Atlantic States Marine Fisheries Commission

Atlantic Menhaden Management Board

May 9, 2017
3:30 – 5:45 p.m.
Alexandria, Virginia

Draft Agenda

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

1. Welcome/Call to Order *(R. Ballou)* 3:30 p.m.

2. Board Consent 3:30 p.m.
   - Approval of Agenda
   - Approval of Proceedings from February 2017

3. Public Comment 3:35 p.m.

4. Consideration of Hilborn et al. 2017 Paper for Technical Review 3:45 p.m.
   (*R. Ballou*) **Possible Action**

5. Biological Ecological Reference Point Work Group Progress Report (*S. Madsen*) 4:00 p.m.

6. Update on Draft Amendment 3 *(M. Ware)* **Possible Action** 4:05 p.m.
   - Review Allocation Workgroup Recommendations
   - Provide Guidance/Additional Input to Plan Development Team Regarding Management Options

7. New York Participation in Episodic Events Program (*J. Gilmore*) 5:10 p.m.
   Possible Action

8. Provide Guidance to Technical Committee Regarding Stock Projections 5:20 p.m.
   - Review Stock Projection Methodology *(J. McNamee)*

9. Consider Approval of 2017 FMP Review and State Compliance Reports 5:40 p.m.
   (*M. Ware*) **Action**

10. Other Business/Adjourn 5:45 p.m.

The meeting will be held at the Westin Alexandria, 300 Courthouse Square, Alexandria, Virginia; 703.253.8600

MEETING OVERVIEW

Atlantic Menhaden Management Board Meeting
Tuesday-May 9, 2017
3:30 – 5:45 p.m.
Alexandria, Virginia

Chair: Robert Ballou (RI) Assumed Chairmanship: 05/16	Technical Committee Chair: Jason McNamee (RI)	Law Enforcement Committee Representative: Capt. Kersey (MD)
Vice Chair: Russ Allen (NJ)	Advisory Panel Chair: Jeff Kaelin (NJ)	Previous Board Meeting: February 1, 2017
Voting Members: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, PRFC, VA, NC, SC, GA, FL, NMFS, USFWS (18 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from February 2017

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. Hilborn et al. 2017 Paper (3:45-4:00 p.m.) Possible Action

Background

- In April 2017, Hilborn et al. published a paper regarding harvest policies for forage fish. Given the potential relevance of this paper to Draft Amendment 3, Board members have requested a discussion of this paper (**Briefing Materials)**.

Board actions for consideration at this meeting

- Task the BERP Workgroup to review Hilborn et al. (2017)

5. BERP Workgroup Progress Report (4:00-4:05 p.m.)

Background

- The Board has tasked the BERP Workgroup to develop Ecosystem Based Reference Points (ERPs) for Atlantic Menhaden.
- The BERP Workgroup met on April 10-11 to review the multi-species statistical catch-at-age model.

Presentations

- BERP Workgroup progress report by S. Madsen

6. Update on Draft Amendment 3 (5:05-5:10 p.m.) Possible Action

Background

- In February 2017, the Board tasked the PDT with developing draft Amendment 3. The PDT met via conference call on February 22nd, March 31st, and April 26th to work on a preliminary draft of Amendment 3.
- The Allocation Workgroup met via conference call on April 17th to discuss the allocation options in Draft Amendment 3 and provide recommendations to the Board on ways to hone in on the options currently included in the document.

Presentations

- Update on development of Draft Amendment 3 by M. Ware (**Supplemental Materials)**
- Summary of Allocation Workgroup recommendations by M. Ware **(Supplemental Materials)**

7. New York Participation in Episodic Events Program (5:10-5:20 p.m.) Possible Action

Background

- In May 2016, the Board approved New York to harvester under the episodic events program and capped the state at 1 million pounds for 2016.
- New York is again seeing a high abundance of menhaden in state waters and anticipates reaching their quota shortly. They would like to harvest under the episodic events program.

Board actions for consideration at this meeting

- Approve New York to participate in the episodic events program until implementation of Amendment 3

8. Provide Guidance to TC Regarding Stock Projections (5:20 -5:40 p.m.)

Background

- The Board established a 200,000 mt TAC for the 2017 fishing year.
- The Board must discuss what projections are needed to inform the TAC setting discussion for 2018.

Presentations

- Review of stock projection methodology by J. McNamee

9. Fishery Management Plan Review (5:40 -5:45 p.m.) Action

Background

- State compliance reports were due on April 1, 2017.
- The PRT reviewed and compiled the annual FMP Review.
- New Hampshire, Pennsylvania, South Carolina, Georgia, and Florida have requested *de minimis* status.

Presentations

- Overview of the 2017 Fishery Management Plan Review by M. Ware **(Briefing Materials)**

Board actions for consideration at this meeting

- Accept the 2017 Fishery Management Plan Review and approve *de minimis* requests.

10. Other Business/Adjourn

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

ATLANTIC MENHADEN MANAGEMENT BOARD

The Westin Alexandria
Alexandria, Virginia
February 1, 2017

These minutes are draft and subject to approval by the Atlantic Menhaden Management Board
The Board will review the minutes during its next meeting

TABLE OF CONTENTS

INDEX OF MOTIONS

ATTENDANCE

Board Members

Terry Stockwell, ME, proxy for P. Keliher (AA)
Steve Train, ME (GA)
Cheri Patterson, NH, proxy for D. Grout (AA)
G. Ritchie White, NH (GA)
Dennis Abbott, NH, proxy for Sen. Watters (LA)
Sarah Ferrara, MA, proxy for Rep. Peake (LA)
Raymond Kane, MA (GA)
Nichola Meserve, MA, proxy for D. Pierce (AA)
Eric Reid, RI, proxy for Sen. Sosnowski (LA)
Robert Ballou, RI, proxy for J. Coit (AA)
David Borden, RI (GA)
Mark Alexander, CT (AA)
Steve Heins, NY, proxy for J. Gilmore (AA)
Emerson Hasbrouck, NY (GA)
John McMurray, NY, proxy for Sen. Boyle (LA)
Adam Nowalsky, NJ, proxy for Asm. Andrzejczak (LA)
Loren Lustig, PA (GA)
Andy Shiels, PA, proxy for J. Arway (AA)
John Clark, DE, proxy for D. Saveikis (AA)
Craig Pugh, DE, proxy for Rep. Carson (LA)
Roy Miller, DE (GA)
Rachel Dean, MD (GA)
Dave Blazer, MD (AA)
Ed O'Brien, MD, proxy for Del. Stein (LA)
Rob O'Reilly, VA, proxy for J. Bull (AA)
Kyle Schick, VA, proxy for Sen. Stuart (LA)
Michelle Duval, NC, proxy for B. Davis (AA)
David Bush, NC, proxy for Rep. Steinburg (LA)
W. Douglas Brady, NC (GA)
Malcolm Rhodes, SC (GA)
Robert Boyles, Jr., SC (AA)
Patrick Geer, GA, proxy for Rep. Nimmer (LA)
Kathy Knowlton, GA, proxy for S. Woodward (AA)
Jim Estes, FL, proxy for J. McCawley (AA)
Martin Gary, PRFC
Derek Orner, NMFS
Sherry White, USFWS

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

Ex-Officio Members

Jason McNamee, Technical Committee Chair
Jeff Kaelin, Advisory Panel Chair

Staff

Bob Beal
Toni Kerns
Katie Drew
Shanna Madsen
Megan Ware

Guests

Jennie Bichrest, CCA
Benson Chiles, Chiles Consult.
Robert Crockett, Richmond, VA
Jeff Deem, VMRC
Shaun Gehan, Omega Protein
Matt Gates, CT DEEP
Joseph Gordon, PEW
Zak Greenburg, PEW
Marin Hawk, MSC
Peter Himchak, Omega Protein
Ken Hinman, Wild Oceans
Jimmy Kellum, Kellum Maritime
Aaron Kornbluth, PEW
Wilson Laney, USFWS
Ben Landry, Omega Protein
Arnold Leo, E. Hampton, NY
Nicole Lengyel, RI DEM
Chris Moore, CBF
Jonathan O'Connor, MSBA
Patrick Paquette, MSBA
Jim Rogers, Deltaville, VA
Tera Scott, NOAA
David Sikorski, CCA
Jack Travelstead, CCA
John Whitehead,
Kate Wilke, TNC

The Atlantic Menhaden Management Board of the Atlantic States Marine Fisheries Commission convened in the Edison Ballroom of the Westin Hotel, Alexandria, Virginia, February 1, 2017, and was called to order at 2:52 o'clock p.m. by Chairman Robert Ballou.

CALL TO ORDER

MR. ROBERT BALLOU: Welcome, I would like to call this meeting of the Menhaden Management Board to order. My name is Bob Ballou; I have the honor of serving as board Chair.

APPROVAL OF AGENDA

CHAIRMAN BALLOU: Our first item on the agenda is the agenda itself. Does any member of the board have any recommended additions to the agenda? Seeing none; is there any objection to approving the agenda as proposed? Seeing none; the agenda stands approved by consent.

APPROVAL OF PROCEEDINGS

CHAIRMAN BALLOU: The next item is our meeting minutes, the proceedings from the board's last meeting held on October 26, 2016. Are there any recommended changes to the meeting minutes? Seeing none; is there any objection to approving the minutes as proposed? Seeing none; the minutes stand approved by consent.

PUBLIC COMMENT

CHAIRMAN BALLOU: Next on our agenda is public comment. This is an opportunity for anyone from the public who would like to comment on any issue that is not on today's agenda to do so. We have a signup sheet, but we do not have anyone signed up; so I will ask if there are any hands. But before I do so, I would like to welcome Lynn Fegley to the microphone, and I know Lynn has a few words that she would like to share. Lynn.

MS. LYNN FEGLEY: I am here; I wanted to offer a brief word of remembrance and appreciation for one of our Maryland constituents. He passed away shortly before Christmas; Captain Jim Price died just after a long and heroic battle with cancer. Jim was very active in menhaden, both at the board level and at the science level.

Many of you may remember him as the director of the Chesapeake Ecological Foundation; which he founded. We didn't have many board meetings go by without comment from Jim. He was a tireless advocate for the need to manage forage fish in a multispecies context. In the state of Maryland he was a legendary recreational striped bass fisherman.

Sometime in the 1990s he began to observe what appeared to be declining health of striped bass, and he attributed that to declining numbers of menhaden; and he demanded attention to this issue. For any of you who spent time in conversation, you know exactly what I mean by demanded. Jim was not a politician, he did not mince words, and he never hesitated to tell you exactly what he thought of you.

But he was different, because Jim didn't just talk; Jim did, and he did a lot. He went out with his wife with his own money and collected thousands of striped bass; analyzed their stomachs, collected data. He presented results to the scientists. He often found himself at odds, a businessman by training, he was a businessman. He often found himself at odds with our ASMFC scientists. But that didn't hold him back and that didn't daunt him; and he steadfastly continued, improving his methods, gathering data, and refining his ideas.

When he was diagnosed I understand that the doctors didn't give him long to live; yet he survived for years. A friend of his said at his funeral that he was just too damned busy to leave; his passion kept him going. I believe that Jim taught a lot of us many things, not only about the feeding behavior of striped bass in

the Chesapeake Bay, but also about how to take the bull by the horns; about being an active participant in finding a solution, and about perseverance. I just want to take this moment to thank him for his legacy, and you for your time. Thanks.

CHAIRMAN BALLOU: Thank you, Lynn, and I know I speak for everyone on the board when I say how appreciative we are of Captain Price's contributions to our work and our heartfelt condolences for his loss. Is there anyone else from the public that would like to address the board on any issue that is not on our agenda? Terry Stockwell.

MR. TERRY STOCKWELL: I'm not in the public, but I would like to take this opportunity on the behalf of the state of Maine to thank North Carolina and the Commonwealth of Virginia for generously bailing the state of Maine out by transferring some of your unused 2016 commercial quota.

REVIEW OF THE SOCIOECONOMICS STUDY OF THE ATLANTIC MENHADEN COMMERCIAL FISHERY

CHAIRMAN BALLOU: Are there any other comments? Seeing none; we will move on to Item 4 on our agenda. This is a review of the Socioeconomics Study of the Commercial Menhaden Fishery; undertaken by Dr. John Whitehead from Appalachian State University, and Dr. Jane Harrison from North Carolina Sea Grant.

As a quick reminder, this study has been undertaken at the behest of the board, and in close coordination with the Commission's Committee on Economics and Social Sciences for the purpose of characterizing the commercial menhaden fishery along the east coast; and helping to inform the development of Amendment 3.

The study as I understand it, and as I'm sure we're about to hear more on, is largely complete and although the full report is still under development. The PIs have put together an Executive Summary, which is in your meeting materials; and they are here to brief the board on the study results.

We have allocated a little less than an hour for this agenda item, but my understanding from talking to Dr. Harrison is that they plan to present for about a half an hour, and then leave about 15 minutes or so for questions and answers. With that I will turn the floor over to Dr. Harrison. Thank you.

DR. JANE HARRISON: Thanks Bob, and thank you all for having myself and John here this afternoon. We're very happy to get to share some of the study results with you; and to be able to answer some of your questions. Without further ado I am going to turn it to our first slide. Just to remind you all what we said we would do, hopefully we have accomplished these goals. The overall aim of the study was to characterize the socioeconomic dimensions of fishery stakeholders for Atlantic menhaden. I'm going to go over primarily the industry perspectives that we heard; and then I'm going to turn it over to John and he will speak to some of the economic impacts of the menhaden industry. Again, this is for both the reduction and the bait industries. Then he will also speak to a survey we conducted with the public; so trying to understand their perceptions of menhaden, how they're managed, concerns.

Really this study we're trying to understand diverse stakeholder interest, the public at large, and the industry specifically. The role that I played in the study was to gather industry perspectives up and down the Atlantic coast. To those aims I worked with several research associates to collect both quantitative and qualitative data; so these are original, primary data sources through surveys with commercial menhaden fishermen and bait dealers; as well as interviews with menhaden fishermen, bait

dealers, industry, management and the end users of menhaden.

When you think about where this fish comes from, out of the sea. Who is catching it, who are they selling it to, who's processing it, who's distributing it, who's buying it for what end? We really tried to look at the entire supply chain related to the Atlantic menhaden; again for both the commercial reduction industry and the bait industry.

From my look into the literature, I really couldn't find a study that had done that kind of work in the past. In the surveys data that was really primarily used to validate the interview data to make sure that the interviews we were conducting really reflected the entire industry; as well as to validate some of the secondary data sources that we used for our economic impact analyses.

The survey data, we had contact information for about 2,000 possible menhaden fishermen and bait dealers up and down the Atlantic Coast; this is really just seven states where the industry has a sizeable role. Now many of these potential or possible fishermen and bait dealers, we got a lot of surveys returned. We didn't have good addresses; we didn't have good e-mail addresses.

Some fishermen, they used to fish for menhaden; it was 10 years ago, they're not doing it any longer. It is hard to say what our total sample was here. We got the contact information from the various Division of Marine Fisheries and Departments of Natural Resources, or equivalent agencies in each state.

In the end we had about 106 completed surveys, so the response rate wasn't great; if you consider your total population to be 2,000. But my guess is our total population is going to be under 1,500. It could be even as small as 1,000; hard to say with some of the returns we got from the survey.

But what I will say in terms of the data quality, I feel like we got a very good representation across the different states, and if you look at the respondents from different states, you know we got more respondents from the states where the industry has a bigger presence; so where there are more fishermen and bait dealers where the state quotas are higher.

I feel pretty good about that. I'm not going to go into the survey results too much; again mostly those were used to validate some of our other data sources. I'm just going to point you to one table though from the survey results, and this is just looking at some of the issues that are important to menhaden fishermen and bait dealers. On the higher side, so these are one and two being extremely important to very important; we saw that health of menhaden and habitat, the state quotas and gear restrictions are some of the most important issues to our industry members. Now things that were not as important or elements not as important were competition among fishermen from other states, crew and labor issues, and competition among local fishermen. Those issues were moderately to slightly important, so more on the three to four range. This is just to give you kind of a sense of the concerns that they're thinking about; the issues that are important to them in this fishery.

I'm going to focus here really on the interview data, and when you look at the Executive Summaries that were passed out, and they should be back in the room, I believe. You can follow along with me if you like. With the interview data, this was a pretty short turnaround and I'm pleased how many interviews we were able to conduct.

We went around, again in these seven different states, conducted interview; 42 with menhaden fishermen and bait dealers. Then we also conducted additional interviews with the management of various menhaden businesses, not necessarily those catching the fish but

certainly the reduction oil and meal facility in Reedville; and some of the larger bait distributors up and down the coast.

We also talked to end users, so we interviewed those who were buying reduction oil and meal products. We interviewed lobstermen, we interviewed crabbers. Now they don't show up in this chart here, this chart is just reflecting the fishermen and bait dealers, but we feel we did a pretty good job at reaching data saturation. Overall as the interviews went along, we ceased to hear new themes. We started to hear a lot of repetition of themes; and I feel pretty confident that the results we have are a pretty good reflection of what the industry looks like and the concerns of the industry. I'm going to go on a few themes here, discuss some of the themes from the data, and I can tell you more about how we analyze that data if you wish.

It is kind of a process of coding as we call it in qualitative data analysis. Looking for particular codes in the data that come from the research questions asked, and the research questions were really formulated from the needs that you all laid out in the RFP. Our interview instrument, our survey instrument, were refined and revised by board members, by industry members; they were piloted, so that we would get the kind of information that might be useful to you.

Then we also came up with some themes from the data that really came from the fishermen and the bait dealers, those we interviewed. It came from them, so there might be some ideas that we didn't even ask about; but these were semi-structured interviews so we tried to allow folks to tell us too what was important, or issues that they wanted to make sure this board is aware of.

The themes I'm going to talk about initially are primarily related to market changes the industry has seen; as well as state quota impacts from the change in 2013. First, increase stock, we heard that across the board; fishermen, bait dealers in every state are seeing increased stocks, healthy stocks of menhaden.

We also heard there has been an increase in bait demand, an increase in demand for oil and meal products, and then the last three topics you'll see you could kind of think of these themes as contradictory. But they really just reflect, I would say the diversity in this industry and how folks were affected from the quota impacts. Some in the industry had no personal impact from the changes in 2013. Many did note disparate state impacts, and then some noted decreased landings and depressed incomes. We found that generally those in the smaller scale operations, you know zero, one, two employees, didn't have as much personal impact; whereas the midscale, the larger scale operations did.

Increased stock, like I said, we heard across the board the fishermen, the bait dealers, they see the stocks as healthy; they are not overfished. Some of the reasons that they contended were because of the cyclical nature of fisheries generally, ups and downs that are always going on; warming of waters.

There are folks that are seeing the fish coming up north, coming up to Maine waters that hadn't been seen in many years. Then some did point to the 20 percent reduction of the TAC in 2013 as also having an impact. In this video here, I'm going to see if I can play it. I guess maybe you will need to play it there.

This is from a fish kill in Shinnecock Canal, New York. This was an interviewee from New York. He sent me this video about a week after I was there. I am sure some of you heard of this. You know these fish kills have been taking place, and if I look at that from afar, I almost think it looks like ice; but it's really fish up there.

I think whale watching was going pretty well this fall, but a lot of fish have been coming in,

coming into the bays, into the canals, escaping predators; and again the fishermen noted that this was more evidence of very healthy stocks. The next slide, this theme is related to increase in bait demand.

Many fishermen and bait dealers alike were looking for new markets for their bait. They really saw some possibilities out there, especially from the demand coming from the northern New England states. Some of the increase in bait demand was related to bait shortages; so like herring, especially for lobstermen up north.

They spoke of very few bait alternatives. Some of the bait dealers in Maine, they talked about getting bait from Iceland, spending a lot of money to bring it from New Jersey, from the other Mid-Atlantic states, and having some issues with getting the fresh bait that they want for other fishing industries.

Our interviewees also spoke to the increase in demand for oil and meal products. We interviewed with several different companies, companies that produce animal feeds, aquaculture feeds, and pet food. I realize that my dog actually is likely eating menhaden oil in his dog food; and he looks good, so it's working well for him.

It is very kind of fascinating learning about the market for these fish oil and meal products from talking to these interviewees who use these products. They don't have a lot of other substitutes available, so the main substitutes are anchovies from Chili and Peru. There are some other fish available, but overall demand has gone up because there is not as much consistency and availability of some of these other fish oil and meal products globally.

It is very much a global market. The menhaden reduction oil and meal products have been very consistent in quality and in high demand. Prices have gone up. That seems to be a continuing trend with global population growth and need for quality protein sources. Now we did hear from many fishermen that have not experienced any personal impact due to the state quotas; and this is generally from fishermen that were small scale in nature. They maybe worked by themselves, they might have one or two part-time, maybe a full-time employee.

They tend to use gill and pound nets, perhaps trap nets in Rhode Island, and they're generally satisfied by the bycatch allowance; so about 6,000 pounds per day. In our interviewees, we characterized them as small, medium and large scale; and we had about a third in each of those categories.

We weren't necessarily looking to have a third in each, but that is just kind of how it turned out. When I'm looking at kind of numbers from the interviews, which is a little suspect, as it is not necessarily generalizable; but it seemed like about a third of those that we talked to were satisfied. Their 6,000 pounds a day is working for them.

Those are generally fishermen and bait dealers who catch or sell a mix of species. They are not relying solely or predominantly on menhaden for their operations. Now we did hear from across the board there was concern about disproportionate loss of TAC; so some states very much being impacted negatively by the 2013 state quotas, because they're based on reported historic landings.

Some states felt, some fishermen and bait dealers from those states felt that they had lost out unfairly; especially the small scale fishermen and bait dealers in New York, Maryland and New Jersey. They discussed kind of a culture of under reporting in those areas that also didn't help them in the state quota allocation process.

Now finally, related to state quotas, we did hear over and over again, especially from the medium and large scale fishermen and bait dealers that they have experienced significant decreased landings; and depressed incomes because of the state quota change. In some cases that certainly contributed to layoffs, as well as shorter seasons; so converting year round jobs to seasonal positions, you know high job turnover in some states where businesses cannot keep employees because of this new kind of economic situation for their business.

Some of the large scale operations also discussed the concern that managing the quota changes; it can't simply be done by reducing the labor force. There are significant fixed costs in their businesses with the processing facilities, and not just on the reduction side but also on the bait side. That just continues to be a concern.

There was also much discussion about negative impacts on both fishing related businesses and non-fishing related businesses; so some of the multiplier effects from these state quota impacts. Now I did ask some questions about their fishing community in general. Some of the themes that came out again are going to seem contradictory; but it just reflects the diversity of views from these fishermen.

The fishermen and the bait dealers spoke about commercial fishing being key, being very important to their local communities; and just as often we heard that commercial fishing is on the decline, and you know there is not much there. It really seemed to vary again where we heard commercial fishing key from those in the larger scale operations, in communities where commercial fishing continues to be vibrant; and it is a source of well-paying jobs in these communities. Many of these fishermen, I mean I talked to so many fishermen that are fifth generation. This is an intergenerational occupation; they have very strong familial and social bonds with one another.

They spoke of the economic impacts of their business, so not again just their own employees but the purchasing power that they have in the community, all the other ancillary businesses that are impacted. Finally they spoke of kind of a fishing heritage and the culture around working waterfronts; being a tourist draw, so related to the tourism economy, and certainly some of the fishing products being key exports in some states.

In Maine, for example with lobster and the importance that menhaden plays to make that a cost effective business. Then finally we heard in many communities, commercial fishing is on the decline as well. This was more frequently noted by small scale operations who discussed regulatory restrictions that have made it very difficult to continue fishing.

The fact that there aren't well paying jobs out there if you're not in fishing; and even if you are those are also few and far between. My guess is through these themes I have not necessarily highlighted anything you all don't already know. But at least it is laid out there, hopefully in an objective fashion. I'm going to turn it over now to John, to speak to some of the industry economic impacts in recent years.

DR. JOHN WHITEHEAD: Thanks Jane, and thanks everybody for having us. This first bullet point is a quote from our proposal; and we were hoping to get a bunch of economic data, revenues cost, landings, and that data just isn't out there. Instead of pursuing the economic efficiency analysis that we proposed, we're focusing more on economic impacts.

The data we did receive, we have three datasets, county level annual landings, and then annual landings with disposition; and then state level landings. There was a miscommunication and I don't have all my slides loaded. Let me go through this quickly and we'll see, gosh. All right let me go through here real quick and see what we have and see what I don't have.

Okay, I apologize. Yes, they're here. There is just some stuff that I took out that I didn't want to talk about; but I'll mention it briefly. This is from the data that we do have. There is a statistical analysis, it is in the Executive Summary, and I took it out because this last slide, the effect of tons landed on price is very low. We're proceeding with an assumption that landings do not affect the bait fishery ex-vessel price.

