February 16 and March 15 with a weekend closure, respectively.

Table 1. Annual commercial landings (lbs), landings on weekday, 25% and 35% reduction target, total trips, and weekday trips catching American shad from 2001 to 2011 in the Cape Fear River.

Year	Total Harvest	Week Only	25% Reduction	35% Reduction
2001	12,587	9,674	9,182	8,035
2002	19,188	14,845	12,483	10,177
2003	34,545	29,841	22,955	16,693
2004	28,775	22,322	18,224	13,752
2005	17,323	13,969	13,108	11,278
2006	16,136	13,139	12,569	10,962
2007	29,455	23,710	21,028	16,610
2008	15,929	13,797	13,475	11,671
2009	19,239	15,194	14,386	11,637
2010	23,724	19,191	17,238	13,353
2011	22,501	17,376	17,042	14,605

Table 2. Opening date, closing date, and trip limits that would reduce commercial American shad harvest from 2001 to 2011in the Cape Fear River by 25% and 35%. Closures and trip limits were calculated based on harvest occurring only in March and April, as well as harvest throughout the season (January 1 through April 15).

	Opening Date		Closing Date		Trip Limits	
Reduction	Mar-Apr	All	Mar-Apr	All	Mar-Apr	All
25%	5-Mar	20-Feb	12-Apr	11-Apr	205	184
35%	12-Mar	5-Mar	6-Apr	4-Apr	116	103

Table 2. Estimated landings in different weight categories summed from 2001 to 2011 based on reduction scenarios: no reduction, weekend closure, and 25% and 35% reductions including weekend closure.

Pound Range (lb)	No reduction	Weekend Closure	25% Reduction	35% Reduction
1-5	305	237	237	237
6-10	771	580	580	580
11-15	1,542	1,122	1,122	1,122
16-20	1,616	1,182	1,182	1,182
21-30	4,789	3,994	3,994	3,994
31-40	8,020	6,492	6,492	6,492
41-50	7,590	6,142	6,142	6,142
51-60	9,881	7,837	7,837	7,837
61-70	9,238	7,485	7,485	7,485
71-80	10,957	8,364	8,364	8,364
81-90	11,778	10,102	10,102	10,102
91-100	10,308	8,720	8,720	8,720
101-110	13,965	10,964	10,964	76,516
111-120	12,966	11,251	11,251	
121-130	12,151	9,679	9,679	
131-140	10,468	8,598	8,598	
141-150	8,937	6,922	6,922	
151-160	9,394	7,073	7,073	
161-170	6,040	3,745	3,745	
171-180	6,284	5,226	5,226	
181-190	5,709	4,244	45,975	
191-200	7,978	6,422		
201-210	6,927	5,491		
211-220	5,787	4,716		
221-230	5,131	3,576		
231-240	3,044	2,574		
>240	47,826	40,320		

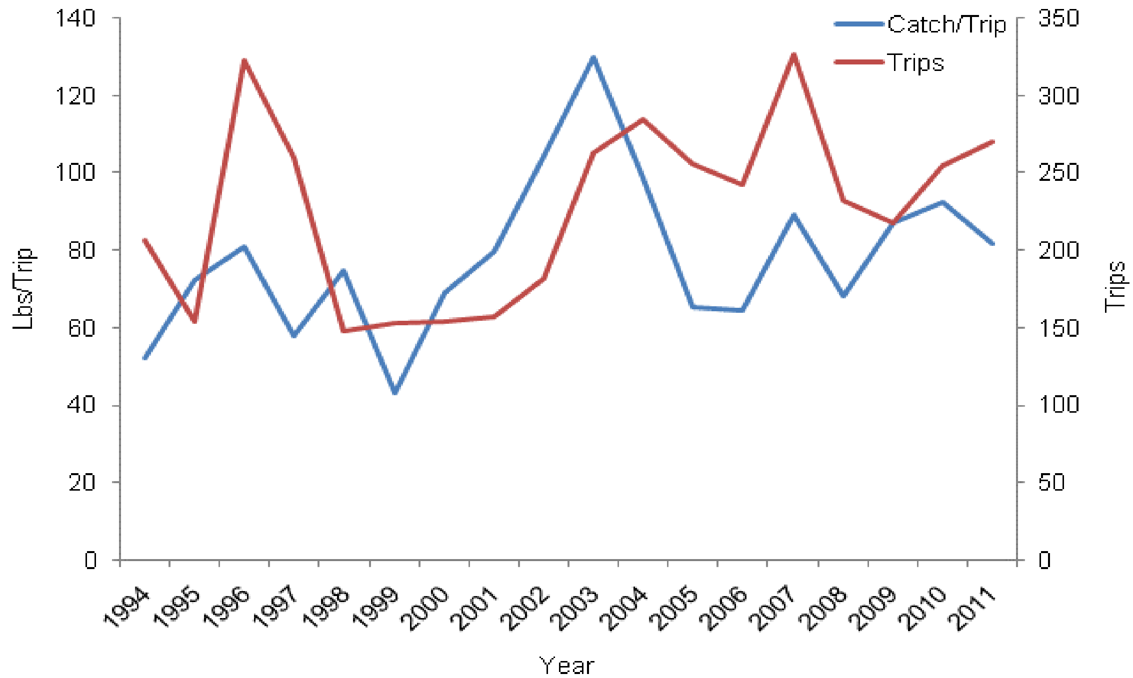


Figure 1. Commercial catch (lbs)/trip and number of trips catching American shad on the Cape Fear River from 1994 to 2011.

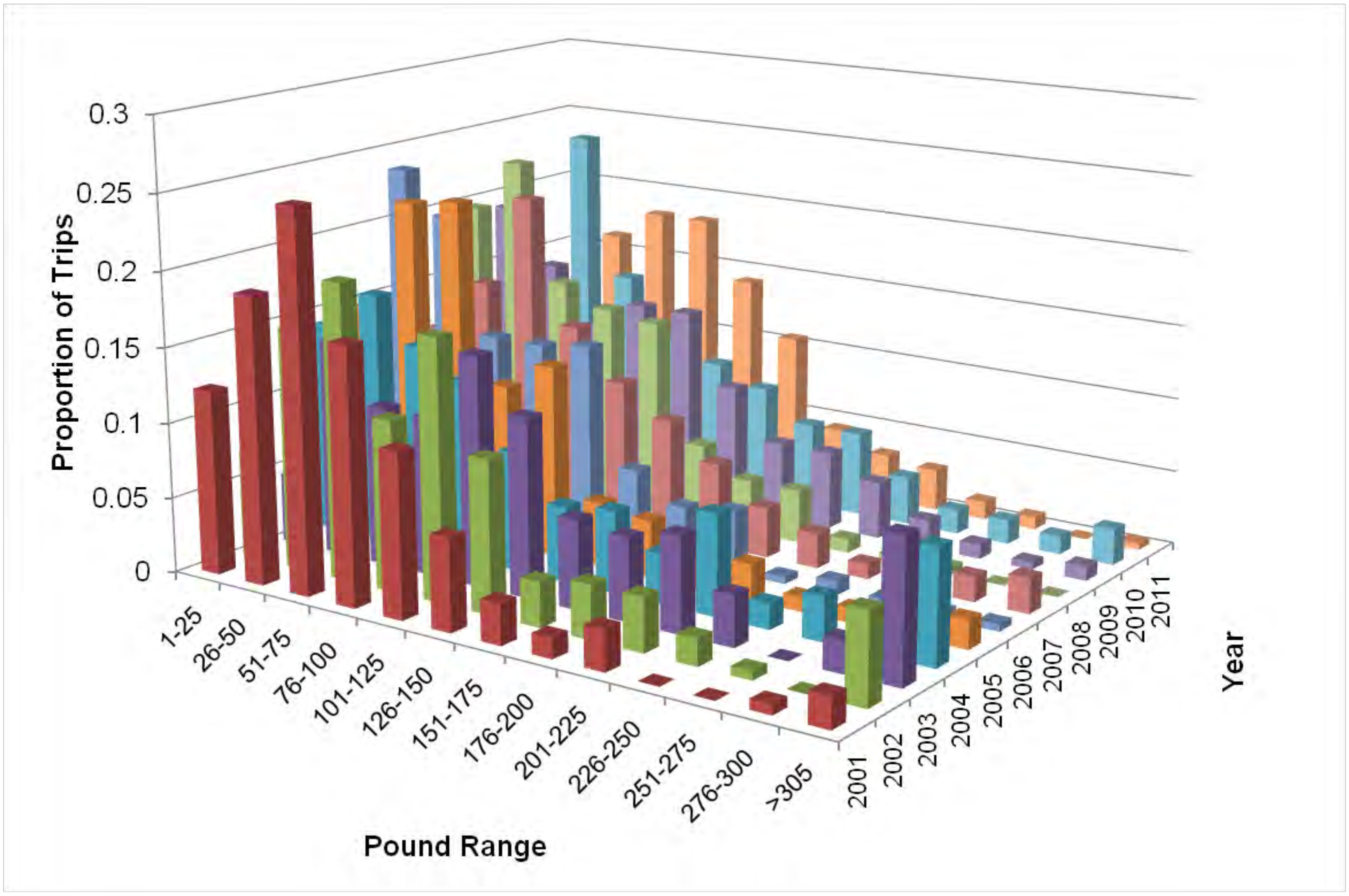


Figure 2. Proportion of trips by pound range catching American shad in the Cape Fear River from 2001 to 2011.

RECREATIONAL HARVEST REDUCTIONS

Data from the 2011 Cape Fear creel report were used to develop percent reductions in recreational harvest (in numbers of fish) associated with bag limit decreases. Each harvest estimate is based on 2011 Cape Fear creel data and each bag limit adjusted for number of fish legal to harvest and the remaining "harvest" appropriately reassigned to the catch category of each angling trip for each bag limit option. Results of these calculations are shown in Figure 1 (below). A 3% catch-and-release mortality rate was applied to all calculations based on Millard (2003). For consistency, the same 3% catch-and-release mortality was also applied to the current 10-fish bag limit. Estimated Total Catch from the 2011 creel survey (22,312 American shad) was kept constant for each scenario. The associated percent decrease in harvest is shown for each one-fish incremental change in bag limit in Figure 1.

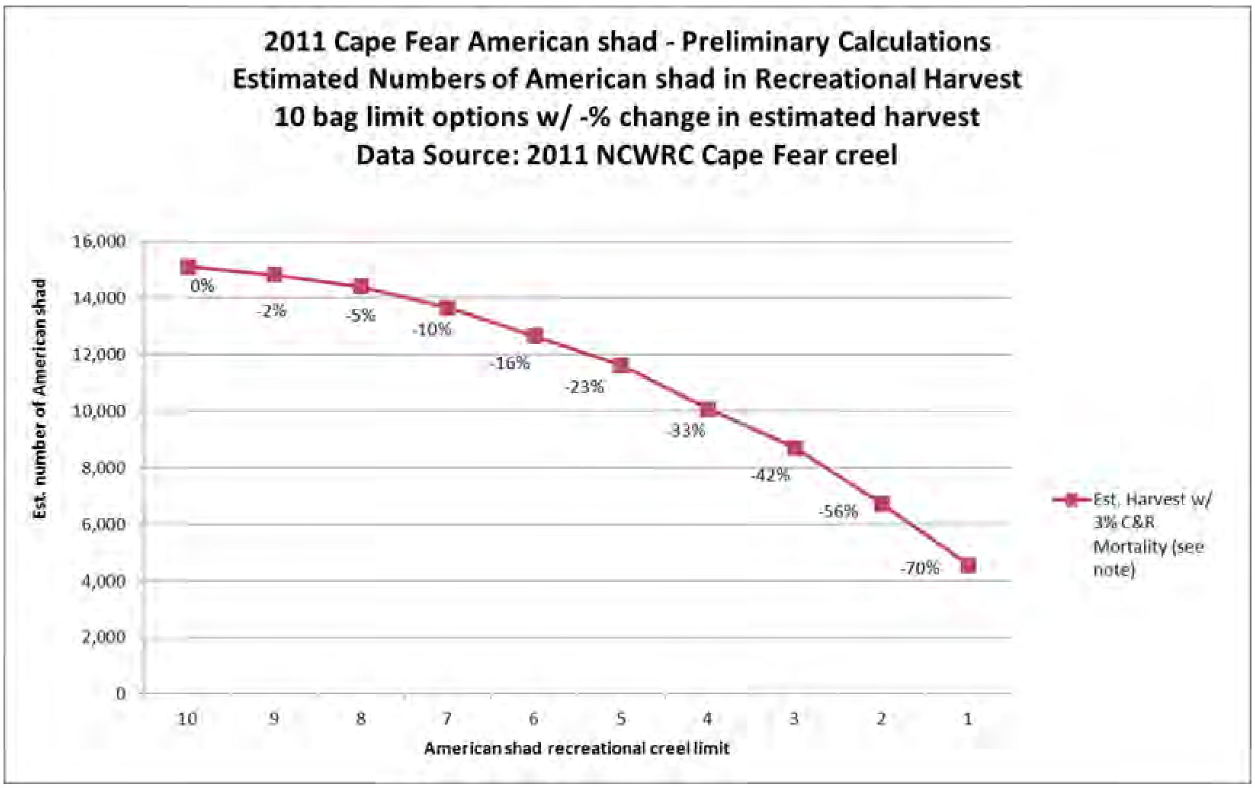


Figure 1. Estimated percent reductions (numbers of fish) in recreational harvest on the Cape Fear River for various bag limit options based on 2011 creel survey data.

Maryland's Fishing/Recovery Plan for American Shad (*Alosa sapidissima*)

Resubmitted to
Atlantic States Marine Fisheries Commission

Prepared by
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10 April 2012

Introduction

American shad are managed in Maryland under Amendment 3 to the Atlantic States Marine Fisheries Commission's (ASMFC) Interstate Fishery Management Plan (FMP) for Shad and River Herring and the Chesapeake Bay Alosa Management Plan (CBAMP). The ASMFC adopted the Interstate FMP for Shad and River Herring in 1985. The CBAMP was implemented in 1989 to coordinate shad and river herring management among states surrounding the Chesapeake Bay (www.chesapeakebay.net). This fishing/recovery plan describes the Maryland Department of Natural Resources' (MDNR) current monitoring and regulatory measures for systems where fishery dependent and independent monitoring is required by Amendment 3 to the ASMFC FMP (the Upper Chesapeake/Susquehanna River, Nanticoke River and Potomac River).

1. Sustainable Fisheries Plan

American shad fisheries will close for states or jurisdictions without an approved sustainability management plan in place by 1 January 2013. Maryland's American shad stocks are currently depleted, and remain low in Chesapeake Bay despite the establishment of moratoria by surrounding states in the 1980s and increased access to optimal spawning habitat. Therefore, Maryland will not develop a sustainable fisheries plan for American shad. Commercial and recreational fisheries for American shad are closed in Maryland and will remain closed until stock indicators have increased significantly. MDNR will continue to monitor and evaluate American shad abundance in coordination with cooperative organizations: the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC), the Potomac River Fisheries Commission (PRFC), and the Delaware Division of Fish and Wildlife (DE DFW).

2. Stock Monitoring Programs

a. Fishery Independent

i. Juvenile abundance indices

American shad juvenile indices are derived from the MDNR Estuarine Juvenile Finfish Seine Survey conducted at fixed stations within the upper Chesapeake Bay, the Potomac River and the Nanticoke River. This survey also gathers data from the Choptank and Patuxent Rivers. SRAFRC uses Maryland's juvenile data from the upper Bay to reflect reproductive success in the Susquehanna River. PRFC uses Maryland's juvenile data from the Potomac River to similarly assess juvenile abundance.

ii. Adult stock monitoring

There is no directed fishery independent stock monitoring for adult American shad in the Nanticoke or Potomac Rivers. However, the MDNR Striped Bass Spawning Stock Survey does provide length, age and sex data from the Potomac River during their gill net survey, which occurs from late March until mid-May. These data are also used in the PRFC's American Shad Fishing and Recovery Plan to assess the spawning stock in the Potomac River. Data availability depends on the continuation of this survey. In addition, the potential for small sample sizes can limit the usefulness of these data to monitor adults in the Potomac River. Data from this survey are not provided for other sampled regions (i.e., the Upper Bay) due to the low number of adult American shad encountered by the gear.

Adult American shad are sampled in the Susquehanna River by hook and line below the Conowingo Dam (tailrace) from mid to late April through late May or early June. Captured American shad are measured to the nearest mm (fork and total length), scales are removed, sex is determined, and fish are tagged (if in good condition). Scales are cleaned, mounted between two glass slides and read for age and spawning history. In addition to being used by Maryland, these data are used in SRAFRC's Migratory Fish Management and Restoration Plan for the Susquehanna Basin to monitor the shad population in the Conowingo Dam tailrace. Adult fish sampled at the Conowingo Dam tailrace and from the Potomac River are currently used to examine the following parameters:

1. *Relative or absolute abundance*
   Hook and line geometric mean CPUE are calculated annually.
2. *Age, size, sex composition*
   Length-frequency (for the Conowingo Dam only), age frequency, and sex ratio are examined annually.
3. *Total mortality (where possible)*
   Total instantaneous mortality rate is estimated based on age or repeat spawning marks. The Z calculated for these fish represents mortality associated with repeat spawning.
4. *Upriver and downriver passage efficiencies (where possible)*
   There is no independent estimate of upriver or downriver passage efficiency at the Conowingo Dam. However, turbine mortality is estimated at 25% for fish emigrating back through the Conowingo Dam. A turbine mortality study was planned by the dam owner in 2011, but could not be completed due to high river flow. The study should be conducted in 2012.

iii. Hatchery evaluation

1. *Proportion of hatchery fish present in juvenile or adult populations*
   Adult American shad otoliths are collected from the West Fish Lift at the Conowingo Dam (Susquehanna River) and are used to determine the percentage of hatchery fish present (analysis by the Pennsylvania Fish and Boat Commission). The percentage of hatchery fish present in juvenile and adult American shad populations are assessed using electrofishing gear by MDNR

personnel in the Patuxent and Choptank Rivers. Restocking in the Patuxent River ended in 2009 to permit maximum stocking effort and impact in the Choptank River. A small portion of the eggs removed from the Potomac River via broodstock are returned as marked reared larval hatchery fish, but Maryland does not conduct a hatchery assessment for American shad in the Potomac River. American shad otoliths obtained from the commercial pound and fyke net survey in Maryland's portion of the Nanticoke River are used by the DE DFW to estimate the proportion of hatchery-reared juveniles that have returned as adults to the upper Nanticoke River to spawn.

b. Fishery Dependent

i. Commercial Fishery

1. *Total catch, landings, and effort*
   The American shad commercial fishery closed in Maryland in 1980. The ocean intercept fishery closed in 2005. Therefore, no catch, landings or effort data are collected.
2. *Age, size, and sex composition of harvested fish*
   MDNR continues to sample commercial fyke and pound nets in the Nanticoke River that were traditionally set for shad in addition to other spring spawning species. No American shad are currently harvested from these nets. Captured American shad are measured to the nearest mm (fork and total length), scales are removed and sex is determined. Scales are later cleaned, mounted between two glass slides and read for age and spawning history.

ii. Recreational Fishery

1. *Total catch, landings, and effort or catch per unit effort from a subsample*
   After closure of the recreational American shad fishery in 1980, Maryland has only permitted a catch and release sport fishery. MDNR conducts a roving creel survey by interviewing anglers during the spawning run below the Conowingo Dam on the Susquehanna River. This survey determines the percentage of anglers that target shad (unspecified species) and the catch of American shad per angler hour in a given year. MDNR also characterizes the spring recreational shad fisheries by distributing logbooks for anglers to report daily catch and effort from which the catch of American shad per angler hour is calculated.

   Normandeau Associates, Inc. conducted a creel survey in 2010 as part of the dam relicensing process required by the Federal Energy Regulatory Commission (FERC Project Number 405). Forty-two of 910 boat and shore anglers targeted American shad while fishing in the lower Susquehanna River in the spring. Additionally, 145 anglers reported fishing for "shad." A total catch of 14,831 American shad was reported in this creel survey.

iii. Bycatch and discards

American shad are primarily captured as bycatch in the spring fyke/pound net commercial fishery for perch and catfish species. This fishery occurs in Maryland's tributaries to the Chesapeake Bay and in the upper Bay in the spring. Commercial fishermen are permitted a 2 fish per day bycatch of dead American shad for personal use (no sale is permitted). Bycatch and discard monitoring does not occur in Maryland because there is no mechanism for fishermen to report American shad as bycatch under the current reporting system; funding and staffing constraints are also factors. Maryland is currently limited to monitoring American shad bycatch through MDNR's fishery dependent survey of commercial pound and fyke nets on the Nanticoke River.

Commercial pound net discard mortality in Maryland was previously estimated as 4,200 pounds (based on pound net surveys conducted by MDNR personnel in the Chesapeake Bay). This estimate was calculated as the average seasonal catch in pound nets multiplied by the total number of spring pound nets in the Bay from the late 1990s to the early 2000s, and likely does not accurately represent the current American shad bycatch (due to the greater abundance of American shad in the past). Similarly, no reliable estimate of the number of American shad recreationally caught and released are available to estimate total Maryland recreational discard mortality. A catch and release study was conducted at the Conowingo Dam in 1997; mortality of American shad (n = 309) in the study was 0.97%, but total recreational release mortality remains unknown.

3. Fishery Management Program

a. Commercial fishery

The American shad commercial fishery closed in Maryland in 1980. The ocean intercept fishery was closed by ASMFC in 2005.

b. Recreational fishery

The American shad recreational fishery closed in Maryland in 1980. Maryland permits a catch and release sport fishery.

c. Bycatch and discards

According to the Code of Maryland Regulations (08.02.05.05), incidental catch of American shad by commercial fishing gear set for other species must be returned to the water. Not more than two American shad may be possessed for personal consumption if shad are found dead when commercial fishing gear operated for other species is retrieved from the water. Maryland does not currently monitor bycatch (with the exception of limited onboard sampling in the Nanticoke River) due to the small allowable possession limit, resource constraints, and the lack of a mechanism for fishermen to report bycatch in the current reporting system.

Atlantic States Marine Fisheries Commission

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Paul J. Diodati, (MA), Chair *Dr. Louis B. Daniel, III, (NC), Vice-Chair* *John V. O'Shea, Executive Director*

Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015

November 22, 2011

Patricia A. Kurkul, Regional Administrator
National Marine Fisheries Service
Northeast Regional Office
55 Great Republic Drive
Gloucester, Massachusetts 01930

Dear Ms. Kurkul,

The Atlantic States Marine Fisheries Commission (Commission) submits the following comments in response to the positive 90-Day Finding on the petition to list river herring (alewife and blueback herring) as threatened throughout all or parts of the species range. The Commission is currently conducting a coastwide stock assessment on river herring, which will be peer reviewed and presented to the Shad and River Herring Management Board (Board) in May 2012. If approved by the Board for management use, the assessment will be made available to the National Marine Fisheries Service (Service) for consideration in the river herring status review.

In the interim, attached is the list of datasets collected by the River Herring Stock Assessment Sub-Committee during the stock assessment process. This data is currently available to the Service for use in the river herring status review. If you have any questions, please feel free to contact Kate Taylor at ktaylor@asmfc.org.

Sincerely,

John V. O'Shea

encl: Surveys and Datasets Collected by the ASMFC River Herring Stock Assessment Subcommittee

cc: ISFMP Policy Board
Shad & River Herring Management Board

Surveys and Datasets Collected by the Atlantic States Marine Fisheries Commission River Herring Stock Assessment Subcommittee

(Preliminary and subject to revision)

Maine *(Data from: ME Department of Marine Resources)*
Damariscotta River Harvest, 1943-2010
Orland River Harvest, 1943-2010
St. George River Harvest, 1943-2010
Union River Harvest, 1975 – 2010
Androscoggin River FI* Adult Survey, 1983 – 2010
Sebasticook River FI Adult Survey, 2000 – 2010
Merrymeeting Bay FI Juvenile Abundance Survey, 1979 – 2010
Gulf of Maine FI Adult Survey, 2000 – 2010

New Hampshire *(Data from: NH Fish and Game)*
Exeter/Squamscott River Harvest and FI Adult Survey, 1991 – 2010
Lamprey River Harvest and FI Adult Survey, 1991 – 2010
Winnicut River Harvest and FI Adult Survey, 1991 – 2010
Oyster River Harvest and FI Adult Survey, 1991 – 2010
Cocheco River Harvest and FI Adult Survey, 1991 – 2010
Taylor River Harvest and FI Adult Survey, 1991 – 2010
Great Bay Estuary FI Juvenile Abundance Survey, 1997 – 2010

Massachusetts *(Data from: MA Division of Marine Fisheries)*
Mattipoisett River Harvest and FI Adult Survey, 1988 – 2010
Monument River Harvest and FI Adult Survey, 1980 – 2010
Nemasket River Harvest, 1996 – 2010
Parker River Harvest and FI Adult Survey, 1971 – 1978 and 2000 – 2010
Town River Harvest and FI Adult Survey, 2000 – 2010
Agawam River FI Adult Sampling, 2006 – 2010
Back River FI Adult Sampling, 2007 – 2010
Mystic River FI Adult Sampling, 2004 – 2010
Quashnet River FI Adult Sampling, 2004
Stony Brook River Harvest and FI Adult Sampling, 1978 – 2004

Rhode Island *(Data from: RI Fish and Wildlife)*
Gilbert Stuart River FI Adult and Juvenile Survey, 1981 – 2010
Nonquit River FI Adult and Juvenile Survey, 1999 – 2010
Buckeye Brook FI Adult Survey, 2003 – 2010
Pawcatcuk River FI Adult and Juvenile Survey, 1988 – 2010
Ocean waters FI Adult and Juvenile Survey, 1979 – 2010
Narragansett Bay FI Adult and Juvenile Survey, 1988 – 2010
Coastal Ponds FI Adult and Juvenile Survey, 1992 – 2010

Connecticut *(Data from: CT DEP Marine Fisheries)*
Connecticut River Harvest and FI Adult and Juvenile Survey, 1955 – 2010

New York *(Data from: NY Department of Environmental Conservation)*
Hudson River Harvest, FD CPUE** and FI Adult and Juvenile Survey, 1975 – 2010

Delaware River and Bay *(Data from: DE Fish and Wildlife, NJ Division of Fish and Wildlife and PA Fish and Boat Commission)*
Delaware River and Bay Harvest, FD CPUE and FI Adult and Juvenile Survey, 1966 – 2010

Maryland *(Data from: Maryland Department of Natural Resources)*
Nanticoke River Harvest, FD CPUE and FI Juvenile Survey, 1959 – 2010
Susquehanna River Harvest, 1973 – 2010
Chesapeake Bay Harvest and FD CPUE, 1959 – 2010

Potomac River *(Data from: MD DNR, Virginia Marine Resources Commission and Potomac River Fisheries Commission)*
Potomac River Harvest and FI Adult and Juvenile Survey, 19559 – 2010

Virginia *(Data from: VMRC and Virginia Institute of Mareine Science and Virginia Department of Game and Inland Fisheries)*
York River Harvest, FD biological sampling and FI Juvenile Survey, 1929 – 2010
James River Harvest, FD biological sampling and FI Juvenile Survey, 1929 – 2010
Rappahannock River Harvest, FD biological sampling and FI Adult and Juvenile Survey, 1929 – 2010
Mattaponi /Pamunkey Rivers FI Juvenile Survey, 1979 - 2010

North Carolina *(Data from: NC Division of Marine Fisheries)*
Albemarle Sound FI Adult and Juvenile Survey, 1972 – 2010
Chowan River Harvest and FD biological sampling and CPUE, 1972 – 2010

South Carolina *(SC Department of Natural Resources)*
Santee-Cooper Harvest, FD CPUE and FI Adult and Juvenile Survey, 1969 – 2010

Georgia *(Data from: GA Department of Natural Resources)*
Altamaha/Ogeechee/Savannah Rivers, Harvest and FI Juvenile Survey, 2010

Florida *(Data from: FL Fish and Wildlife Commission)*
St John's River FI Adult and Juvenile Survey, 1972 – 1973 and 2001 – 2010

*FI = Fisheries Independent Data
** FD CPUE = Fisheries Dependent Catch Per Unit Effort
*** Note: Specific survey datasets may be available for only a portion of the time series noted; some survey datasets may distinguish between alewife and blueback herring

Before the Secretary of Commerce

Petition to List Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalis*) as Threatened Species and to Designate Critical Habitat

Alewife (*Alosa pseudoharengus*)

Blueback Herring (*Alosa aestivalis*)

Source: U.S. Fish and Wildlife Service

August 1, 2011

EXECUTIVE SUMMARY

This is a petition to list the alewife (*Alosa pseudoharengus*) and the blueback herring (*Alosa aestivalis*) each as a threatened species throughout all or a significant portion of its range pursuant to the federal Endangered Species Act (―ESA"). In the alternative, the National Marine Fisheries Service (―NMFS") should designate distinct population segments (―DPSs") of alewives and blueback herring as specified in this petition and list each DPS as a threatened species.

Alewives and blueback herring (collectively known as ―river herring") were once highly abundant in coastal waters, rivers and streams of the eastern United States. From 1950 through 1970, total commercial landings of alewives and blueback herring in Atlantic coastal states averaged more than 50 million pounds per year. Most Atlantic coastal streams and rivers were inhabited by one or both of the species. In the larger rivers, spawning runs could reach well into the millions of individual fish – according to one historical account, three quarters of a *billion* river herring were landed from the Potomac River in 1832.

Populations of alewives and blueback herring are now a tiny fraction of their historical abundance. Overall coastal landings of alewives and blueback herring have averaged a little more than a million pounds over the last decade, a decline of more than 98 percent from the 1950 to 1970 average. In many rivers and streams, including several of the most historically important, river herring populations are either collapsed or entirely extirpated. In most of the others, populations are extremely depleted. Particularly alarmingly, declines have continued or even accelerated over the last decade in many cases. For example:

- On the Maine-Canada border, the run of alewife in the St. Croix River, which once numbered over two million counted fish in a single year, has been at or near zero in recent years and is considered collapsed.

- In New Hampshire‘s Taylor River, what had been the state‘s largest river herring run dropped by 97 percent between just 2000 and 2003 and has continued to decline.

- The alewife count in two of Massachusetts‘ most important remaining river herring runs, in the Monument and Mattapoisett Rivers, dropped almost 85 and 95 percent, respectively, between just 2000 and 2010.

- The huge blueback herring run in the Connecticut River, which averaged 5.4 million fish annually from 1981 to 1995, dropped to just over one million fish per year on average from 1996 to 2001, and then to just over 300,000 fish per year on average between 2002 and 2008 – an overall decline of almost 95 percent. In 2009, seven years after Connecticut instituted a fishing moratorium, state officials still described river herring stocks as ―very low with no signs of an imminent recovery."

- The river herring fisheries of Chesapeake Bay and its tributaries – historically the country‘s largest – have been virtually eliminated, with landings in Virginia, Maryland, and from the Potomac River down 99 percent or more from their 1950 to 1970 averages.

In the Susquehanna River, which drains into Chesapeake Bay, blueback herring passed by the Conowingo Dam East fish passage dropped from almost 285,000 counted fish in 2001 to just 4 fish in 2010.

- By 2007, river herring landings from North Carolina's Albemarle Sound and its tributaries – which once rivaled those from Chesapeake Bay – had dropped by 98 percent or more, prompting the state to close its river herring fisheries. Since that time, North Carolina catch rates for bluebacks and alewives from independent gill net surveys have not shown any meaningful improvement in the populations.

- In South Carolina, the alewife is considered extirpated.

Alewives and blueback herring are imperiled by the present and threatened destruction, modification, and curtailment of their habitat and range; by overutilization for commercial, recreational, and scientific purposes; by predation and disease; by the insufficiency of existing regulatory authorities, laws, and policies; and by other natural and manmade factors. Existing stressors that most endanger the survival of alewives and blueback herring include fishing-related mortality, water pollution, dams, and dredging. In addition, recent studies indicate that global warming is already harming certain alewife and blueback herring subpopulations and will become an increasingly significant stressor in the future, including by exacerbating harmful water quality conditions and increasing flooding. Without substantial mitigation and management of these stressors, the alewife and the blueback herring are likely to become endangered and eventually extinct throughout all or significant portions of their ranges.

NMFS should list the alewife and the blueback herring each as a threatened species as a whole. The alewife and the blueback herring are unitary species likely to become endangered within the foreseeable future throughout all or significant portions of their ranges, including rivers in Maine, New Hampshire, Massachusetts, Connecticut, the Chesapeake Bay and its tributaries, and many coastal river systems in the Carolinas.

If NMFS does not list the alewife and the blueback herring each as a threatened species as a whole, the agency should designate four DPSs of alewife and three DPSs of blueback herring as threatened as follows: Central New England DPS of alewives, Long Island Sound DPS of alewives, Chesapeake Bay DPS of alewives, and Carolina DPS of alewives; Central New England DPS of blueback herring, Long Island Sound DPS of blueback herring, and Chesapeake Bay DPS of blueback herring. These DPSs encompass fish that originate from a river within the DPS and include the marine range of such fish.

The Central New England DPSs for alewives and for blueback herring would include the Winnicut River, Exeter River, Cocheco River, Taylor River, Oyster River, and Lamprey River in New Hampshire, and the Parker River in Massachusetts. These DPSs should be listed as threatened species because they are likely to become endangered within the foreseeable future throughout all or significant portions of this range, including as a result of fishing-related mortality, dams, dredging and blasting, water pollution, and global warming.

The Long Island Sound DPSs for alewives and for blueback herring would include the Monument River, Nemasket River, and Mattapoisett River in Massachusetts, the Nonquit River and Gilbert-Stuart River in Rhode Island, and the Shetucket River, Farmington River, Connecticut River, Naugatuck River, and Mianus River in Connecticut. These DPSs should be listed as threatened species because they are likely to become endangered within the foreseeable future throughout all or significant portions of this range, including as a result of fishing-related mortality, dams, dredging and blasting, water pollution, and global warming.

The Chesapeake Bay DPSs for alewives and blueback herring would include the Bay itself, and the Nanticoke, Potomac, Susquehanna, Rappahannock, York, and James Rivers. These DPSs should be listed as threatened species because they are likely to become endangered within the foreseeable future throughout all or significant portions of this range, including as a result of fishing-related mortality, dams, dredging and blasting, water pollution, and global warming.

The Carolina DPS for alewives would include the Chowan River and Albemarle Sound, Roanoke River, Pamlico Sound/Pamlico, Tar and Neuse Rivers, and Cape Fear River in North Carolina and the Winyah Bay (including the Waccamaw, Pee Dee, and Sampit rivers), Santee River, and Cooper River in South Carolina. This DPS should be listed as a threatened species because it is likely to become endangered within the foreseeable future throughout all or a significant portion of its range, including as a result of fishing-related mortality, dams, dredging and blasting, water pollution, and global warming.

NOTICE OF PETITION

Hon. Gary Locke
Secretary
U.S. Department of Commerce
1401 Constitution Ave. NW
Washington, DC 20230

Jane Lubchenco
Under Secretary of Commerce for Oceans &
Atmosphere & National Oceanic and
Atmospheric Administration (―NOAA”)
Administrator
U.S. Department of Commerce
1401 Constitution Avenue, NW
Washington, DC 20230

Eric C. Schwaab
Asst. Administrator for Fisheries
NOAA
1315 East-West Highway, Building 3
Silver Spring, MD 20910

PETITIONER:

Natural Resources Defense Council
40 West 20th Street
New York, NY 10011
Tel: (212) 727-2700

The Petitioner Natural Resources Defense Council (―NRDC” or ―Petitioner”) hereby formally petitions the Secretary of the United States Department of Commerce (―Secretary”),[1] pursuant to 5 U.S.C. § 553(e) and 50 C.F.R. § 424.14, to list the alewife (*Alosa pseudoharengus*) and the blueback herring (*Alosa aestivalis*) each as threatened species under the Endangered Species Act, 16 U.S.C. §§ 1531, *et seq*. In the alternative, Petitioner petitions the Secretary to delineate four DPSs of alewives and three DPSs of blueback herring as described in the attached petition and to list them as follows: the Central New England, Long Island Sound, Chesapeake Bay and Carolina DPSs for alewife should be listed as threatened species; and the Central New England, Long Island Sound, and Chesapeake Bay DPSs for blueback herring should be listed as threatened species.

[1] Pursuant to the 1974 NMFS-U.S. Fish and Wildlife Service policy, NMFS should be the lead agency reviewing this petition.

Petitioner also requests that critical habitat be designated for alewife and for blueback herring concurrently with listing, pursuant to 16 U.S.C. § 1533(a)(3)(A) and 50 C.F.R. § 424.12.

I. Petitioner

NRDC is a national, non-profit environmental organization with more than 1.2 million members and online activists nationwide, including more than 373,000 members and activists in the Atlantic coastal states. In these Atlantic coastal states, NRDC actively works to improve the management of marine and estuarine resources. NRDC‘s members regularly visit alewife habitat and blueback herring habitat for recreational and related purposes, seek to view both alewives and blueback herring in the wild, and are concerned about the drastic decline in each species‘ numbers and each species‘ risk of extinction. NRDC can be contacted in New York City at 40 West 20th Street, New York, NY 10011, (212) 727-2700.

II. Specific Requested Actions

Petitioner requests that NMFS:

A. List alewife as threatened.

B. List blueback herring as threatened.

C. In the alternative, designate and list as threatened the following DPSs: Central New England, Long Island Sound, Chesapeake Bay, and Carolina DPSs for alewives; Central New England, Long Island Sound, and Chesapeake Bay DPSs for blueback herring; or, alternatively, NMFS should conduct its own DPS analysis and list the DPSs that meet the legal criteria.

D. Designate critical habitat for alewives and all identified DPSs of alewives.

E. Designate critical habitat for blueback herring and for all identified DPSs of blueback herring.

III. NMFS must issue an initial finding that this petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted."

NMFS must make this initial finding ―[t]o the maximum extent practicable, within 90 days after receiving the petition." *See* 16 U.S.C. § 1533(b)(3)(A).

Petitioner need not demonstrate that listing is warranted; rather, Petitioner must only present information demonstrating that such listing may be warranted. While Petitioner believes that the best available science demonstrates that listing the alewife and the blueback herring or, alternatively, listing each of the requested DPSs as a threatened species is in fact warranted, there can be no reasonable dispute that the available information indicates that listing the two species or the requested DPSs as threatened may be warranted.

NMFS must promptly make a positive initial finding on the petition as required by 16 U.S.C. § 1533(b)(3)(A).

__________________________ Date: This 1st day of August 2011

Bradford H. Sewell
Senior Attorney

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I. INTRODUCTION

One of the country's spine-tingling migratory spectacles once unfolded each spring in rivers and streams up and down the Atlantic coast. Huge numbers of alewife and blueback herring would return from the ocean to the waterways in which they were hatched and head upstream to spawn a new generation. The great schools of silvery, foot-long fish would be greeted by an array of predators hungry after a long winter, including striped and largemouth bass, ospreys, bald eagles, herons, harbor seals and river otters. Native Americans harvested the bounty as well, salting and smoking the herring to eat later and using them to fertilize spring plantings. European settlers developed their own harvest traditions, including the election of an "alewife queen" in some communities.

Today, what was a vital part of both our Atlantic coastal ecosystems and cultural heritage has nearly disappeared. A fishery that dates back at least 350 years has declined almost 99 percent over just the last fifty. As NMFS' parent agency, the National Oceanic and Atmospheric Administration ("NOAA") (2010), has stated, populations of alewives and blueback herring "have exhibited drastic declines throughout much of their range." Particularly alarmingly, their numbers in more than a few rivers have dropped significantly in just the last decade. Up and down the coast, rivers that once had runs of hundreds of thousands – even millions – of river herring now have just a few thousand or even just a few hundred fish.