The economic impact model that we're using is from the Bureau of Economic Analysis. The model is maintained by the BEA, and is called the RIMS II model, the Regional Input-Output Modeling System. What you do is you order multipliers from the BEA by industry sector. We've done that for the fishing sector, for each of the Atlantic states, and also Northumberland County.

We received Type 1 and Type 2 multipliers. Type 1 multipliers include direct and indirect economic impacts; where direct impacts accounts for the first round of inputs purchased by the fishing industry. Then when the industry that sells inputs to the fisheries buys things that is the indirect impact. The Type 2 multipliers include those two effects as well as the money spent by the employees in the industry. The Type 2 multipliers are always going to be larger than Type 1 multiplier and they're inclusive. This is just an example of what the multipliers look like. This is Sector 11-114000, fishing, hunting and trapping and we have the final demand output earnings and employment multipliers for all of the states.

For the economic impact analysis in the bait sector, we're measuring the direct effect in the bait sector as the ex-vessel price; that letter P there with the bar on it. The bar is our assumption that the price is fairly constant with landings; and we multiply that by a markup factor. Then we multiply those gross revenues by the change in the TAC, and then multiply all that by the Type 1 and then the Type 2 multiplier.

The markup that they were using, we're uncertain about what the markup is, so we're using a range. The National Marine Fisheries Service in-plan model, which is an alternative economic impact model, uses a markup of 63 percent for wholesalers and distributors; and that number is from some results from Alaska.

In the survey that we've done with the bait dealers and fishermen, we've estimated a markup of 356 percent for menhaden. What I'm going to present includes the markup that we've computed ourselves, but the report will include sensitivity analysis. This is just some examples of the calculations.

For 2016 the Virginia bait landings are 33.5 million pounds, and the ex-vessel price is 12.5 cents per pound. These are the numbers from the National Marine Fisheries Service. The direct effect is 4.6 million and then the numbers in bold there are the multiplier. The output is 5.6 million, earnings from people as a result of that output is 1.7 million, and the number of jobs as a result of that output is the employment effect, and that is 94 jobs.

Here is the economic impact analysis for the 6.45 percent increase in the TAC for 2017. The result you'll see is that most of the impact flows to New Jersey and Virginia. The overall output effect is 3.5 million with one million in earnings and 42 jobs. Here is the same analysis, the first line for the 6.45 percent change in TAC; and then a simulation of the TAC going from a 10 percent increase up to a 30 percent increase.

As you go from 10 to 30, the output effect goes from 5.4 million to 16.1 million. Earnings go from 1.6 million to 4.7 million, and then employment goes from 66 jobs to almost 200 jobs. The next slide illustrates, it was supposed to illustrate the Type 2 results; including the induced effects. But I failed to update the last

three lines, so you'll see that it's the same, so I'll move on.

In the reduction sector we began with the Kirkley et.al Virginia Marine Resources Commission 2011 study, where Jim Kirkley has developed an economic impact model using in-plan for Northumberland County and the rest of Virginia for the menhaden fishery. This is his reproduction of his Table 5.4 and 5.5, where the output effect is roughly revenues generated by the final demand from Omega Protein.

For our analysis we have scaled the 2011 numbers up to 2015 landings, an increase of about 5 million pounds; and we've increased the dollar values by the Consumer Price Index. The baseline economic impact for Northumberland County, in terms of the Type 1 multiplier would be the sum of the direct and indirect values there; and so we've got about 300 jobs, and 67 million in output and about 10 million in earnings. Then the rest of Virginia adds to those numbers, but most of the impacts were to Northumberland County. Okay so doing the same thing, those were the baseline results, increasing the TAC by 6.4 percent for Northumberland County.

The model suggests that that would lead to 77 additional jobs with the Type 1 multiplier and 79 with the Type 2. The output effect would be 4.5 million, with a Type 1 multiplier, and earnings would be 1.2 million. The Type 2 multiplier adds a little bit to that for Northumberland County and then the last two columns here for the rest of Virginia those are additional impacts; as a result of the 6.5 percent increase.

This table again shows the effects in Northumberland County for going from a 10 percent increase in the TAC to a 30 percent increase in the TAC. Output effects go from 7 to 21 million, earnings almost a 2 million increase to almost 6 million increase, and then employment 119 jobs up to maybe 358. The next two slides I'm going to bounce through quickly.

It's just Type 1, the same analysis Type 1 for the rest of Virginia, Type 2 for Northumberland County, and Type 2 for the rest of Virginia. The pattern of results is the same as I've described before. We also conducted a survey of the public using Survey Sampling Internationals panel. For this analysis we again looked at increases in the TAC, and to see what the public thought about this.

We're also considering ecosystem-based fisheries management in the survey. I'll describe how that worked. The sampler is about 2,000 individuals with 400 in some from both New Jersey and Virginia; and about 200 from each of the other Atlantic states. Just some preliminary questions to go through, not surprising most folks that we talked to didn't know anything about the ASMFC or menhaden.

But they did think that when we described the impact of the menhaden commercial fishy on the economy, and we gave them a snapshot of ex-vessel landings and revenues; and most people think it is either somewhat important or very important. We described results from the most recent stock assessment that menhaden is not overfished.

But we did ask them if they were concerned about overfishing with that information, and most of them are still somewhat concerned or very concerned about overfishing. Then most people think it's important. We described what managing fisheries at the ecosystem level is all about, and most of them think that that is somewhat important or important.

We presented people with alternative quotas and different scenarios; and we asked them if they would vote for or against an increased quota. On the right is like a stylized choice question that we presented to people. On the

left describes the different variations that we included, so each respondent got six scenarios.

We varied the price, the ex-vessel price. We varied the change in the TAC from 10 to 20 to 30 percent. We talked about increases and decreases in jobs, and then we expressed uncertainty about the impacts of alternative TACs on gamefish, shorebirds and water quality; but then told folks, imagine that gamefish would either decrease, there would be no change, or they would increase, same for shorebirds and water quality. We varied that and asked them how they would vote. This is a regression analysis for the increase scenario. The numbers to focus on are the ones in the northwest part of this picture. The results are pretty much as we would expect as ex-vessel revenue increases or jobs increase from increasing the TAC; survey respondents are more likely to vote in favor of increasing the TAC.

If water quality would get worse, if gamefish populations would decline, or shorebird populations would decline then people are less likely to vote in favor of increasing the TAC. In terms of a social choice mechanism, if 50 percent of the people vote for the referendum then it's a good idea or people are mostly in favor of it.

We've done some simulations along that. If there are no water quality, gamefish or shorebird effects, people are in favor of increasing the TAC. If there are negative effects for all three of those attributes then people are not in favor of an increase in the TAC. This is just a way of summarizing the results.

You can think about the tradeoffs people are willing to accept to receive more or less of water quality, gamefish or water birds. The most important characteristic for our survey respondents was water quality. They are willing to give up 13 million dollars in ex-vessel revenues in order to avoid a decrease in water quality.

They are willing to give up 914 jobs in the commercial fishing industry to avoid a decrease in water quality. Similar for the decrease scenario, we presented the same type of policy question; in this case respondents are voting in favor or against a decrease in the menhaden TAC, and the hypothetical is that if the TAC falls then water quality might increase, gamefish populations might increase, or shorebird populations might increase.

In this case people are not willing, they are not in favor overall of decreasing the TAC unless all three of those characteristics, those attributes would come into play. It takes an increase in water quality, an increase in gamefish populations, and an increase in shorebird populations to get people to be 50 percent or more in favor of reducing the TAC.

This is a similar type of analysis and this shows a similar type of tradeoff analysis, and it shows that water quality is most important in the minds to the survey respondents. But you see the number of jobs that are willing to be traded off is lower than for the increase scenario, and that is consistent with the fact that survey respondents were more in favor of increasing the TAC than decreasing the TAC. Questions?

DR. HARRISON: Just as a follow up, we will have a final report out at the end of March that should be helpful. If you can look at the Executive Summary as well, I know we presented a lot of information and John might have had some numbers up there you couldn't read. But I would suggest reading the document; that will be helpful.

CHAIRMAN BALLOU: Certainly a wealth of information, probably more than we may have ever had on any fishery that I'm aware of; at least with regard to socioeconomic characterizations. Deeply appreciated, and I

know we all look forward to the final report. Questions for either – lots of questions – let's go right to left. Terry Stockwell.

MR. STOCKWELL: Thank you both for your presentation. Dr. Harrison, you mentioned three tiers, large, medium and small scale fishermen. Could you please explain what the differences are between each tier?

DR. HARRISON: The way that those are categorized is small scale operations were 0 to 2 employees, and we allowed that to be part-time as well; so those may not be full-timers. Medium scale is 3 to 9 employees, and then large scale was 10 plus employees. That is arbitrary, but we were just trying to get a sense of some of the differences. Generally the small and the medium scale are going to be your pound netters and your gill netters; and once you go up to that 10 plus you've generally got purse seiners.

CHAIRMAN BALLOU: I'm sorry, I didn't take note of whose hands went up; so who would be next with a question? Rob O'Reilly.

MR. ROB O'REILLY: Thank you very much to both of you. I guess for Dr. Whitehead, I did see a reference in the Executive Summary to the 10 percent increase. It's been a while since I guess all this information was put forth to you to look into. Is there going to be in the report an indication of what the 20 percent reduction in the TAC meant; in terms of economic input or economic output, I should say, or economic impact, however you do that?

I know with the in-plan model that the late Dr. Kirkley had that economic output as well, so was that considered or will that be in the report as well; so that we can see what has happened since 2013, as we moved forward with both the 10 percent increase in TAC and the 4.65, what did you say 4.65 percent?

DR. WHITEHEAD: The Kirkley report only looked at decreases in the TAC. For the impact analysis that we've done, I took as a guide what's been going on with ASMFC over the course of the year. That is where the 10 percent increase, the 10, 20, and 30 percent increases came from for the economic impact analysis that I've just presented. But it's pretty easy to do the negative analysis, reducing the TAC. The numbers are all the same, it's symmetric and I'm more than happy to put that in the report.

MR. O'REILLY: Pardon me for being out of my league here a little bit, so the jobs aspect and everything else plays in to that impact when you go in either direction?

DR. WHITEHEAD: Yes, a decrease in the TAC would lead to a decrease in output earnings and employment.

CHAIRMAN BALLOU: A show of hands of others who have questions; keep your hands up. Let's go to Dr. Duval.

DR. MICHELLE DUVAL: Dr. Whitehead, you mentioned that you weren't able to do the analyses that had been originally proposed due to data limitations. What would have been required in order to do the analyses that you had originally proposed? What specifically was missing?

DR. WHITEHEAD: I think it is the stuff that is going on in the boats. We received information on the number of crew, on fishing trips, but that was two data columns that did not have identifiers that allowed us to link it back to the output data. If we had those identifiers then we could estimate the cost of the crew and gear and develop some profit or rent estimates for the bait sector to compare to or just to develop those estimates. But the data that we received was separate and just not complete; and that was from ACCSP data.

CHAIRMAN BALLOU: Dr. Rhodes.

DR. MALCOLM RHODES: Thank you both for that presentation, it was interesting, and from back here trying to read the tables was remarkably intriguing. I should have brought opera glasses. I had one question, and it may have been I wasn't paying as close attention as I could. But when you were talking about the 6.45 percent increase creating 42 new jobs, the slide before that; I was thinking you said there were 94 jobs in that 6.45 percent increase created 42 jobs or did I misunderstand that?

DR. WHITEHEAD: Yes, the slide before that you mentioned, I believe that's the baseline economic effect, so that would be the snapshot of the 2016 menhaden economy. Then the 42 additional jobs would be the 6.45 percent increase in the TAC, and the 42 jobs are for the entire Atlantic coast; and that example of 94 jobs was for Virginia.

DR. RHODES: Then the total jobs for the coast was what, because I just had that 94 and 42 and that 6.45; it was like a 45 percent increase in jobs, which would be a remarkable multiplier.

DR. WHITEHEAD: Yes, I don't have the number for the number of jobs on the entire Atlantic coast that comes out of the model for 2016 in front of me, but I will be sure and include that in the final report.

DR. RHODES: All right, thank you.

MS. MEGAN WARE: John McMurray, you can go next.

MR. JOHN McMURRAY: I understand that this was geared really towards the bait reduction fishery, but I'm wondering if anybody reached out to the recreational community or the recreational industry, and if there was any analysis on what the impact for that sector was.

DR. HARRISON: Yes, the only element where we included recreational industry elements was the recreational bait markets; so we did talk to sport bait shop dealers. But we did not do any kind of like a travel cost analysis of the recreational industry; that was outside of the scope of our research.

MR. McMURRAY: I know you weren't tasked with doing this, but I think a really important component when we're discussing socioeconomic impact is availability of fish along the coast, and the opportunity it provides for a host of stakeholders; not just two sectors.

DR. HARRISON: I know John does those kinds of studies; you can maybe employ him to do that.

CHAIRMAN BALLOU: Emerson Hasbrouck.

MR. EMERSON C. HASBROUCK: Thank you to our two presenters for your report. Thank you also for contacting and including fishermen from New York in your survey. They have contacted me and I know they were very appreciative of the fact that they were included in this. My question is for Dr. Whitehead.

One of the last slides that you had up there where you correlated water quality, I think the slide said with an increase in water quality fishermen were less inclined to reduce the TAC; or maybe I misunderstood you. But it was one of your last slides. It was the last slide or second to the last slide.

DR. WHITEHEAD: We presented two types of scenarios to people, one was for an increase in the TAC and the other is for a decrease in the TAC. If people were presented with an increase in the TAC, they were told that either water quality would not change or water quality might decrease. For the decrease in the TAC, respondents were told either water quality would not change or water quality might improve.

In the statistical analysis from both those scenarios shows that people recognize the tradeoff. If there is a potential for a water

quality improvement, people are less likely to vote for the increase in the TAC. In the other scenario, when there is the potential for water quality improvement, people are more likely to vote to decrease the TAC. The same logic applies to the other two attributes, the gamefish and the shorebirds.

CHAIRMAN BALLOU: Emerson, you have a follow up?

MR. HASBROUCK: Does that mean, and maybe I'm getting into sociology here perhaps. Does that mean that fishermen saw some relationship or do you have any explanation for that? Did they see a relationship between an increase in the TAC with an associated increase in improving water quality? Maybe I am just misunderstanding your analysis.

DR. WHITEHEAD: These results are from the public survey where we used Survey Sampling International's panel, which is a nonrandom sample of the public; so just anybody who signs on to that online panel could be included in our survey. We do know the folks in that who have some connection to the commercial fishing industry; and we do know the people who are anglers. We can look and see how those two demographic groups would vote differently under different situations.

CHAIRMAN BALLOU: One more time.

MR. HASBROUCK: Very quickly. I would suggest then in your final report you make that explicit, in terms of what that population was; because to me it was not explicit in your presentation.

DR. WHITEHEAD: Will do.

CHAIRMAN BALLOU: Nichola Meserve.

MS. NICHOLA MESERVE: There is a lot in this presentation, more than the Executive Summary, so I look forward to your final report in March. I did note, being from Massachusetts that none of the participants in either the survey or the interview set were from Massachusetts; and you may have addressed this partially with Emerson's question. That was a little disappointing for me, but how those people were pooled from again that had that results is one question, and secondly, could you clarify for me whether the final report is going to have economic impact information that compares the bait and reduction fisheries and potential quota allocation between the two?

DR. HARRISON: I can answer that first one. We really worked hand in hand with the board and ASMFC to consider which states to do interviews and surveys. We were limited with time and resources, and we certainly wanted to get a diversity of the industry, you know what it looks like from state to state. I will say though when I was in Rhode Island, I did talk to some folks that also work in Massachusetts; there are some connections there. I am getting mixed up when I think about my travels.

I was in Massachusetts for a moment in somebody's house, but then that fisherman, I believe all of his quota is with the state of Rhode Island; although he might have had a mix. I was close, but anyway that was really kind of a decision from some of the folks that we've been working with here on which states to include, so I apologize that you guys weren't there. Then the other question, can you just repeat that?

MS. MESERVE: If there will be economic impact data comparing the bait and the reduction fisheries, in terms of quota allocation between the two. I wasn't sure if the Virginia economic impact data that you were showing was for Virginia as a whole, including both their bait and reduction or one or the other; and if the two could be compared, for example.

DR. WHITEHEAD: Yes. I guess it wasn't clear on the slides, but we do have the Virginia impact

numbers for the bait and the reduction sectors split out in the report. It will be straightforward to see how the economic impacts for the different sectors compare. I am not sure if we're going to do an explicit allocation analysis; that wasn't in the proposal. But the economic impact stuff will be there if that's whatever you would like to do.

CHAIRMAN BALLOU: John Clark, and then I would like to wrap up.

MR. JOHN CLARK: Just to follow up on some of the other questions, I think that Rob and Nichola asked. Is that formula used for predicting jobs just based on a certain amount of extra quota it leads to extra dollars and extra jobs therefore? It doesn't take into account whether the operation was working to capacity beforehand, and I think Rob was getting to that point. You had real world data when the quota was reduced by 20 percent, did you see a reduction in the number of jobs in the menhaden fishery that you would expect based on your model at that time?

DR. WHITEHEAD: I'm going to ask you to repeat that second question. But let me answer the first one. The model assumes, in economics we say a perfectly and elastic supply, which means that if you inject something into an economy then the economy has the capacity to absorb that and pursue the economic activity. There are no capacity constraints in this model, so in that case it can be unrealistic in certain situations. I'm not familiar with whether that's the case here or not.

MR. CLARK: Right and I think that is just what I was getting at, because you had a real world example of when the quota was cut 20 percent; and could you go back and look and see if, okay in the menhaden fishery based on this model, we lost the number of jobs in that fishery we would have expected based on this or whether because of other things going on that you didn't see that or if there was any way to look at that at all.

DR. WHITEHEAD: I haven't done this analysis yet though, but I have a county level jobs income and output data from NOAA that I am going to analyze with the actual menhaden landings from those coastal counties. Then that way I can groundtruth the results from the RIMS model.

CHAIRMAN BALLOU: Kyle Schick, and then we really do need to wrap up.

MR. KYLE SCHICK: Yes, just a quick question. I understand the effects of menhaden with gamefish and water fowl, I guess more like the eagles and predator birds. Where was the water quality issue brought up? I don't know of any studies that show a definitive answer that catch decrease/increase effects water quality. I was just wondering if that was something you put in there just as kind of a placeholder for environmental issues, or is there something that you have as a quantitative analysis that shows that water quality is affected by the catch of menhaden.

DR. WHITEHEAD: We're not scientists and we haven't done an extensive review of the scientific literature; but water quality is an issue that I think has been raised in the past. In the survey I think we tried to characterize that effect as uncertain; and the survey allows us to turn that characteristic on and turn the characteristic off to simulate votes and tradeoffs, depending on how the science works its way out. We were very careful not to make assertions about the scientific impacts; but we wanted to create a model that was flexible enough to handle scientific results that may come down the road after a number of years.

CHAIRMAN BALLOU: Okay so I am sorry, Roy, I really think we do need to move along. But I will take the board's interest to be indicative of the fact that this was an important piece of

work for us and my understanding as to where we go from here is the completion and submittal of the final report by late March; at which time it will be put on the ASMFC website, so not only made available to the board but made available broadly to anyone who may be interested.

Then of course that would be available to us to draw upon as a board as we move forward with the Amendment 3 process. I think that's where we are. I think we obviously stand to benefit immensely from this very impressive body of work, so on behalf of the entire board I just really want to thank both Dr. Whitehead and Dr. Harrison for their excellent work.

I also want to just take a moment to further recognize and commend Shanna Madsen at the far end of the table to their right, or your left as you look at them; from the Commission's Fisheries Science Program, who very competently ushered this study from beginning to end, so thank you, Shanna as well.

Are there any other further comments or questions regarding this agenda item? Seeing none; we'll move on, and again say thank you to both doctors for their excellent work. I think they're going to swap out their seats for a couple of other staffers who are going to move in; and this brings us to Item 5 on our agenda, the PID for Amendment 3.

PUBLIC INFORMATION DOCUMENT FOR AMENDMENT 3

CHAIRMAN BALLOU: Actually our next two agenda items are very closely related. First we're going to review the public comments submitted on the PID, the Public Information Document for Amendment 3. We also have an AP report on the PID, and then following that as the subsequent agenda item, we will roll up our sleeves and begin the process of tasking the Plan Development Team on the development of the Draft Amendment.

Turning first to the PID, Megan has put together a summary of the public comments; and I'm about to turn to her to present that summary to the board. Before I do, on behalf of the entire board I would like to offer our deep appreciation to the many thousands of stakeholders who weighed in. Our management process is designed to accommodate and be responsive to public input.

The PID is a key step in that process. If we didn't get much feedback, we wouldn't have much to go on. But thanks to the 25,606 comments we received on the PID, we have a lot to go on; and for that we say thank you to everyone who took the time to write in, attend hearings, and otherwise voice their opinion. With that and with the understanding that we have about 45 minutes for this particular item, Megan, the floor is yours.

REVIEW PUBLIC COMMENT

MS. WARE: I will be reviewing the public comment that we received on the Amendment 3 PID. Just a brief overview of how we're going to go through the comments. I'll start with a timeline of Amendment 3, and remind us of where we are and where we're going. Then I'm going to dive right into the public comment, so I'll start with the public hearings and also the written comment we received.

Then we'll have Jeff Kaelin provide an advisory panel report. Then after that we'll kind of take a step back and evaluate where the board wants to go with Draft Amendment 3. To kick us off on that discussion, Katie Drew is going to just provide a brief refresher on the different ecosystem or reference point options, so that everyone has a clear idea of what those different options mean and can provide proper guidance for the board. This is our timeline for Amendment 3.

Today the board is going to review public comment, and also provide direction to the Plan

Development Team on what to include in Draft Amendment 3. Plan Development Team is going to work on Draft Amendment 3 from now until August, and we will do a check in at the May meeting. This will provide an opportunity for the board to see the progress of the Plan Development Team; and also provide an opportunity for the Plan Development Team to ask any other questions of the board.

Hopefully at the August board meeting we will approve Draft Amendment 3 for public comment, and this will make our public comment period from August to October, 2017. Given that annual meeting this year is a little earlier than normal, it is October 16th through the 19th, and the fact that we anticipate a high volume of public comments, we are going to have a separate meeting for menhaden in November, 2017.

This will be similar to what was done for Amendment 2, where we'll devote a full day to a menhaden meeting; and we'll focus on final action on Amendment 3. Moving to our public comments, we conducted 14 hearings in 13 jurisdictions, and those ranged from Maine to Florida; and in total we had about 300 individuals attend those hearings. Turning to written comment, as was mentioned we had 25,606 comments received; 75 of those were from organizations, 283 were from individuals, and over 25,000 were form letters. We're going to start with reference points just to orient everyone to how the tables work. I recommend if you have the meeting materials in front of you, to look at the tables on a paper; because it may be easier to read.

But on the top there in black we have our different management alternatives or options. Then the first three rows individual organization and form letter, those were comments received either written or via e-mail. Then we have a break where it says hearings, and after that we have the different states; so those were the comments that were received by individuals who attended a public hearing.

Turning to reference points, reference points were the most commented issue on the PID. We did receive over 25,000 comments in support of Option D, which is existing guidelines for forage fish until menhaden specific ERPs are developed by the BERP; with someone from every state commenting in support of this option.

Some of those who supported this option highlighted the importance of menhaden to the ecosystem as forage fish, and a need for policy to reflect this ecosystem role. Others looked at the fact that menhaden support larger fish, birds, marine mammals, and as a result they're important to the health of our oceans; as well as coastal economies which include things such as tourism, recreational fishing, birding, and whaling.

Several commented that there is a need for greater protection of menhaden, as even though we have growing abundance in our waters, there continues to be low recruitment in the Chesapeake Bay. We did have some who are in favor of Option A, which is maintaining our single species reference points.

Those in favor of this option generally stated that the current reference points are working as by our definition the stock is not overfished and overfishing is not occurring. Others noted that the board could have increased the TAC by 40 percent, and according to our definition of overfishing there was a small likelihood of exceeding that.

Then others noted some concern with unexpected consequences of ecosystem reference points; particularly economic consequences. We did have some who were in favor of Option B, which would be implementing existing guidelines for forage fish. Those in favor of this option stated that

ecosystem reference points are needed now and the board should not wait.

Then finally we had some who were in favor of Option C, which is maintaining our single species reference points until those menhaden specific reference points are ready by the BERP. Those who favored this option stated that they want the BERP to continue work on ERPs, but for the meantime the board should stick with what it knows.