The exact causes of the alewife's and blueback herring's precipitous decline remain uncertain. Early on, industrial development along the waterways used by spawning river herring was mostly to blame. Mill dams and other obstructions and water pollution sharply reduced the quantity and quality of available spawning habitat. Some runs were wiped out; others persisted, albeit at lower levels. In the 1960s, a new threat arrived offshore. By the end of the decade, foreign commercial fishing fleets had nearly doubled the overall recorded harvest of river herring and had sent populations into a freefall. It took the forced exit of foreign fishing operations and the adoption of stringent conservation measures over the course of the following decade to finally arrest the collapse. As for the sudden drop in river herring counts seen in many rivers over just the last decade, many point to increased bycatch and incidental catch of the species in certain ocean fisheries occurring in federal waters, such as the New England and Mid-Atlantic herring and mackerel fisheries, in which such catch of alewives and blueback herring has been estimated by some to be two to three times the total catch in the entire coastwide river herring fishery.[2] It is likely that different factors are affecting different subpopulations to varying degrees.

Looking ahead, climate change poses a grave threat to both species. Warming water temperatures will accelerate the spread and severity of hypoxic zones in spawning and nursery

[2] With respect to river herring, the term "bycatch" is sometimes used to refer to river herring that are caught as non-target species and are either discarded at sea or retained and sold. Alternatively, bycatch is used to refer only to discarded river herring and the term "incidental catch" is used to refer to caught river herring if they are retained and sold. To avoid confusion, this petition uses both terms, which collectively are intended to encompass river herring that are caught as non-target species and are either discarded or sold.

areas such as in the Chesapeake Bay and Delaware River. Changing weather patterns will increase water flow patterns and pollutant loadings to such an extent that these and other water bodies may no longer provide hospitable habitat. Changes to ocean, estuarine, and riverine environments may interfere with migratory cues. As anadromous species that segregate out into river-specific populations, the alewife and the blueback herring have limited capacity to shift range, particularly in the short-term, in response to changing environmental conditions. The highly-depleted status of most of these river populations also means relatively low genetic diversity, which further limits capacity to evolve and spread out in response to changing environmental conditions. The alewife has already been extirpated from South Carolina, historically the southern end of the species' range, and is now threatened in North Carolina as well.

The recent dramatic declines in alewife and blueback herring populations have prompted four states – Massachusetts, Rhode Island, and Connecticut, as well as the aforementioned North Carolina – to impose fishing moratoriums in their state waters. Numerous additional states, including New Jersey, Pennsylvania, Maryland, Delaware, Virginia, Georgia and Florida, are likely to follow suit over the next year. In May 2009, NOAA listed the alewife and the blueback herring as ―Species of Concern." Although these actions have likely benefitted certain populations of alewives and blueback herring and have made clear how dire the status of these species is, they are not nearly enough. There continues to be a lack of coordinated, effective, and comprehensive management measures that will adequately protect alewife and blueback herring populations throughout their ranges and life cycles and that will halt these populations' decline.

II. SPECIES ACCOUNTS

A. Biology and Status

1. Physical Descriptions

Alewife

Alewives are anadromous fish that reside offshore for most of the year and return to freshwater and coastal rivers to spawn (ASMFC 2008). They reach an average length of 10 to 11 inches and an average weight of 8 to 9 ounces (Bigelow and Schroeder 1953; ASMFC 2008). They have a grayish-green dorsal surface, which is distinguishable from the dark bluish-green dorsal surface of blueback herring, and paler and silvery ventral surface and sides (Bigelow and Schroeder 1953). The peritoneum of an alewife is pale grey or pink, or white, rather than the sooty or blackish color of the peritoneum of the blueback herring (Bigelow and Schroeder 1953). Alewives have much larger eyes and deeper bodies than blueback herring (ASMFC 2008).

Blueback Herring

Blueback herring are anadromous fish that reside offshore for most of the year and return to freshwater and coastal rivers to spawn (ASMFC 2008). They reach an average length of 11 inches and an average weight of 7 to 8 ounces (Bigelow and Schroeder 1953; ASMFC 2008). They have a dark bluish-green dorsal surface, which is distinguishable from the grayish-green dorsal surface of alewives, and paler and silvery ventral surface and sides (Bigelow and

Schroeder 1953). The peritoneum of a blueback herring is sooty or blackish in color, rather than the pale grey, pink, or white peritoneum of an alewife (Bigelow and Schroeder 1953). Blueback herring have smaller eyes and, on average, more slender bodies than alewives (Bigelow and Schroeder 1953). The fins of blueback herring are slightly lower than those of alewives (ASMFC 2008).

2. Historic Range, Present Range, and Stock Structure

Historic Range

Prior to the turn of the 20th century, multiple historical accounts indicate that alewives and blueback herring inhabited the vast majority of coastal rivers and estuaries along the Atlantic Coast.[3] Additionally, historical commercial landings records show that significant catches of alewives and blueback herring were landed in each Atlantic coastal state in years prior to 1950 (ASMFC 2008).

Alewife

The alewife was present historically in rivers located along the Atlantic coast, from northeastern Newfoundland to South Carolina.

The alewife historically occurred in significant numbers throughout the Bay of Fundy and the northern Gulf of Maine (Bigelow and Schroeder 1953; Flagg 2007; ASMFC 2008). Historical records indicate that alewives were commonly harvested in waters around Yarmouth, Nova Scotia; in the Annapolis Basin; in the Minas Channel; and farther up the Bay of Fundy (Bigelow and Schroeder 1953). For example, in 1896, the reported commercial catch for alewives in the Bay of Fundy was over 11.6 million alewives for the New Brunswick shore of the Bay of Fundy; and over 3.2 million individual alewives for the Nova Scotian side of the Bay of Fundy and for the west coast of Nova Scotia (Bigelow and Schroeder 1953).

The St. John River system in New Brunswick, Canada, historically supported a very significant population of alewives. Significant populations of alewives also historically occurred throughout the central and southern Gulf of Maine. For example, commercially-exploitable alewife populations are reported to have historically occurred in the St. Croix, Pennamaquan, Dennys, Orange, East Machias, Narraguagus, Tunk, Union, Orland, Penobscot, Ducktrap, Megunticook, Pemaquid, Damariscotta, St. George, Medomak, Sheepscot, Kennebec, Androscoggin, Presumpscot, Saco, Kennebunk, Mousam, Salmon Falls Rivers, West Harbor Creek, Nequasset, Cobboseecontee Stream, Walker Pond Stream, Carleton Stream, Allen Mill Stream, Patten Stream, Prospect Harbor Stream, and Pleasant River in Maine; the Piscataqua, Newmarket, and Exeter Rivers in New Hampshire; in the mouth of the Merrimack River between Massachusetts and New Hampshire; and in Cape Cod Bay (Kircheis *et al.* 2002; Bigelow and Schroeder 1953;

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[3] In the case of a number of historical accounts cited in the petition, it is not clear whether alewives were being accurately distinguished from blueback herrings and vice versa. Depending on the river system being referred to, the description may actually reflect the presence and abundance, at least in part, of the other species.

United States Congressional Serial Set (―Cong. Serial Set”), Issue 3816; Rounsefell and Stringer 1945). In 1896, reported commercial catches were over 5.8 million individual alewives from Maine waters; over half a million individual alewives from New Hampshire streams; and over 2.6 million individual alewives for Cape Cod Bay and for the Merrimack River combined (Bigelow and Schroeder 1953). Of the reported catches of alewives in 1896, the largest was recorded in the Damariscotta River in Maine, followed by the Connecticut River, Taunton River, Merrimack River, St. George River, and Penobscot River (Cong. Serial Set, Issue 3816). Historical alewife fisheries are also reported to have occurred in the following rivers in Massachusetts: Essex River, Merrimack River, Charles River, Mystic River, Neponset River, Connecticut River, Taunton River, Mill River, Herring River, Agawam River, Wareham River, Mattapoisett River, Monument River, and Town Brook (Belding 1920).

Further south, significant populations of alewives also occurred in rivers along the Long Island Sound and in the middle Atlantic. Commercially-exploitable populations of alewives historically occurred in rivers and streams in Rhode Island; on the shores of Long Island, in the Hudson and St. Lawrence Rivers; on the shores of New Jersey; and in the Delaware River and Bay (Cong. Serial Set, Issue 3816; Rounsefell and Stringer 1945; Kraft *et al.* 2006a; Buckley *et al.* 2001). A 1608 historical account described that several billion anadromous fish, including alewives and blueback herring, entered the rivers of the Chesapeake Bay to spawn and ran far upstream, ―reaching deep into central Pennsylvania and even into south-central New York, as well as the eastern slopes of the Blue Ridge Mountains and the Alleghany Plateau” (Chesapeake Bay Foundation (―CBF”) 2010). Commercial alewife fisheries operating in the Chesapeake Bay historically yielded large catches of alewives (Cong. Serial Set, Issue 3816). According to commercial catch records, ―the basin of the Chesapeake Bay (in Maryland, Virginia, Delaware, Pennsylvania, and the District of Columbia) yielded more than half of the entire catch of [alewives in] the United States,” of which ―[u]pwards of one third of the output … was taken in the Potomac [River]” (Cong. Serial Set, Issue 3816). Historical information indicates that, in 1896, the Potomac River was the ―leading alewife stream” in the United States (Cong. Serial Set, Issue 3816). Large commercial catches of alewives also historically occurred in the Susquehanna, Elk, Chester, Choptank, Nanticoke, Wicomico, Pocomoke, and Patuxent Rivers in Maryland; the Potomac River between Maryland and Virginia; and in the Rappahannock, York, and James Rivers in Virginia (Cong. Serial Set, Issue 3816).

In the southern Atlantic, alewife populations historically occurred in North Carolina and South Carolina. In North Carolina, rivers and tributaries in the Albemarle Sound historically ―rank[ed] next to the Chesapeake [Bay area] in production of alewives in 1896,” with ―more than one-fifth of the aggregate catch of the [United States]” (Cong. Serial Set, Issue 3816). In particular, the Chowan River had a very large alewife fishery that ―rank[ed] next to that of the Potomac in extent” in 1896 (Cong. Serial Set, Issue 3816). Other waters in North Carolina also supported commercially exploitable populations of alewives (Cong. Serial Set, Issue 3816). For example, commercial landings records indicate that large populations of river herring historically occurred in the Albemarle, Croatan, Currituck, and Pamlico Sounds and in the Chowan, Roanoke, and Pamlico Rivers (NCDMF 2007: 15-16, Table 4.1; NCDMF 2010a: 4-6, Table 1). These records also indicate historical populations of river herring in the Neuse and Cape Fear Rivers (NCDMF 2007: 15-16, Table 4.1; NCDMF 2010a: 4-6, Table 1). Relatively recently, in 1994, populations of alewife occurred in North Carolina in the North, Pasquotank, Little, Perquimans, Yeopim, Chowan, Meherrin, Roanoke, Cashie, Scuppernong, and Alligator Rivers (all tributaries to Albemarle Sound); Lake Mattamuskeet and canals to the lake, Tar-Pamlico, Pungo, Neuse, and Trent Rivers (tributaries to the Pamlico Sound); and the New, White, Cape Fear, Northeast Cape Fear, and Brunswick Rivers (NCDMF 2007: 28).

Populations of alewives also historically occurred in waters in South Carolina, which was the southernmost portion of the species' range (ASMFC 2008).

Blueback Herring

The blueback herring was present historically in rivers located along the Atlantic coast, from northeastern Nova Scotia to northern Florida. Although the blueback herring is believed to occur in higher abundances in mid-Atlantic and southern waters, Bigelow and Schroeder (1953) found blueback herring populations widespread throughout the Gulf of Maine, with ―schools of bluebacks … expected anywhere between Cape Sable and Cape Cod."

In Canada, populations of blueback herring historically occurred in waters throughout Nova Scotia and New Brunswick. Bigelow and Schroeder (1953) reported that river herring from Yarmouth, Nova Scotia, St. John Harbor, and Shubenacadie River appeared to be blueback herring. Blueback herring were also ―reported, at least by name, from the St. Croix River" (Bigelow and Schroeder 1953). The blueback herring historically occurred, and was the dominant river herring species, in the St. John River estuary of New Brunswick, Canada, and in the Gulf of St. Lawrence in Nova Scotia (Klauda *et al.* 1991; Jessop *et al.* 1983). Within the St. John River system, populations of blueback herring occurred in the Kennebecasis Bay; in the Washademoak, Grand, and Indian Lakes; and in the Oromocto River (Jessop *et al.* 1983).

In the northern and southern portions of the Gulf of Maine, blueback herring were historically reported in ―[the] Dennys River, Eastport; Bucksport; Casco Bay; Small Point; Freeport; and sundry other localities along the coast of Maine, as well as from the shores of Massachusetts, including Cape Cod" (Bigelow and Schroeder 1953). In Massachusetts, blueback herring populations historically occurred in coastal rivers, including the Merrimack, Parker, Mattapoisett, Nemasket, Monument, and Blackstone Rivers (ASMFC 2008; Meade 2007).

Significant populations of blueback herring historically occurred in rivers along the Long Island Sound, the mid-Atlantic coastal area, and the Chesapeake Bay. Historical information indicates that blueback herring populations occurred in the Gilbert-Stuart, Nonquit, Annaquatucket, and Blackstone Rivers in Rhode Island; in the Connecticut, Naugatuck, Farmington, Shetucket, and Mianus Rivers and in Bride, Latimer's and Mill Brooks in Connecticut; in the Mohawk and Hudson Rivers in New York; in the Delaware River; and in Chesapeake Bay's Nanticoke (including its tributaries Deep Creek and Broad Creek), Susquehanna, Potomac, Rappahannock, York, and James Rivers (ASMFC 2008; Meade 2007; Kraft *et al.* 2006b; Buckley, *et al.* 2001). The Connecticut River, in particular, historically supported a very significant blueback herring population (ASFMC 2008). Historical information indicates that, while the alewife was the dominant species in many New England rivers, the blueback herring has been the dominant species in the Connecticut River (Klauda *et al.* 1991). In the Chesapeake Bay, a 1608 account described that several billion anadromous fish, including alewives and blueback herring, entered the Chesapeake's rivers to spawn and ran up far upstream, —reaching deep into central Pennsylvania and even into south-central New York, as well as the eastern slopes of the Blue Ridge Mountains and the Alleghany Plateau" (CBF 2010).

In the southern Atlantic, populations of blueback herring historically occurred from North Carolina to Florida. In North Carolina, commercial landings records indicate that river herring – many, if not most, of which were likely blueback herring – were landed from the Albemarle, Croatan, Currituck, and Pamlico Sounds and from the Chowan, Roanoke, Pamlico, Neuse, and Cape Fear Rivers (NCDMF 2007: 15-16, Table 4.1; NCDMF 2010a: 4-6, Table 1). In addition, and as described *supra*, historical information indicates that North Carolina's Albemarle Sound and Chowan River historically supported a very large alewife fishery. Given the range and distribution of the alewife and the blueback herring, it is likely that the Albemarle Sound and other waters in North Carolina also historically supported large populations of blueback herring. Blueback herring have generally been more prevalent than alewives in Albemarle Sound rivers and tributaries (ASMFC 2008: 483). Relatively recently, in 1994, populations of blueback herring occurred in North Carolina in the North, Pasquotank, Little, Perquimans, Yeopim, Chowan, Meherrin, Roanoke, Cashie, Scuppernong and Alligator rivers (all tributaries of the Albemarle Sound); the Tar-Pamlico, Pungo, Neuse, and Trent Rivers (tributaries to the Pamlico Sound); and in the New River, White Oak River, Cape Fear River, North East Cape Fear River, and Brunswick River (NCDMF 2007: 34).

In South Carolina, distribution records and anecdotal information indicate that populations of blueback herring historically occurred in rivers and estuaries throughout the state (USFWS/SCDNR 2001). A minimum of eight populations of blueback herring are believed to have historically occurred in South Carolina waters – in the Waccamaw-Pee Dee, Santee-Cooper, Ashley, Edisto, Ashepoo, Combahee, Coosawhatchie, and Savannah River systems (USFWS/SCDNR 2001). Populations of blueback herring also likely occurred in the major tributaries of the Waccamaw-Pee Dee River basin, including the Waccamaw, Little Pee Dee, Great Pee Dee, Lynches, Black, and Sampit Rivers (USFWS/SCDNR 2001). Available evidence indicates that populations of blueback herring occurring in the Waccamaw-Pee Dee, Santee, and Savannah Rivers historically ascended these larger river basins well inland of the fall line and into North Carolina and Georgia (USFWS/SCDNR 2001).

The blueback herring historically occurred as far south as the St. John's River in Florida (ASMFC 2008).

Present Range

Alewife

The alewife currently occurs in certain Atlantic coastal rivers and estuaries, from northeastern Newfoundland to North Carolina. Alewives are most abundant relative to blueback herring in the Mid-Atlantic and New England states. Spawning alewife populations are monitored in the following United States river systems: the Androscoggin River (ME), Damariscotta River (ME), Kennebec River (ME), Sebasticook River (ME), Saco River (ME), St. Croix River (ME), Union River (ME), Exeter River (NH), Cocheco River (NH), Oyster River (NH), Taylor River (NH), Lamprey River (NH), Winnicut River (NH), Bellamy River (NH), Salmon Falls (NH), Piscataqua River (NH), Acushnet River (MA), Agawam River (MA), Back River (MA, combined passage with bluebacks), Bound Brook (MA), Coonamessett River (MA), First Herring Brook (MA), Second Herring Brook (MA), Third Herring Brook (MA), Herring Brook (MA), Herring River (MA), Jones River (MA), Little River (MA), Marston-Mills River (MA), Pilgrim Lake (MA), Quashnet River (MA), Sippican River (MA), South River (A), Stony Brook (MA), Town River (MA), Trunk River (MA), Wankinco River (MA), Ipswich River (MA), Monument River (MA), Mattapoisett River (MA), Parker River (MA), Nemasket River (MA), Town Brook (MA), Mystic River (MA), Gilbert-Stuart River (RI), Nonquit River (RI), Buckeye Brook (RI), Connecticut River (CT and MA), Naugatuck River (CT), Farmington River (CT), Shetucket River (CT), Bride Brook (CT), Roaring Brook (CT), Mianus River (CT), Mill Brook (CT), Latimer‘s Brook (CT), Hudson River (NY), Delaware River (NJ and DE), Nanticoke River (DE), Nanticoke River (MD), Susquehanna River (MD), Potomac River (MD, DC and VA), Chesapeake Bay (MD and VA), Anacostia River (DC), Rock Creek (DC), Rappahannock River (VA), York River (VA), James River (VA), and Chowan River (NC) (ASMFC 2008; Chilakamarri 2005; District of Columbia Fisheries & Wildlife Management Division (―DCFWMD”) 2010; Maine Department of Marine Resources (―MEDMR”) 2010b; Massachusetts Department of Marine Fisheries (―MADMF”) 2010; MADMF 2011; New Hampshire Fish and Game Department (―NHFGD”) 2011b).

The alewife is believed to have been extirpated from waters in South Carolina, as the species has not been documented in any waters south of North Carolina in recent years (ASMFC 2008). The historical alewife populations in the Presumpscot River, Pembrok River, Nehumkeag Brook, and Cobboseecontee Stream in Maine; the Saugus River in Massachusetts; the Magothy River, Honga River, and Wye River in Maryland; and the Wicomico River, Port Tobacco River, and Anacostia River are believed to be either virtually nonexistent or extirpated (Klauda *et al.* 1991; Rounsefell and Stringer 1945; Bigelow and Schroeder 1953; Purinton *et al.* 2003). Gray (1992) noted that 14 out of 20 alewife runs in Rhode Island were either remnant or non-existent as of 1991. Klauda *et al.* (1991) also related that, as of that time, only remnant populations of alewives at very low levels of abundance remained in the following rivers and tributaries in the Chesapeake Bay region: the Susquehanna River‘s Deer and Octoraro Creeks; the Bush, Gunpowder, Patapsco, Severn, South, West, Patuxent, Pocomoke, Choptank, Chester, Sassafras, Bohemia, Elk, and Northeast Rivers; the Potomac River‘s Nanjemoy and Piscataway Creeks; and the Mattaponi and Pamunkey Rivers.

Alewife populations are also found in several inland freshwater bodies, where they were introduced (ASMFC 2009b; USDA 2010). Evidence indicates that landlocked and anadromous populations of alewives are genetically divergent (ASMFC 2009b).

Blueback Herring

The blueback herring currently occurs in certain Atlantic coastal rivers and estuaries, from northeastern Nova Scotia to northern Florida. Blueback herring are most abundant in river systems in the Chesapeake Bay and southward (ASMFC 2009a). Spawning blueback herring populations are monitored in the following United States river systems, sometimes as part of combined passage with alewives: the Androscoggin River (ME), Damariscotta River (ME), Kennebec River (ME), Sebasticook River (ME), Union River (ME), Exeter River (NH), Cocheco River (NH), Oyster River (NH), Taylor River (NH), Lamprey River (NH), Winnicut River (NH), Bellamy River (NH), Salmon Falls (NH), Piscataqua River (NH), Acushnet River (MA), Agawam River (MA), Back River (MA, combined passage with alewives), Charles River (MA), Coonamessett River (MA), Third Herring Brook (MA), Herring Brook (MA), Herring River (MA), Jones River (MA), Little River (MA), Mystic River (MA), Merrimack River (NH/MA), Quashnet River (MA), Wankinco River (MA), Marston-Mills River (MA), Monument River (MA), Town Brook (MA), South River (MA), Stony Brook (MA), Town River (MA), Wankinco River (MA), Gilbert-Stuart River (RI), Nonquit River (RI), Connecticut River (CT and MA), Naugatuck River (CT), Farmington River (CT), Shetucket River (CT), Bride Brook (CT), Mianus River (CT), Mill Brook (CT), Latimer‘s Brook (CT), Hudson River (NY), Delaware River (NJ and DE), Nanticoke River (DE), Nanticoke River, including its tributaries Deep Creek and Broad Creek (MD), Susquehanna River (MD), Potomac River (MD, DC and VA), Chesapeake Bay (MD and VA), Anacostia River (DC), Rock Creek (DC), Rappahannock River (VA), York River (VA), James River (VA), Chowan River (NC), Santee-Cooper river system (SC), the Winyah Bay tributaries (Sampit, Lynches, Pee Dee, Bull Creek, Black, and Waccamaw Rivers) (SC), Ashepoo River (SC), Combahee River (SC), Edisto River (SC), Savannah River (SC), and St John‘s River (FL) (ASMFC 2008; Chilakamarri 2005; DCFWMD 2010; MADMF 2011; NHFGD 2011b; SCDNR 2010a).

As of 1991, the blueback herring populations in the Magothy River in Maryland were believed to be extirpated (Klauda *et al.* 1991; Rounsefell and Stringer 1945; Bigelow and Schroeder 1953). Only remnant populations of blueback herring at very low levels of abundance remained in the Annaquatucket River in Rhode Island (ASMFC 2008); and in the following rivers and tributaries in the Chesapeake Bay region: the Susquehanna River‘s Deer and Octoraro Creeks; in the Bush, Gunpowder, Patapsco, Severn, South, West, Patuxent, Pocomoke, Honga, Chester, Sassafras, Bohemia, Elk, and Northeast Rivers; and in the Potomac River‘s Nanjemoy and Piscataway Creeks and Wicomico, Port Tobacco, and Anacostia River‘s Deer Creek, Octoraro Creek, Bush River, Gunpowder River, Patapsco River, Severn River, South River, West River, Patuxent River, Pocomoke River, Chester River, Sassafras River, Bohemia River, Elk River, and Northeast River (Klauda *et al.* 1991).

In addition to coastal river systems, blueback herring populations are also found in several inland freshwater bodies, where they are believed to have been introduced (ASMFC 2009b). It is likely that landlocked and anadromous populations of blueback herring genetically diverged as they evolved in their respective habitats.

Figure 1: Map of U.S. Atlantic coast, showing current and historic significant spawning runs of alewives and blueback herring

Stock Structure

The alewife and the blueback herring exhibit natal philopatry, which means that individual alewife and blueback herring return to spawn in the rivers or estuaries where they were hatched (ASMFC 2009a; ASMFC 2008). It has been observed that alewives return with accuracy both to their natal river systems and to their natal areas within those rivers (Jessop (1994), as cited in

NOAA 2009); olfactory clues appear to play an important role in this high rate of natal site fidelity (Chilakamarri 2005). Messieh (1977) also reported support for natal river homing by alewives. Natal philopatry keeps alewife and blueback herring populations reproductively isolated by river. Clear genetic differences between anadromous alewife populations in the St. Croix River and populations in the LaHave and Gaspereau Rivers further support natal philopatry among alewife populations and at least partial reproductive isolation between alewife spawning runs (Bentzen and Paterson 2005). Studies have also shown genetic and physiological differences among anadromous alewife populations in two rivers in Connecticut, Bride Brook and Roaring Brook, with the differences suggesting that although there is some gene flow between the neighboring Connecticut River populations, selection is nonetheless strong enough to differentiate them (Chilakamarri 2005).

Evidence indicates that landlocked alewife stocks are distantly related to anadromous stocks (ASMFC 2009b). Statistical tests confirmed that anadromous and landlocked populations of alewives in the St. Croix River are genetically divergent, which implies that very little, if any, interbreeding occurs between the two populations (ASMFC 2009b). Similar findings show anadromous stocks of alewives in Connecticut rivers are genetically distinct from Lake Michigan‘s landlocked population, as no inbreeding can occur between the populations (Chilakamarri 2005). Landlocked stocks of blueback herring occur in some areas of the southeastern United States but they are rarer than those of alewives (ASMFC 2009b).

3. Life History, Longevity and Growth

Individual alewife and blueback herring can live as long as ten years and may reach a maximum length of approximately 15 inches (38 cm). The alewife and the blueback herring are dependent on river and estuary habitats for reproduction (ASMFC 2008).

Alewives and the blueback herring return to their natal rivers to spawn in fresh water (ASMFC 2009b). Blueback herring rarely use brackish or tidal waters for spawning (ASMFC 2009b). Olfaction appears to be the primary factor affecting homing behavior for both species (ASMFC 2008, ASMFC 2009b). Although the timing of sexual maturity may vary regionally, most alewives are sexually mature at age 4 or 5 (ASMFC 2008; ASMFC 2009b). Most female blueback herring are sexually mature by age 4 or 5, and most male blueback herring are sexually mature by age 3 or 4 (ASMFC 2008; ASMFC 2009b). Fecundity increases with age and size; older fish are more fecund than younger fish (ASMFC 2008: 139-40). Each female alewife produces between 60,000 and 100,000 eggs annually, depending on the age and size of the fish (ASMFC 2008). Each female blueback herring produces between 60,000 and 103,000 eggs annually, depending on the age and size of the fish (ASMFC 2008). Young alewives and young blueback herring have very high mortality rates, as less than 1 percent of eggs survive to produce young fishes that reach the ocean (USFWS 2001; MEDMR 2003).

The onset of spring spawning for the alewife and the blueback herring is related to water temperature and varies with latitude (ASMFC 2008). Alewives spawn at lower temperatures than other alosines and typically migrate earlier (ASMFC 2008). They are usually the first anadromous species available for harvest each year in most rivers along the Atlantic Coast (ASMFC 2008). In the spring, alewives spawn when water temperatures are between 16 and 19 degrees Celsius (60.8 to 66.2 degrees Fahrenheit) (NOAA 2009). Alewives spawn from late-February to June in the southern end of their range and from June through August in the northern portion of their range (ASMFC 2008). Blueback herring spawn when water temperatures are approximately 20 and 25 degrees Celsius (68 to 77 degrees Fahrenheit) (ASMFC 2009b). Blueback herring spawn as early as December in Florida (ASMFC 2009b). Blueback herring begin spawning in early-March in South Carolina, in early-April in the lower tributaries and in late-April in the upper tributaries of the Chesapeake Bay, in late-April in the mid-Atlantic river systems, in mid-May in Connecticut and the surrounding area, and in June in the northern reaches of its range, where blueback herring may spawn through August (ASMFC 2009b). In areas where alewives and blueback herring co-occur, blueback herring generally spawn 3 to 4 weeks after alewives (ASMFC 2009b).

With respect to spawning habitat, blueback herring will ascend freshwater far upstream (ASMFC 2009b). In some tributaries, such as the Rappahannock River in Virginia, upstream areas were found to be more important for blueback herring spawning than downstream areas (ASMFC 2009b). Alewives spawn in more lacustrine areas (*e.g.*, ponded habitats or slow sections) of river systems, while blueback herring generally spawn in the main stream flow of river systems (*i.e.*, where water flow is fairly swift) and actively avoid areas with slow-moving or standing water (ASMFC 2008). In the allopatric range, where there is no co-occurrence with alewife (*i.e.*, South Carolina, Georgia, and Florida), blueback herring have been found to select a great variety of spawning habitat types where the substrate is soft and detritus is present (ASMFC 2009b). Blueback herring generally do not spawn in ponds in the northern portion of their range (ASMFC 2009b).

Alewives and blueback herring leave the spawning grounds immediately after spawning and reach deep water by fall (ASMFC 2008; ASMFC 2009b). According to Watts (2003), alewives can spawn up to four times. However, it is unknown how many times the majority of individual alewives spawn. In certain areas, blueback herring experience high post-spawning mortality (ASMFC 2009a). Post-spawning mortality is highest in the states south of North Carolina, and most of these populations of blueback herring are considered to be semelparous, which means that individual fish spawn once and then die (ASMFC 2009a: 4).

Alewives and blueback herring are broadcast spawners, which means that they release their eggs randomly over a variety of substrates such as sand, gravel, organic detritus, and submerged aquatic vegetation (ASMFC 2008; ASMFC 2009b). Pardue (1983) suggested that substrates with 75 percent silt (or other soft material containing detritus and vegetation) and slow-moving waters are optimal spawning conditions for alewives and blueback herring because the substrates provide cover for their eggs and larvae (ASMFC 2009b). But others found that blueback herring eggs adhered to sticks, stones, gravel, and aquatic vegetation along the bottom of a fast-flowing stream in the Gulf of St. Lawrence (Johnston and Cheverie (1988), as cited in ASMFC (2009b: 117)). Fertilized alewife and blueback herring eggs remain demersal and adhesive for several hours before they become pelagic and are transported downstream (ASMFC 2009b). Alewife eggs usually hatch within 80 to 95 hours (3 to 4 days) after spawning (ASMFC 2008). However, depending on water temperature, alewife eggs may hatch anywhere from 50 to 360 hours (2 to 15 days) after spawning (ASMFC 2008). Blueback herring eggs usually hatch within 38 to 60 hours (within 2.5 days) after spawning (ASMFC 2008). For both species, within 2 to 5 days of hatching, the yolk-sac is absorbed and the larvae begin to feed externally (ASMFC 2009b; ASMFC 2008).

Juvenile alewives and blueback herring typically spend 3 to 9 months in their natal rivers before returning to the ocean (ASMFC 2009b). Alewives begin migrating from their nursery areas as water temperatures decline in the fall (ASMFC 2009b). Juvenile blueback herring begin migrating from their nursery areas as water temperatures decline in the late summer through early winter, depending on geographic area (ASMFC 2009b). Other factors that may also trigger downstream migration include changes in water flow, water levels, precipitation, and light intensity (ASMFC 2008; ASMFC 2009b). Juvenile alewives respond negatively to light and observe diel movement patterns (ASMFC 2009b). There is some evidence that a high abundance of juvenile alewives or blueback herring may trigger a very early (*e.g.*, summer) migration of large numbers of small juveniles from their nursery area (ASMFC 2008). Juvenile blueback herring are believed to migrate gradually in response to environmental cues, although a population of juvenile blueback herring has been observed to migrate out of a river system rapidly (*e.g.*, within a 24-hour period in the Connecticut River) (ASMFC 2009b).

Little information is available concerning the life history of sub-adult and adult alewives and blueback herring once they migrate to the sea (ASMFC 2008). It is believed that most juvenile alewives and blueback herring join adult populations at sea within the first year of their lives and follow a north-south seasonal migration along the Atlantic coast (ASMFC 2009b). Alewives typically congregate in large schools of similar-sized fish to migrate and may form mixed schools with other herring populations (ASMFC 2009b).

Alewives and blueback herrings suffer high rates of mortality throughout their life cycle, as less than 1 percent of eggs survive to produce young that reach the ocean (USFWS 2001; MEDMR 2003). Ross (1991) estimated annual mortality of all adult alewives to be 70 percent. Annual mortality of adult and juvenile alewives may be currently higher as a result of increased bycatch and incidental catch mortalities caused by the introduction of more efficient commercial fishing gear since 1995 and the increasing use of mid-water trawls in ocean fisheries operating off the mid-Atlantic and New England coast.

Year-class strength for alewives and blueback herring is driven primarily by environmental factors (ASMFC 2009b). It has been suggested that, if the parent stock size falls below a critical level due to natural and anthropogenic environmental impacts, the size of the spawning stock will likely become a factor in determining juvenile abundance (Kosa and Mather (2001), as cited in ASMFC (2009b: 81)).

4. Habitat and Feeding Habits

Alewife and the blueback herring require a variety of habitats throughout their lifecycle. Alewives spawn in quiet, slower-moving water, with water temperatures ranging from 16 and 19 degrees Celsius (60.8 and 66.2 degrees Fahrenheit) and depths of less than one meter (ASMFC 2009b). Blueback herring spawn in swifter-moving freshwater (*e.g.*, in the main stem of a river system), with optimal water temperatures ranging from 20 to 25 degrees Celsius (68 to 77 degrees Fahrenheit) (ASMFC 2009b). Alewives and blueback herring require spawning areas with substrates that consist primarily of sand, pebbles, and cobbles (*i.e.*, substrates that are usually associated with high-gradient streams) (ASMFC 2009b). Pardue (1983) suggests that water with substrates comprised of 75 percent silt (or other soft material containing detritus and vegetation) provide optimal spawning conditions for alewives and blueback herring. More recently, spawning areas for alewives and blueback herring around the Rappahannock River, Virginia, were found to have substrates that consisted primarily of sand, pebbles, and cobbles, while little or no spawning occurred in areas with high concentrations of organic matter and finer sediments (*i.e.*, substrates that are usually associated with lower-gradient streams and comparatively more agricultural land use) (ASMFC 2009b: 113, citing Boger (2002)).

Alewives and blueback herring require freshwater or semi-brackish portions of rivers and their associated bays and estuaries for nursery habitat (ASMFC 2008). Nursery habitats occur in non-tidal freshwater, tidal freshwater, and semi-brackish areas during spring and early summer, with locations moving upstream during periods of decreased flows and encroachment of saline waters (ASMFC 2008). Juvenile blueback herring have been found to remain in freshwater up to one month longer than juvenile alewife (Loesch (1968) and Kissil (1968), as cited in ASMFC (2009b)).

Juvenile alewives and blueback herring occur in various water depths, depending on the time of day and the season. Juvenile alewives in the Potomac River were observed to be abundant near surface waters during the day in the summer (Warriner *et al.* (1970), as cited in ASMFC (2009b: 85)). They shifted to mid-water and bottom depths in September and remained there until they emigrated in November. In contrast, juvenile blueback herring in the Potomac River were found to remain at the surface or at mid-water depths during daylight hours from July through November, with almost no fish appearing at the bottom (ASMFC 2009b).

When water temperatures begin to drop in the late summer through early winter (depending on geographic area), alewives and blueback herring begin to move downstream, initiating their first phase of seaward migration (ASMFC 2009b). Changes in water flow, water levels, precipitation, and light intensity are believed to encourage seaward migration of juvenile alewives and blueback herring, although the precise combination of migration cues remains unknown (ASMFC 2009b). The influence and magnitude of environmental changes on the migration of juvenile alewives may vary considerably (ASMFC 2009b). Extremely high water discharges may adversely affect juvenile migration, and high or fluctuating water discharges may lead to a decrease in the relative abundance of adult and juvenile fish (ASMFC 2009b). In addition, high water temperatures may negatively affect alewives (ASMFC 2009b). The upstream migration of alewives slows as water temperatures rise and has been reported to cease when water temperatures reach 21 degrees Celsius (ASMFC 2009b). Alewife spawning ceases altogether at 27.8 degrees Celsius (ASMFC 2009b). In general, average time to median hatch for alewife eggs varies inversely with water temperature (ASMFC 2009b). Evidence indicates that optimal hatching performance for alewife eggs occurs between 17.2 and 21.1 degrees Celsius (ASMFC 2009b).

Although alewives and blueback herring spawn in freshwater, they spend most of their adult lives in the marine environment. Sub-adult and non-spawning adult alewives and blueback herring reside in open ocean waters, although they have rarely been found more than 130 meters from the coast, and the extent to which alewife and blueback herring populations overwinter in deep water off the continental shelf is unknown (ASMFC 2009b; ASMFC 2008). Alewives and blueback herring in offshore waters are caught most frequently in water depths of 56 to 110 meters (ASMFC 2009b). However, alewives offshore of Nova Scotia, the Bay of Fundy, and the Gulf of Maine were found in water depths of 101 to 183 meters in the spring; shallower, near-shore water depths of 46 to 82 meters in the summer; and deeper, offshore water of 119 to 192 meters in the fall (Stone and Jessop (1992), as cited in ASMFC (2009b)). The water depth distribution of alewives and blueback herring may depend on the size and age of the fish as well as on zooplankton concentrations (ASMFC 2009b). Stone and Jessop (1992) found that smaller fish (i.e., sexually immature) occurred in shallow regions (<93 meters) during the spring and fall and larger fish were found in deeper areas (≥ 93 meters) throughout the year (Stone and Jessop (1992), as cited in ASMFC (2009b)). While the number of zooplankton per liter consumed is assumed to be critical for the survival and growth of juvenile alewives and blueback herring, feeding intensity decreases with increasing age of a fish (ASMFC 2009b). Temperature may also play a role in depth distributions: adult alewives and blueback herring have been caught in offshore waters, from Nova Scotia to Cape Hatteras, North Carolina, where surface temperatures ranged from 2 to 23 degrees Celsius (35.6 to 73.4 degrees Fahrenheit) and bottom temperatures ranged from 3 to 17 degrees Celsius (37.4 to 62.6 degrees Fahrenheit) (ASMFC 2009b). Catches in this area were most frequent where the bottom temperature was between 4 and 7 degrees Celsius (39.2 to 44.6 degrees Fahrenheit) (ASMFC 2009b).

Distribution of alewife and blueback herring populations offshore in Atlantic coastal waters varies depending on the time of year. In general, alewives are found from North Carolina to Labrador, Nova Scotia, and northeastern Newfoundland (ASMFC 2009b). Sixteen years of catch data showed blueback herring populations are generally to be found from Cape Hatteras, North Carolina, to Nova Scotia during the spring, with most found south of Cape Cod, and no fish collected south of 40° N in the summer (ASMFC 2009b). Both alewives and blueback herring can migrate along the Atlantic seaboard for as many as 2000 kilometers to return to their natal rivers to spawn (ASMFC 2009b).

The spring adult alewife spawning migration progresses seasonally from south to north, with alewives typically spawning from late February to June in the south and from June through August in the north, with populations further north returning later in the season as water temperatures rise (ASMFC 2009b). During spring, much of the alewife population that overwinters on the Scotian Shelf (and possibly some of the U.S. Gulf of Maine population) moves inshore to spawn in Canadian waters, and alewives from waters offshore of middle Atlantic States generally move inshore and north of 40 degrees latitude to Nantucket Shoals, Georges Bank, coastal Gulf of Maine, and the inner Bay of Fundy. Alewives from waters offshore north of Cape Hatteras may move south along the Atlantic coast for homing to southern rivers (ASMFC 2009b). The blueback herring follows the same pattern – generally moving inshore and north – with spawning in southernmost areas beginning as early as December and in its northernmost reaches beginning in June and running until August (ASMFC 2009b).

Canadian spring surveys have found alewives and blueback herring primarily distributed along the Scotian Gulf, southern Gulf of Maine, and off southwestern Nova Scotia, from the Northeast Channel to the central Bay of Fundy; the fishes are found to a lesser degree along the southern edge of Georges Bank and in the canyon between Banquereau and Sable Island Banks (ASMFC 2009b). By early fall, blueback herring populations have been found concentrated along the northwest perimeter of the Gulf of Maine and also along Nantucket Shoals, Georges Bank, and the inner Bay of Fundy (ASMFC 2009b). In later fall, alewives and blueback herring move offshore and southward to the mid-Atlantic coast between latitudes 40 and 43 degrees north (ASMFC 2009b). They remain in this area until early spring (ASMFC 2009b).

Alewives and blueback herring are opportunistic feeders (ASMFC 2009a; ASMFC 2008). They feed largely on particulate zooplankton (*e.g.*, euphausiids, calanoids, copepods, mysids, hyperiid amphipods, chaetognaths, pteropods, decapod larvae, and salps) and may also consume small fish (ASMFC 2009b). Juvenile alewives and blueback herring either select their prey individually or non-selectively filter-feed (ASMFC 2009b). An individual fish's feeding mode depends primarily on prey density, prey size, and water visibility, although it also partially depends on size of the individual fish (ASMFC 2009b). Adult alewives feed most actively during daylight hours (ASMFC 2009b). Nighttime predation occurs but is usually restricted to larger zooplanktons that are easier to detect (ASMFC 2009b). It is believed that adult blueback herring follow the diel movement of zooplankton while at sea (ASMFC 2009b). However, direct evidence of this behavior is lacking for the species (ASMFC 2009b).

5. Ecological Role

During all of their life stages, alewife and the blueback herring play an important role in the dynamics of food chains in freshwater, estuarine, and marine ecosystems, and in maintaining the health of these ecosystems (ASMFC 2009a). While at sea, alewives and blueback herring are forage for many species, including sharks, tunas, mackerel, and for marine mammals, including porpoise and dolphin (ASMFC 2009a). Sufficient abundance of river herring is believed important for the recovery of New England cod (Cournane 2010). In fresh and brackish waters, American eel and striped bass consume both adult and juvenile alewives and blueback herring (ASMFC 2009a). Juvenile alewives and blueback herring are high quality prey for largemouth bass (*Micropterus salmoides*); accelerated growth of young bass occurs when herring consumption is high (ASMFC 2009a). Tissues taken from predatory fish in tidal freshwaters following the residency of migrating alosines, such as alewife and the blueback herring, had between 35 and 84 percent of their carbon-biomass derived from marine sources (ASMFC 2009a).

Alewife and blueback herring populations along the Atlantic coast, particularly populations in the southeast where post-spawning mortality is highest, provide vital nutrients and carbon into riverine systems, similar to nutrient dynamics provided by salmon in the Pacific Northwest (ASMFC 2009a). For example, the James River in Virginia may have received annual biomass input from alosines of 155 kg/ha (138 pounds/acre) before dams blocked migrations above the fall line (ASMFC 2009a).

More than 40 species of birds and mammals congregate to feed on migrating anadromous fish in southeastern Alaska (ASMFC 2009a). Similar relationships likely occur between populations of alewife and blueback herring along the Atlantic coast and birds and mammals (ASMFC 2009a). Fish-eating birds like osprey (*Pandion haliaetus*) and bald eagle (*Haliaeetus leucocephalus*), prey upon alewives and blueback herring and may have evolved their late winter and spring nesting strategies in response to the availability of food resources supplied by pre- and post-spawning alosines (ASMFC 2009a). Alewives and blueback herring also provide cover for upstream migrating adult salmon that may be preyed on by eagles or osprey, and for young salmon in the estuaries and open ocean that might be captured by seals (MEDMR 2008). Nutrients released from carcasses of post-spawning alosines can substantially subsidize aquatic food webs by stimulating productivity of bacteria and aquatic vegetation, thereby stimulating the assimilation of marine derived nutrients into aquatic invertebrates and fish (ASMFC 2009a).

Importantly, researchers have documented that forage fishes like alewives and blueback herring may be at significant risk at population sizes that are a fraction of their historical levels but are still large compared to what would be considered normal for other ESA listed species (Dulvy *et al.* 2004). For instance, research from other marine fishes (Sadovy 2001) suggests that there is likely a biological requirement for a critical threshold density of herring during spawning to ensure adequate synchronization of spawning, mate choice, gonadal sterol levels, and fertilization success. In the case of an anadromous Pacific herring, the euchalon, scientists believe that high minimum viable population sizes are necessary to: (1) ensure a critical threshold density of adults are available during breeding events for maintenance of normal reproductive processes, (2) produce enough offspring to counteract high in-river egg and larval mortality and planktonic larval mortality in the ocean, and (3) produce enough offspring to buffer against the variability of local environmental conditions which may lead to random ‗sweepstake recruitment'' events where only a small minority of spawning individuals contribute to subsequent generations (NMFS 2009c: 74 Fed. Reg. 10857: 10868-69).

6. Population Trends for the Alewife and the Blueback Herring[4]

Alewives and blueback herring were historically very abundant along the Atlantic coast (ASMFC 2008). Both species, however, have suffered dramatic population declines throughout their Atlantic coastal ranges, including over the last four decades (ASMFC 2008; ASMFC 2009a).

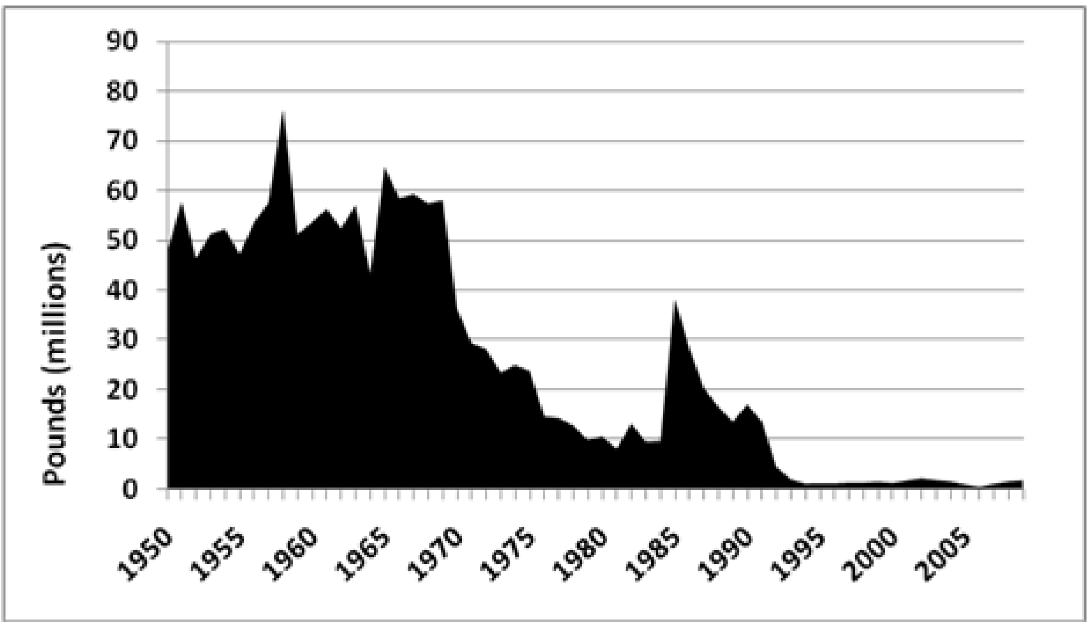
The significant decline in abundance of alewives and of blueback herring is reflected in commercial landing trends. From 1930 through 1970, total commercial landings of alewives and blueback herring in Atlantic coastal states averaged almost 43 million pounds per year (ASMFC 2008: 55-57, Table 1.5.1.1).[5] During years of peak recorded harvests (late 1940s and early 1950s to 1970), annual commercial landings of alewives and blueback herring were consistently the highest in Virginia and North Carolina (ASMFC 2008: 55-57, Table 1.5.1.1). During some of these peak years, annual commercial landings of alewives and blueback herring numbered over 36 million pounds in Virginia and over 12 million pounds in North Carolina (ASMFC 2008: 55-57, Table 1.5.1.1). In addition, high annual commercial landings of alewives and blueback

[4] Unless otherwise noted, and for the purposes of this section, the terms, ―alewife and blueback herring," ―alewives and blueback herring," or ―river herring" will be used when the available data either does not distinguish between the species or refers to both species collectively as ―river herring."
[5] This would equal approximately 86 million fish landed annually on average, if 8 ounces is assumed as the average weight for an individual alewife or blueback herring (Bigelow and Schroeder 1953).

herring were consistently recorded in Maine, Massachusetts, and Maryland during this time period (ASMFC 2008: 55-57, Table 1.5.1.1).

Starting in the early 1970s, however, commercial landings of alewives and blueback herring went into sharp decline. Since 1994, annual coastwise landings have totaled 2 million pounds or less (ASMFC 2008: 55-57, Table 1.5.1.1). Figure 2 shows the sharp drop-off in total coastwide landings of both species from 1950 to 2009.

Figure 2. Total (in-river and ocean) commercial landings (pounds) of river herring for the U.S. Atlantic coast (domestic), 1950-2009
Source: NMFS (2010a). Note: Prior to 1998, NMFS landings data do not differentiate between alewife and blueback herring and all river herring landings are listed as ―alewife" landings; after 1998, the data are available separately and the chart below sums the data for both species.



As further discussed below, population declines have also occurred in the majority of the specific alewife and blueback herring populations for which trend analysis is possible. Many rivers have seen a significant decline in abundance of both species since the 1990s.

United States/Canada River Systems

St. Croix River

The St. Croix River, which runs through Maine and Canada, historically supported a significant population of alewives that once numbered over two million fish in a single year (Flagg 2007; ASMFC 2008). However, in the mid-1990s, the Woodland Dam and Grand Falls fishways on the St. Croix Rover were closed to upstream passage of spawning alewives into spawning habitat, which resulted in the collapse of the fishery (ASFMC 2008: 140). While hundreds of thousands of river herring passed through fishways on the St. Croix River through 1998, numbers tumbled in 1999 to just over 25,000 fish and continued to fall thereafter, averaging only 5,970 fish from 2000 through 2009 (MEDMR 2010a: 10, Table 2) – even with active management efforts (including the annual stocking of 2,000 fish) by Canadian fisheries agencies (ASFMC 2008: 140-41). Another report notes the run size of alewives as only 900 fish in 2004 (Flagg 2007), approximately a 99.9 percent decline from its high of over 2.6 million fish in 1987 (Flagg 2007).[6]

United States River Systems

Maine Rivers

Reported landings of Maine river herring have declined from historical levels in the 1950s. The reasons for the decline in river herring stocks are not clear, though habitat loss, poor fish passage, predation, directed fisheries, and incidental catch/bycatch in ocean fisheries all affect Maine river herring populations (ASMFC 2008: 132). Average ―catch per unit effort" (―CPUE") for bluebacks was at or below average for all river segments in Maine in 2009; average CPUE for alewives was below average for all river segments in Maine, except the Upper Kennebec River, in 2009 (ASFMC 2010: 14). Maine rivers are home to both alewives and blueback herring, but alewives appear to dominate catches: commercial in-river river herring fisheries are 97 percent alewives and 3 percent blueback herring (MEDMR 2010c: 6).[7]

The MEDMR has a goal of stocking approximately 120,000 to 500,000 alewives in Maine rivers each year, with the majority of fish stocked in the Androscoggin and Sebasticook rivers; it has generally stocked between 400,000 and 500,000 fish per year in rivers throughout the state, though these numbers may have declined with the recent removal of barriers to upstream river passage in some watersheds (ASMFC 2008: 141-42, 144). The stocking locations in these two watersheds do not have upstream migration and require the transport of spawning fish around existing barriers (ASMFC 2008: 141-42). The MEDMR has been actively involved in the restoration of anadromous fish in the Androscoggin River since 1983 (ASMFC 2008).

Union River

A sizable population of alewives is believed to have spawned in the Union River watershed in the 19th century (College of the Atlantic (―COA") 2004).

The MEDMR has been able to maintain a commercial fishery in Union River through the annual stocking of 90,000-100,000 adult alewives above the hydropower dam at the head-of-tide (ASMFC 2008: 148; MEDMR 2010a: Table 10). The in-river exploitation rate for alewives and blueback herring in the Union River has historically been very high (ASMFC 2008). For example, in-river exploitation rates for the Union River ranged from approximately 0.90 to 0.98 during the 1980s (ASMFC 2008: 131). As recently as 2007, the in-river exploitation rate was

[6] MEDMR (2010a) indicates the year the alewife run was 900 fish was 2002, not 2004 (MEDMR 2010a: 10, Table 2).

[7] However, because Maine state law defines both alewives and blueback herring as ―alewives," river herring counts for Maine river systems, including the St. Croix River, may overestimate the proportion of alewives relative to blueback herring.

above 0.50 (ASMFC 2008: 131); as of 2009, it remained at 46 percent (MEMDR 2010c: 8). In addition, despite the ongoing stocking, the size of the Union River alewife population remains historically low (COA 2004: Figure 2). For example, the size of the Union River alewife population in 2003 was over 75 percent smaller than it was at its peak in 1986 (COA 2004: Figure 2). It has continued to vary around these historically low levels through 2009 (MEDMR 2010a: Table 10).

Damariscotta River

The Damariscotta River system historically supported a significant commercial run of alewife (Rounsefell and Stringer 1945). Available information indicates that the Damariscotta River alewife population rapidly increased, and became commercially exploitable, following its establishment in 1803 and that it was once ―the most consistent large commercial run in Maine" (Rounsefell and Stringer 1945). The historical significance of the run is evidenced by its cultural significance to local communities, with one such community holding an annual alewife festival that included the election of an ―alewife queen" who received two bushels of alewives as a prize (COA 2004). According to some sources, ―Damariscotta" is derived from the Native American word meaning ―place of an abundance of alewives."

Commercial harvest records for Damariscotta Lake support the historical significance of the alewife population in the Damariscotta River. Large commercial harvests of alewives occurred in Damariscotta Lake up until the early 1980s (ASMFC 2008: 147, Figure 2.15.2). According to the ASMFC (2008), from 1952 to 1981, commercial harvests of alewives from Damariscotta Lake ranged from 1,543,000 pounds and 551,000 pounds (ASMFC 2008: 147, Figure 2.15.2).[8]

From 1981 to 1983, however, the alewife harvest from Damariscotta Lake precipitously declined to near zero (ASMFC 2008: 147, Figure 2.15.2). It has remained at a similarly low level since 1983 (ASFMC 2008: 147, Figure 2.15.2). The in-river exploitation rate for alewife and the blueback herring in the Damariscotta River is high (ASMFC 2008). During the late 1980s, in-river exploitation rates greater than 0.6 were recorded in the Damariscotta River system (ASMFC 2008: 131, Figure 1.12.1). After a slight decline in the rate during the 1990s, the in-river exploitation rate in the Damariscotta River has significantly increased since 2000 (ASMFC 2008: 131, Figure 1.12.1). In 2007, the in-river exploitation rate was over 0.5 (ASMFC 2008: 131, Figure 1.12.1); it has been greater than 37 percent since 2004 (MEDMR 2010b: 8)

Kennebec River System (Sebasticook River)

The Kennebec river system historically supported abundant runs of anadromous fish (ASMFC 2008). Immense numbers of alewives were reported to have once ascended the Kennebec River well inland (Kircheis, *et al.* 2002; Rounsefell and Stringer 1945). Today, aside from one tributary of the Kennebec River (the Sebasticook River) that appears to still support a healthy alewife population, alewife populations in the main stem of the Kennebec River and the river's other tributaries are much smaller than historic levels (ASMFC 2008).

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[8] Calculations based on 700,000 kilograms of alewives commercially harvested in 1952 and 250,000 kilograms harvested in 1981 (ASMFC 2008: 147, Figure 2.15.2), converted to 1,543,000 pounds and 551,000 pounds, respectively.

In 1986, the MEDMR implemented a restoration plan for alewives in the Kennebec River watershed above Augusta that involved stocking alewives in the initial years of the plan to increase the population size. The restoration plan was implemented in response to an agreement with hydroelectric dam owners in the Kennebec watershed (ASMFC 2008: 143). According to ASMFC (2008: 142-43), stocking of alewives in the Kennebec river system continues today. Such stocked fish may account for a portion of what are recorded generally as ―river herring" passing through certain fishways located at dams in the Kennebec river system. Petitioner was unable to locate information regarding the percentage of non-stocked alewives and/or blueback herring returning to the Kennebec river system, but at least 152,198 alewives were stocked in the Kennebec River watershed in 2009 (MEDMR 2010a: Table 8).

The Sebasticook River is a major tributary in the Kennebec river system and has historically supported abundant runs of anadromous fish (ASMFC 2008: 155). It is one of the few remaining rivers on the east coast that supports an abundant run of alewives, supported at least in part by Maine‗s stocking program, and it currently supports the largest run of alewives on the east coast (MEDMR 2009). The Sebasticook River is the only river in Maine that supports an alewife population that numbers over one million fish per year. This dwarfs the alewife populations in the other Maine rivers.

In 2009, the number of alewives that passed at the Benton Falls dam on the Sebasticook River was approximately 1.6 million fish, which is the largest recorded population on the east coast (MEDMR 2009). Commercial harvesters operating near Benton Falls took approximately 500,000 fish in 2009, which means that the alewife population was likely at least 1.7 million fish (MEDMR 2009). In 2009, over 40,000 blueback herring passed at the Benton Fall dam on the 16 days sampled from June 8 to July 28 (MEDMR 2009: 2-11, Table 2). The majority of these blueback herring passed the dam in mid-June (MEDMR 2009: 2-11, Table 2).

Data collected in 2009 indicate that the age distribution of both the alewife and the blueback herring in the Sebasticook River is relatively young. In 2009, the age distribution of alewives collected at the Benton Falls dam on the Sebasticook River ranged from age 3 to age 6, with only one age 6 fish collected (MEDMR 2009). The mean sample age was 4.2 years for male alewives and 4.5 years for female alewives (MEDMR 2009). The age distribution for blueback herring collected at the Benton Falls dam in 2009 ranged from age 3 to age 7, with only one age 6 fish and one age 7 fish collected (MEDMR 2009). The mean sample age was 4.2 years for male blueback herring and 4.3 years for female blueback herring (MEDMR 2009). Loss of age structure and reliance on younger year classes – as is the case with many river herring populations up and down the coast – likely increases their vulnerability to perturbations and provides less of a buffer against year-class failure.

The Sebasticook River alewife population serves as a source of broodstock for state restoration projects east of the Kennebec River (ASMFC 2008).

Androscoggin River

The alewife run count for the Androscoggin River in Maine peaked during the late 1980s and then dropped to a near-historic low in the early 1990s (ASMFC 2008). The annual run of alewives on the Androscoggin River over the past 28 years has averaged 42,261 (MEDMR 2010c: 14). It is unclear whether this alewife population is sustained by stocking conducted by the MEDMR or is self-sustaining: in 2006, about 74 percent of the river herring passing through the Brunswick fishway on the Androscoggin River was stocked by way of truck-and-transfer operations to inaccessible nursery pond habitat; in 2007, at least 41 percent of the river herring passing through the fishway was stocked; in 2008, at least 29 percent were stocked; and in 2009, at least 52 percent were stocked (MEDMR 2010a: Table 9; MEDMR 2010c: 13, Table 1).[9] Age data collected at fish passage facilities on the Androscoggin and Sebasticook rivers indicates that most returning alewives and blueback herring range from age 4 to age 6 (ASMFC 2008: 155). Fish over age 6 represented only a small proportion of the fish sampled (ASMFC 2008). According to the ASMFC (2008), this is ―an apparent shift in the age structure for all Maine alewife and blueback herring runs, commercial and non-commercial" (ASMFC 2008: 155). According to the ASMFC (2008), scale samples collected from 15 commercial fisheries in 2008 had few fish over age 6, whereas commercial catches during the 1980s commonly had fish as old as age 8 (ASMFC 2008: 155). This trend appeared to continue in 2009, with only 4 of 200 sampled at age 7, and no sampled fish over age 7 (MEDMR 2010c: 33, Table 15).

According to the ASMFC (2008), the maximum age of male and female alewives in the Androscoggin River was historically older than age 6 but has decreased by approximately one age year since the late 1990s and early 2000s. A significant decrease in mean length-at-age was observed for age 3 female alewives in the Androscoggin River from 2000 to 2008 (ASMFC 2008). Mean length-at-age for alewives in age classes 4, 5, and 6 was lower in 2008 than in 2000, although trend analysis did not detect a significant change in any of these age classes (ASMFC 2008).

Saco River

Fish passage on the Saco River became available in 1993 when fish passage facilities were built (ASFMC 2008: 143). The number of adult river herring passing through fish passage facilities on the Saco River increased to a peak of almost 67,000 fish in 2001 and has declined since then, dropping to 2,012 fish in 2009 (MEDMR 2010a: 10, Table 2).

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[9] Important alewife spawning habitat is located in lakes and ponds associated with tributaries of the Androscoggin River – the Sabattus and Little Androscoggin – that are not currently accessible due to impassable dams (ASFMC 2008: 141). To assist in restoration efforts, MEDMR captures alewives at the Brunswick fishway (a vertical slot fish passage facility) and transports them to the currently inaccessible upstream nursery pond habitat (ASFMC 2008: 141; MEDMR 2010c: 13, Table 1). In operation since the 1980s, since 2004 the transfer program has carried between 16,000 and 25,000 fish per year to upstream ponds (MEDMR 2010c: 13, Table 1). In addition, between 300 and 7,500 fish per year have been taken from the fishway and stocked in out-of-basin nursery locations (ASFMC 2008: 141; MEDMR 2010c: 13, Table 1). The adult release target for the Androscoggin watershed for river herring has been achieved in recent years with fish from the Brunswick fishway so there has been no need for stocking with fish from outside the watershed (MEDMR 2010c: 16-17).

New Hampshire Rivers

The majority of alewife and blueback herring populations in New Hampshire rivers and tributaries have declined since the early 2000s, with observed declines beginning much earlier in some rivers (ASMFC 2008). According to NHFGD (2009: 5), the number of alewives and blueback herring returning to New Hampshire rivers declined by approximately 45 percent between just 2004 to 2008; recently updated data show that decline appears to have continued through 2010, with numbers of fish counted in the ladders dropping another 12 percent (NHFGD 2011a).[10] Only a remnant fishery remains in state waters, with as few as 2000 fish estimated to have been harvested in recent years (NHFGD 2011).

Taylor River

Historically, the Taylor River supported the state's largest alewife and blueback herring population in New Hampshire, with a population once numbering at least 450,000 fish (NHFGD 2009: 16, Table 1-1). The Taylor River alewife and blueback herring population has dramatically declined since around 1980 and remains at historic low levels (ASMFC 2008: 104, Figure 1.6.1.1). From a peak of 450,000 fish in 1976, the number of counted Taylor River alewives and blueback herring dropped to 675 fish in 2010 – a decline of more than 99 percent (NHFGD 2009: 16, Table 1-1; NHFGD 2011a). Although flood conditions in 2005, 2006, and 2007 likely decreased the number of alewives and blueback herring returning to the Taylor River during each of those years, population levels of the alewife and the blueback herring were already at historic lows prior to 2005 (NHFGD 2009: 16, Table 1-1). From just 2000 (44,010 fish) to 2003 (1,397 fish), the monitored run declined 97 percent (NHFGD 2009: 16, Table 1-1). The population has continued to drop, with only 675 fish counted in the river's fish ladders in 2010 (NHFGD 2011a). According to NHFGD (2009: 6), the monitored Taylor River run is currently comprised almost entirely of blueback herring (except 2007, when 100% of fish sampled were alewives).

Samples collected from the Taylor River indicate a decline in the age structure in the blueback herring populations. In 2004, blueback herring comprised 98.5 percent of the samples collected from the Taylor River and 17.5 percent of the sampled fish were age 6 or older (NHFGD 2009: 17-18, Table 1-2 and 1-3). In 2005, blueback herring comprised 100 percent of the samples and there were no fish that were age 6 or older; all of the fish were age 3 to 4 (NHFGD 2009: 17, Table 1-2). In 2008, blueback herring again comprised 100 percent of the samples collected and all of the fish were ages 3 to 4 (NHFGD 2009: 17, Table 1-2). The only year in which the age structure in the samples collected from the Taylor River changed was in 2007, when 100 percent of the samples collected were alewives (NHFGD 2009: 18, Table 1-3). In that year, 42.2 percent

[10] Count data for alewives and blueback herring are presented in tables included in annual reports (*e.g.*, NHFGD 2009: 16, Table 1-1). Petitioners believe they have the most recent data (from 2010) in a standalone table (NHFGD 2011a). Although the data in the charts from 2009 and 2011 are generally the same, there are some minor discrepancies. For example, the table included in the 2009 report indicates 174 fish were found on the Exeter River in 2008; the 2011 chart has only 168 fish that year. Where there are discrepancies and petitioners are making calculations based on the counts, petitioners rely on NHFGD (2011a).

of the fish sampled were age 6 or older (NHFGD 2009: 17, Table 1-2). There were no samples collected from the Taylor River in 2006.

Oyster and Exeter Rivers

Alewife and the blueback herring populations in the Oyster River and Exeter River – two adjacent rivers that drain into the Little and Great Bay near Portsmouth, New Hampshire – have significantly declined in size within the past decade (NHFGD 2009: 16, Table 1-1; NHFGD 2011a). According to NHFGD (2009: 5-6), the run in the Oyster River is dominated by alewives and Exeter River by blueback herring. Population levels of the alewife and the blueback herring in the Oyster River have historically been the second largest in New Hampshire (after the Taylor River). After averaging 102,571 fish per year from 1990 through 1999, the Oyster River count dropped to an average of only 35,277 fish per year from 2000 to 2010 (NHFGD 2011a). Recent data updates show the downward trend continuing, with the Oyster River river herring count averaging only 15,207 fish in 2009 and 2010 (NHFGD 2011a). The river herring count in the Exeter River has experienced a similar drop since 2001, with the spawning count decreasing by 99 percent from 2001 to 2010 (NHFGD 2011a). In 2010, only 69 individual alewives and blueback herring were counted returning to the Exeter River (NHFGD 2011a).

From 2004 to 2008, river herring samples collected from the Oyster River were dominated by blueback herring (ranging from 100 percent in 2005, 2006, and 2007 to 97 percent in 2008) (NHFGD 2009: 18, Table 1-3). The percentage of sampled fish in the Oyster River that were age 6 or older declined by 40 percent from 2004 to 2008 (NHFGD 2009: 17, Table 1-2). In 2008, an estimated 88 percent of the sampled fish were age 3 to 5 (NHFGD 2009: 17, Table 1-2). In the Exeter River, an estimated 89 percent of sampled alewives and blueback herring in the Exeter River were age 5 or older in 2004 (NHFGD 2009: 17, Table 1-2). By 2008, only an estimated 43 percent of the sampled fish were age 5 or older (NHFGD 2009: 17, Table 1-2).

From 2002 through 2005 repeat spawners comprised 51 percent of spawners on the Oyster River and 33 percent of spawners on the Exeter (NHFGH 2011b: Table 6). From 2006 through 2009, repeat spawners only comprised 42 percent of spawners on the Oyster River and 24 percent of spawners on the Exeter (NHFGD 2011b).

Cocheco, Lamprey, and Winnicut Rivers

Although there were three rivers in New Hampshire that supported a relatively stable or increasing alewife and blueback herring population from 2000 to 2010 – the Cocheco, Lamprey, and Winnicut rivers – herring populations in all three rivers number fewer than 34,000 fish, with one of the rivers (Winnicut) supporting a population of fewer than 5,000 fish in 2009 (NHFGD 2011a). The increase in the abundance of alewives and blueback herring in the Lamprey River is believed to be partially related to enhanced stocking in an upper impoundment of the river system, which allows alewives and blueback herring to utilize inaccessible spawning and nursery habitat within the Lamprey River drainage system (NHFGD 2009: 8). According to NHFGD, both the Cocheco and Lamprey are dominated by alewives and the Winnicut has more alewives than blueback herring, although these relative proportions may be influenced by each species' relative use of fish ladders (NHFGD 2011).

Merrimack River

Similar trends can be seen on New Hampshire's Merrimack River (which also runs down through Massachusetts). According to USFWS (2011), from 1987 through 1992, river herring counts at the Essex Dam Fish Lift in Lawrence, Massachusetts on the Merrimack River averaged 258,865 fish; from 1998 through 2004, river herring counts at that fish lift on the Merrimack River averaged 8094 fish, and from 2005 through 2009, counts averaged 818 fish. Other sources have recent counts even lower – averaging 792 fish from 2005 through 2009 (MADMF 2010: 29-30, Tables 1 and 2).

Massachusetts Rivers

Historical information indicates that river herring historically occurred in the majority of coastal rivers and tributaries in Massachusetts (Watts 2003). From 1955 to 1961, commercial landing records indicate that an average of over 16 million pounds of river herring was landed per year in Massachusetts alone. According to Belding (1921), twenty-seven streams along the Gulf of Maine coast once had significant river herring runs.

The overwhelming majority of the state's river herring runs are extirpated or reduced to remnant levels. In recent years, and particularly since 2000, the alewife populations and blueback herring populations in the remaining Massachusetts rivers with meaningful runs have declined to historic low levels (ASMFC 2008). MADMF (2011) noted specifically the "precipitous decline" in alewife abundance in three rivers: the Parker River, the Monument River and the Mattapoisett River. In 2005, the MADMF implemented a 3-year moratorium on the harvest, possession, and sale of alewives and blueback herring throughout the state as an emergency conservation measure (ASMFC 2008). This moratorium was extended in October 2008 for an additional three years (*i.e.*, through 2011) because of a lack of recovery of alewife and blueback herring runs in both the state and the surrounding region (MADMF 2008).

Parker River

The Parker River alewife population has dramatically declined from its population size during the 1970s and has been at historically low levels since 2001 (ASMFC 2008: 195, Table 4.4; MADMF 2011: 53, Appendix Table 4).[11] From 1972 to 1978, the average size of the alewife run in the Parker River was 20,390 counted fish. By 2000 to 2005, the average size had shrunk to 2,889 fish – a decline of 86 percent (MADMF 2011: 52, Appendix Table 4). The alewife count dropped to 500 fish in 2006 and to 60 fish in 2007 (MADMF 2011: 52, Appendix Table 4). According to MADMF (2010), stream weir failure affected fish passage in 2006, skewing the count low. However, the Parker River alewife population was already at historic lows during the four years prior to 2006, and has remained low since 2007, with only 485 counted fish in 2008, 800 in 2009 and 1,800 in 2010 (MADMF 2011: 53, Appendix Table 4).

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[11] The Parker River fish count data in ASFMC (2008) differ (sometimes they appear to be rounded) from the numbers included in MADMF (2011). Petitioners use the data from the MADMF (2011) where there are discrepancies.

Monument River

The alewife population and the blueback herring population in the Monument River have precipitously declined since 2000 (ASMFC 2008: 195, Table 4.3). Prior to 2001, the average size of the Monument River alewife run was 312,965 counted fish per year, with a peak of 597,937 alewives returning to the Monument River in 2000 (ASMFC 2008: 195, Table 4.3). The average size of the Monument River alewife run declined to 205,088 counted fish per year from 2001 to 2004 (ASMFC 2008: 195, Table 4.3). From 2005 to 2010, the alewife run in the Monument River further declined to an average of only 89,404 counted fish per year – a decline of 71 percent from its average size prior to 2001 (ASMFC 2008: 195, Table 4.3; MADMF 2011: 52, Appendix Table 4). Comparing its peak size in 2000 with its size in 2010, the alewife run in the Monument River has declined in size by 84 percent (ASMFC 2008: 195, Table 4.3; MADMF 2011: 52, Appendix Table 4).

The blueback herring run in the Monument River has experienced a similarly precipitous decline. Prior to 2001, the average size of the Monument River blueback herring run was 46,989 counted fish per year, with a peak of 99,646 counted blueback herring in 1991 (ASMFC 2008: 195, Table 4.3). From 2001 to 2004, the Monument River blueback herring run averaged 45,447 counted fish per year (ASMFC 2008: 195, Table 4.3). From 2005 to 2010, the blueback herring run in the Monument River averaged only 18,617 counted fish (ASMFC 2008: 195, Table 4.3; MADMF 2011: 52, Appendix Table 4). Comparing its peak size in 1991 to its size in 2010, the blueback herring run in the Monument River has declined in size by 91 percent (ASMFC 2008: 195, Table 4.3; MADMF 2011: 52, Appendix Table 4).

The age structure of the alewife population and the blueback herring population in the Monument River has significantly declined since the 1980s (ASMFC 2008: 204, Table 4.9). From 1985 to 1987, female alewives that were age 6 or older comprised approximately 28 percent of the samples collected from the Monument River (ASMFC 2008: 204, Table 4.9). Male alewives that were age 6 or older comprised 13 percent of the samples collected from 1985 to 1987 (ASMFC 2008: 204, Table 4.9). From 2004 to 2010, there were only six female alewives and one male alewife that were older than age 6 in the samples collected; in that period, female alewives that were age 6 or older comprised only 5.41 percent of the samples collected, while male alewives that were age 6 or older comprised only 2.1 percent of the samples collected (ASMFC 2008: 204, Table 4.9; MADMF 2011: 63, Appendix Table 10). In the Monument River blueback herring population, female fish that were age 6 or older comprised 15.4 percent of the samples collected from 1985 to 1987 (ASMFC 2008:204, Table 4.9). Male fish that were age 6 or older comprised 4.8 percent of the samples collected (ASMFC 2008: 204, Table 4.9). From 2004 to 2010, there were only two female blueback herring that were older than age 6 and no male blueback herring that were older than age 6 (ASMFC 2008: 204, Table 4.9). Age 6 and older female blueback herring (five fish total) comprised only 1 percent of the samples collected; age 6 male blueback herring comprised only 0.2 percent of the samples collected (ASMFC 2008: 204, Table 4.9; MADMF 2011: 63, Appendix Table 10). The average age of female and male alewives in the Monument River peaked in 1987 at 5.2 years and 4.7 years, respectively; in 2010, the average age of female alewives was only 4.4 years and male alewives was only 3.9 years (MADMF 2011: 64, Appendix Table 11). The average age of female and male blueback herring in the Monument River in 1987 were 5.1 years and 4.3 years, respectively; in 2010, the average

age of female and male bluebacks had declined to all-time lows of 3.7 years and 3.3 years, respectively (MADMF 2011: 64, Appendix Table 11).

The numbers of repeat spawning alewife and repeat spawning blueback herring in the Monument River have significantly declined over the past three decades. From 1986 to 1987, female alewives that were returning to spawn in the Monument River for their third or fourth time represented 18.4 percent of the female alewife repeat spawners (ASMFC 2008: 205, Table 4.10). From 2004 to 2010, less than 2 percent of female alewife repeat spawners were returning for their third or fourth time to spawn (ASMFC 2008: 205, Table 4.10; MADMF 2011: 67, Appendix Table 13). Female alewives that returned to the Monument River to spawn for their second time represented 26 percent of the female alewife repeat spawners from 1986 to 1987 but less than 10 percent from 2004 to 2010 (ASMFC 2008: 205, Table 4.10; MADMF 2011: 67, Appendix Table 13). Male alewives returning to spawn in the Monument River for the third or fourth time represented less than 11 percent of the male alewife repeat spawners from 1986 to 1987 but less than 1 percent from 2004 to 2010 (ASMFC 2008: 205, Table 4.10; MADMF 2011: 67, Appendix Table 13). Second-time male alewife repeat spawners comprised almost 30 percent of the male alewife repeat spawning population on the Monument from 1986 to 1987 but less than 8 percent from 2004 to 2010 (ASMFC 2008: 205, Table 4.10; MADMF 2011: 67, Appendix Table 13). Blueback herring returning to spawn in the Monument River for the third or fourth time has declined to zero since the late 1980s. From 1986 to 1987, blueback herring returning to spawn in the Monument River for the third or fourth time represented more than 11 percent of the female blueback herring repeat spawners and almost 4 percent of the male blueback herring repeat spawners (ASMFC 2008: 205, Table 4.10). From 2004 to 2010, however, there were no male or female blueback herring that returned to spawn for the third or fourth time (ASMFC 2008: 205, Table 4.10; MADMF 2011: 67, Appendix Table 13). Blueback herring returning to spawn in the Monument River for a second time represented more than 27 percent of the female blueback herring repeat spawners and 17 percent of the male blueback herring repeat spawners from 1986 to 1987 (ASMFC 2008: 205, Table 4.10). However, from 2004 to 2010, blueback herring returning to spawn in the Monument River for a second time represented less than 6 percent of both female and male blueback herring repeat spawners (ASMFC 2008: 205, Table 4.10; MADMF 2011: 67, Appendix Table 13).

The size of female and male alewives and blueback herring in the Monument River has also declined over the past three decades. On average, male and female alewives and blueback herring are approximately 20 to 27 mm smaller than fish of the same species and sex sampled from 1984 to 1987 (ASMFC 2008: 199-200, Table 4.5). Trend analyses of mean lengths indicate significant decreases in mean lengths for male and female alewives and blueback herring (ASMFC 2008: 34).

Mattapoisett River

The Mattapoisett River alewife population has precipitously declined in size during the past decade. From 1998 to 2000, the Mattapoisett River alewife run averaged 113,667 counted fish per year (MADMF 2011: 52, Appendix Table 4).[12] From 2001 to 2003, the average size of the

[12] The Mattapoisett River fish count data in ASFMC (2008) differ from the numbers included in MADMF (2011). Petitioners use the data from the MADMF (2011) where there are discrepancies.

Mattapoisett River alewife run dropped by more than 55 percent (to an average of 50,667 counted fish per year) (MADMF 2011: 52, Appendix Table 4). From 2004 to 2010, the average size of the Mattapoisett River alewife run dropped to an average of 8,333 counted fish per year, an estimated 93 percent decline from its 1998 to 2000 average size (ASMFC 2008: 195, Table 4.3; MADMF 2011: 52, Appendix Table 4).

The number of repeat spawners has also dropped. In 1995, the rate was 0.33 for females and 0.19 for males; in 2007, it was 0.04 for females and 0.03 for males. Recent 2006 to 2007 Z estimates for alewives are also significantly higher compared to 1995.