Others commented that one model does not fit all, and so they had concerns about applying a general forage fish rule to menhaden. Others stated that they wanted something to be peer reviewed. We did have one proposal for a new ERP, and this was based on osprey; so I'll do my best to present this to the board. It looks like osprey populations in Connecticut and New York, which are sensitive to menhaden abundance, and the hypothesis of this proposal is that osprey's serve as bio-monitors of menhaden abundance as fluctuations in the abundance of osprey have mirrored those changes in the abundance of menhaden. The proposed reference points are two young ospreys per successful nest; and that would serve as the reference point for the Connecticut River estuary and one young osprey per active nest for the Gardeners Bay, New York area.

If reproduction of osprey fell below these reference points that would indicate menhaden depletion and for reference in 2016 there were 2.5 young osprey per successful nest in the Connecticut River estuary and 1.39 young per active nest in Gardiners Bay, New York. The authors of this proposal did note that ecological conditions also affect osprey, so things such as predation and weather.

That's why there is a difference between a successful nest and active nest, where active nests are all nests and successful nests are those that did not fail outright. Our next issue is quota allocation. A majority was in favor of Option B, which is jurisdictional quotas with a fixed minimum; and there was support from this option from almost all of the states.

Many felt that this represented a fair way for each state to participate in the fishery, and that allowing each state to receive 1 percent of the quota would solve many other issues in the fishery; such as the bycatch provision or episodic events. Overall people supported this option, generally because they felt it would protect small scale fisheries.

Going through the other options here, I am going to go left to right, so A through H here. Option A is our state-by-state or jurisdictional quotas. Those in favor of this option liked the current allocation strategy of state-by-state allocations, and thought that the true problem was with the allocation timeframe.

They generally felt that it works well administratively, and there was the greatest support for this option at the Maryland public hearing; although many fishermen did feel as though they don't have a measurable impact on the stock, and should not be subject to a quota. Option C is our coastwide quota, and those in favor of this option wanted to distribute landings along the coast.

There was the greatest support for a coastwide quota in Maine. However, they recommended that it be combined with a seasonal quota, so that landings could primarily occur in the summer when bait is most needed. We did receive several letters which did not support a coastwide quota, and the primary reason for this opposition was that it could cause a race to fish.

Option D was our seasonal quotas. Those who favored this wanted to spread harvest throughout the year. There was a recommendation for a winter fishery, in which remaining quota is pooled into a coastwide fishery in November and December. Option E

was our regional quotas. Similar to seasonal quotas, those who favored this option wanted to spread harvest out along the coast.

Several liked the combination of a regional and seasonal quota to divide harvest spatially and temporally. Others such as those in Massachusetts and New York did not like the option of regional quotas, and they expressed concern that they may be beat out by southern states such as Rhode Island and New Jersey to that quota. Option F is our disposition quota, so that splitting the quota between the bait and reduction fisheries. This was the second most popular option, and many felt it would be a way to protect the bait fishery. Most recommended a 30/70 split with 30 percent of the allocation going to the bait fishery and 70 percent going to the reduction fishery. Option G was a fleet capacity quota, and there was general support for this option as a way to protect quota allocated to different gear types. Some fishermen expressed concern that they might be pigeonholed into a specific fleet type based on landings, and they would not be able to increase their landings if the menhaden stock continued to improve.

Some people did comment on the option of soft quotas, and overall there was much greater support for a hard quota, as people did not have confidence in soft quotas to cap harvest. Our final option was Option H; so this is an allocation strategy based on the TAC level. We had one individual and one organization that supported this option.

Those who supported the option stated that the fishery needs to be made whole first, and then the board can work to allocate more quotas to the bait sector. There were several comments that spoke against this issue, as it might result in perverse incentive to change the TAC. Throughout the public hearings we did see or receive many other suggestions on ways to allocate menhaden.

Some of those I've already discussed, so that would be the coastwide distribution, by season or combining regional and seasonal quotas; but some of the others included a fixed minimum quota with a four-region split, fixed minimum quota with a coastwide winter fishery, seasonal quotas with state allocations.

One of the new ones was progressive catch limits, so the idea behind this is that there would be a catch limit, and that would get progressively smaller as the fishery got closer to achieving that TAC. This would be a way to preserve the fishery for some of the smaller gear types. Then a comment we received several times was that allocation should be based on the biology of the species.

Moving to our allocation timeframe; while there were two comments in support of the current allocation timeframe, which is 2009 to 2011. The majority of comments felt that the allocation timeframe should be changed; so a majority supported Option C, which was for longer time series average.

Some stated that the time period needs to be longer to encompass a full generation of menhaden, and others provided specific dates. Some recommended going back to 1955, others in Rhode Island and Maine pointed to high catch in the 1980s, and recommended that these years get included.

Some states such as Maryland wanted to make sure 2012 was included in a longer time series; since this was a good year for them. Then in Florida they did note that they've had a net ban since 1994, and that this should be considered when setting the allocation timeframe. We did have some who supported Option B, which is 2012 to 2016.

Most of them were in New York, and they noted that they've had issues with the lack of reporting; so the most recent years include all of the catch. Others did not like this option,

because it includes years when we have had a TAC in place, and as a result catch has been limited. Then finally Option D, which is weighted allocation. Some supported Option D as a compromise between considering past trends and current harvest rates. Our next issue is quota transfers. There weren't specific management alternatives in the PID for this, but I've tried to group the comments into different categories to provide a bit of a summary here. The majority supported quota transfers, but also noted that greater accountability measures are needed to prevent abuse of this provision. Some of the recommendations for greater accountability measures included that a state could not do transfers two years in a row, that a state could only accept a transfer if the quota has not been exceeded, or that transfers can only occur within a region.

That way quota that has been allocated for example to Maine can't be suddenly changed to Florida. People had concern about the science behind that. Others opposed quota transfers. Many felt that it would not be necessary if reallocation was properly done, and that overages should not be forgiven. Others felt that transfers encouraged states to exceed their quota or allow for increased harvest in certain areas which could result in localized depletion.

Some expressed concern about the growing abundance of menhaden and the fact that this may lead to kind of the commodification of menhaden transfers. We did ask questions about quota reconciliation, and overall there was pretty limited support for this option. Those who did support it stated that it was an easy way to address overages.

Our next issue is quota rollovers, a majority opposed quota rollovers and there were approximately 1,500 comments that opposed them. Those in opposition stated that rollovers allowed for significantly higher harvest in some years than what the science recommends; that rollovers may allow for localized depletion.

Others recommended that there be no rollovers so that unused quota can serve as a buffer for the stock. Many commented that if a state is not catching its quota that might be an early sign of poor stock condition. Some did favor rollovers or limited rollovers, and they stated that states should be allowed to catch everything that it is allocated, but they did note that the stock should be in good conditions; so we should maintain those provisions that rollovers can only occur if the stock is not overfished and overfishing is not occurring.

Moving on to incidental catch, the majority did favor Option C or Option F, and just for clarity there were many letters which recommended that the catch be included in the TAC, and that was counted as Option C and F; since both of these options achieve that goal. Those in favor of Option C generally stated that they wanted incidental catch to be included in the TAC.

The same goes for Option F, which is our small scale fishery set-aside, but those in favor of this option also stated that it relieves administrative burden, it protects small scale fisheries. Florida was in favor of this option at the public hearing, and those in the cast net fishery did note that the cast net fishery is a directed fishery, and they want to be considered as such; so this option would kind of allow them to be a part of that fishery.

We did have those in favor of Option A, which is our status quo, so setting aside some sort of limit per vessel. In Maryland they supported Option A, as long as they get to keep the provisions of Addendum I, and just as a reminder that allows two permitted individuals fishing from the same vessel to land up to 12,000 pounds of menhaden; if they're fishing stationary gears.

Overall there was pretty limited support for Options B, D and E. Turning to the Episodic Events Program, the majority supported the removal of the Episodic Events Program, and

they felt it wouldn't be necessary with proper reallocation. Others expressed concern that an episodic event is not well defined, and several commented that it's a short term solution for a long term problem. Others did support the maintenance or an increase in the set-aside. Many of the New England states commented that they would need an episodic even program if reallocation does not provide them with more quotas.

New York stated that they want to be included in the set-aside or have their own set-aside. Then individuals in Florida recommended that participation be limited to small-scale gears and in-state residence. Our next issue is the Chesapeake Bay cap. A majority of participants wanted to either maintain or reduce the cap.

Those who were interested in maintaining the cap said it was an important tool for the management of Chesapeake Bay, and that it was an important stop-gap to protect the nursery grounds. Over 2,000 comments were in support of reducing the cap, and many expressed concern that the reduction fishery could expand to twice the level that it's at now in the Chesapeake Bay.

Recommendations on the level of reduction ranged, but a majority were in favor of a 50 percent reduction to current levels. Others recommended that we should use a five-year average; and others recommended expanding the geographic extent of the cap to some of the Virginia coast. We did have a couple who were in favor of removing the cap, and those stated that the majority of catch is coming from the mouth of the bay in Virginia, and so the cap is not necessary.

Finally, our last issue here is a research set-aside. There was a slight majority against a research set-aside, with concerns about the abuse of the system and the fact that maybe a high volume of fish isn't needed for research. Those who were in favor of research set-aside stated that it would foster collaboration with industry, and that there are many research questions that still need to be answered.

Then this final slide here is just a list of all of the research programs that were recommended. I'm not going to go into this list here; but some of the themes were relation to the environment, so how the environment affects menhaden, but also how menhaden effect the environment, greater regional trends, and speciation of menhaden. If there are any questions about the list I am happy to answer them.

ADVISORY PANEL REPORT

CHAIRMAN BALLOU: Let's do this. Let's roll right into the AP report, and then I think we'll pause and open the floor to questions. I know we have a few slides that captured the AP report; and I guess I'll let Jeff Kaelin our AP Chair run through those, thanks.

MR. JEFF KAELIN: I'm Jeff Kaelin with Lund's Fisheries in Cape May, New Jersey; and I am the AP Chair. I am privileged to sit here as the AP Chair. There are several AP members in the audience today, and I think Megan put together a slide presentation that encapsulates the memo of January 23, which you have.

Rather than reading that I'll just ask Megan to go through that I think, since you made it. We reviewed it. I think it captures what occurred on the call. What we did on the call, Mr. Chairman, was we reviewed the public hearing comments; the written comments weren't available at the time. We try to operate by consensus.

We didn't take any votes or anything, but I did give all of the AP members on the call, and you were on the call too as I remember, an opportunity to make a statement that was kind of qualitative in terms of their overall view. That is what we have and if you want to go ahead and comment on that Megan that's great.

MS. WARE: As Jeff mentioned we had an AP call on January 9, we had 14 members in attendance; which I think is really great, and shows how the kind of revitalization of this AP is really working. I presented some of the summaries from the public hearings but not the written comments.

I've split the AP comments into three different categories; the first is comments on reference points. Three members supported Option D, which is again the existing guideline for forage fish until ERPs are developed by the BERP. Some commented that reference points dictate how the fishery is allocated between all stakeholders; it is not just between the reduction and the bait fishery but the recreational fishermen, the environment, tourism industries and things like that.

One member stated that a one-size-fits-all approach to managing forage fish is not appropriate. One member commented that few fisheries are in as good a shape as menhaden, and he questioned why there was such a need to change the management strategy. One member noted that ERPs would help the resource and the economy.

Then one member recommended that the option which states the possibility of combining the 75 percent unfished biomass target with the 40 percent unfished biomass threshold, be forwarded in Draft Amendment 3. The next sets of comments are on the allocation. Three members highlighted the need for a longer allocation timeframe; with historic fisheries in New York and New England, and that those should be recognized.

Two members supported Option H, which again is our allocation strategy, based on the TAC level, and noted that the fishery needs to be made whole again, and then additional quota can be distributed to the bait sector. One member supported Option B, which is our state specific quotas with a fixed minimum, and Option D, which is seasonal quotas; and commented that quotas should be reserved for seasons when it is most needed.

One member just supported reallocation in general. Then just some other comments, there were two recommendations for Draft Amendment 3. There was a recommendation that a table be added to Draft Amendment 3, which compares the various reference points on a common currency; and there was a recommendation that a table be added to Draft Amendment 3 which summarizes catch by state, gear type, and year. With that we'll take questions.

CHAIRMAN BALLOU: Great, before I open up the floor to questions I do want to note that I was on the AP call. I really am impressed with both Jeff's stewardship and the thoughtful comments offered by the members; so thank you to Jeff and through you to all the AP members for their contribution.

I would be remiss if I didn't note that Megan once again really did an outstanding job coordinating all the public hearings from Maine to Florida. We are a large board geographically here, and she attended and conducted many of those hearings herself, and then in remarkably short order pulled everything together for board consideration today. Again, to her and other staff members who lent their assistance, we extend our appreciation. With that I will open the floor to questions. We're not in comment mode, we're about to go into comment mode but we're not there yet; so at this point are there any questions for Megan or Jeff on the public review of the Public Information Document? Yes; Rob O'Reilly.

MR. O'REILLY: Thank you Megan, thank you, Jeff. I know it is not available I suspect, but you know the public had quite a few comments; it looks to me about 358 written comments, and then the rest were form letter style. It would

probably be good as we go along if we had one table that showed all the majority.

I know there were a couple that were close, but generally there was some real good majority elements there; so as we go through we can turn to the Technical Committee, turn to Jason and get some advice on, for example, what is really practical and what is not. I'll just take one. I know in the hearing that we had in Virginia there was some clamoring for using data as far back as we had it.

Let's use data back into the fifties, and then there was one for let's use data back to 1985. I really didn't have much to say until the end of the meeting, but I did point out then certain parts that had to be looked at, such as when do we really think the data are suitable to look at this allocation question?

I know there are some recent gaps in recent years that we have from New York, and I guess also Florida had a situation. We have that but in general that is not a deterrent, as in some of the earlier years when you go back and you realize that you can't assume that if you're missing data that it's missing data for all.

There is not a systematic omission of data as you go back. That would be one thing to look at. It would be nice if we could go through these as we proceed; Mr. Chairman, and kind of keep that approach. Megan, I don't think you have that type of table for us to look at. I don't know. But it would be good; for those of who kept notes, we can sort of simulate that as we go on, so that's my question.

MS. WARE: If I understand the question, Rob, I think you're asking for a table that shows kind of the majority vote at the end. When we move into our discussion for tasking the PDT on what should be included in Draft Amendment 3, I have slides that show just total what the votes or counts were for each of the options; and then some questions to kind of help prompt that discussion. Hopefully that will help answer your questions, and I can provide a bit more information as we go on; for example years of data, and what might be more reliable than other years.

CHAIRMAN BALLOU: Other questions for either Jeff or Megan. Yes, Dave.

MR. DAVID BLAZER: I just want to say kudos to Megan for an outstanding public hearing in Maryland, it got a little bit feisty there in the beginning, but she worked her way through it and we appreciate all the hard work that you did. My question, Megan, is on the state specific quotas and the first couple options. In Option B, where it talks about the state specific quotas with a fixed minimum, I have a couple different interpretations of that. If you could refresh exactly what we mean by the 1 percent allocation as kind of a minimum.

MS. WARE: Yes, so the 1 percent is just an example. Something I'll be looking from the board today is if you guys want to pursue that option, what that percentage would be. But how that option would work is that they, we'll use 1 percent as an example, would be allocated to each state and then the remaining amount would be allocated based on average landings from an allocation timeframe.

PROVIDE GUIDANCE TO THE PLAN DEVELOPMENT TEAM ON THE DEVELOPMENT OF DRAFT AMENDMENT 3

CHAIRMAN BALLOU: It seems like this might be a good segue way to move into our next item, which really blends so well with what we just went through; and that is Item 6, Guidance for the PDT on the Development of Draft Amendment 3**.** To summarize our aim now is to essentially launch the next step in the amendment process by providing guidance to the Plan Development Team on the issues and options to be included in the document; and subject to further development.

We've got about 45 minutes for this item, and we've got a lot to work though; so let's see how well we can do here. To help frame and guide the discussion, let me give you a sense as to how we plan to proceed today and how we plan to proceed over the next five months. A lot of this Megan has already noted, so I'm just going to tick through this quickly.

For today we're going to go back over the issues set forth in the PID, and consider which issues and options the board wants to retain; and which if any the board wants to eliminate, modify or add. My M.O. will be to seek consensus and call for motions and votes only if there are competing views among board members; and I would hope that that would not happen often, but we'll see.

Given the large amount of public input received during the review of the PID, I do not plan on taking any additional public comment today. Keep in mind that we're still essentially at the conceptual stage; that is framing the issues and options to be fleshed out by the PDT for development of the draft amendment, which in draft form will be brought back before the board for further review.

In moving forward today the board is not committing to any particular direction or outcome; we're just framing. Looking ahead, as Megan indicated this is a relatively new development, but I think it's an important one. We are going to use our May meeting to hear back from the PDT in the form of an interim status report. That will give the PDT the opportunity to report out on how their work is progressing, and the opportunity to seek clarification from the board on any issues or options they may need further guidance on.

It will also give the board and the public the opportunity to see how things are taking shape and respond accordingly. Then of course we'll use our August meeting to review and approve the draft amendment for public comment. Are there any questions on where we are, where we're going or how we plan to get there with particular reference to our goals and objectives this afternoon? Is everyone clear on what we're about to undertake?

I think the context is very important. Sometimes these sorts of discussions tend to get into a pro and con as to which option we prefer. That is not really the point. The point is how do we want to frame the document to be developed by the PDT? I see no hands, so I assume I was effective in trying to characterize where we are. We'll move through the issues now by first addressing. As Megan noted and I think this is going to be very helpful to kind of help set the stage for the board's review of the reference point issue, Katie Drew has kindly agreed to provide a brief overview of that issue; summarizing both the work being undertaken by the BERP Working Group and the existing guidelines set forth in the PID. Katie, the floor is yours.

DR. KATIE DREW: As was discussed, basically I just want to give you guys a refresher on some of the options that were name dropped in the PID; so that everybody kind of knows what we're talking about when we go through and discuss the various pros and cons of the options that are going to go out for public comment.

What we have basically on the table for consideration are single species reference points, which are a product of the most recent benchmark stock assessment, generalized ecological reference points that are kind of existing guidelines for forage fish; and this includes specifically the Lenfest Report and the 75 percent BMSY Rule of Thumb that have been referred to specifically within the document.

The third option would be the products of the Biological Ecological Reference Point Working Group that is working on this issue now for ASMFC. This is kind of a table of some of the various options that are on the table, so that

you can get an idea of the scale that we're talking about.

The top in gray is the Amendment 2 BRPs. That is what has been used most recently to manage menhaden. That includes the F15% MSP where MSP is your maximum spawning potential. The idea of these F reference points is that F15% MSP would leave 15% of your maximum spawning potential in the water; so that you would fish at a rate that leaves the population at 15% of its maximum spawning unfished potential.

You can see the values over on the far side. The threshold in the past was 2.98 or 15% MSP; and the target was 1.03 or 30% MSP. The most recent benchmark stock assessment produced single species reference points that are similar in concept but recommended different values. The threshold proposed by the most recent benchmark stock assessment is the 1.26 or 26% MSP and the target would be F 57% MSP of 0.38.

The Lenfest Report recommends a value that is essentially based on where we are with the stock; half of the natural mortality value for this species, which works out to an F of 0.29, and that is essentially equivalent to an F of 64% MSP. On the bottom row you can see where we are right now that is the F in 2013 was 0.22, so it was below all of these reference points indicating overfishing is not occurring.

This is kind of a framework for some of the options that we're going to talk about with actual numbers attached. The first option kind of on the table is these generalized ERPs for forage fish; existing guidelines I think they're called in the document. Where they come from is essentially a meta-analysis of ecosystem models.

A suite of ecosystem models such as EwE that is ecopath with ecosim, ATLANTIS, a few other options; were run for multiple different forage species, multiple different ecosystems. Some of these studies looked at menhaden in the Chesapeake Bay, but they also included things like sardines in California, anchovies, throughout the Pacific and the Atlantic, the north Atlantic, a number of different species and ecosystems were analyzed together. The intent was to provide sort of a generic conservation buffer and a control rule; especially for data limited situations that would ensure that you left enough fish in the ocean to prevent stock collapse for the exploited species, as well as to prevent adverse effects for the predators involved.

The meta-analysis component was trying to look at options that would reduce this risk or reduce the adverse consequences to an acceptable level across multiple different situations. That is why they are sort of in a sense generalized for forage fish, but they cover a wide range of ecosystems. One specific example that's in the PID is a product of the Lenfest Report; it is also cited as Pikitch et al, where they have a number of different information tiers.

Based on what they laid out, the TC felt that menhaden fell in the intermediate information tier; which means that you apply this hockey stick control rule with a biomass threshold of greater than 40 percent unfished biomass and an F less than or equal to 50 percent of your natural mortality rate.

That is kind of laid out in this figure here where that dashed line across the top represents your F threshold; that you wouldn't go above that F threshold, which represents about 0.29 for menhaden. Then that happens at sort of your maximum stock size, and you ease that fishing mortality back as your stock declines; and below 40 percent of your unfished biomass no fishing is allowed.

This is an example of this specific type of reference point from this specific report.

Another option that was mentioned specifically in the report is this sort of 75 percent unfished biomass reference point from Smith et al. Again it is a similar type of meta-analysis of ecosystem models, where the idea is you exploit the population; your target exploitation is a level that would leave 75 percent of the unfished biomass in the water.

That is essentially an F target of 75% MSP, which means that if we're at about F 70% now we are close to the target; but still below the F threshold, which was sort of proposed to go along with this would be an F40% would be your threshold, and you would not fish above that 40 percent threshold. The other option in terms of ecosystem models is the product of the BERP Working Group.

These are a little different from the generalized models, in that they are going to be menhaden specific models and this includes a multispecies statistical catch-at-age that is in production now. They are intended to really allow the evaluation of tradeoffs between menhaden quota, predator biomass and levels of acceptable risk; so that the board could say, we're willing to accept a certain level of risk of overfishing in the stock.

We want to accept a certain level of risk of overfishing our predators; or our predators not having enough prey at different levels of risk, different levels of quota, and to be able to actually evaluate the tradeoffs from that perspective. As a reminder, we had an Ecosystem Management Objective Workshop in August of 2014 that laid out some of the board goals for ecosystem management.

That included the goal of sustaining menhaden to provide for fisheries, sustaining menhaden to provide for predators, and providing stability for all types of fisheries. These types of reference points all essentially meet these goals; that they are intended to provide menhaden to fisheries, provide menhaden to predators, and provide kind of a stability and understanding of how these rules will be applied. But there are sort of pros and cons to each approach. The pros of the generalize model obviously are that they are available now; that this work has been done and it's been peer reviewed, and they are available for management use now.

The BERP products will not be available until 2019. They will be peer reviewed, but they're still under development. The generalized models also include birds and mammals in there; they're very comprehensive, ecosystem models. The BERP products that will be used for management focus on the major finfish predators.

We will have an ecosystem type model, a EwE model for Atlantic menhaden, but it's intended to be more of a compliment to the actual models that will be used for management purposes. The generalized models do include specifically birds and other marine mammals, whereas the BERP products will not for management.

The pros of the BERP approach are that they are menhaden specific, so we will not be incorporating any data from other ecosystems, from other species or other fisheries; this is really focused on the menhaden ecosystem, the menhaden fishery. The other benefit of the BERP working group over the generalized models is that they do allow those tradeoffs.

To be able to say this level of menhaden quota is going to result in this level of striped bass biomass, of weakfish biomass; so that you can compare the effects of increasing or decreasing your menhaden quota on the predators that you're interested in. Then evaluate what is worth it, essentially in that level of tradeoff; as well as being able to specify the level of risk that you are willing to accept as a board.

The generalized models essentially have their level of risk and of tradeoff already baked in,

and there is not a way to adjust that; not a way to quantitatively evaluate those effects. This is kind of just a general overview of some of the things you may be wanting to think about as you go forward with these options; and I'm happy to take any questions about the BERP products or some of these other options.

CHAIRMAN BALLOU: Questions for Katie.

MR. O'REILLY: Thank you Katie, and the way you presented that is very elegant, so thank you. I guess what I don't know are a couple things. I'm going to be indirect about the process a little bit, but the meta-analysis, is that as rigorously set as an assessment process that I'm more familiar with.

Does the meta-analysis have the same scientific rigor that perhaps what's been done with the BAM model or something else? That's one question. I would like to get the other question out, because I don't want to raise my hand twice on this issue, so if that would be okay with the Chair.

CHAIRMAN BALLOU: Sure.