Nemasket River

Although the Nemasket River alewife run is relatively large compared with the size of the alewife and the blueback herring runs in other rivers in Massachusetts and the surrounding region, the current Nemasket River alewife run is much smaller than its historic size and has significantly declined in size since 2002. The average size of the Nemasket River alewife run from 2003 to 2010 (663,791 fish) dropped almost 40 percent from its average prior to 2003 (1,037,583 fish) (MADMF 2011: 52, Appendix Table 4).[13]

The age structure and length frequencies of the alewife population, as well as the number of repeat spawners, in the Nemasket River have also declined in the last several years. From 2004 to 2010, there was a significant shift in the age structure of samples of male and female alewives collected from the Nemasket River that indicates that the Nemasket River alewife population is currently comprised of younger fish than it has been historically (ASMFC 2008: 203, Table 4.8; MADMF 2011: 61, Appendix Table 9). For example, in 2004, there were no age 3 female fish in the samples collected from the Nemasket River (ASMFC 2008: 203, Table 4.8; MADMF 2011: 61, Appendix Table 9). Female alewives that were age 4 and 5 comprised 61 percent of the samples collected, while female fish that were age 6 and 7 comprised 39 percent of the samples collected (ASMFC 2008: 203, Table 4.8; MADMF 2011: 61, Appendix Table 9). By 2010, female fish that were age 3 increased to comprise 12 percent of the samples collected, while female fish age 4 and 5 increased to comprise 80 percent of the samples collected and female fish age 6 and 7 decreased to 8 percent of the samples collected (MADMF 2011: 61, Appendix Table 9). Male alewives in the samples collected from the Nemasket River experienced a similar decline in age structure (ASMFC 2008: 203, Table 4.8). In 2004, age 3 male fish comprised just under 3 percent of the samples collected, age 4 and 5 male fish comprised almost 75 percent of the samples collected, and age 6 and 7 male fish comprised almost 23 percent of the samples collected (ASMFC 2008: 203, Table 4.8). In 2010, male fish that were age 3 comprised 22 percent of the samples collected and male fish age 6 and 7 decreased to 4 percent of the samples collected (MADMF 2011: 61, Appendix Table 9). Although the percentage of male fish age 4 and 5 stayed the same at approximately 74 percent of the samples collected, the number of age 4 and 5 fish were reversed: in 2004 age 4 fish comprised 28 percent and age 5 fish 47 percent of

[13] Data was available for 1996 and 1998 through 2003 (ASMFC 2008). Fish count data for 2007 for the Nemasket River in ASFMC (2008) differ slightly from that included in MADMF (2011). Petitioners use the data from the MADMF (2011) for 2007.

samples collected, while in 2010 age 4 fish comprised 47 percent and age 5 fish only 27 percent of samples collected (MADMF 2011: 61, Appendix Table 9).[14]

The length frequencies among female and male alewives in the Nemasket River also has declined from 2004 to 2010 (ASMFC 2008: 196, Table 4.4; MADMF 2011: 54, Appendix Table 5). Overall, the percentage of larger (*i.e.*, older) fish among male and female alewife samples collected from the Nemasket River declined between 2004 and 2010 (ASMFC 2008: 195, Table 4.3; MADMF 2011: 54, Appendix Table 5). For example, in 2004, just over 33 percent of the female fish and about 11 of the male fish measured 300mm or longer (MADMF 2011: 54, Appendix Table 5). In 2007, only just under 7 percent of the female fish and less than 4 of the male fish collected measured 300mm or longer (MADMF 2011: 54, Appendix Table 5). By 2010, just under 5 percent of the female fish (11 of 231 fish) and less than 1 percent of the male fish (one of 276 fish) collected measured 300mm or longer (MADMF 2011: 54, Appendix Table 5). Overall mean size of alewives decreased by 13mm (from 254mm FL and 214g to 241mm FL and 187g) from 2004 to 2009 (MADMF 2010: 21).

Finally, the number of repeat spawners for alewives in the Nemasket River has also decreased significantly over the last several years, from 0.43 for females and 0.44 for males in 2004 to 0.23 for females and 0.16 for males in 2010 (MADMF 2011).

Other Massachusetts Rivers

The Ipswich River has historically supported healthy populations of alewives and blueback herring that helped to shape the region‘s culture from pre-colonial times until the early 1800s (Ipswich River Watershed Association ND). River herring runs in the Ipswich River were once capable of supporting a commercial fishery that exported thousands of barrels of fish (Frank 2009: 7). Alewives and bluebacks disappeared from the river in the early 1900s, because of a lack of both spawning habitat and passage to this habitat (Frank 2009). The MADMF began restocking efforts in the 1990s; despite stocking over 46,000 fish in the Ipswich River from 1990 through 2007, returns remained low, with only between 98 and 420 adults per year counted returning to spawn (Frank 2009: 7, Figure 1.A.1). Although alewives were the dominant species historically, from 1990 through 2003, blueback herring were restocked; from 2003 through 2007, alewives were restocked (Frank 2009: Table 1.A.1). Besides an isolated event where spawning behaviors were observed in a downstream tidal reach, there has been no evidence of fish spawning or juveniles reported upstream of the Ipswich Mills Dam (Frank 2009: 32).

Mill River‘s runs of alewives and blueback herring and Penn Brook‘s alewife run are considered eliminated (Tomczyk 2002: 18-22, 37-41). Only a remnant population is left of what had historically been a large run of alewives in Monatiquot River (Gomez and Sullivan Engineers, P.C. 2001: *i*).

[14] The age data in MADMF (2011) are the same as those in ASFMC (2008) with the following notable exceptions: (1) 2006 data for the Mystic River appear not to have been entered in ASFMC (2008), and (2) 2005 data for the Nemasket River and Town Brook are different in the two reports for unclear reasons. Petitioners rely on the more recent publication (MADMF 2011) when there are discrepancies.

In the Charles River, the proportion of male river herring repeat spawners was 0.49 in 1985 and 0.25 in 1993; for females, the proportion was 0.54 in 1985 and 0.44 in 1993. Mortality on both sexes also increased and average age decreased significantly over this period (1985-1993) (MADMF 2011).

Rhode Island Rivers

Currently there is a moratorium on harvest of alewives and bluebacks in Rhode Island's fresh and marine waters. Due to drastic declines in the spawning size of monitored stocks beginning in 2001, Rhode Island passed regulations in March 2006 that implemented the complete closure of the fisheries. The Annaquatucket River once had a spawning river herring population of over 300,000 fish – it now has only a remnant population, despite stocking efforts (ASMFC 2008). The Nonquit and Gilbert-Stuart rivers are now home to the largest river herring runs in the state. Counts since 2003 have also documented river herring on Buckeye Brook, with counts averaging just over 20,660 fish annually from 2003 through 2011 (Rhode Island Department of Environmental Management (―RIDEM")/Fish and Wildlife 2010: Figure 3; RIDEM/Fish and Wildlife 2011).

Nonquit River

The estimated alewife spawning stock in the Nonquit River has drastically declined since 1999, when it numbered an estimated 230,853 fish (ASMFC 2008: 251, Table 5.6). The average size of the Nonquit River alewife spawning stock has dropped in size by more than 54 percent, from an average of 160,835 fish per year from 1999 to 2002 to an average of 73,719 fish per year from 2003 to 2010 (ASMFC 2008: 251, Table 5.6; RIDEM/Fish & Wildlife 2011).

The percent of river herring repeat spawners – likely all or mostly alewives – in the Nonquit River has declined since the beginning of the time series in 2000 (ASMFC 2008: 259, Figure 5.6). According to the ASMFC (2008), the percent of repeat spawners in the Nonquit River was at or near 18 percent in 2000 and 2003 (ASMFC 2008: 259, Figure 5.6). However, since 2003, the percent of repeat spawners in the Nonquit River has been near or under 10 percent (ASMFC 2008: 259, Figure 5.6). The five-year average, from 2003 to 2007, for repeat spawners in the Nonquit River was under 7 percent (ASMFC 2008: 242).

The mean length-at-ages of Nonquit River river herring observed in 2000 were lower than those observed in 1976, which was when the mean lengths were last reported (ASMFC 2008: 242).

Gilbert-Stuart River

The estimated alewife spawning stock in the Gilbert-Stuart River has drastically declined over the last decade (ASMFC 2008: 251, Table 5.6). The average size of the Gilbert-Stuart River alewife run dropped in size by approximately 82 percent, from an average of 243,894 counted fish per year from 1998 to 2002 to an average of 44,087 counted fish per year from 2003 to 2010 (ASMFC 2008: 251, Table 5.6; RIDEM/Fish & Wildlife 2011).

The catch rate for juvenile river herring – likely all or mostly alewives – in the Gilbert-Stuart River averaged 170.01 catches per hour per year for the five-year period from 1988 to 1992, which included a peak of 343.30 catches per hour in 1992 (ASMFC 2008: 254, Table 5.10). In 2007, the catch rate for juvenile river herring in the Gilbert-Stuart River was only 94.90 catches per hour, which is 72 percent lower than the 1992 catch rate and 44 percent lower than the 1988-1992 average catch rate (ASMFC 2008: 254, Table 5.10).

The percent of river herring repeat spawners in the Gilbert-Stuart River has decreased significantly since the 1980s (ASMFC 2008: 259, Figure 5.6). According to the ASMFC (2008: 259, Figure 5.6), the percent of repeat spawners in the Gilbert-Stuart River was at or near 70 percent in the mid-1980s. However, since 2002, the percent of repeat spawners in the Gilbert-Stuart River has been under 20 percent (ASMFC 2008: 259, Figure 5.6).

The mean length-at-ages of Gilbert-Stuart River river herring observed since 2000 have been consistently lower for all age classes than those observed in 1992 (ASMFC 2008: 242). In addition, pooled age data (1980 to 1992) from the Gilbert-Stuart River indicated that 15 percent of the river herring collected as samples were ages 6, 7, or 8 (ASMFC 2008: 242). From 2003 to 2007, age data indicated that there were no age 7 or age 8 river herring and that there were very low percentages of age 6 fish (ASMFC 2008: 242).

Connecticut Rivers

Observations by the Connecticut Department of Environmental Protection (―CTDEP") indicate that there have been significant declines in the run sizes of alewives and blueback herring at a majority of sites in Connecticut (Davis and Schultz 2009: 91, citing Gephard *et al.* 2004). Most of these declines have been relatively recent.

Connecticut River

The Connecticut River is the largest river system in Connecticut. The alewife and the blueback herring historically occurred throughout the lower Connecticut River basin (Connecticut River Atlantic Salmon Commission (―CRASC") 2004). In the Connecticut River, blueback herring are currently found in the main stem of the Connecticut River up to Bellows Falls, Vermont (CRASC 2004). Unlike blueback herring, alewives currently occur in the Connecticut River south of Holyoke, Massachusetts and are rarely found north of the Holyoke dam (CRASC 2004).

The blueback herring population in the Connecticut River has precipitously declined over the last two decades. During the 1980s, the Connecticut River supported a blueback herring population estimated to consistently number over 5 million fish per year, with a peak of approximately 9.4 million fish in 1985 (ASMFC 2008: 283, Table 6.1). After averaging an estimated 5.4 million fish from 1981 to 1995, the Connecticut River blueback herring population dropped to an estimated average of just over one million fish per year from 1996 to 2001 (ASMFC 2008: 283, Table 6.1). From 2002 to 2008, the Connecticut River blueback herring population declined further, averaging only an estimated 311,997 fish per year (ASMFC 2008: 283, Table 6.1). Overall, the average size of the Connecticut River blueback herring population has declined by 94 percent since its 1981 to 1995 estimated average size (ASMFC 2008: 283, Table 6.1).

The status of the alewife population in the Connecticut River is unclear because the Connecticut state status report included in ASMFC (2008) considered fish counts from only a couple of tributaries of the Connecticut River and based its conclusions regarding the Connecticut River alewife population primarily on data from Long Island Sound trawl surveys (ASMFC 2008: 261). The Connecticut state status report also did not provide any historical data on the abundance of alewives in the Connecticut River.

Juvenile young-of-the-year surveys for blueback herring in the Connecticut River indicate that the relative abundance of ―young of the year" (―YOY") blueback herring has significantly decreased since the 1980s (ASMFC 2008: 283, Table 6.1). The geometric mean for YOY blueback herring has declined by 96 percent since its peak in 1984 (ASMFC 2008: 283, Table 6.1). Juvenile Abundance Index (―JAI") geometric mean CPUE for blueback herring on the Connecticut River has declined significantly from 1990 to 2009. From 1990 to 1994, it averaged 12.8 annually, from 1995 to 1999, it averaged 6.1; from 2000 to 2004, it averaged 4.0; and from 2005 to 2009 it averaged 3.6 (CTDEP 2010). It was the lowest on record – 1.77 – in 2009 (CTDEP 2010; ASMFC 2010).

In 2002, the State of Connecticut imposed a moratorium on the commercial and recreation harvest of alewives and blueback herring in all Connecticut waters (ASMFC 2008: 266). The moratorium has been extended each year and continues to the present (CTDEP, Press Release, Mar. 24, 2010; CTDEP 2011). According to the Connecticut Department of Environmental Protection, the ―monitoring conducted during 2009 indicated that the river herring stocks remain very low with no signs of an imminent recovery" (CTDEP, Press Release, Mar. 24, 2010, citing William Hyatt, Chief of CTDEP‘s Bureau of Natural Resources).

Bride Brook

A case study examining temporal shifts in the demography and life history within the Bride Brook alewife population found declines in the population‘s abundance, age, mean length, and the likelihood of repeat spawning (Davis and Schultz 2009). The Bride Brook alewife population in recent years had lower abundance and consisted of smaller fish that were less likely to be repeat spawners (Davis and Schultz 2009). While the 1966 run of spawning alewives in Bride Brook was dominated by age 5, 6, and 7 fish, the recent alewife spawning runs were dominated by age 3 and 4 fish (Davis and Schultz 2009). The Bride Brook alewife population recruited to the spawning run at younger ages and at smaller sizes (Davis and Schultz 2009). In recent years, first-time spawners have primarily been age 3 fish whereas first-time spawners have been dominated by age 5 fish in 1966 (Davis and Schultz 2009). In addition, the mean length in the Bride Brook alewife population decreased by 10 percent between 1966 and 2006 (Davis and Schultz 2009).

New York Rivers

Hudson River

The alewife and the blueback herring populations in the Hudson River are much reduced from historic levels (ASMFC 2008: 324). According to the New York State Department of Environmental Conservation (―NYSDEC"), there has been a steady decline in total commercial landings in New York while total effort has increased at a high rate (ASMFC 2008: 315). Because total catches should rise with total effort in a lightly exploited population and the opposite is occurring in New York, the NYSDEC has expressed concern regarding the status of the state's alewife and blueback herring populations (ASMFC 2008: 315).

Relative abundance of alewives and blueback herring in the Hudson River is tracked by observed CPUE statistics of fish taken in the commercial fixed gill net, drift gill net, and scap net fisheries in the Hudson River Estuary (ASMFC 2008: 312). Total effort has increased for all gear types since 1996 (ASMFC 2008: 314; 375, Figure 7.8; 335, Table 7.7). However, since 2000, annual CPUE has dropped dramatically for all gear types (ASMFC 2008: 314; 376, Figure 7.9; 334, Table 7.6).

From 2001 to 2007, mean total length and weight for alewives and blueback herring in the Hudson River declined (ASMFC 2008: 341-43, Table 7.11; 344-46, Table 7.12). Monitoring data from commercial vessels (which may understate the decline, as these vessels use selective gill nets that tend to capture the relatively similar size ranges of fish with little inter-annual change (ASMFC 2008: 319)) found average length of alewives from 2001to 2005 was 271.7mm; since 2005, that average has been 264.4mm (NYSDEC 2010: Table 12).[15] Mean length of bluebacks has also declined during the decade: average length from 2001-2005 was 264.7mm; since 2005, that average has been 259.5mm (NYSDEC 2010: Table 12).[16] Data from Hudson River estuary spawning stock surveys show an even more dramatic decline for alewives: average length from 2001 to 2005 was 261.6mm for alewives and 251.6mm for bluebacks; since 2005, that average has been 251.3mm for alewives and 246.3mm for bluebacks (NYSDEC 2010: Table 22). The observed decline in the size of Hudson River alewives is greater than that of Hudson River blueback herring (ASMFC 2008: 319). According to the NYSDEC, this occurrence may be the result of higher fishing pressure on Hudson River alewives because they are the first species to return to the Hudson River when the demand for striped bass bait is at its highest (ASMFC 2008: 319).

The NYSDEC has measured relative abundance of YOY alewives and YOY blueback herring in the Hudson River Estuary since 1980 (ASMFC 2008: 322). NYSDEC data indicates significant fluctuations in both the YOY alewife and the YOY blueback herring indices for which there is no clear explanation, though the blueback YOY indices show a slightly declining trend over all years (ASMFC 2008: 322-23; NYSDEC 2010: 5). The same erratic trend observed in the YOY alewife and YOY blueback herring indices from 1998 to 2007 also occurred in the YOY indices for American shad (ASMFC 2008: 323). According to the NYSDEC, the co-occurrence of these

[15] No data were available for 2006 and 2008 (NYSDEC 2010: Table 12).
[16] No data were available for 2001 and 2003 (NYSDEC 2010: Table 12).

erratic YOY indices trends may be indicative of a change in the overall stability of the ecosystem (ASMFC 2008: 323).

Delaware River

The Delaware River once hosted abundant populations of alewives and blueback herring. ASMFC (2008: 392) includes accounts of how alewives and blueback herring were so numerous in Delaware River tributaries that the fishes ―often flipped onto the creek banks of Delaware River tributaries each spring." Although the numbers were considerably reduced from those in the 19th century, all of the major tributaries of the Delaware River and Delaware Bay contained spawning runs of alewives and blueback herring as recently as 1990 (ASMFC 2008: 395). Both species occurred in the Delaware River and Bay on the east side of the state and in the Nanticoke River, including its main tributaries, Deep Creek and Broad Creek, and some small tributaries (Delaware Department of Natural Resources and Environmental Control (―DDNREC") 2010). Blueback herring are most abundant in Nanticoke River drainage, whereas alewives predominate in the Delaware estuary (DDNREC 2010: 5).

Since 1990, available information indicates a significant decline in alewife and blueback herring abundances in the Delaware River. Indices of the adult alewife and the blueback herring populations indicate a particularly marked decline from 2001 to 2007 (ASMFC 2008: 399; 409, Figure 8.6). The commercial CPUE for Delaware River alewives and blueback herring landed in Delaware has been in decline since the early 1990s, with three of the lowest data points occurring within the last three years of the time series (2005 to 2009) (ASMFC 2008:399; DDNREC 2010: 5, Figure 1[17]). From 1991 to 2001, commercial landings averaged 19,688 pounds (DDNREC 2010: Table 1).[18] From 2002 to 2008, commercial landings averaged 5,270 pounds (DDNREC 2010: Table 1).[19] In 2009, they dropped to 1,453 pounds, a 93 percent reduction from the 1991 to 2001 average (DDNREC 2010: Table 1).[20] The commercial CPUE for Delaware River alewives and blueback herring landed in New Jersey has also remained low throughout the time series (1997 to 2007), with the exception of 2000, with two of the lowest data points occurring with the last three years of the time series (ASMFC2008: 403, Table 8.3; 408, Figure 8.4). Commercial landings in New Jersey[21] have also declined: they averaged 3,459 pounds annually from 1995 through 2000, 3,066 pounds on average annually from 2001 to 2006, and 867 pounds on average annually from 2007 to 2009 (New Jersey Department of Environmental Protection (―NJDEP") 2010: 9, Table 13).

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[17] The report mistakenly labels this figure as ―Table 1", although there is another ―Table 1" and the text refers to it as ―Figure 1."

[18] Calculation based on average of 8,929 kilograms of river herring (alewives and bluebacks), converted to 19,688 pounds.

[19] Calculation based on average of 2,390 kilograms of river herring (alewives and bluebacks), converted to 5,270 pounds.

[20] Calculation based on 659 kilograms of river herring (alewives and bluebacks), converted to 1,453 pounds.

[21] Landing estimates for river herring were obtained from the NMFS for 1995 to 1999 while estimates for 2000 to 2009 were obtained from mandatory logbooks of the New Jersey small mesh gill net fishery (New Jersey Department of Environmental Protection (NJDEP) 2010: 9).

The recreational CPUE for Delaware River alewives and blueback herring landed in Delaware has declined by approximately 65 percent or more in recent years (2001 to 2003, 2007) compared with the CPUEs recorded from 1996 to 1998 (ASMFC 2008:399; 404, Table 8.4). No surveys have been conducted since 2007 (DDNREC 2010: 7).

The juvenile index of relative abundance for the Delaware River alewife population declined, on average, from 2002 to 2007, compared with its average indices from 1980 to 2000 and from 1990 to 2000 (ASMFC 2008: 405, Table 8.5). However, as with most juvenile indices of relative abundance, the Delaware River indices for alewife and blueback herring fluctuated throughout the time series without a discernable long-term trend (ASMFC 2008: 400). According to the ASMFC (2008), the observed fluctuations are mostly due to the environmental conditions around the time of alewives and blueback herring spawning through the early nursery period (ASMFC 2008: 400). Juvenile blueback herring recruitment for 2009 (3.55) (derived from New Jersey‘s Striped Bass Recruitment Survey in the Delaware River) remained below average for the fourth year in a row, with the juvenile index from 2006 to 2009 representing the lowest average of any four year period except 1980 to 1983 and showing a serious decline in the overall health of the blueback herring stock within the Delaware river and its tributaries (NJDEP 2010: 9, Table 14). Alewife recruitment for 2009 (0.06) (also from New Jersey) was also very poor for the third time in four years (NJDEP 2010: 9, Table 14). Juvenile numbers (YOY and age 1 fish) in the Delaware estuary in Delaware for both alewives and bluebacks generally remained low in 2008 and 2009 (DDNREC 2010: 11-13).

According to the ASMFC (2008), the overall assessment of data indicates that the Delaware River alewife and blueback herring populations are declining (ASMFC 2008: 401). In addition, the assessment of data indicates that the blueback herring population in the Delaware River is declining to a greater extent than the Delaware River alewife population, particularly in recent years (ASMFC 2008: 401).

Chesapeake Bay

Upper Chesapeake Bay, including Nanticoke River

Significant populations of alewife and blueback herring historically spawned in rivers and tributaries of the Upper Chesapeake Bay (ASMFC 2008: 416). An average of 3,568,710 pounds of alewives and blueback herring were commercially landed per year in Maryland from 1950 to 1970 (ASMFC 2008: 56, Table 1.5.1.1). An average of only 180,426 pounds of alewives and blueback herring were commercially landed per year in Maryland in 2000 and 2001 and, from 2002 to 2009, the average amount of alewives and blueback herring commercially landed per year in Maryland dropped again to only 45,570 pounds per year – an overall decline of 99 percent from the 1950 to 1970 landings average (ASMFC 2008: 57, Table 1.5.1.1; MDNR 2010: 21, Table 12).

The mean YOY for alewives in the Upper Chesapeake Bay has declined over time, from an annual average of 0.440 for 1959 to 1984 to an annual average of 0.305 for 1985 to 2009

(ASMFC 2008: 444-45, Figures 9.11 and 9.12).[22] The mean YOY indices for blueback herring in the Upper Chesapeake Bay have also declined, with an annual average of 0.923 for 1985 to 2009 compared to an annual average of 1.426 for 1959 to 1984 (ASFMC 2008: 445-46, Figures 9.13 and 9.14).[23]

Available data indicates that, in the last few years, older alewives and blueback herring are no longer present in the Nanticoke River and mean length-at-age for male and female alewives and blueback herring is decreasing (ASMFC 2008: 423). This trend continued in 2009, with none of the 216 alewives or 66 bluebacks sampled in the Nanticoke River over 7 years of age (no male alewives were over 6 years of age, and no male bluebacks were over 5) (MDNR 2010: 20, Table 11). In general, through 2007, ages 4 and 5 were the most prevalent fish in the samples but alewives and blueback herring were generally not fully recruited to the spawning population until age 5, as shown with the freshwater spawning mark not present on all five year-old fish (ASMFC 2008: 423). In 2009, age group 4 was the most abundant year class for both alewives and bluebacks, and, again, some five year-old fish were first-time spawners (MDNR 2010: 10-11; 19-20, Tables 10 and 11). Calculated CPUEs for both alewives and blueback herring on the Nanticoke River are trending downward (MDNR 2010: 11). In the Delaware portion of the Nanticoke River, the JAI increased for blueback herring in 2009, it remained at low levels for alewives (DDNREC 2010: 14).

Potomac River

Alewives and blueback herring were historically extremely abundant in the Potomac River (ASMFC 2008: 449). Significant numbers of alewives and blueback herring were landed in the 19th century, with an estimated 750,000,000 individual fish landed in 1832 (ASMFC 2008: 449, citing the 1835 Gazetteer of Virginia).

The number of alewives and blueback herring commercially landed under the jurisdiction of the Potomac River Fisheries Commission has drastically declined since the mid 1960s (ASMFC 2008: 449; 55-57, Table 1.5.1.1). From 1960 to 1970, such commercial landings of alewives and blueback herring averaged approximately 6,770,878 pounds per year (ASMFC 2008: 55-57, Table 1.5.1.1). By the early 2000s, commercial landings of alewives and blueback herring declined by 99.5 percent – to an average of approximately 32,810 pounds from 2000 to 2004 (ASMFC 2008: 55-57, Table 1.5.1.1). From 2005 to 2009, the average number of alewives and blueback herring commercially landed per year declined further to an average of 7,148 pounds per year (ASMFC 2008: 55-57, Table 1.5.1.1; PRFC 2010, Table 1).

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[22] Calculations based on numbers for the Nanticoke River provided in spreadsheets available under the ―alewife herring (YOY)" section of the web page http://www.dnr.state.md.us/fisheries/juvindex/index.asp, at the link identified as ―Abundance Data and Graphs."

[23] Calculations based on numbers for the Nanticoke River provided in spreadsheets available under the ―blueback herring (YOY)" section of the web page http://www.dnr.state.md.us/fisheries/juvindex/index.asp, at the link identified as ―Abundance Data and Graphs."

Mean YOY indices also indicate a significant decline in alewife and blueback herring abundance in the Potomac River. Available data indicates that, from 1959 to 1996, the mean YOY indices for the Potomac River alewife population averaged 0.558 per year but declined to an average of 0.33 per year for the subsequent fourteen year period (1997 to 2010) (Durell, E.Q., and Weedon, C. 2010 (alewife herring abundance data and graphs)).[24] Available data indicates that, from 1959 to 1996, the mean YOY indices for the Potomac River blueback herring population averaged 1.59 per year but declined to an average of 0.92 per year for the subsequent 1997 to 2010 period (Durell, E.Q., and Weedon, C. 2010 (blueback herring abundance data and graphs)).[25]

Susquehanna River

Historical reports indicate that river herring were very abundant in the Susquehanna River and provided for an important historical fishery (Susquehanna River Anadromous Fish Restoration Cooperative (―SRAFRC") 2010: 8). In 1920, alewives were ranked first – above American shad, Atlantic croaker, striped bass, weakfish, and white perch – in terms of Maryland's harvest from the river, with 6.7 million pounds harvested (SRAFRC 2010: 11).

By 1928, what had been the most productive river herring run on the Atlantic Coast was closed off to migrating fish by dams, except for its lowermost 10 miles (SRAFRC 2010: 12, 34-35). In 1991, the Pennsylvania Electric Company (PECO, now the Exelon Corporation) completed construction of a fish passage facility at the Conowingo Dam – the Conowingo Dam East Fish Passage Facility – as a result of a 1988 settlement agreement (SRAFRC 2010: 15). The west fish passage facility, a fish trapping facility also built and operated by PECO, has operated each spring since 1972; it was designed to trap fish for trucking upstream to spawning areas, but has experienced mixed success with these efforts (SRAFRC 2010: 18). For example, from 1990 to 2001, river herring were transported to four upstream areas, but as few juveniles were found in those areas in annual monitoring efforts, the project was deemed unsuccessful and terminated (SRAFRC 2010: 19). Other data confirm little reproduction above the Conowingo Dam facility; netting efforts from 1997 to 2003 suggested only one year of possible blueback herring reproduction, with 134 bluebacks netted in 2001 (SRAFRC 2010: 27).

Data for the Susquehanna River show dramatic declines in fish passage since the late 1990s. At the Conowingo Dam East Fish Passage Facility,[26] blueback herring passage declined from a recent high of almost 285,000 in 2001 to 4 in 2010; alewife passage declined from almost 7,500 fish in 2001 to 1 in 2010. Even looking at the data from the time the fish passage was constructed in 1991, passage declined from 13,149 blueback herring and 323 alewives to 4 and 1

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[24] Calculations based on numbers for the Potomac River provided in spreadsheets available under the ―alewife herring (YOY)" section of the web page http://www.dnr.state.md.us/fisheries/juvindex/index.asp, at the link identified as ―Abundance Data and Graphs."

[25] Calculations based on numbers for the Potomac River provided in spreadsheets available under the ―blueback herring (YOY)" section of the web page http://www.dnr.state.md.us/fisheries/juvindex/index.asp, at the link identified as ―Abundance Data and Graphs."

[26] The Conowingo Dam, built in 1928, is about 6 miles below the Pennsylvania/Maryland border and 10 miles from the mouth of the river at the head of the Chesapeake Bay.

respectively. The west lift facility also shows a dramatic decline starting in the late 1990s and early 2000s, with more than 133,000 bluebacks passing in 1997 and only 7 in 2008; there was a recent high of just over 9,000 alewives passing in 2000, but only 2 in 2008 (ASFMC 2008: 440, Table 9.2; SRAFRC 2010: Table 4; Summary of selected operation and fish catch statistics at the Conowingo Dam East Fish Passage Facility, 1991 to 2010: Table 4; Operations and fish catch at Conowingo West Fish Lift, 1985 – 2010: Table 5).[27]

Virginia Rivers

Lower Chesapeake Bay, including the Rappahannock, York, and James Rivers

Significant populations of alewife and blueback herring historically spawned in rivers and tributaries of the Lower Chesapeake Bay (ASMFC 2008: 4). According to commercial landings records, an average of approximately 24,923,657 pounds of alewife and blueback herring were commercially landed per year in Virginia from 1950 to 1970 (ASMFC 2008: 55-57, Table 1.5.1.1).

By the early 2000s, commercial landings of alewives and blueback herring in Virginia had plummeted. Between 1996 and 2004, an average of only 132,676 pounds of river herring per year was caught – a decline of more than 99 percent (ASMFC 2008: 55-57, Table 1.5.1.1). From 2005 to 2007, landings declined further to an average of 84,948 pounds of river herring per year (ASMFC 2008: 55-57, Table 1.5.1.1).

One commercial fisherman‘s voluntary logbook records (1995 to 2008) support a significant decline in the abundance of alewives and blueback herring in the Lower Chesapeake Bay (ASMFC 2008: 455). According to these records, average annual total catches of alewives and blueback herring from the Rappahannock River from 2005 to 2008 declined approximately 85 percent from those from 1999 to 2002 (ASMFC 2008: 469, Figure 11.9). Experimental surveys conducted by the Virginia Institute of Marine Science similarly show that the annual relative abundance of adult alewives and blueback herring in the Rappahannock River has significantly declined since the mid 1990s and remains at historically low levels, despite a slight increase in 2008 (ASMFC 2008: 470, Figure 11.12).

Annual mean JAIs also show a decline in alewife and blueback herring populations in the Lower Chesapeake Bay. From 1979 to 1987, the mean JAIs averaged 3.5 per year for the Mattaponi River alewife population and 1.8 per year for the Pamunkey River alewife population, but declined to an average of 1.4 and 0.49 per year, respectively, for the period 1991 to 2002 (ASMFC 2008: 464, Table 11.5) . From 1979 to 1987, the mean JAIs averaged 10.6 per year for the Mattaponi River blueback herring population and 37.0 per year for the Pamunkey River blueback herring population, but declined to an average of 6.6 and 9.3 per year, respectively, for the period 1991 to 2002 (ASMFC 2008: 464, Table 11.5). The annual JAIs for the alewife populations in the Rappahannock, York, and James River have fluctuated at historically low levels since the early 1990s (ASMFC 2008: 472, Figure 11.16). Although the annual JAIs for

[27] According to ASFMC (2008), some of this decline may be due to changes in flows designed to prioritize passage of shad, as well as because the fish lifts are operated in April after alewives‘ peak spawning time (ASFMC 2008: 420).

the blueback herring populations in the Rappahannock, York, and James River have fluctuated at higher levels than those of the alewife populations, the annual blueback herring JAIs have been at near-historically low levels since the mid 1990s (ASMFC 2008: 472, Figure 11.16).

According to Hewitt *et al.* (2009: 100), juvenile alewives are less abundant than juvenile blueback herring in the York River system's Mattaponi and Pamunkey Rivers. As of 1991, only remnant populations of alewives at very low levels of abundance were recorded in the Mattaponi and Pamunkey (Klauda *et al.* 1991).

North Carolina Rivers

River herring were documented in many waterbodies in North Carolina in the 1960s. In 1962, commercial landings included more than 3,262,600 pounds of river herring from Albemarle Sound; 20,000 pounds from Croatan Sound; 25,000 pounds from Currituck Sound; 10,786,000 pounds from the Chowan River; 122,000 pounds from the Roanoke River; 16,200 pounds from Pamlico Sound; 62,100 pounds from the Pamlico River; 2000 pounds from the Neuse River; and 100 pounds from the Cape Fear River (NCDMF 2010a: 4-5, Table 1). By 2006, however, the only river with a documented river herring fishery was the Chowan River. Even the Chowan River had suffered a decline in landings of more than 99 percent with just over 67,404 pounds landed; landings from Albemarle Sound (the only other location in North Carolina with landings greater than 10,000 pounds) had also declined by more than 99 percent (to just 22,573 pounds) by 2006 (NCDMF 2010a: 5-6, Table 1).

In 2007, and in response to declining stock levels, the North Carolina Marine Fisheries Commission implemented a statewide moratorium on the harvesting of alewives and blueback herring in waters within its jurisdiction (ASMFC 2008: 17). The North Carolina Wildlife Resources Commission also enacted regulations prohibiting the harvest of alewives and blueback herring (6 inches and longer) within its jurisdictional waters in the coastal river systems (ASMFC 2008: 17).

Albemarle Sound and Chowan River

Significant populations of alewives and blueback herring historically spawned in the Chowan River and Albemarle Sound in North Carolina (ASMFC 2008: 473). This region has historically had the largest alewife and blueback herring fisheries in the country, with blueback herring historically being more prevalent than alewives (ASMFC 2008: 483).

Over the last three decades, the average amount of alewives and blueback herring landed overall in North Carolina dropped from an estimated 12,879,871 pounds of alewives and blueback herring per year from 1950 to 1970 to an estimated 308,347 pounds of alewives and blueback herring per year from 1996 to 2006 – a decline of 98 percent (ASMFC 2008: 55-57, Table 1.5.1.1). Landings of both alewives and blueback herring from the Chowan River experienced a particularly dramatic decline in abundance between 1972 and 2004 (ASMFC 2008: 495, Table 3). From 1972 to 2004, Chowan River alewife landings dropped by 98 percent and Chowan River blueback herring landings declined by 99 percent (ASMFC 2008: 495, Table 3). Catch rates for bluebacks and alewives from independent gill net surveys have not shown any significant increases since the harvest moratorium was implemented in 2007 (NCDMF 2010b: Figure 22).

Sustained high exploitation of both the alewife and the blueback herring population in the Chowan River over the past three decades has reduced the spawning stock biomass (―SSB") to the extent that the current population levels of both species are insufficient to produce even moderate recruitment (ASMFC 2008: 488). Annual estimates of recruitment for Chowan River blueback herring and Chowan River alewife are significantly lower than both species' historic recruitment (ASMFC 2008: 508-09, Figures 17 and 18). Estimated average annual recruitment for blueback herring in the period 1999-2003 was 98 percent lower than in the period 1972-1985 (ASMFC 2008: 481; 508, Figure 17). Estimated average annual recruitment for the alewife in the period 1999-2003 was 96 percent lower than in the period 1972-1986 (ASMFC 2008: 481-82; 509, Figure 18). The SSBs for the alewife and the blueback herring populations in the Chowan River indicate a rapidly decreasing trend for both species (ASMFC 2008: 482).

Annual catch curve analyses for blueback herring and for alewives in the Chowan River suggest a high total mortality, averaging 1.44 for blueback herring and 1.48 for alewives from 1972 to 2003 (ASMFC 2008: 480-81). Cohort based catch curves plotted by fishing year illustrate both the steep decline in abundance and the relative similarity of the declining slopes of each blueback herring and alewife cohort (ASMFC 2008: 480-81).

According to the ASMFC (2008), available data from the Chowan River pound net fishery indicated a decline in mean sizes of male and female alewives and of male and female blueback herring (ASMFC 2008: 35). Female and male alewives and blueback herring sampled from 2004 to 2007 were approximately 15 to 20 millimeters smaller, on average, than alewives and blueback herring of the same sex sampled from 1971 to 1978 (ASMFC 2008: 35). Trend analysis indicates significant decreases in mean length-at-age for males and females ages 3 to 6 for both species (ASMFC 2008: 37). Mean sizes of male and female alewives and bluebacks from ages 4 through 6 have stayed low or continued to trend lower since the statewide harvest moratorium was implemented in 2007 (NCDMF 2010b: Figures 20 and 21).

The maximum age of male and female blueback herring in the Chowan River was generally greater than age 7 prior to 1984 but declined thereafter to age 6 to age 7 through 2003 (ASMFC 2008: 36). Since 2003, the maximum age of Chowan River blueback herring has declined further to ages 5 to 6 (ASMFC 2008: 36). Similarly, the maximum age observed for male and female alewives in the Chowan River ranged from age 6 to age 9 prior to 1983, but declined to ages 6 to 7 by 2005 (ASMFC 2008: 36). Since the statewide moratorium on harvesting both species was implemented in 2007, maximum ages for both species have remained low. Sampling in the Chowan River in 2009 showed a maximum age of 6 in males and 7 in females for both blueback herring and alewives (NCDMF 2010b: Tables 36 and 37). In that Chowan River sampling, virgin fish – first time spawners – comprised 80 percent of bluebacks and 69 percent of alewives; about 2 percent of bluebacks were repeat spawners and 11 percent of alewives were repeat spawners (NCDMF 2010b: Tables 36 and 37).

Sampling in Albemarle Sound in 2009 showed a maximum age of 7 for female bluebacks and 6 for male bluebacks, and 7 for both male and female alewives (NCDMF 2010b). In the same

2009 sampling, virgin fish comprised 71 percent of bluebacks and 52 percent of alewives; about 5 percent of bluebacks were repeat spawners and 16 percent of alewives were repeat spawners (NCDMF 2010b: Tables 38 and 39).

A downward trend in annual JAIs for both alewives and blueback herring in the Albemarle Sound is apparent in recent years (ASMFC 2008: 476). Fishery-independent surveys from 1972 to 2004 show a decline in the blueback herring JAIs to levels near zero since the mid 1990s (ASMFC 2008: 476). The average annual blueback herring JAI for 1972 to 1985 was over 75 percent higher than its level in 2004 (ASMFC 2008: 519, Figure 5). The annual JAIs for Albemarle Sound alewives also show a similar decline, with JAIs levels near zero during the early 1990s (ASMFC 2008: 519, Figure 6). The alewife JAIs have continued to fluctuate at historically low levels since the mid 1990s (ASMFC 2008: 519, Figure 6). This trend has not reversed since the harvest moratorium was implemented in 2007. According to recent data available on the NCDMF website, the Albemarle Sound JAIs from 2000 to 2010 for bluebacks averaged 3.11 and for alewives averaged 0.98 (NCDMF 2011; NCDMF 2010b: Table 40); the average from 2007 through 2010 for blueback herring was 1.05, and for alewives was 1.07 (NCDMF 2011; NCDMF 2010b, Tables 40 and 41).[28] The mean JAI for bluebacks from 1972 to 1980 was180.52; the mean for the same time period for alewives was 5.7 (NCDMF 2010b; Tables 40 and 41).