MR. O'REILLY: The other question is, has the Technical Committee changed its recommendation concerning the use of the Lenfest or the Lenfest derivative models for menhaden, and whether they have or have not, is that extra work? Is there any diversion there to moving to something like that as an interim approach? I hope that's enough to be understood.

DR. DREW: I would say the Lenfest Report; these EwE models are certainly robust scientific products. I mean it's not quite the same process as a stock assessment, and I think probably the stock assessment has to be a little more conservative in some of the choices it makes; in terms of what quality of data, where we borrow data from and things like that.

But definitely the Lenfest Report is a very robust product of multiple scientists. There was a peer review process. The TC hasn't changed its recommendations, which is that it's not like we feel this is garbage science by any means. I think we do feel this is good science. But with menhaden I think we can do better, and we can do it specifically for menhaden.

I think our concern is not about the robustness of the meta-analysis, and not about the robustness of the data that went into the ecosystems; it's more concerned about the generalized nature and the multi-ecosystem, multi-species features compared to the benefits of a product that is specific for menhaden and for our fisheries.

CHAIRMAN BALLOU: We have Jason McNamee, our TC Chair. I think he may want to add to Katie's response.

MR. JASON McNAMEE: I agree with everything Katie just said. I just thought I would hit one other aspect of your question, Rob, and that was I think you asked about the workload. I actually thought about that a little bit in talking with Megan. We checked in on that specifically with Dr. Schuler about that. Dr. Schuler always puts things in these really nice ways, so I'm going to quote her directly and she said, "If we get a couple well defined additional reference points, we can handle it."

The ones that we've been looking at here I think meet those metrics, if we're talking about one, two, maybe that third hybrid version; I think we would be okay to produce them. Keep in mind, I guess I will add that when you're talking about the BERP and the Menhaden Technical Committee and the update assessment, you're talking about the same people each time; so that is something to keep in mind also.

CHAIRMAN BALLOU: Additional questions? Emerson.

MR. HASBROUCK: I have two questions, if you will please, one for either Katie or Jason, the other one for Jeff; relative to the AP. My first question is Katie, in your presentation and also in the document you refer to generalized models frequently. Are those generalized models in that they are general for a lot of different species, or are these generalized linear models that are being used, or are they generalized linear models that are being used for a general assemblage of species; that's my first question.

DR. DREW: The models themselves are very broad in scale. I would say the reference points are what are generalized, in that they come from a meta-analysis or a combination of multiple different models; but each model was built for a specific system. They would build a model for sardines in the California current; they would build a model for Peruvian anchovies, and these kinds of different ecosystems. There was a model for menhaden in the Chesapeake Bay. It is specific to an ecosystem, which is obviously a huge question in and of itself, but then those results from those multiple different models and multiple different ecosystems were combined to create a rule that could apply to a number of different forage fish situations in general; that you might have a data poor situation or couldn't have a specific model for.

I think the reference points are sort of generalized, in the sense that they're meant to apply across a broad forage fish species without concern for a specific ecosystem. The models themselves that were built to support this larger analysis are specific to each individual ecosystem that it was built for. Does that answer your question?

CHAIRMAN BALLOU: Did you have a follow up for Jeff?

MR. HASBROUCK: Yes. Jeff, in your presentation you mentioned providing some tables to show, and I think your term was in a common currency, what the different options will result in. Then Katie had a table that she showed relative to the different reference points. Is that the type of thing that the AP was looking for, and if so I would encourage these things to be in the next iteration of this document?

MR. KAELIN: Yes I thought Katie's table was good. It still has the values, it has targets in terms of percent, F rates and so forth. I think our discussion at the AP, and this I think was really kind of a consensus outcome, was it would be helpful to have projections in metric tons around those values. I think I just heard Katie say that that was something that the TC was going to be doing anyway.

That is exactly what we were talking about, because it is really hard to know in output where we are now; with all these various reference points, and how do you shift from MSP to unfished biomass? I think the AP was looking for some numbers too. I don't know if that's possible or not. There was broad agreement, people from different parts of the political spectrum felt the same way in our AP, I think so.

CHAIRMAN BALLOU: Katie, did you want to offer something?

DR. DREW: I was specifically referring to the BERP products rather than the TC products, but if that is something that the board and the PDT would feel would be helpful; again within a limited set of options, so it is not go out and do this for every single ecosystem reference point you can think of. But if you could limit it to a couple of options, I think we could do some projections on that if that would be helpful.

CHAIRMAN BALLOU: Just to remind the board, we're going to be having to set specifications for 2018 at about the same time that we're going to be working through these options; so

the two really do go hand in hand, and I think it's inevitable that we're going to be looking at projections that relate to these various options once we get to that point. That is my sense. John McMurray, you had a question?

MR. McMURRAY: Katie, it looks like the BERP product won't be ready until 2019, but presumably that has to go through a number of hurdles, and it has to be formally evaluated. When can we expect it to be ready for prime time or for real management use?

DR. DREW: The 2019 timeline does include the peer review process. In 2019 it is intended to compliment the most recent benchmark, the benchmark assessment for menhaden; so that they can come through together and you'll get management advice for both of those together in 2019.

MR. McMURRAY: Just a quick follow up. If we do utilize rule of thumb end term BRPs, there is no real tradeoff, right? I mean they would not impede the work of the working group nor would they push the timeline back at all.

DR. DREW: No. Again, as long as you're picking stuff that is already existing; then it would require minimal additional work for the TC.

REFERENCE POINTS FOR DETERMINING STOCK STATUS

CHAIRMAN BALLOU: Good questions; further questions for Katie or anyone else up here? Seeing none; I think I'm going to turn it back to Megan and Megan if you want to walk the board through the issues starting with reference points. Now we're at the point of really looking to make sure that the board is comfortable with the issues that the PDT will be taking up for development; beginning with reference points.

MS. WARE: What we have on this slide here are the public comment summary, but I've just taken the total column at the bottom of the tables that I previously presented; just to again remind the board of what the various comments were in favor of. Then I've put some questions up on the screen for the board to hopefully prompt some discussion. Some of the questions are which of these options should be included in the draft amendment?

Are there any other options that should be added; for example the osprey ecosystem reference point that was newly proposed as a part of the public comment process? If the board is interested in some of these existing guidelines, which Katie was just talking about, which guidelines would the board like to pursue? Again we have kind of these three options that are on the table now, it would be very helpful for the board to kind of pick out some of the ones they are most interested in pursuing.

CHAIRMAN BALLOU: Okay. Thoughts, comments; yes, David.

MR. DAVID BUSH: I'm not prepared to tell you which ones to use, but I do have a question that might be something beneficial for folks to look at. You just asked the question I wanted to ask a moment ago about, what do we anticipate these impacts to be if we change the reference points that we're using now?

Whichever ones we do, I do think it will be helpful to preface it by if you do change this is what it's going to mean at least qualitatively. It doesn't have to be super specific, but if you go from this option to that option, this is going to potentially be a 5, 10, or 80 percent reduction from what they're catching now; something along those lines.

CHAIRMAN BALLOU: Comments, thoughts, suggestions for how we should proceed on this issue? I would remind the board that Options A, and B in the PID both ended with the line, the BERP Working Group would stop their work and turn to something else. As we think about this,

I'll just sort of pose the question. Is there any interest on the part of the board in calling upon the BERP Working Group to cease and desist in their efforts to try and develop the multi-species modeling approaches?

If so, let's get that out there. If not, we could probably just on that issue alone kind of winnow things down a bit. I'm trying to ask some leading questions here to try to get things going. Again, it seems like the options as I see them are to sort of look at current single species approach, compare that to an interim guideline approach, and compare that to the ultimate outcome that the BERP Working Group might be pursuing. My sense is that that is sort of how I see this issue framed, but I do understand. John's got a comment or question, so go ahead, John.

MR. JOHN CLARK: I just had a question, I know some of these have status quo put right into the PID. This one I was assuming was the single species reference point. Isn't that status quo? Could we take it out? We had support for keeping that in the amendment; I just wanted to make sure. Does that have to be in the amendment, because I was working under the assumption that it did have to be there?

MS. WARE: Yes. That basically is our status quo option, so I think that would remain there. I think the question is really if the board wants to remove Option B, which is go straight to the existing guidelines and have the BERP stop work on the menhaden specific ecosystem reference points.

CHAIRMAN BALLOU: What's the pleasure of the board, in terms of how to proceed? Cheri?

MS. CHERI PATTERSON: I think that there is just general conversation about the issues with the Lenfest Report that continues to not only lead this board, and I'm a short-timer so I could be misspeaking for some members; also, the public comment seemed to be very widespread to move forward with ERPs. My recommendation would be to remove Option B out of these three.

CHAIRMAN BALLOU: Dr. Duval, did I see your hand up?

DR. DUVAL: I was just going to make the same suggestion as Cheri, to just remove Option B.

CHAIRMAN BALLOU: Let's try and do it this way. Is there any opposition to removing Option B; that is to not include it in the development of the Draft Amendment? Seeing no opposition; it seems like we've made some headway on that issue. Other thoughts and comments in terms of how to frame this issue, with particular reference I think to the range of existing guidelines; and whether that can or should be honed at all. I think there were at least two or three examples. Terry Stockwell.

MR. STOCKWELL: My sense is to leave the other three issues in there. I can't speak for all the other public hearings. As Megan's presentation displayed, there were no public comments in Maine on the reference points. I think clearly it's because most of the people in the room didn't have a clue what she was presenting.

I don't think Maine was unique. I think as we collectively have work to do to help our fishermen and our public members understand what this means, so they can make more informed the more choices they have I feel more comfortable about. I would be against whittling down this list any more.

MR. HASBROUCK: Yes I would agree with what Terry just proposed as well.

CHAIRMAN BALLOU: Okay so I have removing Option B and retaining Option D as a Full Monte so to speak, but again those are just suggestions and I'm looking for comments on those suggestions; hoping to achieve consensus in

terms of the pleasure of the board. Are there any other thoughts, pro or con, versus or relating to any of the suggestions that have been made so far? Seeing none; I guess I'll turn to Megan and see if you think that is enough guidance for the PDT or whether you feel there is a need to do more.

MS. WARE: I say we'll take this guidance for now and we'll see how the PDT is doing, and in May we'll report back. If we need to gather further comments we can do so.

CHAIRMAN BALLOU: We're about to move on to allocation, but before I do I just want to make sure, are there any other thoughts or comments on the reference point issue? We're going to obviously be coming back to this often; so this is by no means a last chance, but it is the last chance for today. David Borden.

MR. DAVID BORDEN: I just want to understand what your sense of timing is. I mean we don't have much time to deal with all these issues today, obviously. We're going to deal with whatever we deal with, and then we'll get a report, and then we'll continue the development at the next meeting.

CHAIRMAN BALLOU: That is correct. I anticipate this is going to be an iterative process and we'll get our head of steam going today as we are now doing; and we'll see where we are in May and take it from there. Okay let's move on to the next issue, Megan.

QUOTA ALLOCATION

MS. WARE: Our next issue is quota allocation, and again I have a table with the total public comments in favor of each of the options; then just reminders of other allocation methods that were recommended during the public hearing process. The questions are which of these options should be included in the draft amendment?

If the board is interested in Option E, which is the regional quotas or Option G, which is the fleet capacity quotas, it would be very helpful for the board to specify how many fleets or how many regions; and then, is the board interested in pursuing soft or hard quotas?

CHAIRMAN BALLOU: Okay the floor is open for discussion, comments. Do you like the suite of options as presented? Do you want to make any suggested changes? Let me go to Steve Train first.

MR. STEPHEN TRAIN: I have a question before we go out with this. We've talked about changing the timeline on how far back we go. If we go to an option like H, and further along we decide to change the timeline, would that change the timeline in Option H or do we have to stick to the years we chose in this?

MS. WARE: If I understand your question, Steve, what I envision for Draft Amendment 3 is kind of a mix and match; so you would pick your allocation strategy and you would pick your allocation timeframe. The goal would be to have some sort of table in Draft Amendment 3 that would show you what the result of those two mixings would be; and we would do that for every combination of allocation strategy and timeframe.

CHAIRMAN BALLOU: Steve, did that answer your question?

MR. TRAIN: Yes.

MR. STOCKWELL: Megan, on Section G under the fleet capacity, on the medium capacity fleet my comment is purse seine needs to be added into that category. State of Maine has a number of small purse seiners 35 and 40 feet. I would not consider them large capacity.

CHAIRMAN BALLOU: Duly noted, thank you. Additional comments on the suite of allocation

options that we would ask the PDT to further develop. Rob O'Reilly.

MR. O'REILLY: I want to follow up on Steve Train a little bit. Option H is one that I made the motion for in Maine, and it is really not tied to a timeline as much as to a restoration of where the TAC was before the 20 percent reduction. There was not a lot of time to say everything. But obviously one thing behind Option H was this board at the summer meeting came within an eyelash of pretty much reinstating that 212,500 metric tons by 1 percent, which the 1 percent represents the set-aside or the episodic set-aside.

That really was the driving force I think of anything else. I think all of us remember that nice day in August, and that was why in Maine the impetus for that motion. But it is tied to that situation prior to 2013 when we started on the 20 percent reduction, so thank you.

CHAIRMAN BALLOU: Additional thoughts, comments. Nichola.

MS. MESERVE: I would suggest that the board consider removing Option C, coastwide. I struggle to see how that would be an effective management tool for the fishery, given the timeline of the different state fisheries perpetuating a race to fish, et cetera.

Based on the level of comment supporting Option H, I would at least suggest that we consider removing that option the allocation strategy based on the TAC level. It had very limited favorable response and the negative response to it suggested that it could encourage the board to set a TAC higher than the science dictates, and that's not a public perception that I would hope to perpetuate.

CHAIRMAN BALLOU: Let's take those one by one. There is a recommendation to remove Option C, the coastwide option, thoughts on that. Is there anyone opposed to removing that from the document or from further development as an option? Seeing no hands; I'm going to take that as a consensus agreement, as agreement on that recommendation and that will be taken out. On the next issue, removing Option H, do we have thoughts on that? Yes, Kyle.

MR. KYLE SCHICK: Option H is really status quo, and I think that needs to stay in there. I think most people don't even understand that that's the way we're doing things, as far as a lot of the comments go. I do think we need to leave that in there; as far as a status quo statement.

CHAIRMAN BALLOU: Interesting perspective as to whether or not it constitutes status quo, but I'll leave it at that. Rob.

MR. O'REILLY: Seriously opposed to removing Option H, and again one of the main reasons that that option is there is because in August we were just about there. I don't want to go into how it didn't happen, but I think everyone should remember that the 10 percent would have passed, except for maybe some unforeseen circumstances there.

Then we got into a – to use the word twice today from someone else – a quagmire, and we didn't get out of it until we got to Maine. But I think that even from the first allocation subgroup meeting that Robert Boyles chaired, even at that time part of the discussion that first meeting, even the second meeting was there needs to be some consideration of what is meant by allocation; because truly we were looking at a reduction, and we weren't back to where we really could look at an allocation system the way we should, which is fair.

Part of the call throughout the process, I think there were seven calls that Robert adroitly handled, because he never really made decisions; he allowed the group to have discussions and give the board guidelines. But throughout, fair and equitable were the rallying

thoughts. I think there is a certain amount of fairness, given that Option H is not finding fault with what has happened previously, but it is saying that at the time that there was the reduction; which we've all heard many times.

We went by the science we had. Our current chair at the ASMFC was the one who initiated we need to get away from the problem we're in with the threshold. From there, there was a cascade that lasted about a year. Here we are today, and I think fairness says that Option H should be in this draft document.

I think that the Technical Committee, if you heard last meeting, there was information from our board members that when on earth have you ever seen a situation where a 5, a 10, a 20, a 30 a 40 percent increase does not risk overfishing, does not risk anything; 6.45 percent was settled on. I just can't fathom taking this option out.

MR. HASBROUCK: I don't really see Option H as status quo; I see it as a variance of status quo. I thought that Option A was actually status quo. Maybe we can get some clarification on that please.

CHAIRMAN BALLOU: I have an opinion, but I'm going to let Megan offer hers first.

MS. WARE: Thanks Bob. Option A is technically status quo, so that would maintain state-by-state allocations. Option A is I'll say a twist on that where you maintain it up until the 212 metric tons is achieved, and then you would add variation on to it.

CHAIRMAN BALLOU: Yes that's my take; I didn't mean to be coy there in tossing it to Megan. I just really do feel that Option A is intended to be status quo, and Option H is proposed as a variation on that. That is my take. On this issue and I do want to try to work through this particular issue before we address any others. It has been suggested that Option H be removed, and there has been some opposition to it and in fairness if there remains a difference of opinion, we may want to vote on this issue. I don't anticipate there being many other issues that we'll end up at this place on, so we'll handle it as the board sees fit. Dr. Duval.

DR. DUVAL: Just to address the point that Nichola brought up that there is a perception that Option H would actually allow for an exceedance of the TAC. I think it's the language that is used to describe this particular option, because as I look at it, the wording is that when the TAC exceeds 212,500 metric tons then you would do these things.

What it's really trying to describe is that when the scientifically supported TAC coming out of whatever next assessment goes above 212,000 metric tons, then you would consider potentially one of these other strategies that are laid out in here to allocate any TAC that is above that. I think it's the way this alternative is being written up that makes it sound like, hey we're just going to exceed the TAC and then we'll allocate some things around that.

I think that's what is probably leading to some public misperception that this would not be under the strategy that a TAC would not be scientifically supported. I think it is in the way that it's being described. I know I'm not being very clear, but I'm just starting to warm up right now, so I apologize, Mr. Chairman.

CHAIRMAN BALLOU: We like it when you get warmed up.

MR. ROBERT BOYLES: I'll try not to repeat what Rob O'Reilly said, but as Chairman of the Allocation Working Group, I recall specifically the conversations about this. As I read this, what this option intends to do is give everybody invested in growing this resource.

To Mr. O'Reilly's comment, this was really the conversation in our early allocation discussions

about is this an allocation or is this a reallocation? We've received comments and testimony. People still reference the difficulties of those cuts that we took in 2012. I think for the purpose of getting robust public comment, I would certainly move to keep it in and support keeping it in.

CHAIRMAN BALLOU: Before we go to a motion, which we might or might not need to do, Terry, you had a comment?

MR. STOCKWELL: Although this alternative may not be my preferred, I'm strongly opposed to removing it at this time. We may be able to mix and match with some of the other alternatives when we get together in November, so I hope it's the sense of the board to keep it in the document.

CHAIRMAN BALLOU: Nichola, it's your prerogative. Based on the conversation that's taken place, if you wish to make a motion to remove you're welcome to do so. If you wish to defer to the others on the board who have urged against that it is your call.

MS. MESERVE: I'll certainly defer on this issue, but I would suggest that the Plan Development Team look closely at the language that is used to describe it here, and maybe look to provide some additional justification for it, such as Rob has discussed today.

CHAIRMAN BALLOU: Good discussion I think. Other issues, other comments on this, yes Roy.

MR. ROY W. MILLER: I would like to take another look at Option B, state specific quotas with fixed minimum. The example was given of 1 percent of the coastwide TAC. When we have a report released to the public for comment for this amendment, I think we would be wise to put in some firmer numbers in there. Whether it's a single value or a range of values, I suspect a range would be most useful; so that the public can see specifically what we're talking about and how it will affect individual jurisdictions.

CHAIRMAN BALLOU: Eric, did you have your hand up?

MR. ERIC REID: I wanted to comment on Option H but we've moved on from that; so thanks anyway.

CHAIRMAN BALLOU: If you want to bring it back, I'm sorry.

MR. REID: Well, as far as I read this, Option H is status quo up until 212,000 tons and then it is some other option for the amount over 212; so if we go to 220 then we're going to have status quo for the first 212, and then we're going to have another option for the next 7,800 ton or something like that. For me if I go to 212 from where we are now I get 5,000 pounds. I have a very hard time supporting H staying in the document, because I think it doesn't do anything to accomplish any kind of reallocation. I think it's inequitable.

CHAIRMAN BALLOU: Although I thought we had moved past that issue, if you wish to make a motion to remove it you're welcome to.

MR. REID: I don't have any problem letting it go forward; I just wanted my opinion out there.

CHAIRMAN BALLOU: Fair enough. I saw Dave Blazer, your hand.

MR. BLAZER: I also was thinking about offering to eliminate Option E, the regional quotas. Basically one of the issues we have with it is it kind of creates an inequitable access between the large mobile gears and the stationary gears; and just thinking that those regional options aren't going to play well.

CHAIRMAN BALLOU: Thoughts on that suggestion; removing the regional quota option. David Borden.

MR. BORDEN: I would support that suggestion for exactly the same reason.

CHAIRMAN BALLOU: Are there other thoughts on the proposal to remove the regional allocation option? Terry Stockwell.

MR. STOCKWELL: I'm opposed to it. I think it's an alternative that is worthy of further development and consideration. It was one of the options that were supported in the state of Maine's hearings. I would be remiss if I were not to express that opinion.

CHAIRMAN BALLOU: Duly noted. Cheri, did I see your hand up?

MS. PATTERSON: Yes, I agree with Terry. I think Option E needs to remain as an option for consideration for some of the states that might not see as many fish coming up through on a consistent basis.

CHAIRMAN BALLOU: Dr. Duval.

DR. DUVAL: Based on the comments from my colleagues around the table, I'm certainly supportive of keeping this in there. One thing that the PDT may want to consider is a hybrid of state specific and regional. This sort of speaks a little bit to, I think what we did for spiny dogfish where we had some regional and then state specific. I know there is some history there. But that might be one hybrid option that would satisfy folks around the table.

CHAIRMAN BALLOU: Good thought. David did I see your hand up?

MR. BUSH: I think mine was sort of heading in a different direction, but a different position on it. But if you were looking to get rid of the coastwide and the regional, both of those together, then the seasonal might as well go with it; because at that point the states would be managing their own quota. However, Michelle brought up some good points.

CHAIRMAN BALLOU: Let's stay focused on the issue of the regional option. We've had a couple of suggestions. I guess Dave; I'm going to go back to you in a minute to remove it. There was at least one other board member who supported that idea. We can certainly do this in the form of a motion. But again, having now had the benefit of the board's discussion, go back to you, Dave Blazer and see if you wish to make a motion on the issue.

MR. BLAZER: I won't make a motion. I think it's worth going forward and getting the comments at this point.

CHAIRMAN BALLOU: I see Robert your hand up, but Megan wants to offer something.

MS. WARE: Perhaps if it is the more New England states like Maine and New Hampshire, maybe Massachusetts – I'm not trying to speak for you – who are interested in regional quotas, kind of taking Michelle Duval's suggestion; do a regional quota for the New England states. Rhode Island we can discuss if you're included in that or not; and then state specific quotas for everyone else. I'm just throwing it out there as a compromise.

CHAIRMAN BALLOU: We had thumbs up on that. Robert Boyles.

MR. BOYLES: You know the allocation working group spent a lot of time developing these options. I would just – Megan, don't hate me – but I think it's important. There was a lot of thought, a lot of discussion, and a lot of back and forth in developing each of these options.

I think it's important that we develop them further with seeing what the public has to say about this most important issue. Not to throw water on ideas to toss ideas at this point. But I think this is a critical issue; a lot of time, a lot of effort, a lot of emotion and intellect went into developing these. I think it's worth considering

getting public feedback on each one as they are written.

MR. O'REILLY: I think one of the difficulties is that we don't have quantification, and so I know that Roy Miller was talking about Option B; if I can slide back for a second. We took that at face value just to look at that; and we did 1 percent. That's 53 million pounds. Everyone gets 1 percent, it is 53 million pounds.

New Jersey, Virginia and Maryland a little bit help subsidize that. All of these options probably would make a little more sense if each state or each region or north to south, however it looks, were quantified. That's been done. My staff did that. It does help out a little bit. That might be part of the situation when you're looking at these different options that next time around will help a little bit, so thank you.

CHAIRMAN BALLOU: That's consistent with my thinking is that there will be a next time in May, and as the PDT has had the chance by then to flesh things out, put some – as you say Rob – tie some numbers to some of these options that may, in fact surely will, better inform the board on how they look and whether the board remains comfortable keeping them in.

I do get the sense from everyone's comments and body language that probably best at this point to keep this together as a package, and move it forward to the PDT for further development. But I am just giving you my sense of what I've heard so far; and I'm open to other suggestions. Rob, you had a follow up?

MR. O'REILLY: A quick follow up. The reason it's important for staff to supply this is there is confidential data embedded here, so you can't reconcile everything completely if you do it on your own; but you can come pretty close.

MS. PATTERSON: Yes, considering what you just said then I think we should move Option C back in, the coastwide quota, and leave that in there also.