South Carolina Rivers (Santee-Cooper River System)

Both the alewife and the blueback herring historically occurred in most of South Carolina‘s major rivers (ASMFC 2008: 537; SCDNR 2010a). However, only the blueback herring presently occurs in South Carolina waters (ASMFC 2008: 537). Alewife populations in South Carolina are believed to be extirpated, as no alewives have been documented in waters south of North Carolina in recent years (ASMFC 2008: 537). Historical distribution records and anecdotal information on abundance strongly indicate that all populations of alosines, including the blueback herring, in South Carolina are reduced compared to historic levels (USFWS/SCDNR 2001).

Commercial landings data from South Carolina indicate that the average amount of blueback herring landed per year has declined 75 percent over the last decade, from an average of 392,274 pounds of blueback herring per year from 1995 to 2000 to an average of 96,619 pounds of blueback herring per year from 2001 to 2007 (ASMFC 2008: 556, Table 13.2). Historically, blueback herring were even more numerous: more than 2.2 million pounds of bluebacks – over 1,000,000 kg – were harvested in 1969 (SCDNR 2010a: 3; ASMFC 2008: 545, 556, Table 13.2).[29]

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[28] The slight increase in alewife JAI is the result of a spike up in 2010 (NCDMF 2011).

[29] These data appear to be based on commercial creel surveys conducted by SCDNR starting on the Santee River in 1969, although they may include data reported to NMFS as well (SCDNR 2010a: 2-3; ASMFC 2008: 543-44). The wholesale dealer reporting system utilized by NMFS probably did not include inland landings before 1979 and may not include all herring landings because herring sold as bait to licensed bait dealers may not be reported (SCDNR 2010a: 2; ASMFC 2008: 543-44). Although landings (in weight and numbers of fish) are estimated based on number of bushels (using the average weight of a bushel and the average weight of a blueback herring in South Carolina) and some landings are

Available data indicates an overall decreasing trend in mean length for male bluebacks in the Santee Rediversion Canal (ASMFC 2008: 126, Figure 1.7.2; 559, Table 13.6); these trends continued in 2009 (SCDNR 2010a: 20). Available data also indicates a decline in mean weight of blueback herring in South Carolina rivers since the late 1990s (ASMFC 2008: 557, Tables 13.4 and 13.5).

Blueback herring are currently managed by the SCDNR in the Winyah Bay tributaries (the Sampit, Lynches, Pee Dee, Bull Creek, Black, and Waccamaw Rivers) and in the Santee-Cooper Rivers complex (SCDNR 2010a). Recreational fisheries also exist on the Ashepoo River, the Combahee River, the Edisto River, and the Savannah River (SCDNR 2010a: 3). The bulk of the reported landings since 1989 have come from the Santee-Cooper system. Reported landings for the Pee Dee River of the Winyah Bay system have remained at less than 1,200 pounds per year – 500 kg – since mandatory reporting was initiated in 1998 (SCDNR 2010a: 3). A declining trend has been observed in the commercial CPUE estimates for blueback herring in the Santee River (ASMFC 2008:86, Table 1.13.1; SCDNR 2010: Figure 3).

Florida Rivers (St. Johns River)

A blueback herring population in the St. Johns River in Florida is the southernmost blueback herring population in the United States (ASMFC 2008: 586). Blueback herring have been largely ignored by fishermen in Florida, and there is no recorded Florida fishery for blueback herring (ASMFC 2008:586).

Electrofishing CPUE for blueback herring in the St. Johns River declined precipitously from 2001 to 2002 and remains at very low levels (ASMFC 2008: 30; 114, Figure 1.6.3.3).

B. Distinct Population Segments

For vertebrate species, the ESA defines species to include ―distinct population segments" or DPSs. *See* 16 U.S.C. § 1532 (defining ―species" to include a ―distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature"). To determine the existence of a DPS, NMFS considers the ―1) discreteness of the population segment in relation to the remainder of the species or subspecies to which it belongs; [and] 2) the significance of the population segment to the species or subspecies to which it belongs." *See Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act,* 61 Fed. Reg. 4722, 4724 (Feb. 7, 1996) (―*DPS Policy*").

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occasionally missed during the creel survey, the survey is intended to produce the most reliable estimates of catch and effort available for South Carolina waters (SCDNR 2010a: 2; ASMFC 2008: 544). In 1998, SCDNR mandated reporting of commercial catch and effort, but questions regarding the reliability of these data have hindered successful development of total catch and effort statistics by river from these data. (SCDNR 2010a: 2; ASMFC 2008: 543-44). These by-river reporting data appear to be the basis of 2009 catch statistics included in South Carolina's 2009 annual report to the ASMFC on the status of its river herring fishery (SCDNR 2010b: 33, Table 3).

A population segment is considered ―discrete” if it is ―markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.” *See, e.g., Northwest Ecosystem Alliance v. United States Fish & Wildlife Serv*., 475 F.3d 1136, 1150 (9th Cir. 2007). The meaning of ―markedly” in this context is ―appreciably.” *See Nat'l Ass'n of Home Builders v. Norton*, 340 F.3d 835, 851 (9th Cir. 2003). ―Appreciably,” in turn, means "capable of being perceived or measured." *See Merriam-Webster Online Dictionary* (2009).

A population segment is considered significant based on: 1) ―persistence of the discrete population segment in an ecological setting unusual or unique for the taxon,” 2) ―evidence that loss of the [DPS] would result in a significant gap in the range of a taxon,” 3) ―evidence that the [DPS] represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range, or” 4) ―evidence that the [DPS] differs markedly from other populations of the species in its genetic characteristics.” *See Home Builders*, 340 F.3d at 851. These factors are non-exclusive; if any one factor is satisfied, a discrete population must be considered significant. *See Maine v. Norton*, 257 F. Supp. 2d 357, 388 (D. Me. 2003). A ―gap in the range of a taxon” is defined as ―empty geographic space in the range of the taxon.” *Home Builders,* 340 F.3d at 846 (upholding FWS‘ ―gap in the fence” interpretation as reasonable). A gap may be considered if it would ―decrease the genetic variability of the taxon,” substantially reduce the current geographical or historical range of the taxon, result in a gap at the edge of the species range, or cause the loss of a population that is numerous and a large percentage of total taxon members. *See id.*

If a population segment is discrete and significant, then it is a distinct population segment and must be evaluated for endangered and threatened status. It ―may be appropriate to assign different classifications to different [DPSs] of the same vertebrate taxon.” *DPS Policy* at 4724.

1. If NMFS Does Not List the Alewife and the Blueback Herring Each as Threatened Species as a Whole, NMFS Should Designate Four DPSs of Alewife and Three DPSs of Blueback Herring as Described in this Petition or as Determined by NMFS.

If NMFS does not list the alewife and the blueback herring as threatened species as a whole, the agency should designate four DPSs of alewife and three DPSs of blueback herring as follows: Central New England DPS of alewife, Long Island Sound DPS of alewife, Chesapeake Bay DPS of alewife, and the Carolina DPS of alewife; Central New England DPS of blueback herring, Long Island Sound DPS of blueback herring, and Chesapeake Bay DPS of blueback herring. These DPSs are described as follows and depicted in Figures 3 and 4:

Central New England DPSs for alewives and for blueback herring:
River systems in these DPSs include the Winnicut River; Exeter River; Cocheco River; Taylor River; Oyster River; Lamprey River; and Parker River.

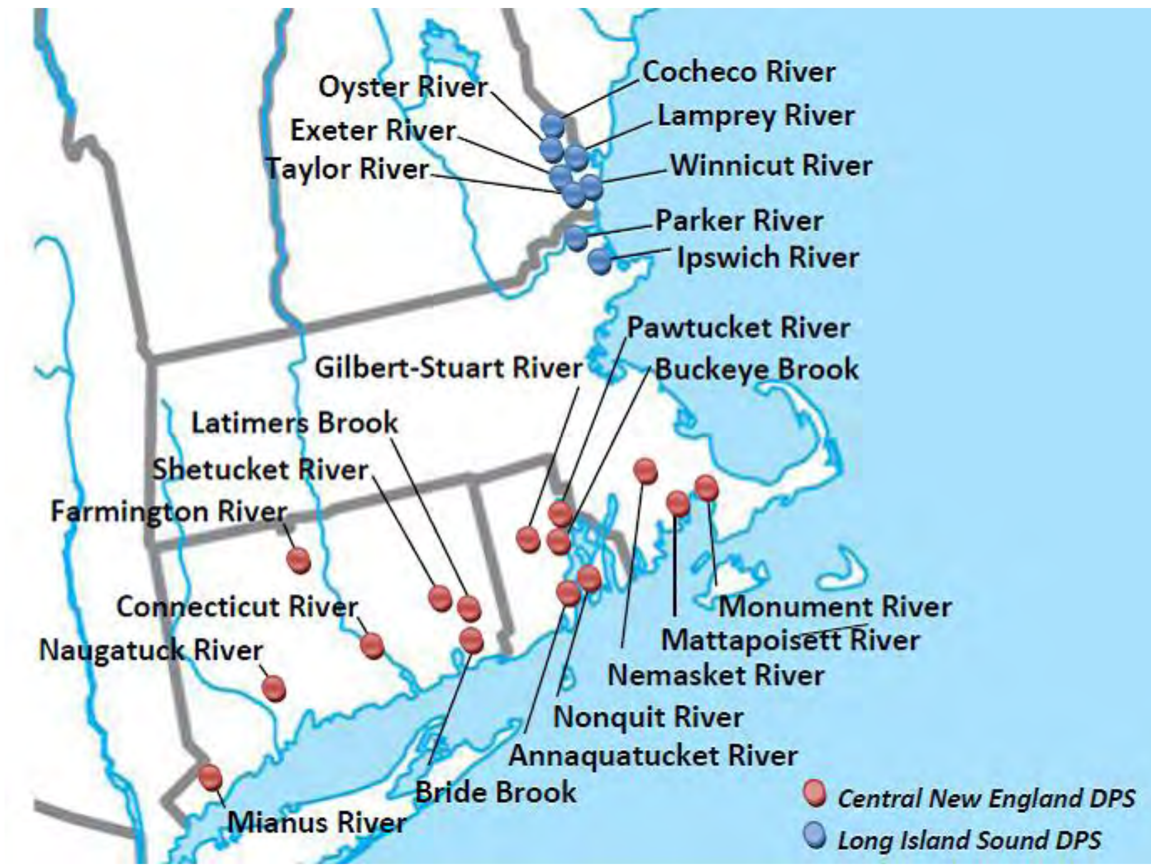
Long Island Sound DPSs for alewives and for blueback herring:
River systems in these DPSs include the Monument River; Nemasket

River; Mattapoisett River; Shetucket River; Farmington River; Connecticut River; Naugatuck River; and Mianus River.

Chesapeake Bay DPSs for alewives and blueback herring: River systems in these DPSs would include the Nanticoke, Potomac, Susquehanna, Rappahannock, York, and James Rivers.

Carolina DPS for alewives: River systems in this DPS include the Roanoke River, Chowan River and Albemarle Sound; Pamlico Sound/Pamlico/Tar and Neuse Rivers; Cape Fear River; Winyah Bay/Waccamaw, Pee Dee, and Sampit rivers; Santee River; and Cooper River.

Figure 3: Proposed Central New England and Long Island Sound DPSs



These DPSs encompass fish that originate from a river within the DPS and include the marine range of such fish. NMFS may modify the boundaries of the requested DPSs based on its technical expertise.

The requested four DPSs of alewife and three DPSs of blueback herring are discrete pursuant to the ESA for the following reasons. The alewife populations and the blueback herring populations in each of these DPSs are behaviorally and physiologically discrete from other members of their respective taxon because they return to their natal rivers in their specific DPS to spawn, which leads to separation by river. As discussed *supra*, evidence indicating that alewives maintain fidelity to their natal rivers and do not stray to adjacent rivers during their spawning runs supports reproductive isolation among alewife and blueback herring populations according to their natal rivers (Messieh 1977; NOAA 2009).

Figure 4: Proposed Chesapeake Bay and Carolina DPSs

Like other anadromous fish, and as NMFS similarly discussed in recently listing a DPS for the eulachon, a Pacific anadromous herring (NMFS 2009c: 74 Fed. Reg. 10857, 10861), populations of alewives and blueback herring have adapted to the unique ecological features, *i.e.*, selective pressures, of their different freshwater/estuarine environments by developing distinguishable behavioral and physiological traits. For example, evidence indicates that northern populations of alewives have a greater tolerance for colder water temperatures than southern populations of alewives, due to antifreeze activity in the blood of the fish in the northern populations that is lacking from the blood of members of more southern populations (Duman and DeVries 1974). Variation in spawning timing among rivers is also indicative of local adaption. Moreover, if sporadic straying does occur, available evidence indicates that individual fish will only stray to adjacent streams or return to a nearby stream in which they were previously extirpated (ASMFC 2008; NOAA 2009).

The geographic distance between each DPS maintains the behavioral and physiological discreteness of the alewife and blueback herring populations in each DPS because it isolates the alewife and blueback herring populations in each DPS from those populations in other DPSs and leads to local adaptations in the fish populations. For example, in 2005, a biological review team (―BRT") studying the status of Atlantic salmon populations along the northern Atlantic coast delineated three DPSs of Atlantic salmon – the Gulf of Maine (―GOM"), Central New England (―CNE"), and Long Island Sound (―LIS") DPSs– based mostly on physiogeographic differences in aquatic environments and the geographic separation between each DPS (Atlantic Salmon BRT (―ASBRT") 2006). The 2005 BRT found that ―marine communities to the north of Cape Cod are shaped by substantially different physical factors and thermal regimes than those to the south" and that the ―nearshore areas north of Cape Cod are rockier and colder than those south of Cape Cod" (ASBRT 2006: 38). In contrast, the southerly latitude of LIS and its shallow nature (24 m average depth) provide substantially warmer nearshore waters than in the Gulf of Maine through which juvenile and adult fish would have to migrate (ASBRT 2006). This thermal regime likely imposes different time windows for juveniles and adults to use to successfully complete their migrations (ASBRT 2006: 41). In addition, groundwater temperatures are also generally higher in the LIS DPSs than in more northern DPSs (Meisner *et al.* 1988 and Meisner 1990, as cited in ASBRT 2006). Warmer groundwater influences the ecological factors such as food availability, assimilation efficiency, and ultimately growth rates (Allan 1995, as cited in ASBRT 2006). Historically, this likely resulted in proportionally younger juveniles being produced in the LIS DPSs than in DPSs to the north because smolt age is strongly linked to temperature (Forseth *et al.* 2001, as cited in ASBRT 2006). These local differences in both freshwater and nearshore temperature regimes likely resulted in local adaptations (*S*, run timing) that differed substantially from stocks to the north (ASBRT 2006).

Furthermore, the significant geographic distance between the CNE and the LIS DPSs described herein, as well as the barrier resulting from Cape Cod, makes it highly likely that any potential straying of individual alewife or blueback herring will occur solely within a specific alewife or blueback herring DPS, rather than between such DPSs. This phenomenon further increases the discreteness of the DPSs. For example, the 2005 BRT found that Atlantic salmon populations in the LIS and CNE DPSs were distinct due to the geographic separation between the DPSs and their relative isolation (ASBRT 2006).

The area encompassed by the Central New England DPSs is also distinguishable from areas to the north based on ecological factors. For example, the northern Gulf of Maine area (*i.e.*, the area along the Atlantic Coast that includes the Penobscot-Kennebec-Androscoggin and more northern ecological drainage area) differs from the Central New England area (*e.g.*, Saco-Merrimack-Charles, Lower Connecticut, Middle Connecticut, and Upper Connecticut) with regard to basin geography, climate, groundwater temperatures, hydrography, and zoogeography (NMFS 2009b: 74 Fed. Reg. 29344, 29346). These differences are believed to have had a

―strong effect” upon Atlantic salmon ecology and production (NMFS 2009b: 74 Fed. Reg. 29344, 29346), and it is probable that these differences exert a similar influence upon other species of anadromous fish such as the alewife and the blueback herring. These differences ―would influence the structure and function of aquatic ecosystems [in the northern Gulf of Maine area] … and create a different environment for the development of local adaptations than [existed in] rivers, such as the Saco and Merrimack, to the south” (NMFS 2009b: 74 Fed. Reg. 29344, 29346).

To similar effect, in designating a Chesapeake Bay DPS for Atlantic Sturgeon, NMFS found the area was ―markedly separate” from areas to the north and south ―as a consequence of physical factors” (NMFS 2010b: 75 Federal Register 61872, 61876). And in designating a Carolina DPS for Atlantic Sturgeon in 2010, NMFS emphasized that it believed the distinction it was drawing between a Carolina DPS and a Southern Atlantic DPS to the south was supported by the Nature Conservancy‘s determination that those two areas were separate and distinct from one another by way of habitat, climate, geology, and physiographic characteristics of the region (NMFS 2010c: 75 Fed. Reg. 61904, 61909). Relative to the more northern proposed DPSs, the Chesapeake DPSs and the Carolina DPSs encompass populations exposed to warmer water temperatures and other different ecological factors; exposure to these relative physical extremes is likely to have created selection pressures that influence the distribution of genotypes in these populations.

These four DPSs of alewife and three DPSs of blueback herring are significant pursuant to the ESA because alewives and blueback herring are each found in these four unique ecological settings.[30] In each of these settings, the ecological significance of the alewife and/or blueback community extends beyond the unique features of the populations themselves and includes the ecosystem context in which they are located. As cornerstone forage species in these ecosystems, both alewives and blueback herring play a vital role in the estuarine and riverine food web. The collapse of the populations in each of these DPSs unquestionably impacts other species to which it is trophically linked. Given the importance of the four unique ecological settings in supporting numerous other at-risk populations and species, a loss of the populations of either blueback herring in the three requested DPSs or alewives in the four requested DPSs would represent a significant impact to conservation of other endangered and/or threatened species.

Available data also indicates that alewife and blueback herring populations are each unlikely to stray to rivers beyond their existing DPS; and, due to low gene flow among populations, the loss of one or more of these populations could negatively impact the species as a whole. Since there is little gene flow among populations from different rivers and estuaries, the loss of even a single population – and certainly the loss of the populations within the entirety of any of the requested DPSs – will result in the removal of a section of the species‘ range where it has been viable and will therefore reduce the genetic diversity of the taxon as a whole. This is especially significant given the expected changes in climate and habitat due to global warming. The ability of the alewife and the blueback herring to each adapt to climate change depends on genetic and

[30] As NMFS noted in proposing DPSs for the Atlantic Sturgeon in 2010, the Central New England DPS, Chesapeake Bay DPS, and the Carolina DPS each persists in unique ecological taxon, as each proposed grouping is found in a separate and distinct ecoregion identified by The Nature Conservancy (NMFS 2010b: 75 Federal Register 61872, 61877; NMFS 2010c: 75 Fed. Reg. 61904, 61909).

geographic diversity, as maximum gene variation increases the odds that genes will carry traits amenable to climate change adaptation, such as for thermal tolerance.

Specifically, the Central New England DPSs for the alewife and for the blueback herring are significant because of the abundant populations of alewives and bluebacks that historically occurred (and served as a significant bait source for commercial and recreational fisheries) in rivers within the boundaries of these DPSs (NHFGD 2009: 3, 16, Table 1-1). For example, the Taylor River in New Hampshire was once home to a run of almost a half million river herring, and the Oyster River saw more than 100,000 river herring annually make their way upriver to spawn as recently as the 1990s (NHFGD 2009: 16, Table 1-1; NHFGD 2011a). Although the runs in these two rivers – a few decades ago, the two largest in the DPSs -- have been decimated, they remain important with the Oyster containing a run of approximately fifteen thousand fish (reportedly dominated by bluebacks) (NHFGD 2011). The Central New England DPSs contain other important alewife populations, including the Cocheco and the Lamprey in New Hampshire.

For alewives in particular, many of the rivers in the Central New England DPS were historically key spawning habitat and the populations in these rivers were a key part of why this species is of such cultural and historical importance for the region. Historically important rivers in this DPS like the Parker River in Massachusetts still retain spawning populations of alewives, even if at a small fraction of their historic size.

The Long Island Sound DPSs for both the alewife and the blueback herring are significant given the numerous intact spawning populations of alewife and blueback herring in the Connecticut River system, which has the largest drainage basin in Long Island Sound, and in other river systems within the DPSs. The Connecticut River has recently supported the largest known population of spawning blueback herring north of the Chesapeake Bay. Several historically and currently important Massachusetts spawning rivers – the Nemasket, the Monument, and the Mattapoisett rivers – also drain to LIS and would be included in these DPSs. River herring were historically one of the most valuable anadromous fishes harvested and sold commercially in Massachusetts (MADMR 2011: 2). Fish counts on the Monument once numbered more than half a million alewives and almost 100,000 blueback herring, and Mattapoisett River alewife counts numbered in the 100,000s as recently as the late 1990s (ASMFC 2008: 195, Table 4.3; MADMF 2011: 52, Appendix Table 4). The Nemasket River has seen an average of almost 800,000 counted spawning alewives annually since 2000 (MADMF 2011: 52, Appendix Table 4).

The Chesapeake Bay DPSs for both the alewife and the blueback herring are significant as demonstrated by the region‘s unparalleled historic river herring fishery. An average of more than 28 million pounds of alewife and blueback herring were commercially landed per year in Virginia and Maryland from 1950 to 1970, and during these peak harvest years Virginia consistently boasted the highest river herring catches of any state (ASMFC 2008: 55-57, Table 1.5.1.1). The traditional river herring fisheries have cultural significance (ASFMC 2008: 453; SRAFRC 2010: 8); in Virginia, alewives are generally the first anadromous species available for harvest each year, and the spring spawning runs of both alewives and blueback herring are important cultural and culinary events (ASFMC 2008: 453). Although commercial fisheries in this region have declined, populations persist in rivers that drain to the Bay.

The Carolina DPS for alewife is significant because of both its historical importance (it boasted the second largest river herring catches in the peak harvest period from the 1950s to 1970s (ASMFC 2008: 55-57, Table 1.5.1.1)) and its remaining population levels, based on available data. Although now much depleted, sampling in the Chowan River and Albemarle Sound in 2009 showed alewives continuing to spawn in the region. In the Chowan River, alewives had a maximum age of 6 in males and 7 in females, and 11 percent of alewives were repeat spawners (NCDMF 2010b: Tables 36 and 37). In Albemarle Sound, samplers found alewives as old as 7; 16 percent of alewives were repeat spawners (NCDMF 2010b: Tables 38 and 39). The Carolina DPS is also significant because it is comprised of the southernmost populations of alewives that are at the highest risk of extirpation, given that alewives are currently absent from rivers where they spawned historically in the southernmost portion of this DPS, as well as in waters south of this DPS.

In the alternative, NMFS should delineate alewife DPSs and blueback herring DPSs based on its expertise and list each DPS pursuant to the ESA listing criteria.

III. The Alewife and the Blueback Herring Satisfy the Statutory Criteria for Listing as Threatened Species

To determine whether a species is endangered or threatened, NMFS must consider five statutorily prescribed factors:

> (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.

16 U.S.C. § 1533(1)(A)-(E). The agency ―must consider each of the listing factors singularly and in combination with the other factors." *Carlton v. Babbitt*, 900 F. Supp. 526, 530 (D.D.C. 1995). ―Each factor is equally important and a finding by the Secretary that a species is negatively affected by just one of the factors warrants a non-discretionary listing as either endangered or threatened." *Nat'l Wildlife Fed. v. Norton*, 386 F. Supp. 2d. 553, 558 (D. Vt. 2005) (citing 50 C.F.R. § 424.11(c)). Likewise, a species must be listed if it is endangered or threatened because of ―a combination of" factors. *See, e.g.,* 50 C.F.R. § 424.11(c).

As further discussed below, the alewife and the blueback herring and each of the requested DPSs are likely to become an endangered species within the foreseeable future in all or a significant portion of each species' ranges as a result of the statutorily-prescribed factors.

A. Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Alewives and blueback herring, like all anadromous fish, are vulnerable to a variety of habitat impacts because they use rivers, estuaries, bays, and ocean waters at various points of their life. Habitat alterations potentially affecting alewives and blueback herring include dam construction and operation, dredging and disposal, and water quality modifications such as changes in levels of DO, water temperature, and contaminants. Loss of habitat and impaired water quality has contributed to the decline of the alewife and the blueback herring since colonial times, and climate change poses an increasing threat to both species.

Industrial development adjacent to waterways along the Atlantic coast contributed to early declines in alewife and blueback herring populations. For example, the construction of mill dams and other blockages prohibited the upstream migration of alewives and blueback herring and significantly reduced their spawning habitat (Watts 2003; ASMFC 2008). In addition, industrial pollution degraded the water quality in coastal rivers and rendered many waters unsuitable as spawning and nursery habitat (Watts 2003; ASMFC 2008). Increased wastewater discharges from a rapidly-expanding population along the Atlantic seaboard, particularly from coastal cities, further impaired many water bodies, including through the formation of dissolved oxygen blocks that prohibited the migration of alewives and blueback herring (ASMFC 2008).

1. Dams and Turbines

Dams are significantly impairing populations of alewife and blueback herring by blocking access to spawning and foraging habitat, changing water flow, quality and temperature, and physically injuring and killing fish as they migrate. Dams, particularly hydropower dams (those associated with hydroelectric facilities that respond to daily changes in electricity use), often produce daily water flows and temperatures that substantially differ from natural seasonal flows. Variations in natural seasonal water flows and temperatures can disrupt productivity and availability of zooplankton needed for larval and early juvenile forage for fish such as alewives and blueback herring (USFWS/SCDNR 2001; Limburg 1996: 223, 232, 235; ASMFC 2009b: 344 and Chapter 4). Flow variations can also adversely affect the survival of larvae and young juveniles by displacing eggs and/or larvae from otherwise highly productive habitats and disrupting both upstream and downstream migration patterns for adult and juvenile alosines (ASMFC 1999; USFWS/SCDNR 2001; ASMFC 2009b: 344 and Chapter 4). Low flows can reduce the suitability of habitat for spawning by reducing minimum flows or dewatering otherwise productive habitats (ASMFC 1999; NMFS 1998; USFWS/SCDNR 2001). Too much water flow also poses a problem at dams with fishways, adversely affecting juvenile migration; at one South Carolina dam, congregating adult blueback herring were unable to locate the entrance to the fish passage due to high turbulence caused by dam discharges (ASMFC 2009b). Water releases from deep reservoirs may be poorly oxygenated and/or of below normal seasonal water temperature, thereby causing loss of suitable spawning or nursery habitat in otherwise suitable river reaches, and thermal effluent from power plants can cause disruptions of fish schooling behavior, disorientation, and death (ASMFC 1999; NMFS 1998; ASMFC 2009b: 344; USFWS/SCDNR 2001). Other problematic water quality changes often related to dams include accelerated eutrophication, artificially destratified waters, and changes in sediment loads and nutrient cycling (ASMFC 1999; NMFS 1998; USFWS/SCDNR 2001; ASMFC 2009b: 344)

Damming rivers used by alewives and blueback herring can result in the loss of access to significant portions of their spawning and foraging habitat. Dams, both hydropower and other types, have cut off access to large portions of alewife and/or blueback herring habitat in such rivers as the Sebasticook, Taylor, Delaware, Susquehanna, and Santee-Cooper.

Entrainment in turbines also causes injury and mortality to eggs, larvae, and juvenile and adult alewives and blueback herring as they drift or migrate upstream and downstream. Turbines can slash migrating fish, harming or killing them, and additional injuries and deaths occur from changing water pressures. Evidence suggests that changes in pressure can have a pronounced effect on juveniles with thinner and weaker tissues as they move through turbines and that, as a result, some fish may die later from stress or become weakened and more susceptible to predation (ASMFC 2009b: 330-31). Turbines are used with both hydropower dams and tidal power plants. Tidal hydroelectric power plants located at the mouths of rivers can directly impact alewives and blueback herring, as well as other anadromous fish, because fish may move into and out of the impacted area with each tidal cycle. Repeated passage into and out of these facilities may cumulatively result in substantial overall mortalities (ASMFC 2009b: 333).

2. Dredging and Blasting

Dredging and blasting operations in riverine, coastal, and offshore areas are a significant threat to the alewife and the blueback herring. These operations are conducted to support commercial shipping and recreational boating, construction, and mining. Harmful environmental impacts from dredging include direct removal/burial of organisms; turbidity/siltation effects; contaminant resuspension; noise/disturbance; alterations to hydrodynamic regime and physical habitat and actual loss of riparian habitat. Specific impacts to important habitat features for the alewife and the blueback herring include increased levels of suspended sediments, changes in water velocities, and alteration of substrates (ASMFC 2009b). Migrating adult alewives and blueback herring have been found to avoid channelized areas with increased water velocities (ASMFC 2009b: 349). Migrating alosines are known to avoid waters with high sediment loads (ASMFC 2009b: 349). The alewife and the blueback herring, as well as other filter-feeding fish, can be negatively impacted by suspended sediments on gill tissues, which can clog gills that provide oxygen and result in lethal and sub-lethal effects to the fish (ASMFC 2009b: 349).

Indirect harm to the alewife and the blueback herring resulting from dredging can include disruption of spawning migrations, releases of contaminants, reduced DO levels, and deposition of re-suspended sediments in spawning habitat. Siltation from dredging can reduce spawning success by causing mortality of eggs or by coating substrates needed for attachment of adhesive eggs (NMFS 1998). Dredging operations that include the draining and filling (or both) of wetlands adjacent to spawning habitat can harm alewives and blueback herring by adversely modifying spawning habitat. Survival of larval alosines decreases as turbidity or suspended sediments increase above 50 mg/l (USFWS/SCDNR 2001).

3. Water Quality

Adverse water quality conditions have resulted in, and will continue to result in, the loss and adverse modification of alewife and blueback herring habitat and significant harm to both species. Water quality threats to the alewife and the blueback herring include hypoxia (low oxygen), due in part to high nutrient loadings; toxic and/or bioaccumulative pollutants, including metals and organic chemicals; excessive runoff of silt and soil; and harmful changes to water temperature and flow (ASMFC 2009b). These water quality threats are the result of activities both in riparian zones and in watersheds as a whole, including nutrient runoff and erosion from residential and industrial development; discharges of toxic pollutants and changes to water temperature and flow as a result of industrial activities; and erosion, runoff of nutrients and agricultural chemicals, and changes to water flow as a result of agricultural and forestry activities (ASMFC 2009b). Poor water quality alone can significantly impact an entire population of alewife or blueback herring. For example, it is believed that the heavy organic loading near Philadelphia, Pennsylvania during the 1940s and 1950s caused severe declines in DO levels and made parts of the lower Delaware River uninhabitable for the alewife and the blueback herring during the warmer months of the year (ASMFC 2008: 392).

Hypoxic water quality conditions pose a particular threat to the alewife and the blueback herring. Both the minimum dissolved oxygen concentration for alewife and blueback herring eggs and larvae and the suggested minimum dissolved oxygen concentration for adult alewives and blueback herring are 5.0 mg/L (ASMFC 2009b). Adult and juvenile alewives become stressed when dissolved oxygen concentrations drop below 3.0 mg/L and 2.0 mg/L, respectively (ASMFC 2009b). Hypoxic water quality conditions in alewife and blueback herring habitat have generally increased in spatial extent and frequency over the last century (ASMFC 2009b: 149). According to the ASMFC (2008), there is a historical correlation between low alewife and blueback herring abundances and an increase in hypoxic conditions. A lack of dissolved oxygen can significantly affect the abundance of anadromous fish generally (ASMFC 2009b: 344). It can also prevent migration upriver or prevent adults from migrating to sea and returning to spawn (ASMFC 2009b: 344). Everett (1983) found that, during times of low water flow when pulp mill effluent comprised a large percentage of the flow, alewives and blueback herring avoided the effluent (ASMFC 2009b). Pollution may be diluted when the water flow increases, but fish that reach the polluted waters downriver before water has flushed the area will typically succumb to suffocation (Miller *et al.* 1982, as cited in ASMFC 2009b).

The alewife and the blueback herring are also susceptible to toxic chemicals and metals that are released into their habitat. The substrate of a significant portion of alewife and blueback herring habitat, particularly habitat near urbanized areas or large industrial discharges, is contaminated with dioxins, polychlorinated aromatic hydrocarbons (―PAHs”), organophosphate and organochlorine pesticides, polychlorinated biphenyls (―PCBs”), and other chlorinated hydrocarbon compounds, as well as toxic metals, such as lead, mercury and arsenic. Alewives and blueback herring are exposed to such contaminants via diet, water, and dermal contact. In 1999, ASMFC (1999: 12) reported that pollution comprised of heavy metals and various organic chemicals had increased over the preceding 30 years in nearly all estuarine waters along the Atlantic coast due to industrial, residential, and agricultural development in the watersheds. This pollution occurs in alewife and blueback herring spawning and nursery habitat and is believed to be harmful to aquatic life (ASMFC 1999:12; NMFS 2010b: 75 Fed. Reg. 61872, 61885).

Effects of chlorinated hydrocarbons and/or metals on fish include acute lesions, growth retardation, malformations, reproductive impairment, reduced egg and larval survival, and behavioral (including homing) impacts (ASSRT 2007; NMFS 2010b: 75 Fed. Reg. 61872, 61885). Exposure to heavy metals specifically can cause increased mortality in fish species, and chronic toxicity can also lead to reproductive failure, changes to physiology, and increased vulnerability to predation and infection (ASSRT 2007; NMFS 2010b: 75 Fed. Reg. 61872, 61885 (noting ―correlation between low abundances of sturgeon during this century and decreasing water quality caused by increased nutrient loading and increased spatial and temporal frequency of hypoxic conditions"). Heavy metals have affected fish species by reducing their reproductive success by as much as a factor of three, and by causing oxidative stress, brain lesions, altered behavior, and vertebrae fragility (ASSRT 2007).

4. Climate Change

Global warming is harming the alewife and the blueback herring and each species' habitat. The severity of these harms will increase in the future. According to NMFS (2009b: 74 Fed, Reg. 29344, 29356), ―[s]ince the 1970s, there has been a historically significant change in climate (Greene *et al.* 2008). Climate warming has resulted in increased precipitation, river discharge, and glacial and sea-ice melting (Greene *et al.* 2008)." More recently, NMFS has specifically acknowledged the adverse effects of climate change on fish species that travel along the Atlantic coast (NMFS 2010b: 75 Fed. Reg. 61872, 61886). For example, a 2005 study found that a ―1 °C increase of water temperature in the Chesapeake Bay would reduce available sturgeon habitat by 65 percent." (NMFS 2010b: 75 Fed. Reg. 61872, 61887). The Intergovernmental Panel on Climate Change (―IPCC") (2007) has concluded that global warming caused by humans is already impacting the habitats and biology of species worldwide. Such effects are occurring faster than scientists had previously predicted (Boesch *et. al.* 2007).

As early as 2001, the IPCC (2001: 670) noted that ―[d]etailed analyses of fish physiological response to water temperature have shown that the potential impact of climate change on freshwater and marine fish is large. . . . High sensitivity to water temperature of fish larval and juvenile stages, combined with the higher susceptibility of headwaters and smaller rivers to air temperature rise, implies important effects of climate change on cold and temperate anadromous species . . . ." More recently, the IPCC (2007: 275) stated that it has a high level of confidence that ―[r]egional changes in the distribution and productivity of particular fish species are expected due to continued warming and local extinctions will occur at the edges of ranges, particularly in freshwater and diadromous species . . . ."

Higher water temperatures as a result of global warming may affect the spatial distribution, migration, and reproduction of alewife and blueback herring populations. As discussed *supra*, for example, the upstream migration of alewives slows as water temperatures rise and has been reported to cease when water temperatures reach 21 degrees Celsius (ASMFC 2009b).

Global warming is also causing increased precipitation in many estuary systems along the Atlantic coast (Kerr *et al.* 2009). In the Northeast United States, annual precipitation is expected to increase by 10 percent (Kerr *et al.* 2009), winter precipitation by 10 to 15 percent (Hayhoe *et al.* 2007), with higher increases in certain areas like Maryland (Center for Integrative Environmental Research (–CIER") 2008). Precipitation in the Northeast has increased 3.3 inches, or 8 percent, over the past 100 years, with eight of the ten wettest years occurring since 1970 and the greatest increases tending to be either near the Atlantic Coast or major bodies of water (Markham and Wake 2005: 16-17). An increase in the number of heavy precipitation events is also predicted (Kerr *et al.* 2009).

The greater intensity of floods, as well as droughts, will lessen the frequency of successful annual reproduction for anadromous fishes (Limburg and Waldman 2009). As discussed *supra,* high and/or fluctuating water flows are believed to adversely affect river herring migration (ASMFC 2009b). For example, global warming is believed to be already changing river flows in New England, resulting in earlier winter/spring seasonal center-of-volume dates because of greater rainfall and earlier snowmelts (Markham and Wake 2005: 11). According to MADMF (2011):

> Changes in weather as a result of climate change can impact many aspects of the alewife and blueback life stages. Changes in rainfall patterns could affect the food production in the nursery areas and cause higher mortality of juveniles as competition for limited zooplankton resources is believed a major factor affecting survival and growth of juveniles (Walton 1983). Such changes can cause shifts in the carrying capacity of a nursery ground and ultimately affect recruitment.

Further, global warming increases the occurrence of and/or severity of hypoxic conditions in estuaries, bays, and rivers (Boesch *et al*. 2007). The capacity of water to absorb oxygen decreases as it warms; in the Chesapeake Bay, for example, the capacity to dissolve oxygen decreases by about 1.1 percent with each degree Fahrenheit that the water warms (EPA ND: 5). Greater precipitation also results in greater discharges of nutrient pollution into rivers and estuaries, leading to increased eutrophication and hypoxic conditions (Howarth *et al.* 2006). These effects have been accelerating in recent years and are expected to continue to accelerate (Howarth *et al.* 2006).

In a recent NMFS study, clear shifts in spatial distribution were observed in the majority of fish stocks studied on the northeast United States continental shelf (Nye *et al.* 2009: 124). Twenty-four of the 36 stocks studied, including the alewife, displayed statistically significant changes consistent with warming, as indicated by a poleward shift in the center of biomass, an increase in mean depth of occurrence, and/or an increase in mean temperature of occurrence (Nye *et al.* 2009: 124). The alewife demonstrated a notable poleward shift in the center of biomass and an increase in mean depth of occurrence (Nye *et al.* 2009: 120). The lack of an increase in mean temperature of occurrence for the alewife suggests that the species shifted their distribution to remain within their preferred temperature range (Nye *et al.* 2009: 125).

The distributional response to higher water temperatures differed between northern populations and southern populations of fish species, with a much larger poleward shift in the center of biomass observed in the southern stocks than in the northern stocks (Nye *et al.* 2009: 124). In response to higher water temperatures, northern populations of fish appeared to respond by shifting to deeper depths and, in general, to experience a range contraction relative to southern populations of fish species (Nye *et al.* 2009: 121,124). Distributional responses were most pronounced in southern species for which their centers of biomass were historically in Southern New England and the Mid-Atlantic Bight, with the center of biomass for most of the southern stocks shifted to the northwest over the time series (Nye *et al.* 2009: 125). Furthermore, because of the influence of temperature as a migratory and reproductive cue, increased temperatures are also likely to substantially alter reproductive timing and possibly reproductive success of many fish species (Kerr *et al.* 2009).

According to Limburg and Waldman (2009), the tendency of most anadromous fish species to segregate out into smaller river-specific populations ―makes them more susceptible to population level extirpations, and, if these extirpations occur serially, species extinction may occur." As NMFS similarly discussed in listing a DPS of the eulachon, a Pacific anadromous herring, because alewives and blueback herring show fidelity to particular spawning rivers, adult and larval/juvenile alewives and blueback herring must respond to local changes in spawning and nearshore-rearing conditions, respectively, and cannot simply shift their ―distribution and geographical center of spawning in response to environmental changes" as fully marine species might (NMFS 2010d: 75 Fed. Reg. 13012, 13017). Moreover, migration between freshwater and the ocean exposes them to sources of harm in two different environments. Limburg and Waldman (2009) note that global warming seems to be pushing anadromous fish towards earlier spawning runs, which may disrupt their established relationships, and may intensify floods and droughts and thereby impair fish reproduction. In listing the Gulf of Maine DPS for Atlantic salmon, NMFS itself has concluded that climate change is already causing environmental changes in the Gulf of Maine, including earlier spring runoff and decreased water flow, and that such changes may be causing changes in run timing for such species as Atlantic salmon.

Global warming is also believed to have caused recent sharp declines in phytoplankton levels, which are down by 40 percent since the 1950s (Borenstein 2010). A sustained decline of phytoplankton threatens the food supply of forage fish species, such as the alewife and the blueback herring, as well as the health of the entire marine ecosystem that depends on forage fish species to convert energy from zooplankton and phytoplankton to sustain larger predatory species.

Other adverse impacts of climate change include (1) as a result of rising sea levels, reduced habitat complexity and quality in alewife and blueback herring spawning and nursery habitat (*e.g.*, Weaver 2009); (2) a further decline in repeat spawners in areas such as North Carolina as energy needs increase for migration because of decreasing habitat quality in downstream areas (Weaver 2009); (3) an increased likelihood that a severe storm will occur during the critical ―hatch-out stage" leading to more frequent year class failures (Gephard ND: 4); (4) increased adverse effects from severe storms as a result of habitat destruction and existing dams (Gephard ND: 4 (for example, when severe storms occur, dams are more likely to fail or allow the release of deleterious substances like sand, oil, plastics and sewage into fish habitat; this is more likely with ―more severe weather predicted with climate change as well as the deterioration of aging dams that were built in the 1800s")); (5) the implementation of flood mitigation measures, such as dikes to counter rising sea levels, that will interfere with migration and impair a variety of habitats (Gephard ND: 6); and (6) increased prevalence and severity of certain marine diseases (Kerr *et al.* 2009; Hoegh-Gulberg *et al.* 2010).

Increasing atmospheric carbon dioxide concentrations are also causing a decrease in ocean water pH (Feely *et al.* 2004). Studies to date indicate that such ―ocean acidification" will generally have negative effects on marine organisms (Kroeker *et al.* 2010). Impacts on fish species such as river herring will be both indirect, such as a result of food web disruptions, and direct. Early fish life stages are considered particularly vulnerable. In a study of early developmental stages of Atlantic herring, Franke and Clemmesen (2011) found that increased carbon dioxide partial pressure in seawater and decreased pH can affect the metabolism of herring embryos negatively and reduce somatic growth of larvae.

The ability of the alewife and the blueback herring to adapt to climate change and ocean acidification depends on genetic and geographic diversity, as maximum gene variation increases the odds that genes will carry traits amenable to climate change and ocean acidification adaptation. Moreover, both species' ability to withstand the stresses that will be brought by climate change and ocean acidification will depend on the species' resilience and relative vitality. Where fish species have both high fertility and mortality, high minimum population sizes may be needed in part to produce enough offspring to buffer against the variability of local environmental conditions that may lead to random ‗sweepstake recruitment'' events where only a small minority of spawning individuals contribute to subsequent generations – and climate change, for example, may intensify extreme weather events like floods and droughts that can lead to such events (NMFS 2009c: 74 Fed. Reg. 10857: 10868-69). Since many alewife and blueback herring populations are disappearing or extremely depleted, climate change and ocean acidification are threats to each of these species as a whole. In part for these reasons, in a recent determination to list another anadromous forage fish, the eulachon, as threatened, climate change specifically was identified as the most significant threat to the species and its habitat (NMFS 2009c: 74 Fed. Reg. 10857: 10870.)

5. Threats to Specific Rivers and Estuaries Affecting the Alewife and the Blueback Herring

St. Croix River

In the mid-1980s, the alewife population in the St. Croix River was estimated at approximately 2.6 million fish (ASMFC 2008). The closures of fishways at the Vanceboro dam in 1988 and at the Woodland and Grand Falls dams in 1995 blocked the upstream migration of alewives(as well as other anadromous fish), preventing them from reproducing (Flagg 2007). Following these closures, the St. Croix alewife population collapsed (ASMFC 2008).

Damariscotta River System

The FWS recently indicated that the fishway at Damariscotta Lake is in need of modification and/or repair (ASMFC 2008). Abnormally high or low water levels at the fishway prevent alewives, especially female alewives, from successfully ascending the fishway (ASMFC 2008).

Kennebec River System

Numerous hydroelectric dams in the Kennebec River and its tributaries present a significant threat to the Kennebec River alewife and blueback herring populations. Even with ―effective" upstream and downstream passage facilities, the MEDMR estimates a loss of 10 percent of migrating American shad, much like alewives, at each main-stem Kennebec River hydropower dam due to turbine entrainment, injury and mortality (MEDMR 2009: 3-1).

The Army Corps of Engineers routinely dredges the lower part of the Kennebec River, and Bath Iron Works conducts maintenance dredging. Dredging, which occurs from November through April, can disrupt the spawning migrations of alewives returning to the Kennebec River and its tributaries.

The head-of-tide to mid-estuary regions of the Kennebec River suffered DO levels of zero ppm during summer months in the late 1960s and early 1970s, causing frequent fish kills (ASSRT 2007). Although DO levels have improved since that time, multiple other water quality problems remain. Dioxin and other dioxin-like compounds were found in fish samples as recently as 2008 and the Kennebec River remains subject to fish consumption advisories (Maine Department of Environmental Protection (―MEDEP") 2006: 4-6, 22; MEDEP 2009: 5-8, 18-21).

Significant salinity changes occurred in the early 1990s in ―the Northwest Atlantic, where … a dramatic shift in shelf ecosystems occurred" (NMFS 2009b: 74 Fed. Reg. 29344, 29376). ―The major shifts observed specifically in the [Gulf of Maine] and Scotian shelf ecosystems in the early 1990s [were] specifically linked to these changes in salinity and lower trophic communities" (NMFS 2009b: 74 Fed. Reg. 29344, 29376). Changes in salinity may hamper the recovery of fish species in the Northwest Atlantic, as it is believed that such changes – specifically, the entrance of cold, low-salinity Arctic waters – in the Northwest Atlantic hampered the recovery of cod after its collapse in early 1990s due to overfishing (NMFS 2009b: 74 Fed. Reg. 29344, 29376). According to NMFS, studies indicate that ―small thermal changes may substantially alter reproductive performance, smolt development, species distribution limits, and community structure of fish populations." (NMFS 2009b: 74 Fed. Reg. 29344, 29377).

Androscoggin River

Numerous hydropower dams between the head-of-tide and spawning and nursery habitat exist on the main stem of the Androscoggin River and on the Little Androscoggin River (ASMFC 2008). These hydropower stations are believed to have significant negative impacts on the survival of downstream adult alewife and blueback herring migrations (ASMFC 2008). These hydropower stations are assumed to significantly impact survival of downstream adult migration of the Androscoggin alewife and blueback herring populations (ASMFC 2008).

The head-of-tide to mid-estuary regions of the Androscoggin Rivers suffered DO levels of zero ppm during summer months in the late 1960s and early 1970s, causing frequent fish kills (ASSRT 2007). Although DO levels have improved since that time, multiple other water quality problems remain and adversely affect the population. For example, the Androscoggin holds the record for the highest levels of dioxin found in fish in the state of Maine. Dioxin and other dioxin-like compounds were found in fish samples as recently as 2008 and the river remains subject to fish consumption advisories (NMFS 20101b: 75 Fed. Reg. 61872, 61885; MEDEP 2006: 4-6, 15-20; MEDEP 2009: 5-8, 15-17).

New Hampshire Rivers

In 2008, the EPA concluded that bacterial and nutrient contamination, toxic contaminants, the loss or fragmentation of habitat, and degraded salt marshes remain high-priority problems for fish and other wildlife inhabiting New Hampshire rivers and estuaries (EPA 2008). These problems are, in large part, the result of a recent rate of population growth in the surrounding area that has been six times the rate for coastal counties in the Northeast as a whole (EPA 2008).

Water quality in New Hampshire rivers and estuaries is relatively poor when compared to other Gulf of Maine coastal areas in the EPA's National Estuary Program (EPA 2008). Non-point source pollution (*e.g.*, stormwater runoff) affects the majority of alewife and blueback herring habitats in New Hampshire and is a major factor affecting the water quality of the Taylor River and other coastal rivers in southern New Hampshire (EPA 2008).

Nutrient pollution in particular has been a growing problem in New Hampshire waterways. NHFGD (2011) cited eutrophication in the impoundment on the Oyster River, which serves as nursery habitat, as well as the use of the river for water supply, as possible reasons for the decline of river herring in the river since the mid-1990s. Poor water quality was also documented in nursery habitat above the Great Dam in the Exeter River (NHFGD 2011). Between 1992 and 2001, nitrogen concentrations increased in the Lamprey River and other rivers around the Great Bay (EPA 2008). According to a 2009 report, the total nitrogen load to the Great Bay Estuary increased by 42 percent in the prior five years, dissolved inorganic nitrogen concentrations increased in Great Bay by 44 percent in the past 28 years, and dissolved oxygen concentrations have consistently failed to meet water quality standards in tidal rivers (Piscataqua Region Estuaries Partnership (―PREP") 2009: 3-4). The significant and continuing population growth in these areas – development has created new impervious surfaces at an average rate of nearly 1,500 acres per year in recent years (PREP 2009: 3, 26) – further suggests that rivers in these areas have an increased risk of eutrophication in the future.

Finally, the fragmentation of open lands due to new roads and sprawling patterns of development pose substantial threats to habitat and hydrologic functions in New Hampshire's coastal watershed (EPA 2008).

Massachusetts Rivers

MADMF (2004) (2005) discussed the multiple obstructions to passage of alewives and blueback herring to spawning habitat on multiple rivers and streams in the state.

Buzzards Bay (Monument River and Mattapoisett River)

In 2007, the EPA rated the sediment toxicity in Buzzards Bay as poor (EPA 2008). There were high levels of contaminants in fish tissue sampled from 2000 to 2001, with 83 percent of fish samples analyzed exceeding EPA Advisory Guidance values for at least one contaminant (EPA 2008). A 2005 study of eelgrass, which is an indicator species for changes in water quality and for tracking the overall health of a marine ecosystem, showed a clear trend in declining eelgrass coverage with increased nitrogen loadings (EPA 2007: 91).

Ipswich River

The Ipswich River has been named one of the most threatened rivers in the nation, and has been listed as impaired under the Clean Water Act (Ipswich River Fisheries Restoration Task Group 2002). River herring on the Ipswich River are adversely affected by water withdrawals and diversions, dams, changes in land use, low dissolved oxygen levels (Ipswich River Fisheries Restoration Task Group 2002).

Narragansett Bay (Nonquit River and Gilbert-Stuart River)

In 2007, the EPA National Estuary Program rated the estuarine conditions in Narragansett Bay as poor (EPA 2008: 266). Major environmental concerns for rivers and tributaries draining into Narragansett Bay include eutrophication, nutrient loading, and pathogens. An increasing array of eutrophic-associated symptoms have been observed, including low DO levels and fish shellfish kills caused by excess nitrogen and other nutrients; a 2005 study compared current DO levels to those from 1959 and determined that the presently observed low DO conditions are likely a relatively new feature of Narragansett Bay (EPA 2008: 255-56).

Low DO levels have occurred in upper portion of Narragansett Bay every summer for at least the past decade (EPA 2008). Since data collection began in 1999, fish kills have been reported every year but one (2000) in the upper portion of Narragansett Bay (EPA 2008). In 2003, hypoxia caused a massive fish kill of more than one million fish (EPA 2008). These events put extreme stress on the marine ecosystem, altering fish distribution and affecting juvenile growth.

EPA has rated the sediment quality in Narragansett Bay as poor (EPA 2008: 266). Moderate and high concentrations of metals and organochlorine chemicals, such as DDT and PCBs, were measured in about half of the Bay‘s sediment samples. More than ninety percent of fish tissue samples collected in 2000-2001 contained PCB levels that exceeded the EPA‘s Advisory Guidance values for fish consumption (EPA 2008: 266).

Connecticut River and Long Island Sound

The Connecticut River is the most significant drainage basin for Long Island Sound, which the EPA National Estuary Program rated as in poor condition in 2007 (EPA 2008). Toxic substances, such as metal and organic chemicals, from manufacturing sources, stormwater runoff, household cleaning and pest-control products, and automobile and power plant emissions continue to enter Long Island Sound (EPA 2008). The loss of wetlands, forests, farm areas, and other open spaces to increased population, development, and urban sprawl has increased pollution and stormwater runoff to the Sound.

A 2006 review of the contaminants in the Connecticut River indicated high levels of total mercury and dioxin-like (coplanar) PCB in the river (ASSRT 2007). The lower portion of the Connecticut River is also dredged every six to seven years to maintain a federal navigation project.

Global warming will increasingly adversely affect alewife and blueback herring habitat in the Connecticut River. Temperatures in Connecticut have been increasing over the last century and are expected to increase an additional 4 or more degrees Fahrenheit in all seasons by 2100 (EPA 1997a; Frumhoff *et. al.* 2007). Precipitation is also predicted to increase by 10 to 20 percent (EPA 1997a). Increased temperatures and precipitation will lead to increased hypoxic conditions in the river, which impairs the use of river habitat by alewives and blueback herring. Marshall and Randhir (2008) modeled the impacts of expected climate change on the Connecticut River watershed. The simulation results showed significant impacts of climate change on the available quantity of water, decreasing water storage during the winter months and impacting surface runoff rates. The change in water availability would place severe strain on spring anadromous fish runs. According to Marshall and Randhir, climate change also will have significant impacts on water quality, increasing sediment loading up to 50 percent and decreasing volumes of receiving water by up to 19 percent. Climate change will also impact nutrient cycles and the N: P ratio of annual loading, likely resulting in increased algal growth. Under two different climate change scenarios, the watershed is more nitrogen limited and has a higher risk of eutrophication.

Hudson River

The EPA's 2004 National Coastal Condition Report noted particular concern about water quality, sediment, and tissue contaminants in the Hudson River, and the 2008 National Coastal Condition Report rated the NY/NJ region's water quality as poor (EPA 2008). PCBs, the chief Hudson River contaminant of concern, cause fin erosion, epidermal lesions, anemia, immune system disorders, reproductive failure, and mortality in fish. While the PCB levels have declined since the 1970s, fish consumption advisories based on PCB contamination are still in place for fish caught between Troy Dam and Catskill. Fish consumption advisories for three species of Hudson River fish based on mercury, PCB, and cadmium contamination are in place in other parts of the river.

Sewage discharge into parts of the Hudson River has been increasing due to population growth in certain adjacent communities, and the decomposition of the sewage has caused hypoxic areas to form in multiple parts of the river (ASSRT 2007). Climate change will likely exacerbate these problems, including by increasing precipitation, and therefore discharges of nutrients, into the river, resulting in increased occurrence and/or severity of eutrophic conditions (Howarth *et al.* 2006).

The Hudson River populations of alewives and blueback herring may also be adversely affected by Verdant Power's proposal to build a marine turbine project on the East River, New York. The company tested two slow speed tidal turbines from 2006 to 2007 and has since installed four more (Ordóñez 2008). At least at one time, the ultimate goal of Verdant Power was to build up to 300 turbines within a one-mile section of the river near Roosevelt Island.

Delaware River

The alewife and blueback herring populations in the Delaware River lost spawning habitat in every tidal stream of the Delaware River in Delaware due to the construction of low-head dams that formed mill ponds dating to the 1800s or early 1900s (ASMFC 2008: 395). All of these Delaware River tidal streams are relatively short in length (with the longest being approximately 10 to 12 miles from the river or bay to the first dam), which results in a fairly steep salinity gradient (ASMFC 2008: 395). Thus, all spawning in these tidal streams in Delaware is usually restricted to the short distance of freshwater near the dam and immediately downstream (ASMFC 2008: 395).

Dredging operations in the Delaware River also adversely affect the river's populations of alewife and blueback herring. Hydrodynamic alterations from past dredging operations, including in conjunction with water sharing agreements with upstream towns, has caused salt water encroachment, modified water flows, and made certain areas unsuitable spawning habitat for anadromous species, including the alewife and the blueback herring, for periods of time (ASSRT 2007).

According to Delaware Riverkeeper (2010), the deepening of the Delaware River main channel for navigational purposes and its maintenance dredging has increased the tidal range of the Delaware Estuary. Hydraulic dredging can entrain anadromous fish species, taking them up into the dredge drag-arms and impeller pumps and resulting in death (Delaware Riverkeeper 2010). Consumptive use and water diversions up river have reduced freshwater flows (Delaware Riverkeeper 2010). The combination of increased tidal fluctuation and reduced freshwater flows has caused saltwater to intrude into the freshwater tidal reach of the estuary, depriving anadromous fish species of freshwater habitat important for spawning (Delaware Riverkeeper 2010). Ongoing dredging continues to change salinity (Delaware Riverkeeper 2010), which can affect the behavior of anadromous fish such as the alewife and the blueback herring.

A planned major dredging project, known as the Delaware River ―Deepening Project," will exacerbate many of the adverse effects of past dredging activities and will further harm the river's alewife and blueback herring populations. The Deepening Project will deepen the river's main shipping channel by 50 feet over 102 miles. Agency comments and technical reports with respect to the dredging project indicate that the dredging operations are expected to result in the resuspension of high levels of PCBs and other contaminants that had been absorbed by the sediment; may result in changes to the salinity and bottom habitat that could negatively impact anadromous fishes that rely on such habitat for spawning and nursery habitat; and may exacerbate the sediment deficit in the Delaware River system (current maintenance dredging removes more sediment from the estuary than is supplied to the estuary and the new 45 foot channel would likely require increased maintenance dredging) (NMFS 2010b: 75 Fed. Reg. 61872, 61884, 61897).

The Southport Marine Terminal Development project further threatens populations of alewife and blueback herring in the Delaware River. The Southport Development project involves filling in 12.28 acres of open water (0.2 of which is emergent wetlands, 1.08 acres of which is shallow water habitat, and 3.62 of which is deep water habitat), 3.75 acres of non-tidal wetlands, and 0.73 acres of a tidal drainage area; filling in an unspecified amount of floodplain lands with 3 to 4 feet of fill in order to raise the area to above the 100-year floodplain (in fact to raise it to the 200-year floodplain); dredging a 35-acre area within the Delaware River to a 40+2foot depth; impacts to approximately 4,600 linear feet of existing shoreline; and the permanent loss of 1.08 acres of submerged aquatic vegetation (Delaware Riverkeeper 2010).

The Southport project will further degrade water quality and habitat in the Delaware River. The water quality effects from this project include impacts on dissolved oxygen levels through the removal of water celery, an important plant that contributes oxygen to the water, and the introduction of contaminants from both resuspension of sediments and disposal in the Fort Mifflin CDF, a known source of contaminants due to the sediments disposed there (Delaware Riverkeeper 2010). According to the U.S. Fish and Wildlife Service, sediments to be used in the Southport project contain contaminant concentrations high enough to pose unacceptable ecological risk to aquatic organisms (Delaware Riverkeeper 2010). This means that these sediments should only be used in areas where they will not be inundated during high water events and in a way that reduces their potential for leaching from precipitation (Delaware Riverkeeper 2010). However, the spoils from the Southport project are planned for disposal at the Fort Mifflin CDF (Delaware Riverkeeper 2010). Fort Mifflin has been shown to effectively discharge pollution back into the River from sediments disposed there rather than filtering it out prior to discharge (Delaware Riverkeeper 2010). Among the toxics discharged to the River by the CDF are cadmium, lead, copper, zinc and total suspended solids (Delaware Riverkeeper 2010). Delaware Riverkeeper (2010) also discusses NMFS‘ concerns about other water quality concerns from dredging and vessel operations associated with the Southport project, including increased turbidity, lowered dissolved oxygen levels, and release/resuspension of chemical contaminants from sediments.

The proposed construction and operation of a Liquefied Natural Gas (LNG) import terminal on the Delaware River near Logan, New Jersey, by Crown Landing, LLC will also impact the populations of alewife and of blueback herring in the Delaware River. This proposal was approved by the FERC in 2006. Construction of the LNG terminal will require hydraulic dredging of 1.24 million cubic meters (―m3”) in the first year followed by maintenance dredging of 67-97,000 m3/year. Dredging will occur from August through December and threatens to significantly harm alewife and blueback herring populations in the Delaware, including by impacting migration patterns and distribution. In addition, it is believed the facility will receive up to 150 shipments per year (Delaware Riverkeeper 2010). LNG carriers take on ballast water as they offload in order to maintain stability – an estimated 8 million gallons will be pumped from the River over a 10 hour period while at the berth with an additional 5 to 11 million gallons being taken on after undocking downstream of the berth area (Delaware Riverkeeper 2010). These activities may result in entrainment and impingement of alewife and blueback herring larvae.

The Delaware River alewife and blueback herring populations are also threatened by exceptionally poor water quality. Petroleum pollution and pollution from dye manufacturing is believed to have contributed to the long-term decline of the river's alewife and blueback herring populations (ASMFC 2008). In addition, heavy organic loading near Philadelphia, Pennsylvania during the 1940s and 1950s caused severe declines in DO levels and made parts of the Delaware River uninhabitable for fish during the warmer months of the year (ASMFC 2008). In giving the Northeast region an overall grade of F for water quality and coastal habitat, the EPA's National Coastal Condition Report (2004) noted particular concern about water pollution and fish tissue contaminants in the Delaware River (EPA 2004). EPA's National Coastal Condition Report (2008) rated the water quality in the Delaware River as poor because of high nitrogen and phosphorous levels; several tributaries of Delaware Bay were also given a poor rating (EPA 2008). The Delaware River also has high levels of PCBs, dioxins, mercury, and chlorinated pesticides in its sediments and is subject to numerous fish consumption advisories. Part of the Roebling-Trenton stretch of the river is a designated EPA Superfund site because of contamination originating from the Roebling Steel plant.

Increased withdrawals from the Delaware River, increasing salt water intrusion and affecting flow patterns, also pose a threat. For example, there has been an explosion of natural gas extraction activity using hydraulic fracturing techniques in the basin (Delaware Riverkeeper 2010). Each natural gas well, when hydraulically fractured, is estimated to use 1 to 9 million gallons of water, with an average of 4.5 million gallons, from the Delaware River system or groundwater supplies (Delaware Riverkeeper 2010).

Climate scientists predict that the impacts of global warming will be particularly significant for coastal and riverine environments in the Northeast and mid-Atlantic regions, including the Delaware River. As discussed *supra,* among other impacts, global warming will exacerbate hypoxic conditions by increasing precipitation and nutrient inputs into water bodies in these regions, including the Delaware (Howarth *et al.* 2006).

Impingement and entrainment at two power plants (the Connectiv Power Plant at Edgemoor, and the Motiva (now Valero) Refinery at Delaware City) are also significant threats. A recent report by Entrix (2008) indicated substantial losses of river herring at the Connectiv Power Plant with the absolute numbers of river herring mortality found to be in excess of 600 million (Entrix (2008), as cited in DDNREC 2010: 8).

Susquehanna River

In Maryland, the construction of two dams in the early 1900s on the Susquehanna River cut off alewife and blueback herring populations from their historical spawning habitat until 1972, when the lower dam was retrofitted with a fish elevator and the fish were trucked above the upper most mainstream dam (ASMFC 2008: 416, 418).

Chesapeake Bay (Nanticoke, Potomac, Rappahannock, York, and James Rivers)

Dams that permanently blocked anadromous fish passage and those with ineffective fishways have significantly reduced the amount of spawning habitat available for alewife and blueback herring populations in rivers and tributaries along the Chesapeake Bay (ASMFC 2008).

Chesapeake Bay‘s nutrient pollution problem is one of the most egregious in the country. Excessive nutrient loading into the Bay stimulates heavy growths of phytoplankton, and the death and decay of phytoplankton blooms involve high rates of dissolved oxygen consumption, resulting in low DO levels in the Bay and its tidal tributaries, particularly in the summer months (Klauda *et al.* 1991; EPA 2008; CBP 2009; Reay 2009). These hypoxic conditions adversely affect alewives and blueback herring, including by affecting migration and distribution patterns. The Bay experienced ―record-sized hypoxic zones" in 2003 and 2005 (Boesch *et al.* 2007:2). Kemp *et al.* (2005: 9) stated that:

> the Bay has become less able to assimilate N inputs without developing hypoxia, a change that may have arisen from the degradation of key ecological processes sensitive to eutrophication effects. Potential mechanisms include (1) loss of benthic plant biomass due to increased turbidity and loss of oyster biomass, both of which tend to retain nutrients and organic matter in shallow waters; [and] (2) increased efficiency of N and P recycling with marked decreases in denitrification and P precipitation in response to recent severe and persistent hypoxia.

Reay (2009) also identified elevated TSS concentrations and poor water clarity resulting from high sediment loadings as persistent and widespread in the Bay. Such excessive sediment loadings into the Bay inhibit alewife and blueback herring spawning (ASMFC 2008). Sediment loadings also serve to transport contaminants and pathogens, exacerbating pre-existing contamination problems in certain portions of the Bay (Reay 2009).

Similar water quality problems exist in many of the Bay‘s tributaries, including those utilized by the alewife and the blueback herring. Much of the York River system fails to meet Submerged Aquatic Vegetation (―SAV") habitat requirements, and degraded nutrient water quality conditions exist in the York River estuary (Reay 2009; ASSRT 2007). Nitrogen levels have increased by 20 percent and phosphorus levels by 122 percent in the Pamunkey River (Reay 2009). In addition, Hirsch *et al.* (2010) found that phosphorus fluxes increased from 2000 to 2008 in the Susquehanna, James, Rappahannock, Appomattox, Patuxent, and Choptank Rivers. While investments in advanced wastewater treatment in the watershed appear to have stabilized nitrogen trends in some rivers, in other rivers, such as the Choptank, nitrogen pollution is still increasing (Hirsch *et al.* 2010).

In addition, there are reoccurring harmful algal red tides in the summer months in the lower York River, and the cyanobacteria *Microcystis aeruginosa* that causes algal blooms in the Chesapeake Bay is common in the York River (Reay 2009). Diel variations in dissolved oxygen concentration in shallow waters can be significant (Reay 2009). Harmful hypoxic conditions also occur in the Potomac River (ASSRT 2007). Finally, fish consumption advisories for PCBs in fish are in place in the James, Potomac, Rappahannock, and York River basins.

Chesapeake Bay‘s severe water quality problems have been comprehensively chronicled by EPA (2004; 2008) and the Chesapeake Bay Program (―CBP") (2009). EPA (2004) gave Chesapeake Bay a score of F in the areas of water quality, sediment, benthos, and fish tissue contamination. EPA (2008) rated the northern and western tributaries of the Bay as poor. According to CBP (2009), the Bay continues to have poor water quality, degraded habitats and low populations of many species of fish and shellfish. Based on these three areas, the overall health of the Bay was rated at 38 percent, with 100 percent representing a fully restored ecosystem (CBP 2009: 4). The Chesapeake Bay Program states that ―[w]ater quality is the most important measure of the Chesapeake Bay‘s health" (CBP 2009: 6), and, in 2008, water quality was again very poor, meeting only 21 percent of the goals, the same as 2007 (CBP 2009: 6). Chemical contaminants also impaired more water in 2008, resulting in a 6 percent decrease in that goal area (CBP 2009: 6). One of the greatest challenges to restoration is that the rate of population growth and development, and resulting increases in pollutant inputs, continues to offset cleanup efforts (CBP 2009: 8).

Climate change is a significant ―emerging stress" for Chesapeake Bay (Preston 2004: 126). Water temperatures within Chesapeake Bay during the 20th century were 2° C to 3° C warmer than over the past millennium, and increased 0.8° C to 1.1° C between just 1949 and 2002 with ―unambiguous and prominent estuarine warming over at least the past two decades" (Preston 2004: 134). Observed average annual water temperatures in the Patuxent River have increased 0.22° C per decade for the period from 1938 to 2006 and in the two most recent decades by ~0.5° C in the winter and spring (Kerr *et al.* 2009). Najjar *et al.* (2010) estimates a water temperature rise for the Bay of 2 to 6° C. Models predict air temperature will be 3 to 4.5° C warmer by the end of the present century, with potential summer increases of 6.5º C in combination with more extremely warm days and more modest winds (Boesch *et al.* 2007).

These temperature changes in the Bay are anticipated to result in increased frequency and intensity of precipitation, increased intensity of tropical and extratropical storm events, increased sea-level variability, and changes in streamflow (Najjar *et al.* 2010; CIER 2008; Reay 2009). For example, precipitation is expected to increase 20 percent in Maryland by the end of the century (CIER 2008). Temperature increases and altered precipitation patterns will also result in reductions in salinity in certain portions of the Bay and a reduction in oxygen exchange between warmer surface waters and cooler deep waters (CIER 2008), as well as a reduction in the amount of oxygen that can be dissolved in the water, enhanced stratification and increased rates of production, decomposition, and nutrient cycling (Boesch *et al.* 2007; Preston 2004).

These changes will, in turn, cause an increase in the severity and extent of hypoxia, an increase in coastal flooding and submergence of estuarine wetlands that filter pollutants, increased sediment and nutrient loading during winter and spring, changes in salinity regimes, including variability, an increase in harmful algae, decreases in water clarity, and likely alterations in fish habitat favoring subtropical fish and shellfish species (Najjar *et al.* 2010; CIER 2008; Reay 2009). For example, as a result of higher precipitation and run-off levels, nitrogen flux within the Susquehanna River, which is the major source of nitrogen discharge into Chesapeake Bay, is expected to increase by as much as 17 percent by 2030 (Howarth 2006). Boesch *et al.* (2007) found that climate change has already exacerbated hypoxic conditions in parts of the Chesapeake Bay. For example, the ―record-sized hypoxic zones" in 2003 and 2005 were caused or exacerbated by climate change-induced high river inflows, warm temperatures, and calm winds (Boesch *et al.* 2007: 2).

Warming temperatures can also affect recruitment and the distribution of pathogens (Preston 2004; Kerr 2009). This may make alewives and blueback herring in the Bay more vulnerable to disease, particularly in conjunction with the additional stress brought on by suboptimal environmental conditions (Preston 2004).

According to Najjar *et al.* (2010), Chesapeake Bay will likely experience a sea level rise of 0.7 to 1.6 meters. The Bay is particularly vulnerable to the impacts of such sea-level rise due to its geography (Glick *et al.* 2008). Many of the Bay‗s coastal marshes and small islands have been lost already, and many more are at risk of being lost soon (Kemp *et al.* 2005). The loss of tidal marshes adversely affects alewives and blueback herring in the Bay, including because tidal marshes maintain water quality through uptake of excess nutrients that contribute to hypoxia and dead zones in the Bay (Kemp *et al.* 2005). Sea level rise also affects hypoxic conditions by increasing stratification via changes in the ratio of salt to fresh water (Boesch *et al.* 2007).

Glick *et al.* (2008) applied the Sea Level Affecting Marshes Model (SLAMM) 5.0 model, developed in 2006/2007, to the entire Chesapeake Bay region and Delaware Bay. Assuming 69 cm of sea-level rise by 2100 (the IPCC‗s A1B Max Scenario), brackish marsh throughout the region declines by 83 percent and the overall area of all tidal marshes declines by 36 percent. Under the 1.5 meter scenario, virtually all of the region‗s ocean beach and brackish marshes are projected to disappear by 2100, as would three fourths of tidal swamp and about half of the tidal flats, tidal fresh marsh, and estuarine beaches. Most of the habitat lost would convert to open water. In the Susquehanna River and northern Chesapeake Bay, the dominant marsh is already precarious, and 97% is predicted to be lost at a sea-level rise of 69 cm. In the eastern Bay region, one fourth of the marshes are expected to be lost even with a lower 39 cm sea-level rise, and 60% are expected to be lost with higher levels of sea-level rise. An earlier (2005) study – referenced by NMFS in its 2010 proposal to list certain distinct population segments of Atlantic sturgeon as endangered and threatened – found that a 1 °C increase of water temperature in the Chesapeake Bay would reduce available sturgeon habitat by 65 percent (NMFS 2010b: 75 Fed. Reg. 61872, 61886-87).

Cumulatively, the adverse impacts on alewives and blueback herring in Chesapeake Bay from climate change are likely to be significant. Boesch *et al.* (2007: 10) warns that ―[p]rolonged shifts in climate and its variability, or in the biota inhabiting the Bay, may have unprecedented effects that drive the ecosystem to a new state."

Albemarle Sound and Chowan River

According to the North Carolina Wildlife Resources Commission (2005), poor water quality negatively affects the alewife and the blueback herring populations in the Chowan River. The Chowan River was the site of North Carolina‗s first known large-scale coastal algae bloom in

1972 (North Carolina Wildlife Action Plan (―NCWAP") 2005), which resulted from excessive levels of nitrogen and phosphorus in wastewater and runoff. During this event, lowered dissolved oxygen levels from excessive nutrient inputs killed fish and led to fish diseases (NCWAP 2005). Agricultural and urban runoff, including runoff of fertilizer and animal waste, further degrade the water quality in the Chowan River (NCWAP 2005). This runoff increases water concentrations of nitrogen and phosphorous, which can cause harmful algae blooms and low DO levels. In 1979, the Chowan River was the first water body in North Carolina to receive the ―nutrient sensitive waters" classification by the NC Division of Water Quality (NCWAP 2005).

During most years, chronic episodes of hypoxia occur in the Chowan River and its tributaries from late June through September (NCWAP 2005). Dissolved oxygen levels frequently fall below 3.0 mg/l, which negatively affects aquatic biota (NCWAP 2005). Extreme storm events have occurred repeatedly within the basin since 1995. The accompanying rainfall, storm surge, inundation and flushing of bottomland swamp habitats have increased stress on an already fragile summer ecosystem, including by lowering dissolved oxygen levels, which has produced major fish kills within the basin (NCDWQ 2002, as cited in NCWAP 2002).

Santee-Cooper River System

The Santee River, formed by the Wateree and Congaree Rivers, was historically one of the longest river systems on the Atlantic coast and, at one time, supported abundant spawning runs of anadromous fish to Great Falls (km 438) on the Wateree River and up to river km 602 on the Congaree River (ASMFC 2008). After the South Carolina Public Service Authority completed a large diversion project to move water from the Santee River to the Cooper River to maintain discharge control and hydroelectric power generation, the number of fish that passed upstream drastically declined (USFWS/SCDNR 2001). The Santee-Cooper diversion project blocked access to all but 87 miles of the Santee River (USFWS 2001). It blocked the blueback herring population from historical nursery and spawning grounds and reduced the Santee River's natural water flow in the thirty-seven miles upstream of the rediversion canal by approximately 97 percent, destroying much of the historical aquatic habitat (American Rivers 2003). Efforts to restore fish passage numbers to pre-diversion project levels in recent years have failed to achieve their goals.

Dredging occurs in the Cooper River without any seasonal restrictions. As discussed by SCDNR as part of its 2005 Comprehensive Wildlife Conservation Strategy, dredging has numerous adverse effects on alosines:

> Dredging can . . . negatively affect alosine populations by producing suspended sediments (Reine *et al.* 1998). Behaviorally, chronic turbidity from frequent or prolonged dredging can also affect fish migration, spawning, conspecific interactions, and foraging (Coen 1995). Migrating alosines are known to avoid waters of high sediment load (ASMFC 1985; Reine *et al.* 1998). Suspended sediments have been linked to a variety of lethal and sublethal responses in juvenile and adult fishes that are consistent with oxygen deprivation due to gill clogging (Sherk *et al.* 1975; Sherk *et al.*

> 1974). Filter-feeding fishes such as alosines are particularly susceptible to negative impacts of suspended sediments on gill tissues (Cronin *et al.*1970).

(SCDNR ND). In addition, contaminated sediment from past industrial operations and military facilities has led to fish consumption advisories in the river for three species due to mercury contamination (ASSRT 2007).

St. John's River

The Kirkpatrick Dam now blocks migration of anadromous fish to extensive potential spawning habitat upstream (ASSRT 2007). Frequent dredging has reduced submerged aquatic vegetation in the river (ASSRT 2007). The river's water quality is degraded and DO is frequently at low levels in summer months (ASSRT 2007).

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

1. Direct Harvest

At one time, alewives and blueback herring were commercially harvested in the majority of Atlantic coastal river systems. The alewife and blueback herring fishery is one of the oldest fisheries in North America (NOAA 2006). U.S. commercial landings in this fishery peaked in the late 1950s at nearly 75 million pounds (NOAA 2006).[31] Beginning in the late 1960s, offshore exploitation of alewives and blueback herring by foreign commercial fishing vessels led to a dramatic reduction in alewife and blueback herring populations along the Atlantic coast (ASMFC 2008). Commercial landings of alewives and blueback herring by foreign fleets peaked at about 80 million pounds in 1969, and the total combined commercial harvest of alewives and blueback herring in 1969 by U.S. and foreign fleets was 140 million pounds (ASMFC 2008). By the time the U.S. instituted its Fishery Conservation Zone in the late 1970s, commercial landings had plummeted to less than 9 million pounds[32] (NOAA 2006).

More recently, from 1996 to 2009, annual commercial landings have varied between about 300,000 pounds and 2 million pounds (NMFS 2010a). Maine, North Carolina and Virginia typically have accounted for more than 90 percent of total commercial landings of alewives and blueback herring (NOAA 2006). Dominant uses of alewives and blueback herring are for bait, including for striped bass and lobster, and human consumption (ASMFC 2008).

Commercial overharvesting has played and continues to play a major role in the profound decline in the abundance of both alewives and blueback herring. Direct harvesting of alewives and blueback herring is currently allowed in Maine, New Hampshire, New York (except the Delaware River basin), New Jersey, Delaware, Maryland, Virginia (except river systems flowing into North Carolina), and South Carolina (ASMFC 2008). The PRFC, which manages fisheries in the main stem of the river, has not adopted specific regulations that limit the harvesting of

[31] 34,000 metric tons converted to pounds, using a conversion factor of 2,204.6 pounds per metric ton.
[32] 4,000 metric tons converted to pounds, using a conversion factor of 2,204.6 pounds per metric ton.

alewives and blueback herring in the Potomac River or otherwise directly addressed the threat of overfishing the river‘s populations of alewives and blueback herring (ASMFC 2008; PRFC 2010: 1). There are also no size or possession limits for alewives and blueback herring in Virginia and Maryland tributaries of the Potomac River (VMRC 2009; MDNR 2010: 10). Maryland‘s seasonal restriction on the commercial harvesting of alewives and blueback herring permits harvesting during the species‘ spawning migration, which reduces the number of spawning adults that are able to reach their freshwater spawning habitat (MDNR 2010: 10). South Carolina‘s commercial fishery targets adult pre-spawning blueback herring for bait and human consumption, particularly roe (ASMFC 2009a; SCDNR 2010b: 18-19).