CHAIRMAN BALLOU: That certainly is an easy exercise, right. I don't see any problem with that. If we move C back in, is that okay? I'm actually forgetting who exactly was advocating for removing it. But obviously a coastwide quota will be very easy to assess, it is the entire quota allocated to the entire coast. It's about a one minute exercise, if I'm not mistaken in terms of developing and presenting it.

I didn't want to do this, but we're now going back and revisiting a decision essentially we already made. Is the board per Cheri's recommendation that she just made, is the board comfortable putting Option C back in and keeping this whole suite of options under allocation together as a package for the time being?

Is there any objection to that suggestion? Seeing none; I'm comfortable moving on, unless there are any other comments or suggestions on this issue. I think this has been a very healthy and productive discussion, even though we sort of zig-zagged a bit. But I think we ended up at a healthy place, particularly given where we are in the process. David Bush.

MR. BUSH: We had mentioned earlier there about possibly quantifying some of the impacts of these. Now given the large suite of options, is this going to be too much to quantify in the timeframe, or does it need to be whittled down at least to be a workable chunk of things to handle?

MS. WARE: I think it's going to depend on the number of allocation timeframes the board is interested in on the next topic. I just want to highlight that it is a pretty tight timeline for Amendment 3. Keeping all of these options in is going to be a pretty hefty workload, and I'm not saying the PDT is unwilling to accept the challenge. But I am going to say that it would

be very helpful to get some guidance perhaps on preferred ones that you would like the PDT to work on first. I don't know if we can do all of the analysis by May, but we can try.

CHAIRMAN BALLOU: I don't think we want to revisit the same discussion. I think let's give the PDT the opportunity to give it their best shot. We'll see where we are in May, and we'll take it from there. I think if we weren't meeting in May, and this was all going to head toward a culmination for our August meeting.

I would be much more concerned that it would be too difficult an exercise, I think, in one meeting in August to try to look at everything that's been developed and try to figure out what we need to go through. Let's move on with the understanding that we're going to have a better view on where things stand at our May meeting. As Megan just indicated, the next issue is going to be very important; perhaps to try and winnow down a bit. Let's look at the next issue. Megan.

ALLOCATION TIMEFRAME

MS. WARE: Our next issue is allocation timeframe. Again, we have the different public comments on the options we had. Some of the questions are which of these options should be included in the draft amendment? If the board is interested in a longer time series, it would be very helpful for specific timeframes to be recommended. Just again, some of the examples that were given were 1985 to 2016, 1955 to 2016, pre-industrial – looking at the 1980s to 1992.

In terms of the quality of data that we have for the different time series, I think we have pretty good data going back to 1985, and we can look at the ACCSP landings going back to 1955. I'm not sure I have the greatest confidence in those, or I would want to review those between 1955 and 1985 before kind of putting that out as what allocation will be based on; but that's something that the PDT could undertake if necessary.

CHAIRMAN BALLOU: This speaks directly to the issue that we just discussed, and that is how much of a workload is it going to be to try to develop the various allocation options. It all depends on how many timeframes or time periods the PDT is being asked to analyze; because each iteration is going to have to take a different dataset, plug it in and see how it looks.

That is why this is such an important issue to really try to think through. For what it's worth, when I ask Megan what her ideal outcome would be from this meeting on this issue, she said, "Three or four options would be a dream come true." Let's see if we can make Megan's dreams a reality. Robert.

MR. BOYLES: I'm ready with a motion if you would like.

CHAIRMAN BALLOU: I don't think we need a motion. Let's hear a suggestion, and if we need a motion we'll take it. But let's hear a suggestion. Go ahead.

MR. BOYLES: I would suggest that we look at the weighted allocation and give 50 percent of the allocation is based on the 2009 to 2011 and the other 50 percent be based on the 2012 to 2016 average.

CHAIRMAN BALLOU: Clearly I take your suggestion as being one that would keep in the weighted allocation option, and with added clarity being 50 percent to the 2009 through 2011 period and 50 percent to the 2012 through 2016 period; is that correct?

MR. BOYLES: Yes, sir.

CHAIRMAN BALLOU: With that on the floor as a suggestion, thoughts on that; and let's just again keep this as focused as possible. We're on the question of whether we should keep

weighted allocation in as an option under timeframe; and if so whether Robert Boyles' suggestion is the one that the board would support for the purposes of PDT analysis. David Bush.

MR. BUSH: I like the idea of the weighted allocation, but I would ask – I don't know – if we only include these two timeframes, how many states is that going to eliminate from having historic landings?

CHAIRMAN BALLOU: I'll leave that as a rhetorical question unless anyone has an answer.

MR. TRAIN: I have a similar sentiment to that question. The other problem I have with this weighted timeframe and weighting 2012 to 2016 so heavily is we already told everyone what they can catch under that timeframe. To base an average based on what we already awarded them doesn't seem like we're taking a long enough historical account. I would encourage that if we're going to use that 2012 to 2016, it gets a much lower weighted average than the previous years; before it was actually awarded out.

MR. MILLER: Follow up question, Mr. Chairman. If we use the weighted allocation between 2012 and 2016, does that in fact include total landings or is it just landings that counted toward the quota? In other words, do the bycatch landings count during that period?

MS. WARE: It would include total landings, so anything caught under the bycatch provision or episodic events; in addition to those landed under the TAC or the state's quota.

MR. BORDEN: It doesn't trouble me to leave weighted allocation in the mix of ideas; but I'm totally opposed to those timeframes. It's just going to get you right back in the status quo. We're crafting a public hearing document. The record is replete with numerous references to including a longer timeframe. I would think something going back to 1985 or 1980 up to 2006 would be an appropriate timeframe to reflect those sentiments.

CHAIRMAN BALLOU: Okay so we have an alternative suggestion for how to craft that weighted allocation option. Conceivably we could ask the PDT to look at two versions, but the hope here is that we can try to hone is as best as possible. I realize how tough this is, because we're not making final decisions; we're just trying to develop options. With that additional thoughts on how to – and again if I could, just because I think it would be as helpful as possible to stay focused on one issue at a time – so on the weighted allocation option. Rob O'Reilly.

MR. O'REILLY: Well it is not going to fit everyone's situation, but what Robert indicated I think since 2013 to 2015 is post regulatory action, if 2009 through 2012 were coupled I think there is a mathematical difference there. I would say that about Robert's suggestion there, or motion, pardon me.

On the other part of it, what I started out today asking about was where the Technical Committee can give us an idea of accuracy, where the Technical Committee thinks the starting point should be. I doubt its 1985, so that poses a problem. I don't know whether it's 1995 on. But I think we need to know that as well, to explore that a little bit.

Those that have worked with the data more closely than we have, certainly have a sense of that. It's not an option, you asked about the weighted option. I do support the weighted option, but maybe it should be pre and post regulatory; if you're going to start with 2009, or even if you're going to go a little bit lower than 2009 or back further.

CHAIRMAN BALLOU: Rob, were you looking for a response as to the extent that the TC might be able to respond to your question?

MR. O'REILLY: If that's possible. I think that's really central to all of this that we need to have a starting point where we look at this, otherwise we're going to come back and there will be a lot of discussion about; well, wait a minute that's not good data because that wasn't reported back then, this wasn't done back then; so we need a starting point.

CHAIRMAN BALLOU: All right, so I'm going to look to my right and see if anyone wants to take a crack at that. Jay.

MR. McNAMEE: Yes, I'm probably not going to give you a very satisfying answer, Rob. I think what we would have to do is go back and re-vet the data with the Technical Committee; because I think we have good records by and large in certain segments. Then there are other elements of the information that I think we don't have as good a sense of. I think it is something that would need to be hashed out explicitly; we've not done that since Amendment 2.

I am not recalling what those timeframes were where we had more confidence. Certainly in the most recent period of time with the advent of ACCSP and people realizing that their history was going to mean something, I think things have improved greatly. But there is still good data back in time as well. But what I would like to be able to provide the board is a better qualification of what the tradeoffs are the further back you go, so that you can make a judgment as to whether that is quality data or not.

CHAIRMAN BALLOU: I'm about to go to Terry, but before I do I just want to note another angle that I think is very important and relevant, and that is going back as far as '85 would include data from reduction fisheries that no longer exist. I think that is something the board should be thinking about carefully.

I think there is a possibility of standardizing the data, in essence, by identifying where those landings may have been attributable to reduction fisheries that no longer exist and removing them. That would be therefore standardizing to bait fisheries only, with the exception of Virginia, of course. I don't know easy that is to do, but I think it might be a relevant issue to at least consider.

MR. STOCKWELL: Just reflecting upon your comment there and following up on Dave Borden's comment about the public support for a longer time series. If you look back, at least in the state of Maine's records, in order to reflect the history of why we're in an episodic fishery right now, much of the landings we had were in the '80s.

If we're going to lengthen the time series, it's got to reflect that time period and pro-rate the reduction landings around that time. Likewise, if we get into a weighted allocation, a portion of it has got to reflect the time when the states had had traditional landings or counted otherwise. The one thing, I can't speak for everyone around the table. I would just as soon remove status quo, it hasn't worked. We're all bickering about it. If we want to get rid of one option let's get rid of status quo.

CHAIRMAN BALLOU: Okay a suggestion made there.

MR. BORDEN: I'll make this quick. Just to follow up on Terry's comment. I just remind everybody, we're managing this stock in an extraordinarily conservative manner; and what's going to happen is the population is going to continue to grow and expand, and I think that's what we all basically wanted.

But one of the things that it will do, it is going to redistribute northward, and especially if there is

global warming going on. It's going to end up in every little nook and cranny up in the Gulf of Maine. If you look at the historical record if those fisheries existed 20 or 30 years ago, there is no reason to expect that we won't have those fisheries again. I think we have to at least put in the public hearing document a really long timeframe that reflects that potential.

CHAIRMAN BALLOU: Okay so this is a challenge, because I do think we need to come to terms with three or four options for the PDT to develop. It is not a final decision, but it is an important step in the process, because it is going to be, I think of critical importance to the PDT as they work through the other allocation options that we just reviewed. Each one has got to be plugged with a dataset reflecting some history. I'm going to challenge the board and say I think it's time.

I would rather not get into motions and votes, although if need be we will; but we all know how those things can go. Maybe what I'm really trying to get at here is a sense as to what would be a fair and reasonable set of options that would bracket this issue from both a long term historical sense, which I don't think anyone disagrees should at least be considered, as well as something more recent perhaps; then perhaps something in between, two or three in between. That is the challenge before us right now is to try to come up with options that really cover the ground well.

MR. BOYLES: I'm going to make another pitch for a weighted allocation, and perhaps I was too earnest in trying to specify the years. I note the document says, notes that the most reliable bait landings data since 1985, so perhaps we might consider a weighted allocation timeframe with half of the weight going to what we might call a long term dataset; reaching back to 1985, and the other half a more recent time series. I would submit to you post Amendment 2. I don't know what that timeframe is, 2013 through the present. I mean clearly we've all got our own fish to fry here, but I think it's important that we keep – well, my effort.

CHAIRMAN BALLOU: That was a new version of a weighted allocation proposal. Dr. Duval.

DR. DUVAL: I certainly support that. I was just going to follow up on Terry and say if we're looking to narrow this down, I would support removing Options A and B. I mean A is not working, and B we had lots of, well I think a good amount of public comment not in support of keeping that in. I recognize that there are some jurisdictions for which they have the greatest confidence in these most recent years; but I think we could encompass that with Option D, with the weighted allocation using something that Robert described.

CHAIRMAN BALLOU: Although it's somewhat awkward to consider removing status quo, since typically with any proposed management action you always offer status quo as your baseline, and then you work from there. I get the point and I think we are interested in trying to winnow down.

Per Dr. Duval's suggestion, what does the board think about removing Options A and B? There seems to be a lot of heads nodding in agreement. Not working, need to change, therefore remove them. Is there any objection to removing Options A and B under the allocation timeframe issue? Yes. Steve Heins.

MR. STEVE HEINS: Frankly, I don't think anything that's in this section of the document is going to work for us; just because of the problem we have with our data, time series. But certainly Option B is a little closer to a real fishery for us. I would be opposed to taking that out. You know New York's become a sanctuary state for menhaden. I really want to remedy that situation.

MR. DENNIS ABBOTT: I'm glad things are getting humorous. I know that you're a very

smart fellow, Robert, so I'm going to ask you a question; a rhetorical question. What would we all do if we just landed in this boardroom with nothing in front of us, no historical records? How would we divide up the menhaden population amongst the states?

That's somewhat truly where we should be at this point, because things have changed. It doesn't make sense that the state of New York can only catch a handful of fish; as an example, or that the state of Maine who needs bait fish, has fish off their coast and has no allocations, and has to go begging to the state of Virginia to get a million pounds to keep their lobster industry going. It really gets funny, but maybe you could answer my question what we would do if we just dropped into this room with nothing but our common sense to lead us to a solution?

CHAIRMAN BALLOU: Nope. You asked that as a rhetorical question, so you're not going to get a response. Robert.

MR. BOYLES: Dennis, may I take a swing? The intention of offering a proposal, in terms of weighting an allocation formula is to account for the historic aspects of this fishery, upon which so many of our communities and anglers and fishermen depend; and kind of looking at the long term allocation. But also recognizing that those of us in fisheries management are often criticized, you know with statements that these allocations are rusted shut, and how do we deal with that? That is where the second part of my equation, in my mind comes from, is you look at a more recent time series that accounts for – now we can't predict the future – if we could predict the future none of us would be here, I don't think. But we could account for more contemporary and more recent changes in the fishery. Dennis, that's how I would do it, honestly. But this is coming from a guy who gets 0 percent, or a state that gets 0 percent of this fishery; so it works for me.

CHAIRMAN BALLOU: If I'm not mistaken, Amendment 2 utilized 2009 through 2011, because those were the most recent three years for which data was available. Because of the way the amendment was reviewed and adopted, it missed 2012, even though it could have included 2012; if I'm not mistaken.

The first year of the actual allocation was 2013. One thought that I have is to retain a recent timeframe just for the purposes of analysis, and that would be 2009 through 2012, would be four years prior to the initiation of the new quota allocation system enacted through Amendment 2. Subsequent to Amendment 2, everybody has been essentially locked in, granted with the bycatch allowance and the episodic event.

It's arguably something that we should still consider; that is landings subsequent or in 2013 and thereafter. But I guess I just want to put on the floor for thought and consideration, just to see if we can get through this. At least for the purposes of analysis, an option that would look at 2009 through 2012, and then I definitely want to entertain further discussion on other options that would go farther back.

But is there objection to using those four years as the sort of proxy for what we looked at and tried to do through the Amendment 2 process? If there is objection, okay sounds like there is objection, so sorry for trying to be thoughtful. Dennis, see I'm not that smart; Ritchie, the problem with that approach.

MR. G. RITCHIE WHITE: I'm struggling here; I'm looking at the public input up there, which we don't seem to be following in what we're discussing. I mean longer time series and weighted is what the public said that they would like us to concentrate on. I also get very concerned about taking two options, maybe three to the public.

I mean we're almost making the decision here if you send that few a choices out. I don't have the answer of what we should do, but I don't think we're reacting to the public; unless we do a longer time series, unless we do some weighted. I think we need a couple of weighted and a couple of longer time series. That is what I think they're telling us.

CHAIRMAN BALLOU: Let me ask you back if I could. Is that fair to those states that have seen recent changes in their fisheries and those recent changes being more reflective of current realities? Does it somehow miss capturing those in the allocations?

MR. WHITE: That's where the weighted can come in. That's how you can reflect that by weighting it.

CHAIRMAN BALLOU: Thank you that was a good answer. Okay Eric Reid.

MR. REID: Thank you, Mr. Chairman, 2009 through 2011 is the reason we have 70,000 pounds of fish, 2012 to 2016, it dumbfounds me that the state of New York would like to use those years when they caught some fish, but they didn't catch very many. Rhode Island caught some fish, but we took advantage of episodic event; and if you took every pound and gave that to us in the future as a quota, we still wouldn't have 1 percent.

I can't even think about using those two datasets. I think we should go back, far back in time as we can. You take Rhode Island for an example, there was a really robust fishery in Narragansett Bay in the late seventies and the early eighties; but no one pound of those fish was landed in Rhode Island. But Narragansett Bay was full of big, giant purse seiners, and the fish went right to Belford, New Jersey.

I don't know how you take that into account, but I want to go back as far in time as possible, not so much to show the fishery and the landings in the state, but the abundance of the resource to the state. I think we need to go back as far as possible. If '85 is the year we have the most reliable data that's as far back as I want to go. If it is more reliable further back, I want that. As far as a weighted allocation goes, as long as we are mix and matching there, I'm good with that. But to use the two short periods is insanity to me.

CHAIRMAN BALLOU: Okay so let's see if we can come to turns on how we want to proceed. There is clearly interest in a long time series. I keep bouncing back and forth between trying to figure out where we can find consensus and then try to build from there. Let's see if there is consensus on a longer timeframe, with '85 being it looks like as far back as the document suggests we might want to look.

Is there anyone who would like to make a proposal for a longer time series; that would be Option C, which was left ambiguous in the PID, and that's why we're struggling with this now, because the public supports it and it sounds like the board supports it? But now we need to put some parameters on that as to what that actually means to enable the PDT to do their work.

That is what I'm looking for. What is the longer time series? What should it be? Let's see if we can get consensus on that and then we'll maybe move back to the weighted option. Does anyone have a suggestion, and maybe it's as simple as 1985 through 2016. I see Robert making a motion; I'm not sure what he meant. We've got such a smart person here sitting to my right. Megan, given your understanding of the issue, do you have some thoughts on how best to frame this?

MS. WARE: I'll humbly offer a suggestion. Just because, as a reminder, you do have options here, it doesn't have to just be one time series. We can take out a couple options. This is just based on what I'm hearing from the board. One

option would be 1985 to 1995. That would look at the more historic time period.

The second option would be 1985 to 2016. That would be more of a longer time series. The third option would be 2012 to 2016. That would look at a more recent time period, and Option 4 would be a weighted allocation from 1985 to 1995 with 50 percent in 2012 to 2016 with 50 percent.

CHAIRMAN BALLOU: So moved. I certainly like that as a proposal, so let's respond to that. I'm sorry Megan; I was following you right up to your weighted. Your last option is the first being '85 through –

MS. WARE: Through '95 and 2012 through 2016, so basically weighting Option A and Option C.

CHAIRMAN BALLOU: Okay let's respond to that proposal. Those are four options. Let's get comment on those four options. Thank you, Megan. What are the board's thoughts on moving forward with those four? Robert.

MR. BOYLES: I like it, just a question. What about the period '95 to 2012? We do not account for that. I was wondering if that is a third interim period and you give each one of those a third, 33 percent.

CHAIRMAN BALLOU: It sounds like that is a workable suggestion. Thoughts on what Megan proposed and what Robert Boyles just amended in the form of options for timeframes. Steve Train.

MR. TRAIN: I think '85 to 2016 does that. Doesn't it, it treats every year the same? That is kind of already there, and once again I still have a problem with, and I'm not saying we need to go back to when Maine had fish. I'm saying I have a problem with weighting an average, when basically only two states are allowed to fish, because we already awarded them quota and giving them a heavier weighted average.

If we're going to treat every year the same that's one thing. But to weight and average when basically two states had the resource. It's not that there weren't fish off of Rhode Island or there weren't fish off of Cape Cod, it's there was no quota awarded to the states, or not enough to make it worthwhile fishing. To weight and average during that period I have trouble with.

CHAIRMAN BALLOU: Understood, these are not decisions these are options to be further developed and subject to further review by the board. Dr. Duval.

DR. DUVAL: Just to bring folks back to something that Megan said previously about trying to create some matrix of how things would look between Issue 2, which is the allocation strategy, and Issue 3, which is the allocation timeframe. I think when we're viewing these different options under Issue 3, the timeframe, we're thinking in a very state-specific sort of sense.

We are also considering options that would get away from a state-specific approach, or have some hybrid in there. I know it's tough to not posture ourselves right now with regard to what timeframe options are put forward. I think these are fine, let's see what we get back from the PDT, because we're going to have to match up some of these allocation timeframes with the different allocation strategies as well.

CHAIRMAN BALLOU: Good point, I concur. Rob.

MR. O'REILLY: I just wanted to comment that again, back to what the board asked to have a working group or subgroup talk over allocation options for many, many phone calls. My interest at that time was to find out what everyone meant about capacity. It sounds to

me that everyone is looking now to where the questions were on those phone calls, not where things stand but where things will be. But in some instances things aren't there yet, and so I think we have to keep that in mind that capacity is going to be different than it has been.

For whatever reason, you know we chose to go a very conservative route when we made our increases to the quota. I think it's worth keeping in mind that by the time we get to Amendment 3, and by the time we have to set the 2018 specifications, some of these concerns might not be there. That is one idea.

The second idea, you know we're going exploring now. Although a lot of us can imagine what things will look like with these different situations of time periods, we really don't know yet; and we will find out and then we'll just have to go from there. But one thing I wanted to mention, which was unusual to me, is 2009 to '11, the status quo, and I heard we don't want to be there; and that's fine.

But generally in a plan, you know status quo is removed the next time you make that amendment. If you think of all the plans we went through, status quo was always an option. It isn't always adhered to by the time you make the amendment or the addendum, but we've sort of just thrown it out it sounds like to me; and I wanted to make sure that was the intent of the board.

CHAIRMAN BALLOU: Well right now that's on the table as a proposal to not have status quo as an option. I'm not aware of any action that I've ever been associated with where status quo was not an option. But we could be treading new ground. Let's see, I had Emerson and then I'll go to Terry and then I'll go to Mark.

MR. HASBROUCK: I have to agree with Michelle. How much time are we going to spend on Issue 3, relative to timelines and landings for each state? How much time are we going to spend? How much effort is the PDT going to put into this, when you look at the different options under Issue 2, there are only I think three of them that are really based on a state-by-state allocation.

The rest of them move away from that. Further down the line here, my preference is probably going to be to go with one of the options under Issue 2 that doesn't lock us into a state-by-state allocation; in which case none of this is relative. But that is my thinking here in New York, and others probably think differently. But I just pose that question. How much time are we going to spend on this? How much time is the PDT going to spend on this, when we may not even chose an option that includes state-by-state allocation?

CHAIRMAN BALLOU: Good point and I don't think we should be spending much more time today; meaning I think we need to try to wrap this piece up as soon as possible. I've got two more on my list, Terrey Stockwell.

MR. STOCKWELL: A question for Megan, then perhaps comment. Prior to 1985, what is the quality of the data that you have? I mean if we're going to go cherry picking for data, Maine's big landing years were in the 1982, 3, and 4; it precludes that. I would be advocating if we're going to do a long time series to begin at 1980.

MS. WARE: I've only looked at data through 1985, so I can't really comment to it. I know it does exist or if you go to ACCSP you can look up data from 1950 onward. To the quality of that data I'm not sure. That would be something that the PDT would have to investigate, and I don't know how long that would take.

MR. MARK ALEXANDER: I object to eliminating Option A; first because there is little precedent for eliminating a status quo option. As we talk about some of these options, some of the time

periods here by which we're going to calculate new allocations, because they are so heavily based or weighted on years by which some states have already been constrained by the Amendment 2 allocations. I just think it's extremely unfair that if we got rid of the status quo option we would be burning a bridge between a meager allocation and a more meager allocation. We have to at least leave that there.

CHAIRMAN BALLOU: Yes it does seem like good form. I mean we're revisiting allocation not committing to change it. The only way to revisit is to have status quo as your Option A, and then have a series of alternatives to that to consider if the board decides to change. From my perch, I like the idea of keeping status quo as Option 1. Then running through what now turns out to be the four other options that Megan offered.

First being '85 through '95, the second '85 through 2016, the next being 2012 through 2016, and then lastly a weighted option 50 percent, '85 to '95, 50 percent 2012 to 2016; are there objections to at this point in the process tasking the PDT with moving forward with the development of the draft amendment using those timeframes? If there are no objections, I am going to take that as a consensus on this issue for now, and an acknowledgement that it's time to move on. Are there any other comments, questions, or concerns on this issue? David.

MR. BUSH: Just a very brief question. If I understood you correctly, Mr. Chairman, you said earlier that status quo would have been 2009 through 2012?

CHAIRMAN BALLOU: Eleven.

MR. BUSH: So it is '11, and we're not including '12 because?

CHAIRMAN BALLOU: Well, it's not the Amendment 2 status quo, so there has been a lot of talk about whether 2012 should be given consideration and of course it is in the fold in one of the options, 2012 through 2016. I hope I've answered your question. Amendment 2 was based on three years, 2009 through 2011. Okay anything else on this, we're running very late and I do think we need to move on. Cheri.