2. Bycatch and Incidental Catch

Significant mortality of alewives and blueback herring occurs as a result of bycatch and incidental catch. This bycatch and incidental catch occurs in both state waters and the nation‘s exclusive economic zone (―EEZ"). The alewife and the blueback herring, as anadromous species, are particularly vulnerable to bycatch and incidental catch, and such bycatch and incidental catch is difficult to monitor, because it occurs in multiple habitats. Both species‘ schooling behavior further increases susceptibility to bycatch and incidental catch mortality. Ocean fisheries present a particularly substantial threat to alewife and blueback herring populations because such fisheries utilize gear types that have the potential to incidentally catch large numbers of migrating alewives and blueback herring. Both species are believed to congregate in certain areas at certain times of year, which is believed to make the species susceptible to large bycatch and incidental catch events. A recent study of alosine bycatch/incidental catch in the Gulf of Maine, Georges Banks, Southern New England and Mid-Atlantic (Lessard *et al.* 2011: 17) found evidence of such ―hotspots" with river herring bycatch/incidental catch concentrated in winter in the northern extent of the region south of Cape Cod to Cape Hatteras; with higher blueback densities in the southern region in the spring, especially along the shore; and with fall bycatch/incidental catch of river herring concentrated in the Gulf of Maine and Georges Banks (Lessard *et al.* 2011: 11-12, 19, Figures 1-10, 11-12).[33]

Information concerning alewife and blueback herring bycatch/incidental catch is available from a variety of sources, including landing records, fishing log books, portside sampling efforts (which currently occur in Maine, New Hampshire, Massachusetts, Rhode Island, and New Jersey), and the NMFS observer program. Sources of information that rely on voluntary reporting, such as fishing log books, likely provide underestimates of alewife and blueback herring bycatch and incidental catch. The NMFS observer program may also provide underestimates of bycatch/incidental catch because of limited coverage and current rules permitting net slippage without catch sampling in certain ocean trawl fisheries, as discussed *infra*.

The ASMFC and a number of states have identified and expressed concern regarding the role of bycatch and incidental catch in ocean fisheries in causing the precipitous decline of alewife and blueback herring populations (ASMFC 2008; ASMFC 2009c; Mid-Atlantic Fishery Management

[33] Data compiled for the August 2011 ASFMC meeting (data that are not always consistent with those reported in ASFMC 2008) show continuing high levels of bycatch in recent years (ASFMC 2011c: 2). In 2008 and 2009, listed total annual incidental catch (in pounds) across all fleets and regions for river herring was equal to almost 80 and 50 percent of reported landings, respectively (ASFMC 2011c: 2).

Council (―MAFMC") 2009). In most recent years, such bycatch/incidental catch has primarily occurred in the Atlantic herring, Atlantic mackerel, longfin squid, and shortfin squid fisheries (ASMFC 2008; Harrington *et al.* 2005: 47-50, Figures 14-17, Tables 21-22). In 2002, four sampled trips from the Atlantic mackerel fishery recorded an estimated 18,179,906 pounds of blueback herring and 66,550 pounds of alewives as bycatch/incidental catch (ASMFC 2008). In the same year, thirty-five sampled trips from the longfin squid fishery recorded an estimated 2,813,841 pounds of blueback herring as bycatch/incidental catch (ASMFC 2008). Twelve sampled trips from the Atlantic herring fishery in 2000 recorded an estimated 1,167,362 pounds of alewives and 63,541 pounds of blueback herring as bycatch/incidental catch (ASMFC 2008). According to the ASMFC (2008: 24), annual estimates of alewife and blueback herring bycatch/incidental catch for all gears in the Atlantic herring fishery ranged from 171,973 pounds (2005) to 1,686,617 pounds (2007) and are similar in range to the bycatch/incidental catch estimates provided by Harrington *et al.* (2005) for the same fishery in 2000 and 2003. A 2011 review of available data from a variety of gear types used in the Gulf of Maine, Southern New England, and Mid-Atlantic regions that used a different method of estimating bycatch/incidental catch (seeking to eliminate certain biases in earlier studies (Lessard *et al.* 2011: 24-25)) found that bycatch/incidental catch of alewives and blueback herring from 2000 to 2008 was approximately 13 million and 14.7 million pounds respectively (Lessard *et al.* 2011: 23, Tables 4 and 5).

Limited observer coverage makes it difficult to determine the exact extent of the bycatch/incidental catch problem of alewives and blueback herring in these fisheries. Because of the highly depleted status of the alewife and the blueback herring, however, even infrequent bycatch/incidental catch events in a high volume fishery like the Atlantic herring fishery poses a threat. In some years, such catch of alewives and blueback herring in the Atlantic herring fishery can be equal to, or exceed, the total of all in-river landings (Cieri *et al.* 2008: 5-6; 9, Table 2). It is likely that bycatch/incidental catch affects different river subpopulations to varying degrees (Miller, T.J. 2010: 2-3).

Most alewife and blueback herring bycatch/incidental catch in commercial marine fisheries occurs in the single and pair mid-water trawl fisheries (ASMFC 2008; Cieri *et al.* 2008: 5; 17, Table 10). A report completed in early 2011 that evaluated river herring bycatch/incidental catch from a variety of gear types in New England waters found that otter trawls, including mid-water paired otter trawls, accounted for the majority of this catch of alewives and blueback herring; bycatch/incidental catch in mid-water otter trawls appears be increasing for both alewife and blueback herring from 2000 to 2008 (Lessard *et al.* 2011: 22, Figures 25-26). These mid-water trawls have CPUEs that are 10 to 100 times more fish per haul than some other gear types, which overwhelms the lower number of hauls with this gear (Lessard *et al*. 2011: 27, Figures 13-18). The 2011 study finds that annual bycatch/incidental catch of alewives and bluebacks likely hovers around half a million to 2.5 million pounds (Lessard *et al.* 2011: 28).

The increased use of mid-water trawlers in the Atlantic herring fishery, as well as the Atlantic mackerel fishery, correlates with the most recent decline in populations of alewife and blueback herring. With respect to the Atlantic herring fishery, it historically was conducted primarily in state waters using fixed gears (*e.g.*, purse seine gear) (NEFMC 1999). Since 1994, however, the Atlantic herring fishery has increased its use of single and pair mid-water trawlers (PEG 2008).

The increased use of mobile gear to target Atlantic herring has resulted in an effort shift into federal waters and a sharp increase in commercial landings and revenue (NEFMC 1999). In addition, the Atlantic herring fishery has increasingly deployed trawlers that are much larger and more efficient than traditional fishing vessels. Compared with traditional fishing vessels, which are typically 40 to 50 feet in length and tow much smaller nets, contemporary mid-water trawlers in the Atlantic herring fishery can reach up to 165 feet in length and tow nets as wide as a football field and the height of a five-story building. These vessels make the fishery considerably more efficient, and the fishery's increasing use of pair mid-water trawls – a large net that is towed between two fishing vessels – in recent years further increases its efficiency. The recent explosive growth of Atlantic herring landings demonstrates the increases in effort and efficiency in the fishery. In 1994, the Atlantic herring fishery landed about 1 million pounds of fish. By 2000, the fishery was landing more than 225 million pounds of fish (NEFMC 1999).

Alewife and blueback herring bycatch/incidental catch also occurs in the bottom trawl fisheries (ASMFC 2008). Warriner *et al.* (1970) found that, at night, over half of juvenile alewife and blueback herring in the Potomac River were taken in bottom trawls (Warriner *et al.* (1970) , as cited in ASMFC 2009b: 123). Although the mid-water trawl fishery results in the most river herring bycatch/incidental catch, the directed Atlantic herring bottom-trawl fleet removes a relatively large amount of river herring given their low Atlantic herring landings (this fishery only accounts for approximately 16 percent of the total catch of Atlantic herring in the Southern New England management area); that fishery's bycatch/incidental catch rate is far higher than the mid-water trawl fishery per pound of Atlantic herring landed, and sometimes exceeds river herring bycatch/incidental catch in the mid-water trawl fleet in the Southern New England area by almost fourfold (Cournane *et al.* 2010: 13, Figure 4).

3. Threats to Specific Rivers and Estuaries Affecting the Alewife and the Blueback Herring

Damariscotta River System

In 1990, scientists determined the alewife population in the Damariscotta River was overharvested to the extent that recruitment failure became apparent (ASMFC 2008: 136). The ASMFC (2008) similarly concluded that alewife in the river were subjected to high in-river exploitation rates prior to 1985. After a slight decline during the 1990s, the in-river exploitation rate increased steadily from 2000 through 2004 (ASMFC 2008).

Hudson River

The present commercial fishery for alewives and blueback herring in the Hudson River exploits the spawning migration of both species (ASMFC 2008). The fishery harvests adults each year from March to early June, with some catch reported as late as July, thereby preventing this portion of the population from reproducing (ASMFC 2008). The fixed gear fishery locates itself downriver of the species' spawning habitats, intercepting and harvesting alewife and blueback herring before they can reach their spawning habitats (ASMFC 2008). The active gear fishery typically sets directly into schools of fish as they migrate upstream to spawn (ASMFC 2008).

Total effort for all gears in the Hudson River commercial fishery has increased since 1996 (ASMFC 2008). Total commercial landings for all gears in the fishery peaked in 2002 and declined thereafter even as the total effort for all gears in the fishery steadily increased (ASMFC 2008).

The recreational fishery that exists throughout the Hudson River and its tributaries also contributes to the total number of alewives and blueback herring harvested each year. Recent estimates of the number of alewives and blueback herring taken by and used in the recreational fishery indicates the magnitude of use by the bait fishery and the potential impacts of such use on the Hudson River alewife and blueback herring populations (ASMFC 2008: 317). The NYSDEC estimated that the total number of river herring used in the striped bass fishery was approximately 197,000 in 2001 and 265,000 in 2005 (ASMFC 2008: 317). A creel survey conducted by a contractor hired by NYSDEC (Normandeau Associates, Inc.) in 2005 estimated a harvest of 134,142 river herring and a retention rate of 75 percent (ASMFC 2008: 316-17).

The taking of alewives and blueback herring remains mostly unregulated in New York, and there are no limits on recreational or commercial harvest (ASMFC 2008).

Delaware River

According to the ASMFC (2008), overharvesting is believed to be one of the main factors contributing to the decline of alewife and blueback herring populations in the Delaware River. In Delaware, commercial landings in the fishery occur annually from January to June, with peak landings occurring in March (ASMFC 2008). The peak in commercial landings corresponds with the migrations of alewife and blueback herring populations to their spawning habitat and prevents a portion of the adults from reproducing. In New Jersey, it is believed that the commercial landings of alewife and blueback herring are ―grossly underreported” (ASMFC 2008: 396). Neither New Jersey nor Delaware have adopted specific regulations to reduce or restrict commercial landings of alewives and blueback herring in the Delaware River (ASMFC 2008).

Commercial discards and landings categorized as ―bait” are potentially significant sources of mortality for alewives and blueback herring in the Delaware River (ASMFC 2008). The use of alewives and blueback herring as bait for striped bass fishing has increased in popularity in recent years and is an additional source of mortality for both species (ASMFC 2008). According to the ASMFC (2008), such mortality could be significant.

Chesapeake Bay (Nanticoke, Potomac, Rappahannock, York, and James Rivers)

Overharvesting has been identified as one of the factors contributing to the recent declines in alewife and blueback herring populations in the Chesapeake Bay (USFWS 2009). Maryland‘s commercial and recreational fisheries annually harvest alewives and blueback herring from January to June (ASMFC 2008). The commercial and recreational open harvest season in Maryland corresponds with the spawning migrations of both species, likely preventing a portion of the adults from reaching their spawning habitats to reproduce. Currently, there are no state limits on total alewife and blueback herring catches (ASMFC 2008). Crecco and Gibson (1990) conclude that the alewife population in the Nanticoke River was overharvested prior to 1990 and severely depleted as a result.

As a result of new regulations that allow the use of alewives and blueback herring as live bait to target striped bass in the upper Chesapeake Bay, a directed commercial alewife and blueback herring fishery has developed in at least one Chesapeake Bay tributary since 2006 (ASMFC 2008). Commercial fishermen have been permitted to target alewives and blueback herring on their spawning grounds using small mesh gill nets, although the significant decline in both species' populations has resulted in most fishermen catching alewives and blueback herring only incidentally when targeting another species (ASMFC 2008).

The increasing popularity of using alewives and blueback herring as live bait in the Delaware striped bass fishery has resulted in the development of a significant recreational fishery developing in the larger tributaries of the Nanticoke River (ASMFC 2008). The recreational fishery has targeted alewives and blueback herring exclusively below blockages in the tributaries during the species' spawning runs (ASMFC 2008). Delaware continues to permit the use of nets in its alewife and blueback herring recreational fishery, and it is unclear whether the daily possession limit that the state recently imposed on its recreational fishery will prevent overharvesting (ASMFC 2008).

Potomac River

Historically, alewife and blueback herring populations in the Potomac River were abundant (ASMFC 2008). In the late 1980s and early 1990s, annual harvests of alewives and blueback herring sharply declined and they have remained low since then (ASMFC 2008).

Overharvesting is believed to be one of the main factors contributing to this sharp decline in Potomac River alewife and blueback herring landings. A 1990 assessment of river herring in selected east coast rivers determined that the alewife population in the Potomac River was overfished and blueback herring populations in the river were severely depleted(Crecco and Gibson (1990), as cited in ASFMC 2009a: 5, Table 1). Bycatch of the Potomac River alewife and blueback herring populations also occurs in fisheries in federal waters and could be substantial. Currently, there are no limits on the amounts of alewives and blueback herring caught as bycatch/incidental catch in ocean waters.

Albemarle Sound and Chowan River

The ASMFC (1990) reported that the alewife population in the Chowan River had been overfished to the extent that recruitment failure became apparent. The 2005 North Carolina River Herring Stock Assessment determined that alewife and blueback herring populations in North Carolina were overharvested and that overharvesting was continuing to occur (ASMFC 2008). Sustained high exploitation over the 25 years before the moratorium was put in place in 2007 reduced the SSBs of both the alewife and the blueback herring populations in the river system to the extent that current levels are insufficient to produce even moderate recruitment for either species (ASMFC 2008: 488; NCDMF 2007).

Santee-Cooper River System

According to the ASMFC (2008), blueback herring from the Santee-Cooper River are likely caught as bycatch/incidental catch in ocean fisheries along the Atlantic coast, from North Carolina to the Gulf of Maine and Canadian waters (ASMFC 2008).

St. John's River

Crecco and Gibson (1990) concluded that the populations of alewives and blueback herring in the St. John's River had been overfished to the extent that recruitment failure became apparent (Crecco and Gibson (1990), as cited in ASFMC (2009a: 5, Table 1).

C. Predation and Disease

1. Predation

Documented predators of alewives and blueback herring include striped bass, bluefish, tuna, cod, haddock, halibut, American eel, brook trout, rainbow trout, brown trout, lake trout, landlocked salmon, smallmouth bass, largemouth bass, pickerel, pike, white and yellow perch, seabirds, bald eagle, osprey, great blue heron, gulls, terns, cormorants, seals, whales, otter, mink, fox, raccoon, skunk, weasel, fisher, and turtles (MEDMR 2003).

Increased predation has been cited as a cause of the decline of at least certain populations of alewife and blueback herring. ASMFC (2008) noted particular concern with respect to striped bass predation. Striped bass are known to feed actively on alewives and blueback herring during their spawning migrations, and the abundance of striped bass along the Atlantic coast has risen to record high levels since 1995 (ASMFC 2008). According to ASMFC (2008), striped bass predation may be a significant factor contributing to the declining population sizes of alewives and blueback herring in the Connecticut and Monument rivers. In addition, the abundance and range extent of cormorants has increased significantly over the past decade (ASMFC 2009b). Cormorants have been shown to feed heavily on alosines (USFWS/SCDNR 2001). Small alosines can comprise up to 65 percent of the cormorant's diet (Johnson *et al.* 1999). Erkan (2002) notes that predation of alosines has increased dramatically in Rhode Island rivers in recent years, particularly by the double-crested cormorant, which often takes advantage of fish staging near the entrance to fishways (ASMFC 2009b). Double-crested cormorants have been observed immediately below many dams, particularly those dams with fish passages and during the winter-spring alosine migration period, in other areas as well (USFWS/SCDNR 2001). Dalton, *et al.* (2009) concluded, however, that, while important predators for alewives in south-central Connecticut, double-crested cormorants did not pose an immediate threat to the recovery of the regional alewife stocks.

2. Disease

The alewife and the blueback herring have been identified as species that are vulnerable to *viral hemorrhagic septicemia* (―VHS") (NY Sea Grant 2009). VHS is a viral infection that is known to infect certain anadromous fishes and that may result in significant cumulative mortality (USGS 1990). In addition, the rate of alewife egg infection by a naturally occurring fungus is significantly increased when there are high levels of suspended solids during and after spawning (ASMFC 2009b).

Concurrent physical stressors likely exacerbate the impacts of disease and parasites on the alewife and the blueback herring. For example, high nutrient levels result in low dissolved oxygen levels harmful to alewife and blueback herring in many water bodies. High nutrient levels have also been linked to outbreaks of the toxic organism *Pfiesteria,* causing numerous significant fish kills in these same locations.

D. Insufficiency of Existing Regulatory Mechanisms

As discussed below, insufficient state and federal regulatory mechanisms are contributing to the precipitous and continued decline of the alewife and the blueback herring throughout all or significant portions of their ranges.

1. State Measures

The ASMFC has the authority, pursuant to 16 U.S.C. §§ 5108-5108, to develop and issue interstate fishery management plans (―FMPs") for in-shore fisheries, which are then administered by state agencies, and to coordinate such management with management in federal waters. In 1985, the ASMFC implemented a coast-wide FMP for American Shad and River Herring to facilitate cooperative management and restoration plans between the Atlantic coastal states; Amendment 1 to this FMP was adopted in 1999 (ASMFC 1999). In 2009, the ASMFC adopted Amendment 2 specifically to address declines in alewife and blueback herring stocks throughout their Atlantic coastal ranges (ASMFC 2009a). In the amendment, the ASMFC (2009a: 1) stated that:

> [t]he closure of river herring fisheries by Atlantic coastal states (*i.e.*, Massachusetts, Rhode Island, Connecticut, Virginia, North Carolina) and observed declines in river herring abundance have led to questions about the adequacy of current management of the species to promote healthy fish stocks. Amendment 1 to the FMP states in its objectives that existing regulations for river herring fisheries ―should keep fishing mortality sufficiently low to ensure survival and enhancement of depressed stocks and the maintenance of stabilized stocks" (ASMFC 1999); however, questions regarding mortality levels and whether they are low enough to prevent further stock declines have arisen. The [ASMFC] and the public have also expressed concern over the lack of monitoring of river herring populations, fisheries and bycatch.

Under Amendment 2, commercial and recreational fisheries in state waters that do not have an approved management plan in place, or are not covered by an approved management plan, by January 1, 2012 will be closed (ASMFC 2009a). Amendment 2 does not propose any definitions of –overfishing” with regard to alewife and blueback herring stocks. Rather, the amendment requires submitted plans to clearly demonstrate that the alewife and the blueback herring fisheries in the state or jurisdiction are –sustainable” through the development of sustainability targets, which must be achieved and maintained (ASMFC 2009a). A sustainable fishery is defined as –a commercial and/or recreational fishery that will not diminish the potential future stock reproduction and recruitment” (ASMFC 2009a). Amendment 2 also requires states to implement fisheries-dependent and fisheries-independent monitoring programs for the alewife and the blueback herring that are similar to current requirements for American shad (ASMFC 2009a). It also contains recommendations to member states and jurisdictions to conserve, restore, and protect critical alewife and blueback herring habitat (ASMFC 2009a).

Maine, New Hampshire, Washington D.C., North Carolina, and South Carolina submitted management plans by the January 1, 2010 deadline (ASMFC 2011a). The ASMFC approved the plans submitted by North and South Carolina and requested revisions to the plans submitted by Maine, New Hampshire and Washington D.C. in August 2010 (ASMFC 2011a). Maine and New Hampshire submitted revised plans for review in September 2010; Maine‘s plan was approved, and New Hampshire submitted a revised plan in January for review (ASMFC 2011a). The ASMFC approved New Hampshire‘s revised plan in March 2011, despite some reservations and recommendations for additional monitoring (ASMFC Technical Committee 2011; ASFMC 2011b: 5).

Amendment 2 is not likely to sufficiently protect the alewife and the blueback herring either alone or conjunction with other planned protection measures. The amendment does not require, and is not likely to result in, adequate measures to reduce significant incidental catch and bycatch/bycatch mortality of these species, particularly in federal waters. Amendment 2 also does not meaningfully address the non fishing related stressors to alewives and to blueback herring.

Significantly, prohibitions on the harvest of alewives and blueback herring that have already been put in place in four states – Connecticut, Massachusetts, Rhode Island, and North Carolina – have not been successful in reversing the species‘ decline. For example, Massachusetts put in place a moratorium on the harvest, possession, or sale of alewives and blueback herring in 2005. In 2008, citing the lack of recovery of the species‘ populations both in the state and in the surrounding region, Massachusetts extended its moratorium for an additional three years. The stories in the other states are similar, *i.e.*, moratoriums have been put in place and maintained after populations of alewives and blueback herring have failed to respond.

2. Federal Measures

The Magnuson-Stevens Fishery Conservation and Management Act (–MSA”), 16 U.S.C. §§ 1801 *et seq*., authorizes regional fishery management councils to prepare FMPs for conserving and managing federally-managed fisheries in the EEZ. For such federally-managed fish stocks, overfishing is prohibited, and fish stocks that are already overfished must be rebuilt within statutorily-prescribed time frames. At present, alewife and the blueback herring are not managed under a federal FMP as stocks in a fishery and thus are not being subjected to the MSA‘s requirements concerning overfishing and rebuilding depleted fisheries.

Although federal FMPs must contain measures related to monitoring and minimizing bycatch, it has been disputed whether such provisions apply to alewives and blueback herring that are caught and sold. Even assuming the applicability of the MSA‘s bycatch-related provisions, such provisions have proven ineffectual to date with regard to alewives and blueback. Specifically, while federal FMPs must establish standardized reporting methods for bycatch, it is widely recognized that such bycatch reporting is limited and generally inadequate and particularly so with respect to non-federally managed fish species such as alewife and blueback herring. Federal FMPs must also include ―practicable” measures to minimize bycatch and bycatch mortality. In practice, the ―practicability” threshold means that significant bycatch reduction measures are rarely included as required management measures in FMPs unless necessary to prevent overfishing or to rebuild a federally-managed fish stock. No FMPs implemented pursuant to the MSA currently contain any provisions specifically intended to reduce the incidental catch or bycatch and bycatch mortality of alewives and blueback herring.

Draft versions of Amendment 5 to the Atlantic Herring FMP, currently under development by the New England Fishery Management Council (―NEFMC”), and Amendment 14 to the Squid, Mackerel, and Butterfish FMP, currently under development by the Mid-Atlantic Fishery Management Council (―MAFMC”), both contain proposals that would improve monitoring of alewife and blueback herring bycatch/incidental catch in these fisheries and potentially reduce such catch of the two species. It is currently uncertain when these FMP amendments will be approved and take effect, whether the amendments will ultimately contain provisions intended to reduce bycatch mortality of alewives and/or blueback herring, reduce incidental catch, and the extent of such bycatch mortality/incidental catch reduction (if any).

NMFS has declined to initiate emergency rulemaking or take other action under the MSA or under the Atlantic Coast Fisheries Act (which authorizes NMFS, in the absence of a federal FMP, to implement regulations in federal waters compatible with the relevant interstate FMP and consistent with the MSA‘s national standards, 16 U.S.C. § 5103(b)(1)) to increase the monitoring of, and to take action to reduce, bycatch/incidental catch of alewives and blueback herring in small-mesh fisheries in the Northeast. In 2009, the ASMFC requested that the Secretary of Commerce take emergency action to improve monitoring of and the regulation of bycatch/incidental catch of alewives and blueback herring in these small-mesh fisheries and to provide additional resources to support the cooperative efforts between the ASMFC, MAFMC, and NEFMC to better manage anadromous fisheries for purposes of reducing bycatch-related mortality and reducing incidental catch (NMFS 2009a). The MAFMC (2009) and NEFMC (2009) supported this request. Also in 2009, multiple non-governmental organizations petitioned NFMS for an emergency rulemaking per ASMFC‘s request (NMFS 2009a; Cape Cod Commercial Hook Fishermen‘s Association *et al.* 2009). NMFS (2009) denied the request, stating that ―emergency rulemaking under section 305(c) or general rulemaking under section 402(a)(2) of the Magnuson-Stevens Act to increase monitoring or observer coverage of river herring bycatch/incidental catch in small-mesh fisheries in New England or the Mid-Atlantic is not warranted or justified at this time.”

The MSA also requires regional fishery management councils to designate ―essential fish habitat" for federally-managed stocks. But because they are not federally-managed, alewife and the blueback herring are not subject to this requirement. Under 1996 amendments to the MSA, a regional council is required to comment on activities likely to substantially affect the habitat of anadromous fishery resources under the council‘s authority. To date, based on the information provided by the ASMFC (2008) and ASMFC (2009a) and to the best of Petitioner‘s knowledge, this provision has not resulted in meaningful modification of any projects or activities with adverse effects on alewife and blueback herring habitat.

Various federal laws and regulations contain requirements and provisions relating to threats to the alewife‘s and the blueback herring‘s habitat, including resulting from poor water quality, dredging, and/or altered water flows. As detailed *supra* and further discussed below, however, such regulatory mechanisms have failed to adequately address these habitat threats.

The federal Clean Water Act (―CWA"), 33 U.S.C. §§ 1251-1387, authorizes the EPA and states with delegated CWA programs to limit the discharge of pollutants into navigable waters. The CWA has produced notable progress in reducing discharges of toxic pollutants from industrial sources, but is widely-recognized to have not adequately regulated nutrients and toxic pollutants originating from non-point sources. The CWA‘s Section 404 also requires entities to obtain a federal permit from the ACOE before discharging dredged or fill material into navigable waters; section 10 of the Rivers and Harbors Act of 1899 similarly requires issuance of ACOE permits in order to place structures in navigable waters or to conduct excavation or filling activities in navigable streams. Such permits, which are routinely granted, sometimes contain restrictions on the timing and location of dredging operations in habitats utilized by alewives and blueback herring, resulting in limited incidental benefits to the species.

The Federal Power Act (―FPA"), 16 U.S.C. §§ 791-828, has provisions for protecting and enhancing fish and wildlife affected by hydroelectric facilities regulated by FERC. Section 10(j) of the FPA requires licenses issued by FERC to include conditions for protecting, mitigating damages to, and enhancing fish and wildlife, and Section 18 requires the construction and operation of fishways. However, the lack of effective and/or maintained fish passage devices for alewives and blueback herring and the degradation of upstream habitat due to impoundment of formerly free-flowing rivers limit opportunities for alewives and blueback herring to benefit from the FPA‘s fishway requirements.

The Anadromous Fish Conservation Act, 16 U.S.C. §§ 757a-757f, authorizes the Secretaries of Interior and Commerce to contract with states and other entities for the conservation, development, and enhancement of anadromous fish, primarily through research, surveys, and the construction and operation of hatcheries. It does not require measures to improve habitat or reduce bycatch or mitigate other threats facing alewife and the blueback herring. Similarly, the Fish and Wildlife Coordination Act, 16 U.S.C. §§ 661-666, authorizes the Secretaries of Interior and Commerce to advise agencies engaged in federal water project development on the potential effects of projects on fish and wildlife habitat. While the law requires construction agencies to file these reports and recommendations with requests for congressional authorization, the recommendations are not binding.

A number of federal and international laws and policies are intended to control the potential spread of fish pathogens from one geographic area to another, such as 50 C.F.R. § 16, the FWS Health Policy, and the North Atlantic Salmon Conservation Organization Williamsburg Resolution but they are focused on salmonid species. The ASMFC FMP recommends that public aquaculture facilities be certified as disease-free and that states submit annual reports regarding such certification, but, to the best of Petitioner‘s knowledge, this recommendation has not been acted on to date.

Various federal protections exist for other anadromous species with ranges overlapping those of alewife and the blueback herring, such as the shortnose sturgeon and Atlantic salmon. These protections may provide some benefits to alewife and blueback herring but such benefits are limited and not sufficient to stop the species‘ declines.

E. Other Natural or Manmade Factors

1. Invasive Species

Invasive species may threaten food sources for alewives and blueback herring (ASMFC 2009b). For example, the introduction of zebra mussels to the Hudson River, and their subsequent explosive growth in the river, quickly caused pervasive changes in populations of phytoplankton (80 percent drop) and micro- and macro- zooplankton (76 percent and 50 percent drop, respectively) communities (ASMFC 2008: 310). Water clarity improved dramatically (up by 45 percent), and shallow water zoobenthos increased by 10 percent (ASMFC 2008: 310). Following these significant changes in habitat, Strayer *et al.* (2004) observed decreases in the growth rate and abundance of young-of-the-year fishes, including both alewives and blueback herring (Strayer *et al.* (2004) , as cited in ASMFC 2008: 310-311).

Alewives and blueback herring may face increased threats from invasive species due to changes in ocean conditions and the marine ecosystem as a result of climate change and other impacts related to increasing carbon dioxide emissions and levels in the atmosphere.

2. Impingement, Entrainment, and Water Temperature

Operations that withdraw water from rivers or other bodies or water can impinge or entrain alewife and blueback herring larvae, YOY, and small juveniles on intake screens, especially when intake structures are located in or near spawning grounds. Large volume water withdrawals (*e.g.*, drinking water, pumped-storage hydroelectric projects, irrigation, and snow-making), especially at pumped-storage facilities, can drastically alter local current characteristics (*e.g.*, reverse river flow) (ASMFC 2009a). This can cause delayed movement past the facility, or entrainment where the intakes occur (ASMFC 2009a). Planktonic eggs and larvae entrained at water withdrawal projects experience high mortality rates due to pressure changes, shear and mechanical stresses, and heat shock (ASMFC 2009a). Well-screened facilities are unlikely to cause serious mortality to juveniles; however, large volume withdrawals can entrain significant numbers (ASMFC 2009a). Impingement of fish can trap them against water filtration screens, leading to asphyxiation, exhaustion, removal from the water for prolonged periods of time, or removal of protective mucous and descaling (ASMFC 2009a). According to the ASMFC (2009a and 2009b), alewife and blueback herring populations can be threatened by entrainment or impingement by commercial, agricultural, or municipal water intake structures.

Studies of three power plant facilities – the Seabrook nuclear power facility in southern New Hampshire, which draws water through pipes from Ipswich Bay; the Pilgrim nuclear power plant in Massachusetts on southern Cape Cod Bay, which draws water directly from Plymouth Bay; and Brayton Point Station, located in Massachusetts on Mount Hope Bay near the Taunton River – showed that significant impingement and entrainment of alewives and their larvae and eggs occurred in and on the power stations' cooling water intake structures. Mean impingement of alewives at Seabrook was 508 fish annually between 1990 and 1998 (EPA 2002: Table G3-2). Mean impingement of alewives at Pilgrim was 3,250 fish annually between 1974 and 1999, although there were no data available from 1975 through 1989 (EPA 2002: Table G3-10). The little data available on entrainment at Pilgrim suggested high levels of entrainment of alewives (larvae and eggs) as well (EPA 2002: Table G3-14). EPA's estimate of mean impingement of alewives at Brayton Point was 5,998 annually from 1978 to 1983 (EPA 2002: Table F3-2). EPA's estimated mean annual entrainment of alewives' eggs and larvae at Brayton Point was 1,076,500 annually (EPA 2002: Table F3-6).

Studies conducted along the Connecticut River found that larvae and early juveniles of alewife, blueback herring, and American shad suffered 100 percent mortality when temperatures in the cooling system of a power plant were elevated above 28°C; 80 percent of the total mortality was caused by mechanical damage and 20 percent was due to heat shock (ASMFC 2009a). Ninety-five percent of the fish near the intake were not captured by the screen, indicating that it may not be possible to screen fish larvae effectively (ASMFC 2009a).

Water withdrawals can also alter physical characteristics of streams, including: decreased stream width, depth, and current velocity; altered substrate; and temperature fluctuations (ASMFC 2009a). In rivers that are drawn upon for water supply, water is often released downstream during times of decreased river flow (usually summer) (ASMFC 2009a). Additionally, failure to release water during times of low river flow and higher than normal water temperatures can cause thermal stress, leading to fish mortality (ASMFC 2009a). Consequently, water flow disruption can result in less freshwater input to estuaries, which are important nursery areas for many anadromous species (ASMFC 2009a).

In addition, cold water releases often decrease the water temperature of the river downstream, which has been shown to cause some juvenile anadromous fish to abandon their nursery areas (ASMFC 2009a). At the Cannonsville Reservoir on the West Branch of the Delaware River, cold-water releases from the dam resulted in the elimination of nursery grounds below the dam for American shad (ASMFC 2009a). The same factors could negatively affect alewives and blueback herring. Facilities that release heated water also cause changes in alewife and blueback herring habitat that can cause mortalities or impairment.

IV. Requested Listings

NMFS must list a species as ―threatened” under the ESA if the species is ―likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.” *See* 16 U.S.C. § 1532(20).

Appropriate Time Frames

In choosing a time frame*, e.g.,* what is the ―foreseeable future” in which a species is likely to become endangered for classification purposes, NMFS must choose a time frame that is reasonable, given the species‘ characteristics and the nature of the threats. *Cf. Black's Law Dictionary*, 8th ed. 2004 (definition of foreseeable is ―reasonably anticipatable”). The time frame should also ensure protection of the petitioned species, and give the benefit of the doubt regarding any scientific uncertainty to the species.

The timeframe for alewife and the blueback herring should be similar to that used for other anadromous fish species. Because global warming is one of the foremost threats to alewife and the blueback herring, NMFS should also use a timeframe that is appropriate for such impacts and relied upon in climate modeling (such a time frame is, for example, inherently ―foreseeable”). The minimum time period that meets these criteria is 100 years. The 100 year time frame has been used for fish with shorter lifespans, such as Columbia River steelhead, Chinook salmon, and, most recently, the GOM DPS of Atlantic Salmon (NMFS 2009b: 74 Fed. Reg. 29344, 29356). Courts have approved the use of the 100 year time-frame for multiple other species as well. *See Western Watersheds Project v .United States Fish and Wildlife Service,* 535 F. Supp. 2d 1173, 1184 (D. Id. 2007) (―To be a ‗threatened‘ species under the ESA, the sage-grouse must be ‗likely‘ to ‗be in danger of extinction‘ within 100 years”); *Southwest Center for Biological Diversity v. Norton,* 2002 WL 1733618, at *12 (D.D.C. July 29, 2002) (for the Queen Charlotte goshawk, the FWS determined that the goshawk would be ―threatened” ―if at any point in the next 100 years there is a 20 percent chance that the species would become extinct.”); *Western Watersheds Project v. Foss,* 2005 WL 2002473, at *15 (D. Id., Aug. 19, 2005) (court ruled that FWS‘ decision not to list a plant with 64 percent chance of extinction within 100 years as threatened was untenable).

The IUCN species classification system also uses a timeframe of 100 years. For example, a species must be classified as ―vulnerable” under the IUCN system if there is a probability of extinction of at least 10% within 100 years. Further, a species must be listed as ―endangered” if the probability of extinction is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

Moreover, in planning for species recovery, agencies routinely consider a 75-200 year foreseeable future threshold (Suckling 2006). For example, the FWS used 100 years in connection with recovery of the Steller‘s Eider (*e.g.*, the Alaska-breeding population of the species will be considered for delisting from threatened status when it has <1% probability of extinction in the next 100 years, and certain populations have <10% probability of extinction in 100 years and are stable or increasing) and 200 years in connection with recovery of the Utah prairie dog, and NMFS used 150 years in connection with the recovery of the Northern right whale (Suckling 2006).

Perhaps most importantly, the time period that NMFS uses in its listing decision must be long enough so that actions can be taken to ameliorate the threats to the petitioned species and prevent extinction. Slowing and reversing impacts from anthropogenic greenhouse gas emissions in particular, a primary threat to alewife and the blueback herring, will be a long-term process for a number of reasons, including the long lived nature of carbon dioxide and other greenhouse gases and the lag time between emissions and climate changes. For all these reasons, Petitioner recommends a minimum of 100 years as the time frame for analyzing the threats to the continued survival of alewife and the blueback herring.

Significant Portion of Its Range

A ―significant portion of [a species‘] range” (also ―SPOIR”) can include both current and historical habitat. *See*, *e.g., Northwest Ecosystem Alliance v. United States Fish and Wildlife Serv.*, 475 F.3d 1136, 1148 (9th Cir. 2007) (―major geographical areas in which it is no longer viable but once was”), citing *Defenders of Wildlife v. Norton,* 258 F.3d 1136, 1145 (9th Cir. 2001). A danger of extinction to a species within a SPOIR is sufficient to require listing. 16 U.S.C. § 1532(6); *Defenders,* 258 F.3d at 1141-42.

Cumulative Impacts of Stressors

Consistent with the ESA‘s requirements, while each factor and each individual stressor may be discussed separately, they must be considered together in making listing decisions. To only consider them ―piecewise, one or two at a time . . . is flawed because the interaction among components may yield critical insight into the probability of extinction. . . . the synergism among processes—such as habitat reduction, inbreeding depression, demographic stochasticity, and loss of genetic variability—is exactly what will be overlooked by viewing only the pieces.” Boyce (1992: 495-6); *see also Western Watersheds Project v. Fish and Wildlife Serv.,* 535 F. Supp. 2d 1173, 1179 (D. Id. 2007) (―It is the ‗cumulative impacts of the disturbances, rather than any single source, [that] may be the most significant influence on the trajectory of sagebrush ecosystems.'”). NMFS has considered cumulative risk in prior listing determinations (NMFS 2009b: 74 Fed. Reg. 29344, 29382-83).

For the alewife and the blueback herring, cumulative risk must be accounted for by considering risks posed by individual stressors and harms in the aggregate. Alewives and blueback herring have a broad geographic range and are susceptible to varied threats throughout their life stages. The ASMFC (2009b) indicates that bycatch/incidental catch in ocean fisheries, predation by other species, direct harvest, barriers to upstream and downstream migration (*e.g.*, dams and hydropower facilities), and habitat degradation can impact the abundance and distribution of alewife and blueback herring populations in Atlantic coastal areas (ASMFC 2009b). Habitat degradation can be caused by pollution (*e.g.*, non-point source, industrial, etc.), agriculture (*e.g.*, sediment load alterations, chemicals, etc.), channelization and dredging, and urbanization (ASMFC 2009b). Climate change may also pose risks to alewife and blueback herring populations. If a population of alewife or blueback herring can sustain only a certain number of mortalities per year and/or over the course of several years but is faced with mortalities that exceed that amount over a sustained period of time, the population is threatened with collapse. This only becomes adequately apparent by adding together the risks posed by different stressors.

In addition, the interaction between individual stressors, and possible synergistic effects, must be considered. For example, dams can compound the risk of predation as large numbers of alewives and blueback frequently congregate in areas immediately below dams and thus become more vulnerable to predators. Boesch *et al.* (2007) stated that ―the interaction between climate and anthropogenic nutrient loading [is] particularly important in determining future hypoxic events."

The alewife and the blueback herring are particularly vulnerable to a variety of anthropogenic and natural disturbances throughout their life cycles. While individual factors may negatively affect the stability or growth of a particular population(s) of alewife and blueback herring, it is likely that a combination of factors negatively affecting multiple populations of alewives and blueback herring could threaten the species' sustained stability and growth. Alewives and blueback herring are likely able to sustain only a certain level of anthropogenic sources of mortality, and a combination of factors negatively affecting alewives and blueback herring at different life stages could exceed their total mortality threshold and inhibit the species' stability or growth. In addition, research indicates that forage fish species, such as alewife and the blueback herring, may be at a significant risk when their population sizes are at only a fraction of their historical levels but are still large compared to what would be considered normal for other ESA-listed species (NMFS 2009c: 74 Fed. Reg. 10857, 10868-69).