MS. PATTERSON: Yes, I'll be quick. Is it possible to have the PDT also be able to make a recommendation on a different time series, since they're going to be crunching these numbers; they might see something and just make a recommendation in regards to what they're seeing?

CHAIRMAN BALLOU: Of course. I mean I think that is the purpose of our May meeting is to have them report back to us on how this exercise is going, and whether they've identified any policy issues that they think the board should take up. Let's try and move on. Mark, you had something else?

MR. ALEXANDER: Yes, I just wanted to throw another idea out there. In looking at Table 2, every state has a period of time in which the fishery may have been important to them for various reasons. Some particular gears may come and go; fish distribution may have come and gone. I would just like to add one more option for the TC to consider, and that is let each state pick its highest ten consecutive years in the range from 1985 to 2016 and that be their total that would be used as a basis for calculating a percentage.

CHAIRMAN BALLOU: Your ten highest over an 11 year period?

MR. ALEXANDER: Your ten highest consecutive years over the '85 through 2016 period.

CHAIRMAN BALLOU: Okay I'm sorry, I wrote that down wrong. I thought you said '05. Are there thoughts on adding that as an additional

option, it seems like that would take a lot of work; Megan.

MS. WARE: The only thing I'm thinking of right away is if we don't use state-by-state allocation that could get a little hairy. If we did something like seasonal quotas, which of those 15 ten year series would we use?

MR. ALEXANDER: I think you may be missing my point. Let's say for Connecticut we might choose '98 through 2007, New York may choose I don't know, '88 through '97, something like that. That is your ten highest years of landings. You would total those amounts up for each state. That would become the denominator, and then you calculate a percentage for each state based on that.

CHAIRMAN BALLOU: Well, it sounds like it can be done, no promises. It just adds yet another layer of analysis; but it sounds like it can be done if there are no objections we can add that to the list. Roy.

MR. MILLER: I don't like it, Mr. Chairman. Thank you. Let me elaborate why, because I think it could potentially reward states that had a historical reduction fishery within their borders. If we extended the time series far enough back, we could eventually even find our way to Delaware, where there was a reduction fishery in the 1950s. I don't like the idea of taking the 10 highest years.

CHAIRMAN BALLOU: Let's do this. I'm going to try and move us forward. Let's leave that out, Mark. Hold it as a thought but leave it out for now, because I'm worried about overloading the PDT in the short time they have to try and get going on this and then have something to report back to us on in May. That's a big lift in and of itself; and the more options we add the harder that is going to be. We may end up not being where we want to be in May, which is at a point where we have a better feel for this. We've had a great discussion. I think everybody gets the issue, and I think it's time to give the PDT an opportunity to develop it, for us to go home, think about it some more and be ready to circle back to it in May. I really feel like that is the best way to move forward here. I don't sense that we're likely to make much further headway if we just keep discussing this. Is the board comfortable moving on at this point with the five options that we've identified; with the full understanding that things can change and likely will, as we move forward with this process? I am not seeing any objection so I am going to move on and we have a few other issues that we need to work through.

QUOTA TRANSFERS AND OVERAGE PAYBACKS

CHAIRMAN BALLOU: Megan, the next I think is quota transfers.

MS. WARE: All right so a similar question here. Which of the options on the screen should be included in Draft Amendment 3, and kind of ask more pointedly, is the board interested in quota reconciliation; since there wasn't much public support for it? We did hear public support for additional accountability measures, so if the board is interested in pursuing that it would be helpful to get guidance on which measures the board would be interested in, and I have listed the three that we heard most frequently on the screen.

CHAIRMAN BALLOU: Okay thoughts on this issue. Dr. Duval.

DR. DUVAL: I would like to see quota transfers stay in the document. I definitely would support some accountability measures or some guidelines for doing that. I know we faced a few challenges this year, with wanting to help out other states and wanting to try to balance meeting some of those needs with our transfers.

CHAIRMAN BALLOU: Any objection to keeping quota transfers in as an option? Seeing no

objections; it sounds like that will stay in, other thoughts on the other alternatives that have been teed up under this issue, Nichola.

MS. MESERVE: Just to say that I would like the quota reconciliation or the ASMFC facilitated process to stay in as an option. I think it was probably tough to explain to the public exactly how that works, and the benefits of it. I would like to give it another shot in the draft amendment.

CHAIRMAN BALLOU: Any objections to keeping quota reconciliation in as an option? Seeing no hands; we'll keep that in. Other thoughts on any of the other issues such as the accountability measures, does anyone on the board feel any of those should be pursued? Dr. Duval.

DR. DUVAL: My comment was definitely specifically yes transfers, but also having some accountability measures that go with that or guidelines that would – I tend to think of them more as guidelines that would help to facilitate the quota transfer process both for states requesting a transfer, as well as for states transferring the quota.

CHAIRMAN BALLOU: Michelle, do you have any thoughts on the three options that are on the screen right now? Do you think those are all viable and worth pursuing or potentially viable and worth pursuing, or do you have any specific thoughts on the types of accountability measures that you would want to see carried forward?

DR. DUVAL: I apologize; I don't feel like I can make any specific comments on the ones that are on the screen right now. I understand not being able to transfer if you've already exceeded your state quota, but I think we have states that unfortunately got into some situations this year, through no fault of their own. I would hate to see them penalized for that. I apologize; I can't provide any useful input at this time, but I promise to sleep on it and perhaps catch up with Megan later.

MR. HEINS: As one of those states. If we get the allocations right, I could support leaving the stuff in. But under these current tiny quotas that we have, we're going to need to not look at that. I guess we could leave it in for analysis, but I'm not supporting those kinds of accountability measures when some of us are trying to manage tiny quotas. Transfers are necessary in case we go over.

CHAIRMAN BALLOU: I hear accountability measures as a sort of place holder without much insight yet as to exactly what they might look like; and the board feeling like they need more time to kind of marinate on that issue and see how things pan out. Do you think that provides enough guidance to the PDT on this issue, Megan?

MS. WARE: Yes, the PDT can kind of marinate on it and we'll maybe provide a suggestion or two in May, and if the board likes that we'll move forward, if not we'll change it out.

QUOTA ROLLOVERS

CHAIRMAN BALLOU: Great, so let's move on to quota rollovers.

MS. WARE: Through the comments there are kind of three alternatives that came forward, I would say. The first would be no rollovers, the second would be allowing rollovers, and the third would be allowing some sort of limited rollovers; so 100 percent up to a poundage level or 50 percent of your unused quota. Should the three management alternatives above be included in the draft amendment, and if the board is interested in limited rollovers, it would be helpful if you have a suggestion on what type of limitation the board would like to pursue.

CHAIRMAN BALLOU: Just as a reminder, rollovers as I understand it is in our current

plan; but have not yet been activated, even though it could. It is sort of there as an option, but the board has decided not to operationalize it pending our Amendment 3 process. Should it stay in? Obviously there seemed to be a fair number of public comments in opposition to the concept, but that doesn't necessarily dictate how we want to proceed on this. David Bush.

MR. BUSH: A lot of times I think, I hate to say it even as somebody who was a layman coming into this a long time ago. I didn't understand the concept of some of these; so when they came out to me I'm like no that's bad, and when they explained it, oh that's actually good. We have bad years, we have good years, and we have cycles.

When we have a bad year we reduce the quota, when we have a good year what do we do; or if fishery efforts shift to other fisheries, whatever. But I would certainly support a rollover, at least using a smaller percentage; maybe your bottom two that you have suggested at 5 and 10 percent. I don't think a pound for pound would be the greatest thing to do, because if we tried to fish on that the following year, we could do some major damage; but most certainly at least the lower percentages.

CHAIRMAN BALLOU: There has been a suggestion to retain rollovers, but give it the clarity that it doesn't currently have in our plan; which is to a limited extent perhaps in the 5 to 10 percent range; thoughts on that issue, Rob.

MR. O'REILLY: I support it the way it is to bring forward. If we have a healthy stock and no overfishing, no overfished condition, and a year in assessment that has been done, everything else, all the conditions say that to mirror what David just said. There is a little bit of flux maybe inter-annual flux and I would hate to see it not be able to be rolled over. I support it the way it is to get further comment later.

CHAIRMAN BALLOU: Rob, if I could ask, do you support it as an open-ended provision, or one that perhaps should have some constraints?

MR. O'REILLY: If by that you mean what's up on the board right now.

CHAIRMAN BALLOU: Yes, as far as the limitations that might be placed. Right now we have an open-ended provision. We don't have any bounds, in terms of what could be rolled over. Do you like it that way and want to keep it that way or do you want to suggest an option that might have some limitations?

MR. O'REILLY: I like the range right now. I think we can narrow it down later on. I like the range that is up there to bring forward.

CHAIRMAN BALLOU: Zero to 100 that's a good range. Additional comments on this issue. Rachel, did you have your hand up? I'm sorry.

MS. RACHEL DEAN: I just wanted to ask really quickly, should this be in the document as a status quo?

CHAIRMAN BALLOU: Yes. I think if we're going to address this issue. Obviously for each of these the question to the board is, is it an issue that should be addressed in Amendment 3, and if so I think it stands to reason that status quo is Option A; and then some variation on that would be Option B, C, D.

Right now we have an open-ended provision in our plan that allows for quota rollovers if the stock is in a healthy condition, which it currently is. But we don't have any bounds on how it might work, how much for example, might be allowed to be rolled over. I think the question that we have posed through the PID and now today to the board is, does the board want to consider any variation on the provision that is currently in our document? Rob.

MR. O'REILLY: Yes just to restate it. I'm not in favor of zero, but I think for right now we can

look at that range of 5 to 100. The history of rollovers in the ASMFC, so with dogfish there is a limited rollover percentage wise, we had issues with striped bass about six or seven years ago where the board did not choose to rollover. I think there has to be some action beyond just today to finally say; well is it going to be 100 percent, which I think it should? But for the sake of bringing this forward, I think we look at all these and wait and see what the board does.

CHAIRMAN BALLOU: Thank you, and thank you for clarifying. I'm sorry if I joked on an issue that really didn't lend itself to a joking comment. Emerson.

MR. HASBROUCK: This may be a joking comment. I agree with Rob that we should have 100 percent rollover, but we should allocate that rollover to the states based on a new allocation schedule that the PDT can develop in conjunction with this. I'm only kidding, I'm only kidding.

CHAIRMAN BALLOU: Okay, I started a bad trend. No kidding, we need to get through this now. Steve.

MR. TRAIN: I think of all the species we manage there is no species that screams for rollover more than this. We just spent the last half hour talking about awarding quota based on historical landings, and if we have a species that travels the entire length of the coast, and some years it makes the extremes and some years it doesn't; and that average landing could change dramatically if you weren't allowed to rollover for the next year when it's there.

CHAIRMAN BALLOU: Is there any objection to keeping quota rollover in with a range of options from 5 to 100 percent as ones that would be subject to further analysis and discussion? That is what I'm hearing is that there is support for at least keeping that in as a provision. Is there any objection to that? It is essentially supporting what's on the board, but not including an option for no rollovers. I think that's what I'm hearing. It sounds like there is support for maintaining a rollover provision and looking at various limitations that the board might wish to put on it. Okay, I don't see any hands – oh, Nichola.

MS. MESERVE: Based on the overwhelming public comment, I would want to keep in the no rollover option at this time.

CHAIRMAN BALLOU: Is there any objection to keeping in no rollovers as an option? Seeing none; we'll keep this intact in the way that it was presented in the PID. As I understand it there I didn't hear any suggestions from the board to change things, so Megan does that provide enough?

INCIDENTAL CATCH AND SMALL SCALE FISHERY ALLOWANCE

CHAIRMAN BALLOU: Okay, we're off onto incidental catch**.**

MS. WARE: Same questions here. Which of these options should be included in Draft Amendment 3? Does the board want a management alternative which could remove the bycatch provision? This is asked because there were many comments that stated that if reallocation was properly done this might not be needed; so I'm just throwing it out there as a question, and does the board have any comments on how a small scale fishery should be defined?

CHAIRMAN BALLOU: Thoughts on this issue. John.

MR. CLARK: More of a question, Bob. On Option C, if incidental catch is included in the quota, this is to the entire TAC not toward a state quota? Is that what was meant by this?
MS. WARE: Yes, so it would depend on how the TAC is allocated, but I think if we just kept our status quo, so state-by-state allocation,

incidental catch in that state would count towards the state's quota. Once the state met that quota the fishery would be shut down for the year.

MR. CLARK: Doesn't that mean there is no incidental catch?

MS. WARE: Yes, you're right.

CHAIRMAN BALLOU: Thoughts on whether all of these options should be included in the draft amendment, or whether we should potentially even remove the bycatch provision; or continue rolling it forward. I realize how tough this is getting, particularly as the hours move on; but we're nearing the end. We've got just three more issues. Dr. Duval.

DR. DUVAL: Well, I definitely support keeping Option F in, having a small-scale-fishery set-aside in some version of what we have now. But I do think it is important that everything be counted. If we're going to have an incidental catch limit per vessel, then I want to make sure that's accounted for in the overall TAC.

CHAIRMAN BALLOU: Rob.

MR. O'REILLY: I have a different view than that and that is that for four years we've allowed this bycatch to go on of 6,000 pounds. There was just recently an addendum which allowed two licensees to have 12,000 pounds; and there was also a qualification by the board as to which gears could have the bycatch.

It has helped in a lot of states, I think, to have the bycatch. I certainly don't favor removing it. As far as counting, it is going to be counted; and while I'm thinking of it, I didn't get a chance earlier when we moved past something. But when we do our allocation, it is my assumption that what will be looked at are total landings, not just what the quota were for the states. I assume that is the way things would be; I just wanted to mention that. But really after four years it has provided some opportunity. My understanding is it is maybe a percentage and a half if that of the total TAC. I don't think we're quite ready to disband that and so I think we have to carry some of these options forward.

But in advance I can tell you that we sort of created a situation where there is some economic advantage in many of the states because of the bycatch, and if we just put it towards the state quota; if there still is state-by-state I should say. If we put it towards that quota then the states are going to be forced to do one thing, which is disadvantage some who have been working on the bycatch; and secondly, monitoring those quotas becomes that much more difficult, which is already a pretty fair task anyway.

CHAIRMAN BALLOU: Additional thoughts on this, Mark.

MR. ALEXANDER: I support retention of Issue 6 and the options there, particularly Option F, the small-scale fishery set-aside. I think for a state like Connecticut that has a very small quota that would provide us with some relief, in the case that more equitable quota allocations can't be arrived at.

MR. STOCKWELL: I am in favor of leaving this in the document, just a word of concern to the PDT would be as you develop the options, don't make it too complicated or burdensome for the states to report a small amount of fish. We have enough trouble with our other programs.

MR. TRAIN: I think it's important this stays in. Personally I like the status quo, but to take a species that is not overfished and not overfishing occurring, and to make it a choke species on the rockfish or the weakfish fishery, and they would have to remove their pound nets or whatever else doesn't make sense to me. I think that this needs to stay.

MS. PATTERSON: I definitely think that this needs to remain. I'm just wondering if Option E is something that is very viable to keep track of. If it would be worth just removing it, just knowing the complexities of keeping track of it.

CHAIRMAN BALLOU: I see your point and it could very well be removed to kind of help narrow the options. Is there any objection to removing Option E, incidental catch defined by percent composition? Does that offer an option that really needs to be kept in, or is that just potentially offering something that would be too complicated?

Is there any objection? Seeing none; let's remove Option E, and at least winnow these down a bit. Clearly there is a sense that I get from the board that this issue needs to stay in and the suite of options as presented should stay in, with the exception of Option E. Are there any other options that the board might wish to remove? Seeing none; is the board comfortable moving along on this with those options as presented with the caveat that E comes out?

EPISODIC EVENTS SET ASIDE PROGRAM

CHAIRMAN BALLOU: Seeing no objection; we'll move on to episodic events.

MS. WARE: I'll just verbally talk here. There were three kinds of again alternatives that popped up from the public comment; they would be no set-aside, a 1 percent set-aside, which is our status quo, or a greater than 1 percent set-aside. Should these three management alternatives be included in the draft amendment? How should we deal with New York in the set-aside, and there was also a proposal that there be a management alternative which splits the set-aside between Maine and the New England states. Is that something the board is interested in pursuing?

CHAIRMAN BALLOU: Thoughts on this, and clearly this is an issue that may or may not become as germane moving forward, depending on how we reconfigure if the board decides to reconfigure the allocation program, this issue may no longer be as important and relevant as it was. But that said; should it remain in the document as an option?

MR. STOCKWELL: Yes to all of Megan's questions. We threw the Hail Mary to develop the episodic event, and it took several meetings longer than this to get it through. I'm hoping it will no longer be necessary when we're through, as to your guidance, Mr. Chair. But at this point we need to retain it in the document.

CHAIRMAN BALLOU: Further thoughts? It looks like I see a lot of heads nodding, that it should be retained at least for now. Is there any objection to retaining it in its current form? I guess that we would have to decide on whether that includes New York or not. I guess our status quo is New York is in.

Should we consider that the status quo approach, and put it forward in that way? I don't see any objection from New York, is there any objection from the board for moving forward with this with the understanding that at least in terms of status quo it is a program that includes New York? As everyone remembers they were added, I think over the past year.

CHESAPEAKE BAY REDUCTION FISHERY CAP

CHAIRMAN BALLOU: Okay seeing no objection; we are on to the next issue Chesapeake Bay reduction.

MS. WARE: Again, three management alternatives kind of formed themselves from the public comment, and those would be removing the cap, maintaining the cap, or reducing the cap. If the board is interested in reducing the cap, what should the reduction level be; so some of the recommendations were a recent five-year average of harvest, or the 96

million pounds, which is about a 50 percent reduction?

CHAIRMAN BALLOU: Thoughts on this issue, in terms of keeping it in, and if so with what set of options associated with the Chesapeake Bay reduction cap? Yes, Andy.

MR. ANDY SHIELS: This one has caught my fancy in looking at the document, because of the large number of comments in the public comments that were in favor of reducing the cap. As we know from the data, the cap is set at 87,000 metric tons. But in the last three years '13, '14, and '15 it ranged from 40,000 to 50,000 metric tons; which means the cap is not being achieved.

The recent five-year average harvest was proposed by some commenter's apparently. I would like to request that there be included in the analysis to use that five-year average harvest as a way to determine what an appropriate cap should be; given that the cap is not being reached now, and that the 87,000 metric tons seems unrealistic, so that's my request.

CHAIRMAN BALLOU: I'll take that as a suggestion to include an option to reduce the cap at a level that would reflect the most recent five-year harvest; thoughts on that as a proposal. Rob.

MR. O'REILLY: I'm certainly not in favor of that. The history is, and we heard the word today a little bit about localized depletion. I think most on the board know, if not everyone that there were some investments in determining this localized depletion. It was not determined. This is a coastwide stock. I think the 2009 assessment information, the advice that came out of that was that there really didn't need to be a Chesapeake Bay cap, but someone can check me on that.

However, I will also note that when there was a 10 percent and then a 6.45 percent increase in the coastwide TAC, the Chesapeake Bay cap was not increased. This had the current cap still has a reference back to the 2006 to '10 timeframe, and I can't tell you why or why not the harvest is where it is, as far as less than that; but I do think the two options should be to finally say what's it doing there, what's it's effect?

Secondly, if that's not what the board thinks about then please consider what I just said, about not taking any of the increases and also that things pretty much are status quo back to the 2006 to '10 period. On the converse of that there is something to be said for not wanting to have zeros or ones in the catch anyway, and that is really not what any fishery really wants right now.

You heard comments also that mostly the fisheries prosecuted near the mouth of the bay. You know there are a lot of instances here that if the board wants to continue on with this, then I think someone else said earlier let sleeping dogs lie. I think this is providing adequate conservation where it is, and then throw on top of that the lack of increases where every other part of the coast did increase; and I wish it was increased more, quite frankly.

CHAIRMAN BALLOU: I hit the wrong button. Rob, do you have any objection to maintaining the three options as set forth, which would be status quo current cap? Option B might be to remove the cap, or maybe in the right order Option B would be a reduced cap as proposed; Option C would be no cap at all. It seems to me that's a pretty good framing of the issue, and gives you the opportunity I think to offer your support for maintaining status quo; if I heard you correctly.

MR. O'REILLY: Yes thank you, Mr. Chair, and I don't have the same button you have so I can't do anything back to you. But I do support that

and we'll have another discussion about that later, and I hope that the board remembers the background that I just provided.

CHAIRMAN BALLOU: And that was indeed an inadvertent hitting of the button on my part, I did not intend that in your direction; other thoughts on this issue? Nichola.

MS. MESERVE: I would suggest adding a sub-option; I guess that would be to remove the rollover provision, if we're considering that for the coastwide quotas in whatever form they take. Then I would want to see a comparable option here.

CHAIRMAN BALLOU: Okay duly noted, thank you, any objection to that suggestion? Seeing none; we'll add that. Other thoughts on this issue or the options associated with it? Seeing no hands; oh, I do see a hand. Ritchie.

MR. WHITE: Just to confirm the suggestion of the recent five-year average; that's going to be in?

CHAIRMAN BALLOU: Yes that would be in for the reduced cap. Is everyone clear, any further questions?

CHAIRMAN BALLOU: Seeing none; we're on to the last issue, the research set-aside issue, which I guess sort of, was it in the PID or did it just come up through hearing? I forget.

MS. WARE: It was in the PID, it was kind of added right before we approved it for public comment. We honestly didn't receive that many comments on it, and so my question for the board is do you want to include this issue in the document? If so, do you have a suggestion on what that set-aside should be?

CHAIRMAN BALLOU: Not much in the way of public comment, is this something we want to include or not? We certainly have our fair share of issues already. Do we want to add this one as well; thoughts on that? Terry.

MR. STOCKWELL: At this time of the day I would say no, for more than just that. It is too complicated a fishery to have an RSA to try to divide between the different fleet types. It would be an administrative nightmare, although it probably would produce some good research. At this point I don't think it's ready for primetime.

CHAIRMAN BALLOU: There is a suggestion to remove it; thoughts on that. Emerson.

MR. HASBROUCK: I would like to keep it in. The fact that we keep it in doesn't necessarily mean it's going to be adopted, but even if we do adopt it we don't have to implement it right away. This isn't something that has to be implemented in terms of a research set-aside program when we implement the new addendum. I would like to see it kept in.

CHAIRMAN BALLOU: If it's kept in I think we're going to need a percentage or some sort of quantitative component to be able to determine what it would constitute.

MR. HASBROUCK: Well it could be up to whatever percent or whatever tenth of a percent or whatever it might be, whatever percentage. Then each year it could be specified whether we're going to allocate up to that RSA or not. That would be my suggestion.

CHAIRMAN BALLOU: We have a suggestion to remove given the complexities of an RSA program; we have another suggestion to keep it in at least as an option, thoughts on those two ideas. Dr. Duval.

DR. DUVAL: I'm kind of along the lines with Terry right now. I almost feel like this might be better fleshed out in an addendum. You know that's something that the board could always consider down the road. I am a little concerned

about the number. We have a number of issues in there already. I appreciate what Emerson is trying to do, and I'm not saying that I wouldn't support it in the future. I just think right now it might be the elephant is already pretty big, getting pretty hard to eat.

CHAIRMAN BALLOU: Other thoughts on this issue? We do have a couple. David Borden.

MR. BORDEN: I agree with almost everybody. Is one of the options we have available to just framework it, put it in as a frame workable item that we could resurrect through a short-term regulatory action, and if that's the case I would suggest we do that. Then if we need it we'll trigger the framework and set the amount at less than 1 percent.

CHAIRMAN BALLOU: Okay, Megan indicates that makes sense so we'll try to keep it in as something that could be pursued down the road; but wouldn't necessarily be a component of this amendment. David, did you have a thought on that?

MR. BUSH: I'm sorry; I was just going to speak in support of that as well. I think it's a great tool to have, especially the direction we're headed with ecosystem-based fisheries management. It would definitely be a valuable tool if we chose to use it later, and if it's a nightmare we don't want to tackle it just stays in the closet.

CHAIRMAN BALLOU: Duly noted, is there any objection to that approach? Seeing none; I do think we have reached the end of this agenda item, and I do have to ask just in conclusion are there any other issues not included in the PID that the board feels should be addressed in the amendment?

This is now the time to offer anything new or different; and I don't see any hands going up, which means the PID did a pretty good job of framing the issues, and I do think it did by the way. I thought it was a very well developed document. I think based on the public response the public concurs. Nice job. Is there any objection to conveying the guidance and recommendations offered today by the board to the PDT?