A. The Alewife and the Blueback Herring Should Each Be Listed as Threatened Species as a Whole.

For the reasons set forth in this petition, NMFS should list both the alewife and the blueback herring as threatened species as a whole because both the alewife and the blueback herring are likely to become endangered in the foreseeable future throughout all or a significant portion of their respective ranges.

As discussed *supra*, significant reductions in and/or the extirpation of populations of alewives and of blueback herring exposes each species as a whole to a much greater risk of becoming endangered within the foreseeable future throughout all or a significant portion of its range. For example, the ability of alewives and blueback herring to adapt to climate change depends on genetic and geographic diversity, as maximum gene variation increases the odds that genes will carry traits amenable to climate change adaptation. The disappearance and/or depletion of alewife and blueback herring populations in many rivers, and the significant risk of increasing rates of depletion and extirpation of such populations, leaves each species as a whole vulnerable to being unable to adapt to changes caused by climate change.

The precipitous and sustained declines of both the alewife and the blueback herring throughout the species' respective ranges despite efforts to stabilize and rebuild populations of both species, indicate that it is necessary to protect alewives and blueback herring using the protections available under the ESA in order to save and recover each species. Accordingly, the alewife and the blueback herring should each be listed as a threatened species as a whole.

B. In the Alternative, the Four Alewife DPSs and the Three Blueback Herring DPSs Should Be Listed as Threatened.

In the alternative, NMFS should list the four alewife DPSs and three blueback herring DPSs as threatened. Each of these DPSs is likely to become endangered within the foreseeable future throughout all or a significant portion of its range for the reasons set forth in this petition.

As discussed *supra*, coastal rivers in the Central New England DPSs, the Long Island Sound DPSs, the Chesapeake Bay DPSs, and the Carolina DPS historically supported abundant populations of both alewives and blueback herrings. Because of multiple stressors, including climate change, fishing-related mortality, and habitat impairment, such as from dams and poor water quality, these populations have significantly declined and are continuing to decline or to persist at unsustainable low levels.

For example, in the proposed Central New England DPSs, the Taylor River supported the New Hampshire's largest alewife and blueback herring population, with a population once numbering at least 450,000 fish, but it has dramatically declined since around 1980 and remains at historic low levels (NHFGD 2009: 16, Table 1-1; ASMFC 2008: 104, Figure 1.6.1.1). From a peak of 450,000 fish in 1976, the Taylor River alewife and blueback herring population (almost entirely bluebacks, according to NHFGD (2011)) dropped to 675 counted fish in 2010 – a decline of more than 99 percent (NHFGD 2009: 16, Table 1-1; NHFGD 2011a). In addition, the monitored alewife and blueback herring populations in the Exeter River, Lamprey River, and Oyster River – three rivers that are located in close proximity to each other – have experienced a combined decline of over 50 percent since just 2004 (NHFGD 2009: 16, Table 1-1; NHFGD 2011a). Historically, the Oyster River was the most important of the three rivers, but its 2009 and 2010 run counts (mostly bluebacks, according to NHFGD (2011)) were just ~15 percent of what they were in the 1990s (NHFGD 2011). To similar effect, between just 2004 and 2008, the age structure of the alewife and the blueback herring populations in the Taylor River, Exeter River, and Oyster River has declined significantly (NHFGD 2009: 17, Table 1-2). Throughout the central and southern portion of these DPSs, alewives and blueback herring have been extirpated or reduced to remnant populations in most rivers and streams. In the Parker River, the average alewife count over the last three years is just 5% of what it was in the mid-1970s (MADMF 2011).

In the proposed Long Island Sound DPSs, coastal rivers that once boasted significant alewife and blueback herring populations include the Monument River, Mattapoisett River, Nemasket River, Nonquit River, Gilbert-Stuart River, and Connecticut River (ASMFC 2008). Today, available data indicates that there is only one river in these DPSs (the Nemasket River) that supports a sizeable alewife population and only one river in these DPSs (the Connecticut River) that supports a sizeable blueback herring population (ASMFC 2008). According to the ASMFC (2008), available data indicates that the other rivers in these DPSs support depleted alewife populations that are an estimated 87 percent to 99 percent smaller than the Nemasket River alewife population (ASMFC 2008; MADMF 2011: 52-53, Appendix Table 4). The blueback herring population in the Monument River, for example, was an estimated 97 percent smaller than the Connecticut River population (ASMFC 2008). Historically, the Monument's alewife run numbered almost 600,000 counted fish and its blueback run more than 100,000 counted fish. In 2010, fish counts in the river showed declines of 84 percent and 91 percent, respectively, from those peaks (ASMFC 2008: 195, Table 4.3; MADMF 2011: 52, Appendix Table 4). These declines (as well as those in other rivers) led the MADMF in 2005 to prohibit the harvest, possession, or sale of alewives and blueback herring throughout the state as an emergency conservation measure – prohibitions which have been continued as a result of continuing population declines (ASMFC 2008; MADMF 2008).

In the proposed Chesapeake Bay DPSs, commercial landings from Maryland's Chesapeake Bay and tributaries have declined more than 99 percent from pre-1970s harvests of more than 3 million pounds (MDNR 2010: 21, Table 12). In Virginia, once the leader in river herring landings on the Atlantic seaboard, commercial landings of river herring have declined from peaks of almost 25 million pounds to recent lows averaging under 100,000 pounds per year (ASMFC 2008: 55-57, Table 1.5.1.1). Historical overharvesting has been identified as one of the factors contributing to the recent declines in alewife and blueback herring populations in the Chesapeake Bay (USFWS 2009). Bycatch and incidental catch – an ongoing concern – likely contributes to this overharvesting problem as there are no limits on the amounts of alewives and blueback herring caught as bycatch and incidental catch in ocean waters. In addition, the Bay's nutrient pollution problem is one of the most egregious in the country, and dams that permanently blocked anadromous fish passage and those with ineffective fishways have significantly reduced the amount of spawning habitat available for alewife and blueback herring populations in rivers and tributaries along the Chesapeake Bay (ASMFC 2008).

In the Carolina DPS, the story is the same for alewives. The fish appears to have been effectively extirpated in South Carolina, and river herring landings data from North Carolina suggest population declines of about 98 to 99 percent from 1950 to 1970 harvest levels (ASMFC 2008: 55-57, Table 1.5.1.1; 495, Table 3; and 537; SCDNR 2010a; NCDMF 2010a: 4-6, Table 1). Data specific to alewives in North Carolina show that average size has decreased significantly in the past 3 decades: female and male alewives sampled from 2004 to 2007 were approximately 15 to 20 millimeters smaller, on average, than alewives of the same sex sampled from 1971 to 1978; mean sizes of male and female alewives from ages 4 through 6 have stayed low since the statewide harvest moratorium was implemented in 2007 (ASMFC 2008: 35, 129, Figure 1.7.1; NCDMF 2010b: Figures 20 and 21). The mean JAI in Albemarle Sound for alewives from 1972 to 1980 was 5.7; between 2000 and 2010, it averaged only 0.98 (NCDMF 2011; NCDMF 2010b: Table 40). Even with the river herring harvest moratorium in North Carolina starting in 2007, populations do not appear to have rebounded. Significant threats include fishing mortality in ocean waters and adverse modification of habitat. For example, poor water quality, especially from urban and agricultural runoff, negatively affects alewives in the Chowan River (NCWAP 2005). In South Carolina rivers, dams block or complicate passage by river herring to traditional spawning habitat and have been found to contribute to dramatic declines seen in river herring spawning runs (USFWS/SCDNR 2001).

Notably, climate change serves as a particularly significant threat to the alewife in the southernmost portion of its range, as discussed *supra*. In a recent NMFS study of different fish species' responses to climate change trends, the alewife demonstrated a notable poleward shift in the center of biomass and an increase in mean depth of occurrence (Nye *et al.* 2009: 120). Another study in North Carolina noted the potential for climate change to, as a result of rising sea levels, further reduce habitat complexity and quality in alewife spawning and nursery habitat and thus also reduce the number of repeat spawners as energy needs increase for migration because of decreasing habitat quality in downstream areas (Weaver 2009). In designating a Carolina DPS for Atlantic Sturgeon in 2010, NMFS noted that the Carolinas region in particular was significantly threatened by climate change and rising sea level, as well as altered surface hydrology caused in part by dams, and a regionally receding water table, probably resulting from both over-use and inadequate recharge (NMFS 2010c: 75 Fed. Reg. 61904, 61910).

In short, these DPSs are likely to become endangered in the foreseeable future, given their small size, declining status, and the multiple significant threats they face. As discussed supra, bycatch/incidental catch, hydropower dams, poor water quality, and climate change independently pose substantial threats to the alewife and the blueback herring populations occurring in these waters. For all of these reasons, and those discussed supra, NMFS should list these four DPSs of alewives and three DPSs of blueback herring as threatened.

V. Recovery Plan Elements

NMFS should establish a recovery plan for the alewife and for the blueback herring that addresses bycatch/incidental catch, habitat degradation, climate change, disease, and other key threats, including the following components:

- Changes in gear and gear deployment, including catch monitoring, gear restricted areas, closed areas, and catch/bycatch caps in mid-water trawl fisheries believed to cause significant alewife and blueback herring mortality;

- Mitigation and management to improve habitat and water quality, particularly in river systems where habitat and water quality is severely degraded, including specifically: 1) elimination of barriers to spawning habitat through dam removal or breaching, or installation of effective fish passage options; 2) operation of water control structures to provide flows beneficial to alewife and blueback herring habitat use in lower portions of rivers (especially during the spawning season); 3) imposition of restrictions on dredging, including seasonal restrictions and avoidance of spawning/nursery habitat; and 4) mitigation of water quality parameters that are restricting alewife and blueback herring use of a river (*i.e.*, DO);

- Measures to address the current and future effects of global warming on the alewife and on the blueback herring, including measures to reduce nutrient loads and otherwise improve water quality conditions; and

- Enhanced implementation and enforcement of fishery restrictions.

VI. CRITICAL HABITAT DESIGNATION

Petitioner requests the designation of critical habitat for the alewife and the blueback herring concurrent with the requested listings, as required by 16 U.S.C. § 1533(b)(6)(C). *See also* 16 U.S.C. § 1533(a)(3)(A). Alewife and blueback herring populations have already precipitously declined from their historic levels throughout the species‘ ranges. Critical habitat should encompass all known and potential spawning rivers. It should also encompass all estuarine and marine habitats in which alewives and blueback herring are known to forage.

Critical habitat is defined by Section 3 of the ESA as: ―(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species." *See* 16 U.S.C. § 1532(5).

The designation and protection of critical habitat is one of the primary ways to achieve the fundamental purpose of the ESA, ―to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved." *See* 16 U.S.C. § 1531(b). In adding the critical habitat provision to the ESA, Congress clearly saw that species-based conservation efforts must be augmented with habitat-based measures: ―It is the Committee's view that classifying a species as endangered or threatened is only the first step in insuring its survival. Of equal or more importance is the determination of the habitat necessary for that species' continued existence . . . If the protection of endangered and threatened species depends in large measure on the preservation of the species' habitat, then the ultimate effectiveness of the Endangered Species Act will depend on the designation of critical habitat." *See* House Committee on Merchant Marine and Fisheries, H.R. Rep. No. 887, 94th Cong. 2nd Sess. at 3 (1976).

The alewife and the blueback herring will benefit from the designation of critical habitat in all of the ways described above. Designated critical habitat will allow NMFS to designate reasonable and prudent alternatives to activities that are impeding recovery but not necessarily causing immediate jeopardy to the continued survival of the species. For these reasons and as already stated, we request critical habitat designation concurrent with these species listings.

VII. CONCLUSION

For all of the reasons discussed in this petition, NMFS should list the alewife and the blueback herring each as threatened species as a whole. In the alternative, NMFS should list the four DPSs of the alewife and the three DPSs of the blueback herring, as described *supra*, each as threatened species. In the alternative to listing the DPSs as described in this petition, NMFS should delineate alternative DPSs for the alewife and for the blueback herring based on the best available technical information and the agency‘s expertise.

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Parts 223 and 224

[Docket No. 111024651–1650–01]

RIN 0648–XA739

Listing Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition To List Alewife and Blueback Herring as Threatened Under the Endangered Species Act

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: 90-day petition finding; request for comments.

SUMMARY: We, NMFS, announce a 90-day finding for a petition to list alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) as threatened under the Endangered Species Act and to designate critical habitat concurrent with a listing. We find that the petition presents substantial scientific information indicating the petitioned action may be warranted. Accordingly, we will conduct a review of the status of alewife and blueback herring, collectively referred to as river herring, to determine if the petitioned action is warranted. To ensure that the review is comprehensive, we solicit information pertaining to this species from any interested party.

DATES: Information related to this petition finding must be received by January 3, 2012.

ADDRESSES: You may submit comments, identified by the RIN 0648–XA739, by any of the following methods:

• *Electronic Submissions:* Submit all electronic public comments via the Federal eRulemaking Portal *http//www.regulations.gov.* Follow the instructions for submitting comments.

• *Mail or hand-delivery:* Assistant Regional Administrator, NMFS, Northeast Regional Office, 55 Great Republic Drive, Gloucester, MA 01930.

All comments received are a part of the public record and will generally be posted to *http://www.regulations.gov* without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

NMFS will accept anonymous comments. Attachments to electronic comments will be accepted in Microsoft Word, Excel, WordPerfect, or Adobe PDF file formats only.

The petition and other pertinent information are also available electronically at the NMFS Web site at *http://www.nero.noaa.gov/prot_res/CandidateSpeciesProgram/RiverHerringSOC.htm.*

FOR FURTHER INFORMATION CONTACT: Kim Damon-Randall, NMFS, Northeast Regional Office (978) 282–8485 or Marta Nammack, NMFS, Office of Protected Resources (301) 713–1401.

SUPPLEMENTARY INFORMATION:

Background

On August 5, 2011, we, the National Marine Fisheries Service (NMFS), received a petition from the Natural Resources Defense Council (NRDC), requesting that we list alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) each as threatened throughout all or a significant portion of their range under the Endangered Species Act (ESA). In the alternative, they requested that NMFS designate distinct population segments (DPS) of alewife and blueback herring as specified in the petition (Central New England (CNE), Long Island Sound (LIS), Chesapeake Bay (CB) and Carolina for alewives, and CNE, LIS, and CB for blueback herring). The petition contains information on the two species, including the taxonomy; historical and current distribution; physical and biological characteristics of the species' habitat and ecosystem relationships; population status and trends; and factors contributing to the species' decline. NRDC also included information regarding the possible DPSs of alewife and blueback herring as described above. The petition addresses the five factors identified in section 4(a)(1) of the ESA: (1) Present or threatened destruction, modification, or curtailment of habitat or range; (2) over-utilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; and (5) other natural or man-made factors affecting the species' continued existence.

ESA Statutory Provisions and Policy Considerations

Section 4(b)(3)(A) of the ESA (16 U.S.C. 1533(b)(3)(A)) requires that we make a finding as to whether a petition to list, delist, or reclassify a species presents substantial scientific or commercial information indicating the petitioned action may be warranted. ESA implementing regulations define substantial information as the amount of information that would lead a reasonable person to believe the measure proposed in the petition may be warranted (50 CFR 424.14(b)(1)). In determining whether substantial information exists for a petition to list a species, we take into account several factors, including information submitted with, and referenced in, the petition and all other information readily available in our files. To the maximum extent practicable, this finding is to be made within 90 days of the receipt of the petition (16 U.S.C. 1533(b)(3)(A)), and the finding is to be published promptly in the **Federal Register**. If we find that a petition presents substantial information indicating that the requested action may be warranted, section 4(b)(3)(A) of the ESA requires the Secretary of Commerce (Secretary) to conduct a review of the status of the species. Section 4(b)(3)(B) requires the Secretary to make a finding as to whether the petitioned action is warranted within 12 months of the receipt of the petition. The Secretary has delegated the authority for these actions to the NOAA Assistant Administrator for Fisheries.

The ESA defines an endangered species as "any species which is in danger of extinction throughout all or a significant portion of its range (ESA section 3(6))." A threatened species is defined as a species that is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (ESA section 3(19))." As stated previously, under section 4(a)(1) of the ESA, a species may be determined to be threatened or endangered as a result of any one of the following factors: (1) Present or threatened destruction, modification, or curtailment of habitat or range; (2) over-utilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or manmade factors affecting its continued existence. Listing determinations are made solely on the basis of the best scientific and commercial data available, after conducting a review of the status of the species and taking into account efforts made by any state or foreign nation to protect such species.

Under the ESA, a listing determination can address a species, subspecies, or a DPS of a vertebrate species (16 U.S.C. 1532 (16)). NRDC presents information in the petition proposing that DPSs of alewife and blueback herring are present in the United States and indicating that it may be appropriate to divide the population into DPSs of alewife and blueback herring as specified in the petition. If we find that listing at the species level is not warranted, we will determine whether any populations of these species meet the DPS policy criteria, and if so, whether any DPSs are endangered or threatened under the ESA.

Life History of Alewife and Blueback Herring

Alewife and blueback herring are collectively referred to as "river herring." Due to difficulties in distinguishing between the species, they are often harvested together in commercial and recreational fisheries, and managed together by the Atlantic States Marine Fisheries Commission (ASMFC). Throughout this finding, where there are similarities, they will be collectively referred to as river herring, and where there are distinctions they will be identified by species.

River herring can be found along the Atlantic coast of North America, from the maritime provinces of Canada to the southeastern United States (Mullen *et al.*, 1986; Shultz *et al.*, 2009). The coastal ranges of the two species overlap, with blueback herring found in a greater and more southerly distribution ranging from Nova Scotia down to the St. John's River, Florida; and alewife found in a more northerly distribution, from Labrador and Newfoundland to as far south as South Carolina, though the extreme southern range is a less common occurrence (Collette and Klein-MacPhee, 2002; ASMFC, 2009a; Kocik *et al.*, 2009). Adults are most often found at depths less than 100 m (328 ft) in waters along the continental shelf (Neves, 1981; ASMFC, 2009a; Shultz *et al.*, 2009).

River herring have a deep and laterally compressed body, with a small, pointed head with relatively large eyes, and a lower jaw that protrudes further than the upper jaw (Collette and Klein-MacPhee, 2002). The dorsal fin is small and slightly concave, pelvic fins are small, pectorals are moderate and low on the body, and the caudal fin is forked (Collette and Klein-MacPhee, 2002).

The coloring varies, ranging from dark blue and bluish green to grayish green and bluish gray dorsally; and silvery with iridescence in shades of green and violet on the sides and abdomen. In adults, there is often a dusky spot that is located at eye level on both sides behind the margin of the gill cover. The colors of alewife are thought to change in shade according to substrate as the fish migrates upstream, and sea run fish are thought to have a golden cast to their coloring (Collette and Klein-MacPhee, 2002).

Blueback herring and alewife are similar in appearance; however, there are some distinguishable characteristics: Eye diameter and the color of the peritoneum. The eye diameter with alewives is relatively larger than that of blueback herring. In blueback herring, the snout length is generally the same as the eye diameter; however with alewives, the snout length is smaller than the diameter of the eye (Collette and Klein-MacPhee, 2002). In alewives, the peritoneum is generally pale/light gray or pinkish white, whereas the peritoneum in blueback herring is generally dark colored and either brown or black, and sometimes spotted (Collette and Klein-MacPhee, 2002; ASMFC, 2009a).

River herring are anadromous, meaning that they migrate up coastal rivers in the spring from the marine environment, to estuarine and freshwater rivers, ponds, and lake habitats to spawn (Collette and Klein-MacPhee, 2002; ASMFC, 2009a; Kocik *et al.*, 2009). They are highly migratory, pelagic, schooling species, with seasonal spawning migrations that are cued by water temperature (Collette and Klein-MacPhee, 2002; Schultz, 2009). Depending upon temperature, blueback herring typically spawn from late March through mid-May. However, they have been documented spawning in the southern parts of their range as early as December or January, and as late as August in the northern range (ASMFC, 2009a). Alewives generally migrate earlier than other alosine fishes, but have been documented spawning as early as February to June in the southern portion of their range, and as late as August in the northern portion of the range (ASMFC, 2009a). It is thought that river herring return to their natal rivers for spawning, and do exhibit natal homing. However, colonization of streams where river herring have been extirpated has been documented; therefore, some effective straying does occur (ASMFC, 2009a).

Throughout their life cycle, river herring use many different habitats ranging from the ocean, up through estuaries and rivers, to freshwater lakes and ponds. The substrate preferred for spawning varies greatly and can include substrates consisting of gravel, detritus, and submerged aquatic vegetation. Blueback herring prefer swifter moving waters than alewife (ASMFC, 2009a). Nursery areas can include freshwater and semi-brackish waters; however, little is known about their habitat preference in the marine environment (Meadows, 2008; ASMFC, 2009a).

Analysis of Petition and Information Readily Available in NMFS Files

In the following sections, we use the information presented in the petition and in our files to: (1) Describe the distribution of alewife and blueback herring; and (2) evaluate whether alewife and blueback herring are at abundance levels that would lead a reasonable person to conclude that listing under the ESA may be warranted due to any of the five factors listed under section 4(a)(1) of the ESA.

Abundance

The NRDC asserts that alewife and blueback herring populations have suffered dramatic declines over the past 4 decades (ASMFC, 2008). The NRDC cites the ASMFC as stating that alewife and blueback herring harvest averaged almost 43 million pounds (19,504 metric tons (mt)) per year from 1930 to 1970. NRDC also cites ASMFC (2008) in stating that peak harvest occurred in the late 1940s and early 1950s and was highest in Virginia and North Carolina. The NRDC notes that commercial landings of river herring began declining sharply coastwide in the 1970s. However, ASMFC (2009a) reports that 140 million pounds (63,503 mt) of river herring were commercially landed in 1969, marking the peak in river herring catch; this is a discrepancy from what is stated in the petition. From the peak landings in 1969, landings declined to a point where domestic landings recently (2000–2007) exceeded only 2 million pounds (907 mt) yearly (ASMFC, 2009a). Declines in catch per unit effort (CPUE) have also been observed in two rivers for blueback herring and for alewife, and declining trends in CPUE for the combined species were also observed in two out of three rivers examined (ASMFC, 2009a).

ASMFC (2009a) also reports declines in abundance through run size estimates for river herring combined, as well as for individual species of alewife and blueback herring. Abundance declined in seven out of fourteen rivers in New England from the late 1960s to 2007, with no obvious signs of recovery; however, since 2004, there have been some signs of recovery in five out of fourteen rivers (ASMFC, 2009a). Coastwide declines have been observed, particularly in southern New England (Davis and Schultz *et al.*, 2009). In the Connecticut River the number of blueback herring passing Holyoke Dam declined from 630,000 in 1985 to a low of 21 in 2006 (Schultz *et al.*, 2009).

ESA Section 4(a)(1) Factors

Present or Threatened Destruction, Modification or Curtailment of Habitat or Range

In the petition, the NRDC states that habitat alterations, loss of habitat, and impaired water quality have contributed to the decline of river herring since colonial times. NRDC further states that climate change now poses an increasing threat as well. NRDC states that dams and turbines block access to spawning and foraging habitat, may directly injure or kill passing fish, and change water quality through alterations in flow and temperature, which NRDC asserts is significantly impacting river herring. NRDC cites ASMFC (2009b) which indicates that flow variations caused by dams, particularly hydropower dams, can displace eggs as well as disrupt migration patterns, which will adversely affect the survival and productivity of all life stages of river herring as well as other anadromous fish. ASMFC (2009b) indicates that increased flows at dams with fishways can also adversely affect the upstream migration of adults, impeding their ability to make it up through the fishway, as well as the downstream migration of juveniles, causing an early downstream migration and higher flows through sluiceways resulting in mortality. According to NRDC, dams have caused river herring to lose access to significant portions of their spawning and foraging habitat. In addition to altering flow and changing environmental parameters such as temperature and turbidity, NRDC indicates that dams, particularly hydropower dams, cause direct mortality to various life stages of river herring through entrainment and impingement in turbines, and changing water pressures. In addition, NRDC states that turbines used in tidal hydroelectric power plants may impact river herring with each tidal cycle as the fish migrate through the area.

Dredging and blasting were also identified by NRDC as significant threats to river herring. The petition cites ASMFC (2009b), asserting that increased suspended sediment, changes in water velocities, and alteration of substrates through dredging can directly impact river herring habitat. In addition, NRDC asserts that these operations may affect migration patterns and spawning success, and they can directly impact gill tissues, producing near fatal effects (NMFS, 1998; ASMFC, 2009b).

The NRDC also asserts that water quality poses a significant threat to river herring through changes in water temperature and flow, introduction of toxic pollutants, discharge, erosion, and nutrient and chemical run-off (ASMFC, 2009b). NRDC states that "poor water quality alone can significantly impact an entire population of alewife or blueback herring." ASMFC (2008) notes that significant declines in dissolved oxygen (DO) levels in the Delaware River during the 1940s and 1950s from heavy organic loading made portions of the river during the warmer months of the year uninhabitable to river herring. ASMFC (2008, 2009a) indicates that river herring abundance is significantly affected by low DO and hypoxic conditions in rivers and that these conditions may also prevent spawning migrations.

River herring susceptibility to toxic chemicals and metals was also identified by NRDC as a threat to the species. The NRDC asserts that river herring are subjected to contaminants through their habitat, which may be contaminated with dioxins, polychlorinated aromatic hydrocarbons, organophosphate and organochlorine pesticides, polychlorinated biphenyls, and other hydrocarbon compounds, as well as toxic metals. Citing ASMFC (1999), the NRDC states that because of industrial, residential, and agricultural development, heavy metal and various types of organic chemical pollution has increased in nearly all estuarine waters along the Atlantic coast, including river herring spawning and nursery habitat. NRDC asserts that these contaminants can directly impact fish through reproductive impairment, reduced survivorship of various life stages, and physiological and behavioral changes (ASSRT, 2007; 75FR 61872).

The NRDC also identified climate change as a threat to river herring habitat. According to NRDC, the spatial distribution, migration, and reproduction of alewife may be affected through rising water temperatures caused by climate change. Citing the International Panel on Climate Change (IPCC) (2001), NRDC states that fish larvae and juveniles may have a high sensitivity to water temperature and suggests that headwaters and rivers may be more vulnerable; thus, the effects of climate change may be more significant to anadromous species, which utilize a multitude of habitats. According to ASMFC (2009b), as water temperatures rise, the upstream spawning migration of alewife declines, and will mostly cease once temperatures have risen above 21 degrees Celsius. In addition to increasing water temperatures, climate change may affect river herring through increased precipitation that may affect rivers and estuaries along the coast. Citing Kerr *et al.* (2009), the NRDC reports that a 10 percent increase in annual precipitation is expected in the Northeast United States from 1990 to 2095 and that precipitation has already increased 8 percent over the past 100 years (Markham and Wake, 2005). As increased water flows may affect anadromous fish migration, increased precipitation and the potential for flooding in rivers due to climate change may pose a significant threat to river herring (Limburg and Waldman, 2009).

Overutilization for Commercial, Recreational, Scientific or Education Purposes

The NRDC identified direct harvest, bycatch, and incidental catch as significant threats to river herring. River herring were historically fished through inshore fisheries, and constitute one of the oldest fisheries in North America (Haas-Castro, 2006). Commercial landings of river herring reached nearly 34,000 metric tons (mt) in the 1950s, but in the 1970s, landings fell below 4,000 mt. According to ASMFC (2008), foreign commercial exploitation of river herring in the 1960s led to drastic declines in abundance of river herring. Annual commercial landings over the past decade have varied from 137 mt to 931 mt, and 90 percent of this catch was typically harvested by Maine, North Carolina, and Virginia fisheries (Haas-Castro, 2006). Historically, river herring were targeted for food, bait and fertilizer purposes; however, they are currently most often used for bait in commercial fisheries (Collette and Klein-MacPhee, 2002). The NRDC contends that declines in river herring abundance are greatly affected by commercial overharvest, noting that direct harvest of river herring currently takes place in Maine, New Hampshire, New York, New Jersey, some rivers in Delaware, Maryland, Virginia, and South Carolina.

Bycatch and incidental catch were also identified by NRDC as resulting in significant mortality of river herring, stating that this catch occurs in both state and Federal waters. NRDC asserts that the anadromous life history of river herring presents the potential for increased bycatch due to the species schooling behavior at congregation sites throughout different portions of migration. Citing Lessard and Bryan (2011), NRDC indicates that "hot spots" of bycatch and incidental catch have been found in the winter between Cape Cod and Cape Hatteras, in the spring with blueback herring in the southern region, and in the fall in the Gulf of Maine and Georges Bank. The NRDC states that a variety of sources including landings records, log books, portside sampling efforts, and the NMFS observer program provide information on bycatch and incidental catch, asserting that most of these sources are likely to underestimate the amount of bycatch that occurs.

The NRDC cites Lessard and Bryan (2011) in stating that the majority of bycatch of river herring is taken with mid-water otter paired trawls, and that catch with this gear type appears to be increasing from 2000–2008, with an estimation of around 500,000 to 2.5 million pounds (227 to 1,134 mt) of river herring caught annually as bycatch. In addition, the NRDC asserts that the Atlantic herring and Atlantic mackerel fisheries are increasing their use of single and pair mid-water trawls, and are using larger, more efficient nets, increasing the effort and efficiency in this fishery. The petition further outlines specific overharvesting issues within the Damariscotta, Hudson, Delaware, Potomac, Chowan, Santee-Cooper, and the St. John's Rivers, as well as Chesapeake Bay and Albermarle Sound.

Predation and Disease

The NRDC identifies predation and disease as another threat facing river herring. Citing the Maine Department of Marine Resources (ME DMR) (2003), NRDC states that river herring may be preyed upon by striped bass, bluefish, tuna, cod, haddock, halibut, American eel, brook trout, rainbow trout, brown trout, lake trout, landlocked salmon, smallmouth bass, largemouth bass, pickerel, pike, white and yellow perch, seabirds, bald eagle, osprey, great blue heron, gulls, terns, cormorants, seals, whales, otter, mink, fox, raccoon, skunk, weasel, fisher, and turtles. It asserts that the decline of some populations of river herring is due to increased predation, citing ASMFC (2008) as noting a concern with increasing striped bass abundance, and identifying predation by striped bass as contributing significantly to the decline of river herring in some rivers. Additionally, many species of cormorants along the coast are increasing in abundance, and predation on alosines by cormorants has been increasing, although Dalton *et al.* (2009) suggested that the double-crested cormorant is not believed to pose an immediate threat to the recovery of alewife in Connecticut.

According to the NRDC, significant cumulative mortality can occur with viral hemorrhagic septicemia, which is a viral infection known to infect certain anadromous fish, including river herring. Additionally, NRDC asserts that when levels of suspended solids are present during spawning, alewife eggs are significantly more likely to contract a naturally occurring fungus infection.

Inadequacy of Existing Regulatory Mechanisms

The NRDC states that state and Federal regulatory mechanisms are insufficient and contributing to drastic declines in river herring populations that continue throughout all or a significant portion of the species' ranges. Due to difficulties in distinguishing between the species, alewife and blueback herring are managed together by the ASMFC as river herring. NRDC states that ASMFC has the authority to develop and issue interstate fishery management plans (FMP) for fisheries administered by the state agencies and will coordinate management with Federal waters.

According to NRDC, ASMFC adopted an amendment to the coast-wide FMP for American shad and river herring in 2009, to specifically address the declining river herring populations coastwide. The petition asserts that this amendment is not likely to protect river herring sufficiently, as it "does not require, and is not likely to result in, adequate measures to reduce significant incidental catch and bycatch/bycatch mortality of these species, particularly in federal waters." NRDC also asserts that this amendment does not address non-fishing stressors on river herring sufficiently. The petition further states that four states have already had prohibitions on the harvest of river herring in place, and even with this prohibition on all harvest, these states have continued to see declines.

The petition notes that river herring are not subject to the requirements and protections of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) because they are not currently managed under an FMP as a stock, and therefore, are not federally managed in regard to overfishing and depleted stocks under the MSA. Even though river herring are caught and sold as bycatch, and FMPs are meant to minimize bycatch, the NRDC asserts that any provisions in FMPs meant to address bycatch of river herring have proven to be ineffective and inadequate. NRDC further asserts that bycatch reporting is inadequate and limited and that there are currently no FMPs under the MSA that specifically address bycatch and bycatch mortality of river herring.

The NRDC notes that currently the Mid-Atlantic Fisheries Management Council (MAFMC) is developing two amendments to two separate FMPs that include proposals for improving the monitoring of bycatch of river herring in these fisheries; however, it asserts that it was unknown whether the bycatch monitoring measures for river herring would be included in the final amendment.

NRDC also indicates that under the MSA or the Atlantic Coast Fisheries Act, NMFS has the potential to initiate emergency rulemaking or other actions to reduce bycatch of river herring in small mesh fisheries, but has declined to do so thus far. NRDC further notes that NMFS has declined to take emergency rulemaking actions for bycatch of river herring in small-mesh fisheries in New England and the Mid-Atlantic.

Federally managed stocks are required to have essential fish habitat (EFH) designated under the MSA; however, since river herring are not considered a federally managed stock under the MSA, EFH has not been designated for this species. A provision under the 1996 amendments to the MSA provides for comments from regional councils on activities that may affect anadromous fish habitat; however, the NRDC asserts that this provision has not provided any significant modifications to activities affecting anadromous fish habitat.

In addition to fisheries, the petition indicates that Federal laws and regulations have also failed to protect river herring and their habitat from threats such as poor water quality, dredging, and altered water flows. The petition briefly describes the Clean Water Act (CWA), the Federal Power Act (FPA), and the Anadromous Fish Conservation Act, and identifies where these regulations present inadequacies that are failing to protect river herring. NRDC notes that the CWA should limit discharge of pollutants into navigable waters and that some progress has been made in terms of industrial sources. NRDC also concludes that the CWA has not "adequately regulated nutrients and toxic pollutants originating from non-point sources." In addition, some permits for dredging and excavation require permitting from the Army Corps of Engineers, and NRDC notes that these may benefit river herring through placing restrictions on the timing and location of activities in river herring habitats. The FPA allows for protection of fish and wildlife that may be affected by hydroelectric facilities. As mentioned previously, NRDC asserts that fish passage at hydroelectric facilities can be inefficient, and the dams themselves affect water flow which can pose a significant threat to river herring. Thus, according to NRDC, FPA protections for river herring are inadequate. The NRDC further states that the Anadromous Fish Conservation Act does not require any measures for river herring that would improve habitat, reduce bycatch, or mitigate other threats to river herring, and therefore provides inadequate protection for the species. The NRDC notes that there are Federal protections that may benefit river herring which are intended for other anadromous species such as Atlantic salmon and shortnose sturgeon; however, it asserts that any benefits from these protections are minor and insufficient to fully protect river herring.

Other Natural or Manmade Factors Affecting Its Existence

The petition describes other natural or manmade factors that may be affecting river herring, including invasive species, impingement, entrainment, and water temperature alterations. The petition states that invasive species may threaten food sources for alewives and blueback herring. ASMFC (2008) describes the negative effect zebra mussel introduction to the Hudson River had on phytoplankton and zooplankton, and subsequently water quality. According to ASMFC (2008), a decrease in both micro and macro zooplankton as well as phytoplankton improved water clarity and increased shallow water zoobenthos by 10 percent. Early life stages of river herring feed on zooplankton as well as phytoplankton (ASMFC, 2008). Strayer *et al.* (2004) hypothesized that the introduction of this invasive species created competition for availability of the preferred food source of early life stages of river herring, and found that larval river herring abundance decreased with increased zebra mussel presence. Thus, according to the petition, invasive species introduction and subsequent water quality changes which may affect plankton abundance can decrease the abundance of early life stages of river herring.

As described previously, the petition asserts that various life stages of river herring may be impinged or entrained through water intake structures from commercial, agricultural, or municipal operations. These intake structures alter flow, and may cause direct mortality to various life stages of river herring if they are impinged or entrained by the intake. In addition, aside from direct mortality, the petition asserts that intakes alter flow, which can affect water quality, temperature, substrate, velocity, and stream width and depth. NRDC suggests that these alterations can affect spawning migrations as well as spawning and nursery babitat, which could pose a significant threat to river herring.

Petition Finding

Based on the above information, whicb indicates ongoing multiple threats to both species as well as potential declines in both species througbout their ranges, and the criteria specified in 50 CFR 424.14(b)(2), we find that the petition presents substantial scientific and commercial information indicating that the petitioned action concerning alewife and blueback herring may be warranted. Under section 4(b)(3)(A) of the ESA, this positive 90-day finding requires NMFS to commence a status review of the species. During our status review, we will review the best available scientific and commercial information, including the effects of threats and ongoing conservation efforts on both species throughout their ranges. Alewife and blueback herring are now considered to be candidate species (69 FR 19976; April 15, 2004). Within 12 months of the receipt of the petition (August 5, 2011), we will make a finding as to whether listing alewife and/or blueback herring as endangered or threatened is warranted, as required by section 4(b)(3)(B) of the ESA. If listing these species is not warranted, we will determine whether any populations of these species meet the DPS policy criteria (61 FR 4722; February 7, 1996), and if so, whether any DPSs are endangered or threatened under the ESA. If listing either species (or any DPS) is warranted, we will publish a proposed listing determination and solicit public comments before deciding whether to publish a final determination to list them as endangered or threatened under the ESA.

References Cited

A complete list of the references used in this finding is available upon request (see **ADDRESSES**).

Information Solicited

To ensure the status review is based on the best available scientific and commercial data, we solicit information pertaining to alewife and blueback herring. Specifically, we solicit information in the following areas: (1) Historical and current distribution and abundance of these species throughout their ranges; (2) population status and trends; (3) any current or planned activities that may adversely impact these species, especially as related to the five factors specified in section 4(a)(1) of the ESA and listed above; (4) ongoing efforts to protect and restore these species and their habitat; and (5) any biological information (life history, morphometrics, genetics, etc.) on these species. We request that all information be accompanied by: (1) Supporting documentation such as maps and bibliographic references; and (2) the submitter's name, address, and any association, institution, or business that the person represents.

Peer Review

On July 1, 1994, NMFS, jointly with the U.S. Fish and Wildlife Service, published a series of policies regarding listings under the ESA, including a policy for peer review of scientific data (59 FR 34270). OMB issued its Final Information Quality Bulletin for Peer Review on December 16, 2004. The Bulletin became effective on June 16, 2005, and generally requires that all "influential scientific information" and "highly influential scientific information" disseminated on or after that date be peer reviewed. The intent of the peer review policy is to ensure that decisions are based on the best scientific and commercial data available. Independent peer reviewers will be selected to review the status review report from the academic and scientific community, tribal and other Native American groups, Federal and state agencies, the private sector, and public interest groups.

Authority: 16 U.S.C. 1531 *et seq.*

Dated: October 27, 2011.

John Oliver,

Deputy Assistant Administrator for Operations, National Marine Fisheries Service.

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 622

[Docket No. 100217095–1652–02]

RIN 0648–AY56

Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; Reef Fish Fishery of the Gulf of Mexico; Amendment 32

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Proposed rule; request for comments.

SUMMARY: NMFS proposes to implement management measures described in Amendment 32 to the Fishery Management Plan for the Reef Fish