We do not need to have a motion on this, it is not an action item; but I do want to ask that question, to make sure the board is comfortable and in concurrence with everything we just discussed, which Megan will have the pleasure of pulling together and conveying to the PDT. They will then get to work and report back to us in May. Okay, we are done with that item. Thank you and we just have a couple of last items that I don't think will take much time; although we never know with this group.

CONSIDER RENEWAL TO ALLOW CAST NETS TO HARVEST UNDER THE AMENDMENT 2 BYCATCH PROVISION

CHAIRMAN BALLOU: Item 7 is the Cast Net Fishery Bycatch Allowance. By way of background, three years ago in February of 2014, the board passed a motion to manage the cast net fisheries for menhaden under the Amendment 2 bycatch provision for two years, 2014 and 2015. Prior to that provision sunsetting in 2015, the board passed another motion in the fall of 2015 to continue the provision for another year through 2016.

That means it has again sunsetted and is no longer in place for 2017. The question for the board is whether it wants to consider another extension. I believe Jim Estes may have an interest in speaking to the issue and possibly offering a motion on it. Jim.

MR. JIM ESTES: That is a good history of it. If we don't, our fishery in Florida is all cast net, and like some of the other states when we first looked at our allocation and we looked at our history, we had some under reporting; and so this was the reason that we did this. I can either tell a really, really long story about how

this would advantage our fishermen and we can do that or when you're ready I can set forth a motion.

CHAIRMAN BALLOU: I think we're ready for a motion.

MR. ESTES: I kind of thought so**. I move to continue the management of cast nets under the bycatch provision until final action on Amendment 3.**

CHAIRMAN BALLOU: Is there a second? Mark Alexander seconds the motion. Moved and seconded, is there discussion on the motion. Yes, Adam.

MR. ADAM NOWALSKY: I'll just ask; do you want it through final action on Amendment 3, or until implementation of Amendment 3? Is it possible that there would be a lame duck period, if you will, at which point we take final action on it and it is actually implemented that could impact your fishermen?

MR. ESTES: Yes thank you. I think that implementation would be better.

CHAIRMAN BALLOU: Mark, do you concur making that as a friendly?

MR. ALEXANDER: Yes I do.

CHAIRMAN BALLOU: Let's change that to until implemented, so I'll reread the motion. **Move to continue the management of cast nets under the bycatch provision until implementation of Amendment 3; motion by Mr. Estes, seconded by Mr. Alexander**. Is everyone comfortable with the motion; any questions or comments on the motion?

Is the board ready? Is there any objection to the motion? **Seeing none; the motion passes unanimously.** Thank you.

REVIEW AND POPULATE ADVISORY PANEL MEMBERSHIP

CHAIRMAN BALLOU: We are on to our last item, AP membership. We are considering a request from Maine to add a member to the menhaden AP. I guess it is either Tina or Terry. Tina.

MS. TINA L. BERGER: Hi, originally Maine requested the addition of Chris Hull to the AP. They removed Chris from consideration and they're offering Vincent Balzano. I have the AP nomination in hand and can forward it to the board once I return to the office.

CHAIRMAN BALLOU: I'm sorry, so has the nomination been provided to the board yet or not yet?

MS. BERGER: Yes.

CHAIRMAN BALLOU: Okay so the board has the nomination of Mr. Vincent Balzano.

MS. BERGER: Balzano, a commercial fisherman from Maine.

CHAIRMAN BALLOU: This would fill an existing vacancy on the AP from the state of Maine; **any objections to appointing Mr. Balzano to the AP? Seeing none; he is appointed with the unanimous support of the board.** Thank you.

ADJOURNMENT

We are on to our final item, which is other business; and please don't say yes to this. Is there any other business to come before the board?

Seeing none; is there any objection to adjourning? Seeing none; we stand adjourned. Thank you very much.

(Whereupon, the meeting was adjourned at 6:44 o'clock p.m., February 1, 2017.)

Fisheries Research xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Fisheries Research

journal homepage: www.elsevier.com/locate/fishres

When does fishing forage species affect their predators?

Ray Hilborn[a,*], Ricardo O. Amoroso[a], Eugenia Bogazzi[a], Olaf P. Jensen[b], Ana M. Parma[c], Cody Szuwalski[d], Carl J. Walters[e]

[a] School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, WA 98195 USA
[b] Department of Marine & Coastal Sciences, Rutgers University, 71 Dudley Rd., New Brunswick, NJ 08901 USA
[c] Centro para el Estudio de Sistemas Marinos, Centro Nacional Patagónico-CONICET, Blvd. Brown 2915, U 9120 ACF Puerto Madryn, Chubut, Argentina
[d] Bren School of Environmental Science and Management, University of California Santa Barbara, Santa Barbara, CA 93101 USA
[e] Institute for the Oceans and Fisheries, University of British Columbia, Vancouver, BC V6T1Z4 Canada

ARTICLE INFO

Article history:
Received 26 August 2016
Received in revised form 12 January 2017
Accepted 16 January 2017
Handled by George A. Rose
Available online xxx

Keywords:
Forage fish
Small pelagics
Marine predators
Ecosystem based fishery management
Ecopath

ABSTRACT

This paper explores the impact of fishing low trophic level "forage" species on higher trophic level marine predators including other fish, birds and marine mammals. We show that existing analyses using trophic models have generally ignored a number of important factors including (1) the high level of natural variability of forage fish, (2) the weak relationship between forage fish spawning stock size and recruitment and the role of environmental productivity regimes, (3) the size distribution of forage fish, their predators and subsequent size selective predation (4) the changes in spatial distribution of the forage fish as it influences the reproductive success of predators. We show that taking account of these factors generally tends to make the impact of fishing forage fish on their predators less than estimated from trophic models. We also explore the empirical relationship between forage fish abundance and predator abundance for a range of U.S. fisheries and show that there is little evidence for a strong connection between forage fish abundance and the rate of change in the abundance of their predators. We suggest that any evaluation of harvest policies for forage fish needs to include these issues, and that models tailored for individual species and ecosystems are needed to guide fisheries management policy.

© 2017 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

1. Introduction

There has been considerable interest in recent years on the impact of fishing low trophic level fishes, commonly called "forage fish", on the higher trophic level fishes, marine birds and marine mammals (Cury et al., 2011; Pikitch et al., 2012; Smith et al., 2011). For our purposes we consider forage fish to be the major small pelagic fishes and squid, but the juveniles of many species are also an important part of the diet of many predators. There is good evidence and theory to suggest that (1) fishing reduces the abundance of targeted fish stocks, and (2) reproductive success of predators is affected by the local density of their prey. The logic seems clear, lower fishing pressure results in more forage fish in the ocean, and thus better reproductive success and higher abundance of the higher trophic level predators. Pikitch et al. and Smith et al. used ecosystem models to quantitatively evaluate the impact of fishing forage fish on their predators, and both papers suggested that forage fish should be harvested at rates lower than would provide long term maximum yield of the forage fish.

Although it would therefore seem obvious that fishing forage fish would have a negative effect on the abundance of their predators, the empirical relationships between forage fish abundance and predator abundance, or population rates of change, have not been examined in a systematic way. There is evidence in the literature (Cury et al., 2011) showing changes in reproductive success in relation to local food abundance, but the assumed link between the changes in total population size of predators and the total forage fish abundance has not been evaluated against historical trends in abundance. Another way to explore the impact of fishing forage fish is to examine the population trends in a dependent predator. Given that most forage fish in the U.S. have been harvested more heavily in the past than they are at present, if predator populations increased under past fishing pressure on forage species, then fishing at those levels did not preclude the ability of the predators to increase. For many reasons, the predators of most concern should be those others that have been decreasing in abundance over recent decades.

* Corresponding author.
E-mail addresses: hilbornr@gmail.com (R. Hilborn), ricardoamoroso@yahoo.com (R.O. Amoroso), ebogazzi@gmail.com (E. Bogazzi), olaf.p.jensen@gmail.com (O.P. Jensen), parma@cenpat-conicet.gob.ar (A.M. Parma), c.s.szuwalski@gmail.com (C. Szuwalski), c.walters@oceans.ubc.ca (C.J. Walters).

http://dx.doi.org/10.1016/j.fishres.2017.01.008
0165-7836/© 2017 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

Most forage fish are well documented to undergo substantial fluctuations in abundance unrelated to fishing (Schwartzlose et al., 1999), a feature that is ignored in the ecosystem models used to evaluate ecological impacts of fishing which were mentioned above. This was recognized as a deficiency by the authors of the Pikitch et al. paper. "Major fluctuations in forage fish abundance have been observed and recorded for centuries. Forage fish can respond dramatically to shifts in oceanic conditions and may exhibit strong decadal-scale variability. Forage fish may be capable of responding quickly to favorable environmental conditions, but their populations cannot be expected to maintain a steady state and can plummet when conditions become unfavorable" (Pikitch et al., 2012, page 84).

Such fluctuations can range over three orders of magnitude. Vert-pre et al. (2013) showed that for about 50% of fish stocks, there were major changes in the productivity of the stocks unrelated to fish stock size. Given great natural variability in abundance of forage fish, a key question is how much does fishing impact abundance relative to the natural fluctuations?

The commonly accepted assumption that higher spawning stock sizes lead (in expectation) to higher recruitment (Myers and Barrowman, 1996; Myers et al., 1994) is implicit in EwE models that do not break taxonomic groups into size or age groups, and explicit in ATLANTIS models and EwE models that do break a group into stages. The assumption that increasing spawning stock size will lead to higher recruitment has been challenged first by Gilbert (1997) then by Szuwalski et al. (2014) who showed that most stocks do not exhibit a stock recruit relationship and of those that do, a large fraction of them have shifts in average recruitment over time. Myers et al. (1999) estimated that forage fish show clear relationships between spawning stock abundance and recruitment, but low spawning stock and low recruitment can be explained equally well by low recruitment generating low spawning stock (Szuwalski et al., 2014). If abundance of forage fish and their recruitment are primarily environmentally driven, then the impact of fishing on the food supply of higher trophic level predators is mainly through depletion of prey cohorts by fishing, not by reduced recruitment.

In addition to the assumption of a direct link between spawning stock and recruitment, the EwE models used to evaluate the impacts of fishing forage fish have a direct link between forage fish abundance, predator consumption and predator abundance implicit in the dynamics. However, few of these models have considered the life histories of the forage fish and their predators in enough detail to capture several key issues in the interaction between fishing on forage fish and impacts on dependent predators. None of the 11 EwE models used by Pikitch et al. considered the size or age structure of the forage fish (Essington and Plaganyi, 2013) and in five cases the modeling was not conducted at the species level, but instead grouped up to eight forage species, amongst which many may exhibit negative covariation in abundance. Indeed, two of the authors of the Pikitch et al. study subsequently questioned the use of "recycled" ecosystem models (i.e., those developed for other purposes) to understand the impacts of forage fish abundance on their predators; "We find that the depth and breadth with which predator species are represented are commonly insufficient for evaluating sensitivities of predator populations to forage fish depletion" (Essington and Plaganyi, 2013). All of the models used by Pikitch et al. were such recycled models.

A key factor determining reproductive success of many birds and marine mammals is the local density of prey within their foraging range of the breeding sites (Thaxter et al., 2012). So in addition to the variability induced by natural fluctuations in total abundance of the forage fish, the spatial availability can also vary, and two breeding colonies feeding on the same stock may see strikingly different food availability. Local density can either amplify natural variability in food supply, or the predators may be able to concentrate on high density locations even at low prey abundance, thus buffering them from the fluctuations in total abundance. Despite the importance of local forage abundance for central place foragers, there is little evidence relating abundance of forage species to the abundance of mobile predators. Jensen et al. (2012) cited several of the studies showing the importance of local abundance to central place foragers but also reviewed the empirical literature relating marine predatory fish abundance to abundance of their prey and found few clear links apart from a decline in cod productivity following the collapse of both herring and capelin in the Barents Sea (Hamre, 1994; Hjermann et al., 2004).

This brings us to another important factor in the life history of forage fish and their predators that is neglected in almost all of the EwE models. Some marine predators consume forage fish at sizes and ages before the fishery harvests them. This is most true for predatory fish and marine birds, where mouth gape sizes limit the maximum size of prey that can be eaten, and probably least true for marine mammals. As an example, Nelson et al. (2006) showed that the mean size of Atlantic menhaden (*Brevoortia tyrannus*) eaten by striped bass (*Morone saxatilis*) in Massachusetts was 8.4 cm but the mean size taken by the fishery was 28 cm. In the extreme, if the recruitment of forage fish is not affected by fishing, and the predators consume sizes smaller than taken by the fishery, then the fishery would have no impact on the food available to the predator. In other words, the fishery harvests only those individuals that have survived and grown large enough to escape most of their predators.

To summarize, the impact of fishing forage fish on dependent predators will depend on (1) the alternative prey available to the predators, (2) the impact of fishing on the recruitment of the forage fish, (3) natural variability in recruitment, (4) the relationship between abundance of the forage fish and what is actually available to the predators, (5) the overlap between sizes/ages eaten by the predators and those taken by the fishery, and (6) other factors that may limit the predator population abundance.

In this paper we explore these issues for a range of U.S. forage fish and their predators. First, we examine the relationship between forage fish abundance and predator population growth rates, then we evaluate the recruitment pattern for each forage species and evaluate the evidence regarding the relative importance of fishing and environmental influences on the recruitment. Thirdly, we compare the size/ages taken by predators to those taken by the fishery. We then model the changes in forage fish abundance as a function of different assumptions regarding the dependence of recruitment on fish stock size and environmental variability to generate scenarios of forage fish abundance as a function of fishing pressure. Finally we examine how much the abundance of forage fish in the target size range is affected by fishing.

2. Materials and methods

Eleven species of forage fish in the U.S. were selected for analysis, and for each of these species we conducted a literature review to identify: (1) what predators eat those species, (2) the importance of the forage fish species in the diet of the predator, and (3) the size range of each forage species found in the diet of the predator. The selected forage species were the Pacific sardine (*Sardinops sagax)*, Northern anchovy (*Engraulis mordax*), Market squid (*Doryteuthis opalescens*), Pacific hake (*Merluccius productus*), Pacific chub mackerel (*Scomber japonicus*), Atlantic herring (*Clupea harengus*), Atlantic menhaden, Atlantic mackerel (*Scomber scombrus*), Shortfin squid (*Illex illecebrosus*), Longfin inshore squid (*Doryteuthis pealeii*) and Gulf menhaden (*Brevoortia patronus*).

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

2.1. Literature search

A systematic review of the literature was conducted by querying the Academic Search and Google's online search engine for articles on prey and predators occurring in the California Current, U.S. East Coast and the Gulf of Mexico. Queries included topical keywords for diet and abundance for identified predators in the geographic range.

2.1.1. Diet

We recorded data from 127 relevant citations in peer-reviewed journal publications, books, technical reports, theses and from online databases (e.g. www.fishecology.org in September and October 2015). Data included individual occurrences of a predator eating a prey. Each record includes information on the citation, study location, date (year and season of observations), sampling methods (e.g. stomach content, visual observation), predator (life-history stage, size/age/sex, sample size) and prey (amount consumed and size eaten, usually estimated through otoliths or beak measurements).

The importance of a prey species in the diet of a predator was defined as the mean proportion of a forage fish consumed by a specific predator reported in a specific unit for measuring consumption. When more than one unit of consumption was available, the following order of preference was set: prey proportions by mass were preferred, followed by numbers, energetic contribution and finally frequency of occurrence.

2.1.2. Abundance of predators

The predators for which the importance of a single prey species was equal to or greater than 0.2 were selected as "dependent predators". We identified 86 different populations of dependent predators of which 52 are commercially important fish species or stocks, 33 are top predators (seabirds and marine mammals) and one is an invertebrate.

Abundance data for the dependent predators were obtained from several sources. For marine mammals, data were obtained primarily from the NMFS Marine Mammal Stock Assessments (Caretta et al., 2006; Waring et al., 2015). For commercially important fish species, data were obtained primarily from the RAM Legacy Stock Assessment Database (Ricard et al., 2012). Other sources of abundance data for seabirds and other species include agencies and government websites, peer-reviewed journal publications, books, technical reports and theses. Information on abundance trends were found for 50 of the 86 dependent predators species identified in this study.

An index of abundance was calculated using available data such as total and spawning stock biomass, density, estimated number of individuals, counts, pup production, nesting pairs, standardized catch per unit effort, breeding pairs and number of nests. The sources for these data are shown in supplemental Table S1.

Graphical data were extracted with DataThief III (Tummers, 2006) when original data in tabular form could not be found.

We compared the population per capita rates of change of the predators to the abundance of forage fish. For exploited species, we used the surplus production, should be there instead of; defined as the change in abundance from one year to the next, plus the catch. The relationship between forage fish abundance and predator rate of change was assessed using a linear model and the significance of the slope was tested using an F test.

2.2. Recruitment analysis

We analyzed the estimated forage fish abundance and subsequent recruitment to assess if recruitment was better explained by environmental variability or fish abundance. The spawner-recruit data were obtained from the RAM Legacy Stock Assessment Database (www.ramlegacy.org) for the forage fish of concern. Four models were fit to the data and compared using AIC: a traditional Beverton-Holt stock-recruitment model, a hockey-stick model, a model that assumes that recruitment is random and independent of stock size and a regime-shift model. In the latter, the presence of regimes was identified by estimating breakpoints in the recruitment time series where the statistical properties (mean and/or variance) change. Different segmentation algorithms exist to search over the entire parameter space for the number and location of breakpoints that maximize the likelihood of the data subject to a penalty to prevent overfitting. We used the PELT algorithm (Pruned Exact Linear Time) proposed by Killick et al. (2012) implemented in the "change point" library (Killick and Eckley, 2014) for the statistical software R (R Core Team, 2014). Differences in both the mean and the variance among segments were allowed and model selection was based on AIC while constraining the minimum segment length to either 5 or 10 years. The PELT method was preferred over the simpler sequential *t*-test method of Rodionov and Overland (2005) used by Vert-pre et al. (2013) because the latter does not search over all possible combinations of breakpoint locations.

Stock-recruitment models (other than regime shift) were fitted using the software AD Model Builder (Fournier et al., 2012). For each model we computed the likelihood and the AIC assuming lognormal errors. The number of parameters in the regime-shift model was computed as the number of breakpoints plus the number of means and variances estimated. We excluded from the analysis the squid as well as the Northern anchovy, because the time series of abundance data available for these stocks were discontinuous.

2.3. Impacts of fisheries on prey abundance

We gathered biological and fisheries information on six species of forage fish and implemented a simulation model to quantify the reduction in food availability to predators from fishing given the size selectivity of both the fishery and the predators. An age structured model was used to simulate the effects of different fishing mortalities on fish abundance. The numbers of individuals of age a at time t were modeled as:

$$N_{a+1,t+1} = N_{a,t}\exp^{(-M+Fv_a)} \tag{1}$$

where M is the natural mortality, F the fishing mortality and v_a is an age specific selectivity. Two different scenarios of recruitment were simulated:

$$\begin{cases} N_{1,t} = R_t & Scenario\,1 \\ N_{1,t} = \dfrac{aSE_{t-1}}{1+bS} & Scenario\,2 \end{cases} \tag{2}$$

In Scenario 1, we assumed that recruitment was independent of the spawning biomass, while in Scenario 2 we used the standard Beverton-Holt stock-recruitment equation. Spawning stock biomass was calculated as:

$$S_t = \sum_a w_a m_a N_a \tag{3}$$

where w_a is the average weight of an individual of age a and m_a is the proportion of sexually mature individuals of age a. Weight at age was calculated as a power function of the average length

$$w_a = \alpha {L_a}^{\beta} \tag{4}$$

Length at age was modeled using the standard Von Bertalanffy growth equation.

$$L_a = L_\infty(1 - e^{(-k(a-t_0))}) \tag{5}$$

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

Table 1
Stock specific parameters used in the simulations. $L\infty$ is asymptotic length, K is the Von-Bertalanffy growth rate, t0 = scale parameter of growth curve, M = instantaneous natural mortality rate, α = length to weight scale parameter, β = length to weight power.

Stock Parameters	Atlantic Herring	Atlantic Menhaden	Gulf Menhaden	Pacific Chub Mackerel	Pacific Hake	Pacific Sardine
$L\infty$ (cm)	32	36.5	26.25	39.2	52	23.7
K	0.36	0.363	0.39	0.39	0.32	0.318
t0 (years)	−1.17	−1.3	−0.99	−2	0	−2.01
M	0.52	0.45	1.1	0.5	0.213	0.4
α ($\times 10^{-6}$)	8.21	4.07	7.41	2.7	5	7.52
B	3	3.2	3.19	3.4	3	3.2332
Maturity at age	1 = 0; 2 = 0.01; 3 = 0.21; 4 = 0.81; 5 = 0.98; 6+ = 1	<2 = 0; 2 = 0.12; 3 = 0.85; 4+ = 1	<2=0; 2+ = 1	0 = 0; 1 = 0.48; 2 = 0.63; 3 = 0.76; 4 = 0.85; 5–6 = 0.91; 7+ = 1	1 = 0; 2 = 0.01; 3 = 0.21; 4 = 0.82; 5 = 0.98; 6+ = 1	1 = 0; 2 = 0.99; 2+ = 1
Selectivity at age	1 = 0; 2 = 0.18; 3 = 0.54; 4 = 0.7; 5+ = 1	<2=0; 2 = 0.1; 3–4 = 1; 5 = 0.19; 6+ = 0	1 = 0.05; 2 = 1; 3–4 = 0.35; 5+ = 0	0 = 0.5; 1+ = 1	1 = 0.07; 2 = 0.18; 3 = 0.37; 4 = 0.62; 5 = 0.81; 6 = 0.92; 7 = 0.97; 8+ = 1	1 = 0.18; 2 = 0.37; 3 = 0.62; 4 = 0.81; 5 = 0.92; 6+ = 1

A global food depletion estimate can be calculated by comparing the equilibrium biomass for a given F with the equilibrium biomass in the unfished state. However, as predators may select prey by size, we are interested in assessing the food depletion for different prey's length intervals. We generated a length composition of the population by assuming that the size of individuals within an age class is normally distributed with mean L_a and standard deviation σ_a. For simulation purposes we assumed a constant coefficient of variation in size-at-age of 20%. We calculated the numbers of individuals (Eq. (6)) and the biomass (Eq. (7)) in the size interval $l_1 - l_2$ as:

$$N_{l_1-l_2} = \sum_a N_{a,l_1-l_2} \tag{6}$$

$$B_{l_1-l_2} = \sum_a w_a N_{a,l_1-l_2} \tag{7}$$

For each fish stock we ran the model for 5000 years under different fishing mortalities and randomly sampled 500 iterations to assess the reduction in the food available to predators. Under Scenario 1, the model was forced using the historical recruitment estimated in stock assessments in order to account for natural variability (we sequentially repeated the recruitment time series to achieve 5000 observations). To perform the simulation under the assumption of a stock recruitment relationship (Scenario 2) we used the spawner-recruit curve best fit to the stock assessment data. To account for natural variability, we calculated the log residuals and used them as multiplicative errors. Similar to Scenario 1, we sequentially repeated the observed errors to achieve 5000 observations.

Our simulations are a simplification of the stock dynamics, since key parameters such as selectivity, growth and natural mortality can be time, size or density dependent. For each fish stock we gathered mortality, growth, maturity, vulnerability to fishing and weight-at-length parameters from stock assessment documents. We ran the simulations for only one fishery for a given stock; when more than one fishery targeted that stock, we used the vulnerability to the fishery that accounted for the largest fraction of the catch.

We calculated the biomass depletion for four size ranges, (small, small-medium, medium-large and large fish) set at the quartiles of the length frequency distribution in the unfished state. We explored the impacts of fishing under $F = 0$, $0.5\,F_{MSY}$, and F_{MSY}. When possible, the value of F_{MSY} was calculated using the stock-recruitment, maturity and growth parameters used in the simulations. For stocks where the stock-recruitment relationship was a flat line, the calculation of F_{MSY} was unreliable, and instead we used the value estimated as part of the stock assessment which was often a proxy. For each F, we computed the median biomass compared to median biomass in the unfished state. Parameters used in the simulations are summarized in Table 1.

3. Results

3.1. Diet data compilation

The literature review yielded 1041 predator-prey pairs that contained information on predators' diet (size eaten and/or proportion of the prey in the diet). For a given predator and prey species, the database can contain several records, since we included an individual entry for the same pair of species if data were obtained in different locations and/or different years or when the data were recorded for different sexes or stages in the life cycle. These records corresponded to 119 species of predators and 11 species of prey, and included multiple years of data for the same species in one location as well as data for one species from different regions. The number of individual predator species identified for each forage fish ranged from five for the Gulf menhaden to 46 for the Northern anchovy.

We identified 203 prey-predator pairs where the mean proportion of a prey item in the diet in a given location was larger than 0.2 (Table S1).

3.2. Empirical relationships between predator and prey trends

Trends in abundance of both predator and prey covering overlapping periods were available for 50 predator-prey pairs out of the 203 pairs where the proportion of a specific forage fish in the diet was larger than 0.2. When multiple abundance time series were available we selected the longest one that did not present gaps in the data. Trends in abundance of most dependent predators were either growing, stable, or fluctuating between periods of high and low abundance (Figs. 1 and S1). Six cases showed a clear decreasing trend in the predator's abundance index over time: Atlantic cod (*Gadus morhua*) in Georges Bank, sablefish (*Anoplopoma fimbria*) on the Pacific coast, mako shark (*Isurus oxyrinchus*), silky shark (*Carcharhinus falciformis*) and spiny dogfish (*Squalus acanthias*) in the N.W. Atlantic, and yellowtail rockfish (*Sebastes flavidus*) on the Pacific coast. No obvious relationship between the prey and predator abundance was apparent in the majority of the cases (Fig. 1 insets).

Although a positive relationship between prey and predator abundance can be interpreted as evidence of trophic dependence, a better way to assess the role of prey abundance in the population dynamics of the predator is to analyze the predator population rate of change or surplus production against the abundance of the

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

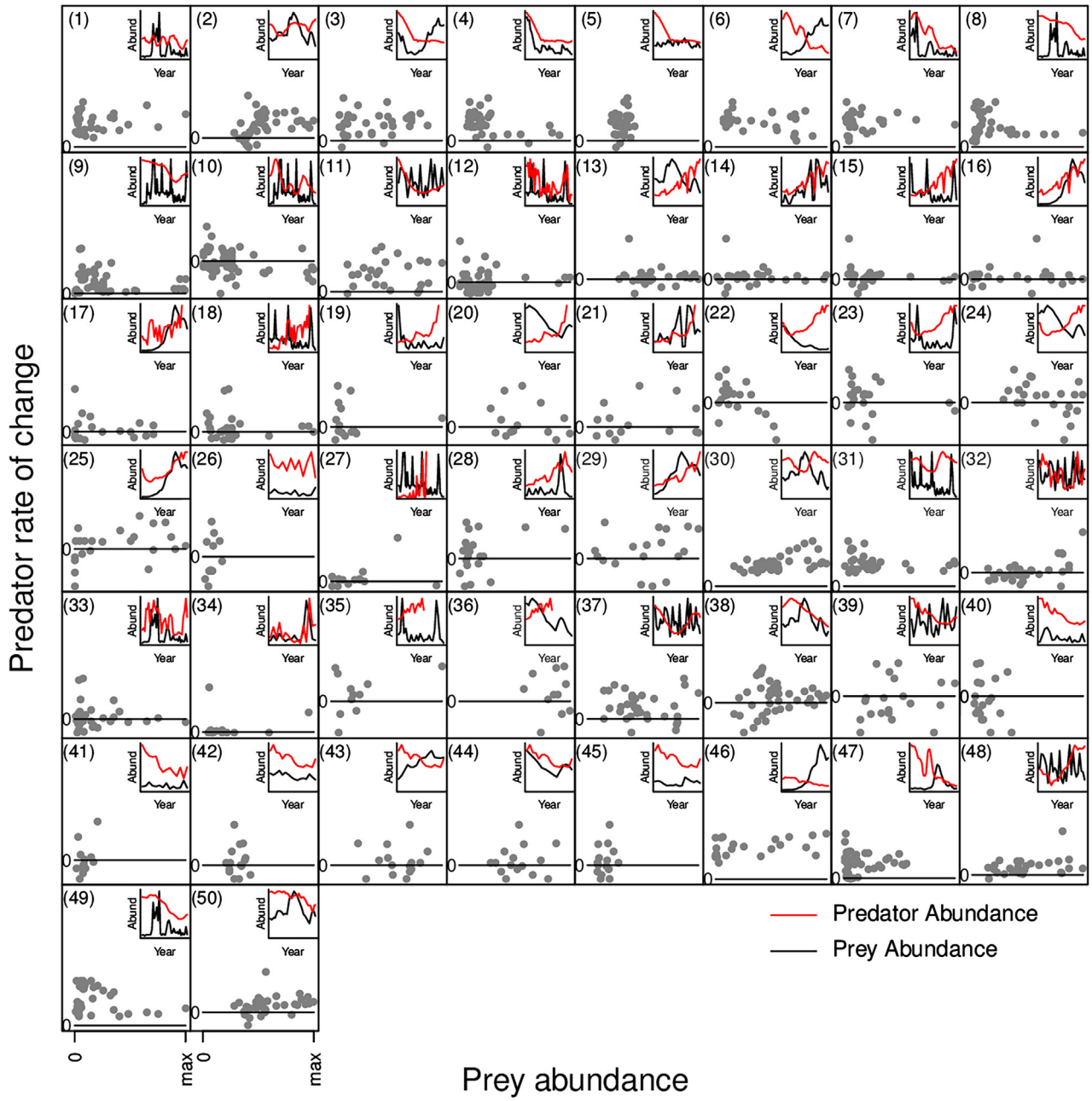


Fig. 1. Relationship between the annual surplus production of the predators and prey abundance. Each panel shows a pair of temporally overlapping predator rate of change and prey abundance data (grey dots). The subplot in each panel shows the relative trend in the abundance index for the prey (black line) and the predator (red line). (1) albacore tuna and shortfin squid; (2) arrowtooth flounder and Pacific hake; (3) Atlantic bluefin tuna and Atlantic herring; (4) Atlantic bluefin tuna and Atlantic mackerel; (5) Atlantic bluefin tuna and Atlantic menhaden; (6) Atlantic cod and Atlantic herring; (7) Atlantic cod and shortfin squid; (8) bigeye tuna and shortfin squid; (9) black rockfish and Northern anchovy; (10) bluefin tuna and Northern anchovy; (11) bluefish and longfin inshore squid; (12) Brandt's cormorant and Northern anchovy; (13) California sea lion and Pacific hake; (14) California sea lion and market squid; (15) California sea lion and Northern anchovy; (16) California sea lion and Pacific sardine; (17) California brown pelican and Pacific sardine (18) California brown pelican and Northern anchovy; (19) common murre and Northern anchovy; (20) common murre and Pacific hake; (21) common murre and market squid; (22) thresher shark and Pacific chub mackerel; (23) thresher shark and Northern anchovy; (24) thresher shark and Pacific hake; (25) thresher shark and Pacific sardine; (26) dolphinfish and shortfin squid; (27) elegant tern (chicks) and Northern anchovy; (28) humpback whale and Northern anchovy; (29) humpback whale and Pacific sardine; (30) North Pacific albacore and Pacific hake; (31) North Pacific albacore and Northern anchovy; (32) offshore hake (mid Atlantic bight) and longfin inshore squid; (33) offshore hake (mid Atlantic bight) and shortfin squid; (34) Pacific bonito and Northern anchovy; (35) Pacific harbor seal and Northern anchovy; (36) Pacific harbor seal and Pacific hake; (37) Gulf of Maine pollock and longfin inshore squid; (38) sablefish and Pacific hake; (39) shortfin mako shark and longfin inshore squid; (40) shortfin mako shark and shortfin squid; (41) silky shark and shortfin squid; (42) spiny dogfish and Atlantic menhaden; (43) spiny dogfish and Atlantic herring; (44) spiny dogfish and Pacific hake; (45) spiny dogfish and Atlantic mackerel; (46) striped marlin and Pacific sardine; (47) striped marlin and Pacific chub mackerel; (48) summer flounder and longfin inshore squid; (49) swordfish and shortfin squid; (50) yellowtail rockfish and Pacific hake.

prey. The data set showed almost no evidence of a strong positive relationship between the predator surplus production and the prey abundance (Fig. 1). While in half of the cases the slope estimates were positive, in only four cases did we find a statistically significant positive relationships between predator and prey abundance (Fig. S2) (with no correction for multiple comparisons): arrowtooth flounder (*Atheresthes stomias*) and Pacific hake (Figure 1.2), yellowtail rockfish and Pacific hake (Figure 1.50), North Pacific

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

Table 2
Summary table for the regime shift (shifts), random, Beverton-Holt and hockey-stick stock recruitment (SR) models. We recognize that this violates the independence assumption of the AIC, but believe it is indicative of relative strength of evidence for competing hypotheses. N is number of years in the time series and Corr is the coefficient of auto-correlation of the logarithm of recruitment. N shifts = number of estimated breakpoints.

Species	Area	N	Corr	N shifts	AIC Shifts	AIC BH	AIC Hockey	AIC Random	Winner
Pacific chub mackerel	California Current	79	0.66	6	166	201	206	239	Shift
Atlantic herring	US East Coast	37	0.34	2	76	81	81	85	Shift
Gulf menhaden	Gulf of Mexico	35	0.06	1	20	22	22	20	Random
Atlantic menhaden	US East Coast	51	0.50	3	63	83	91	89	Shift
Pacific hake	California Current	47	−0.29	1	166	168	168	166	Random
Pacific sardine	California Current	27	0.84	2	85	63	62	112	Hockey
Atlantic mackerel	US East Coast	47	0.52	2	143	129	129	155	BH/Hockey

albacore (*Thunnus alalunga*) and Pacific hake (Figure 1.30), and offshore hake (*Merluccius albidus*) (mid Atlantic bight) and longfin inshore squid (*Doryteuthis pealeii*) (Figure 1.32). The percent variance explained in these four cases ranged from 10% to 34%. The 95% confidence bounds on the estimated slope (y and x axes in units of standard deviation) were often wide, with upper bounds exceeding a value of 0.5 in close to half of the cases.

3.3. Recruitment analysis

For the seven species assessed, the stock-recruitment models outperformed the regime shift and the random models in two cases: Pacific sardine and Atlantic herring (Table 2). For the other five species the regime-shift or the random model had lower values of AIC. This result was independent of the minimum segment length specified for the changepoint analysis (shorter segment lengths yielded larger number of breakpoints, but the general result remained the same).

The hockey-stick and the Beverton-Holt models performed similarly when fit to the stock-recruitment data. Only in three cases – Pacific chub mackerel, Atlantic herring and Pacific sardine – was a breakpoint estimated by the hockey-stick model, indicating a decrease in recruitment below a given stock size. The breakpoint was estimated respectively at 17%, 19% and 13% of the maximum value of spawning biomass in the series. For Atlantic mackerel, a linear decrease in recruitment over the entire time series was favored with no identifiable breakpoint. The species for which evidence of decreased recruitment at lower spawning stock size was strongest also showed a highly auto-correlated recruitment (Table 2). By contrast, no evidence of a decrease in recruitment at low stock abundance was observed for the two menhaden stocks and for Pacific hake. Pacific hake and Gulf menhaden both had the lowest AIC for the random model while a regime-shift model was favored for Atlantic menhaden. Pacific chub mackerel and Atlantic herring also had the lowest AIC for the regime-shift model.

Pacific chub mackerel, Atlantic mackerel and Pacific sardine do show significantly lower recruitment at lower spawning stock size. However, each of those species shows highly auto-correlated recruitments that are consistent with environmentally driven regime changes and the apparent spawner recruit relationship may in fact simply be that periods of low recruitment lead to periods of low spawning stock size.

3.4. Simulated impacts of fisheries on prey abundance

For the six examples considered, the simulations conducted assuming recruitment is independent of spawning stock (Scenario 1) suggest that the abundance of small and small-medium size fish is unaffected by fishing (Fig. 2) and even in the absence of fishing the abundance of all sizes fluctuates greatly. Typically, the small sizes tend not to be caught in the corresponding fisheries (Fig. 3). In contrast, the abundance of large fish can be substantially reduced when F is set at F_{MSY}. When a stock-recruitment relationship is assumed (Scenario 2), in most cases a reduction in fish abundance was observed for all size ranges, the magnitude of which increased with fishing pressure.

Additionally, variability was reduced as fishing pressure increased. The two exceptions were Pacific hake and Gulf menhaden (Fig. 2). For these two species, the fit of the Beverton-Holt curve was flat in the range of observed abundances, which is similar to the assumption that recruitment is independent of stock size (Fig. 4). The fishery simulated for Gulf menhaden targeted almost exclusively individuals of age 2 (approximately 15 cm, Fig. 3), while the population was mainly composed of 0+ (small) and 1+ (small-medium) fish. This is most likely the main reason why abundance of fish does not respond to fishing pressure for this stock. In the case of Pacific hake, a substantial fishing impact was observed only for medium-large and large fish, which corresponds to the sizes selected by the fishery.

These results emphasize the relevance of the size composition of the diet when the fishing effects on predators are assessed. Unfortunately, data on the size compositions of diets are scarce. We could only find 74 records of size of forage fish prey (Fig. 3). While some predators selectively eat small fish (usually not selected by the fishery), others prey on a large range of forage fish sizes. The degree of overlap between fisheries and predators is highly variable. For example, most predators foraging on market squid and Pacific hake do not seem to be in direct competition with fisheries. On the other hand, Pacific chub mackerel, Pacific sardine and Atlantic herring fisheries seem to overlap with predator's preferred prey sizes.

4. Discussion

4.1. Trends in predator populations and growth rates of predators vs prey

For the populations studied, we found little evidence that the abundance of individual species of forage fish was positively related to the per capita rate of change in their predator populations. Of the 50 comparisons, we found five that had a significantly positive relationship between prey abundance and predator rate of change The fact that only four of the time series of predator abundance showed a downward trend also provides some evidence that historical fishing practices on forage prey species have not led to major predator decreases.

Given the very large range of abundance fluctuations seen in many of the forage fish populations, it is surprising that a relationship between forage fish abundance and predator rate of change does not emerge. The most obvious explanation would be diet flexibility. If the predators can switch between alternative prey, then the fluctuations in any individual forage species may be well buffered by the predator switching to other forage species. We also explored various time lags between prey abundance and predator rate of change, and did not find higher rates of correlation. We did not look at the abundance of forage species in aggregate in our one species at a time comparison.

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

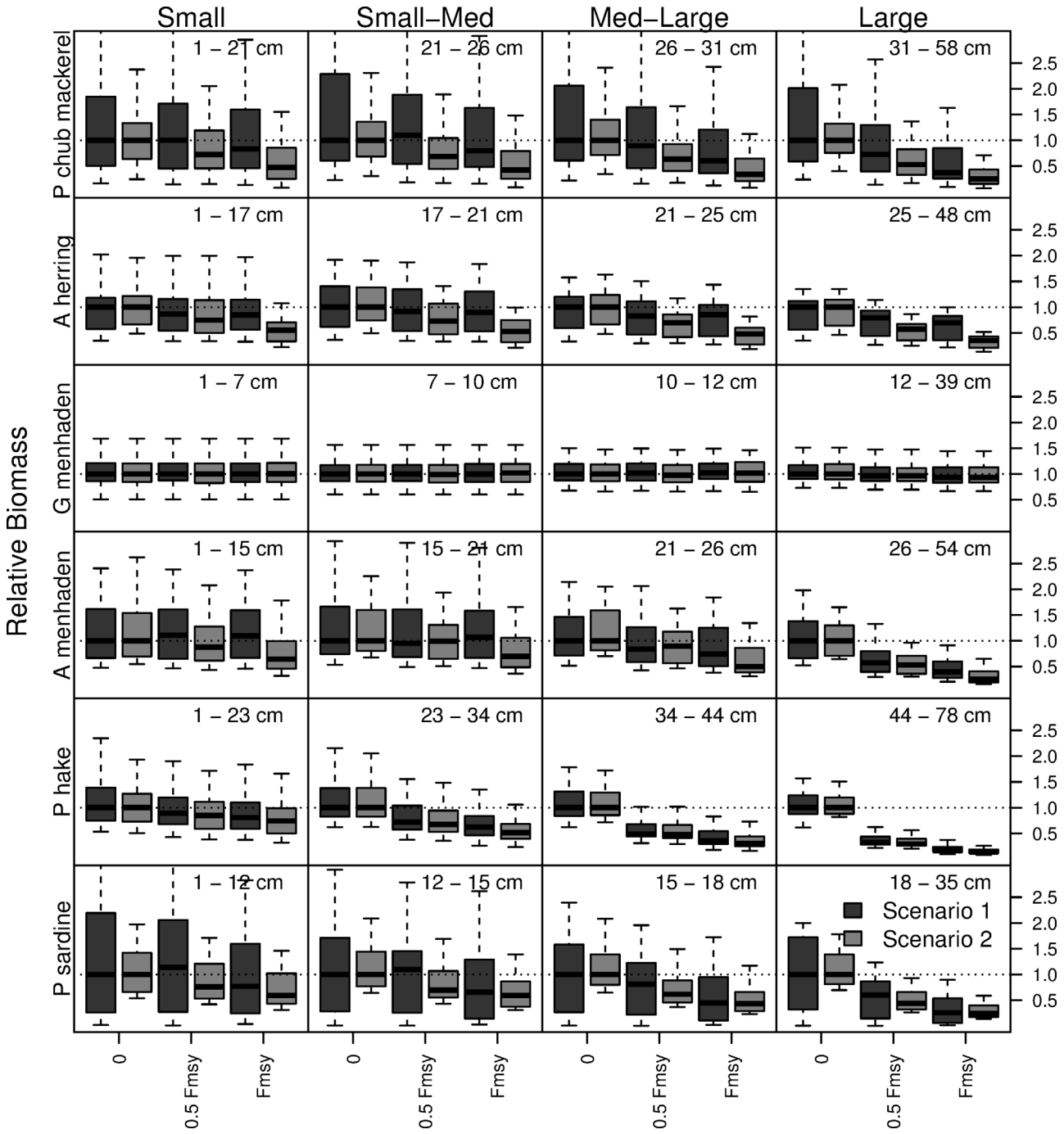


Fig. 2. Change in prey abundance predicted by the simulation model for six forage fish species in different size ranges. Scenario 1: recruitment independent of stock size; Scenario 2: Beverton-Holt stock recruitment relationship.

4.2. Recruitment analysis

If we simply look at the spawner-recruit data for the forage species examined we see little evidence that smaller spawning stocks produce smaller recruitments for both Atlantic and Gulf menhaden, and Pacific hake. Good year classes seem to come from both large and small spawning stock sizes. Pacific chub mackerel, Atlantic mackerel and Pacific sardine do show significantly lower recruitment at lower spawning stock size. However, each of those species shows highly auto-correlated recruitments that are consistent with environmentally driven regime changes and the apparent spawner recruit relationship may in fact simply be that periods of low environmental suitability result in long periods of low recruitment leading to low spawning stock. The relatively short life span of forage fish and several shifts from high to low productivity over the recruitment time series enhances this effect.

We have used statistical tests with changepoint analysis to try to quantify the support for regime changes vs stock-recruitment relationships and for each of these three species (Pacific chub mackerel, Atlantic herring and Atlantic Menhaden) the AIC analysis supports a regime change. This approach is only exploratory and does not provide a reliable basis for choosing a single operating model. Rather, the policy implications of alternative hypotheses should be evaluated within a management-strategy-evaluation framework and understanding the changes in recruitment is essential before evaluating alternative harvest strategies. However, we would argue

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

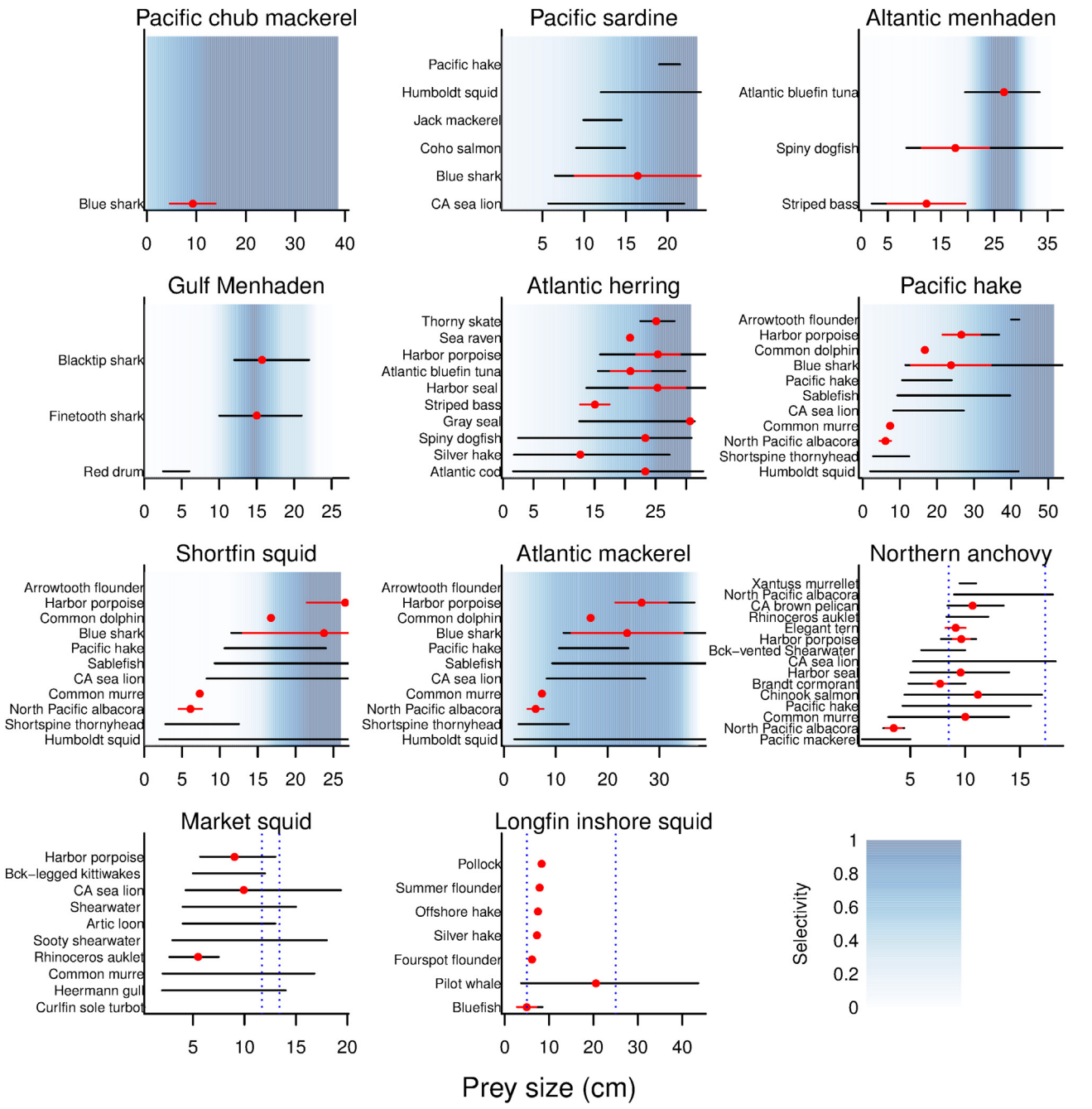


Fig. 3. Prey size consumed by different predators. Black lines indicate the range of sizes eaten. The red dots indicate the mean size of the prey, and the red line the standard deviation. The shading in the background indicates how fishery selectivity changes with fish length. When no estimates of fishery selectivity were found the dotted blue lines indicate the size range of the commercial catch.

that there is strong evidence that recruitments are largely independent of fishing pressure as has been widely accepted for Pacific sardine (Punt et al., 2016) and suggested for many other species globally (Szuwalski and Hilborn, 2015). It is of course not credible that recruitment is independent of stock size for all stock sizes (no eggs, no recruits). We assert only that the range of spawning stock sizes is often not wide enough within regimes to see any effect. It should be noted that within-regime stock-recruitment analysis is subject to strong time series bias, with over-representation of high recruitments at low stock size and low recruitments at high stock size (Walters, 1985) leading to overestimation of the initial stock-recruitment slope and reduced apparent dependence of recruitment on spawning stock size.

4.3. Impacts of fisheries on prey abundance

We found that small size classes are largely unaffected by fishing when the recruitments are simulated at historical levels assuming no impact of spawning stock, and that many, but not all of the predators rely on the smaller sized fish not targeted by fisheries. If we assume a spawner recruit model, then recruitment at F_{MSY} is reduced, so that the abundance of small size classes is also reduced. Given that for most stocks examined, a random recruitment or regime recruitment model was estimated to be best, the evidence for those stocks examined supports little impact of fishing on abundance of smaller size classes of fish. Thus one cannot generalize about the impacts of fishing on food availability to predators

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

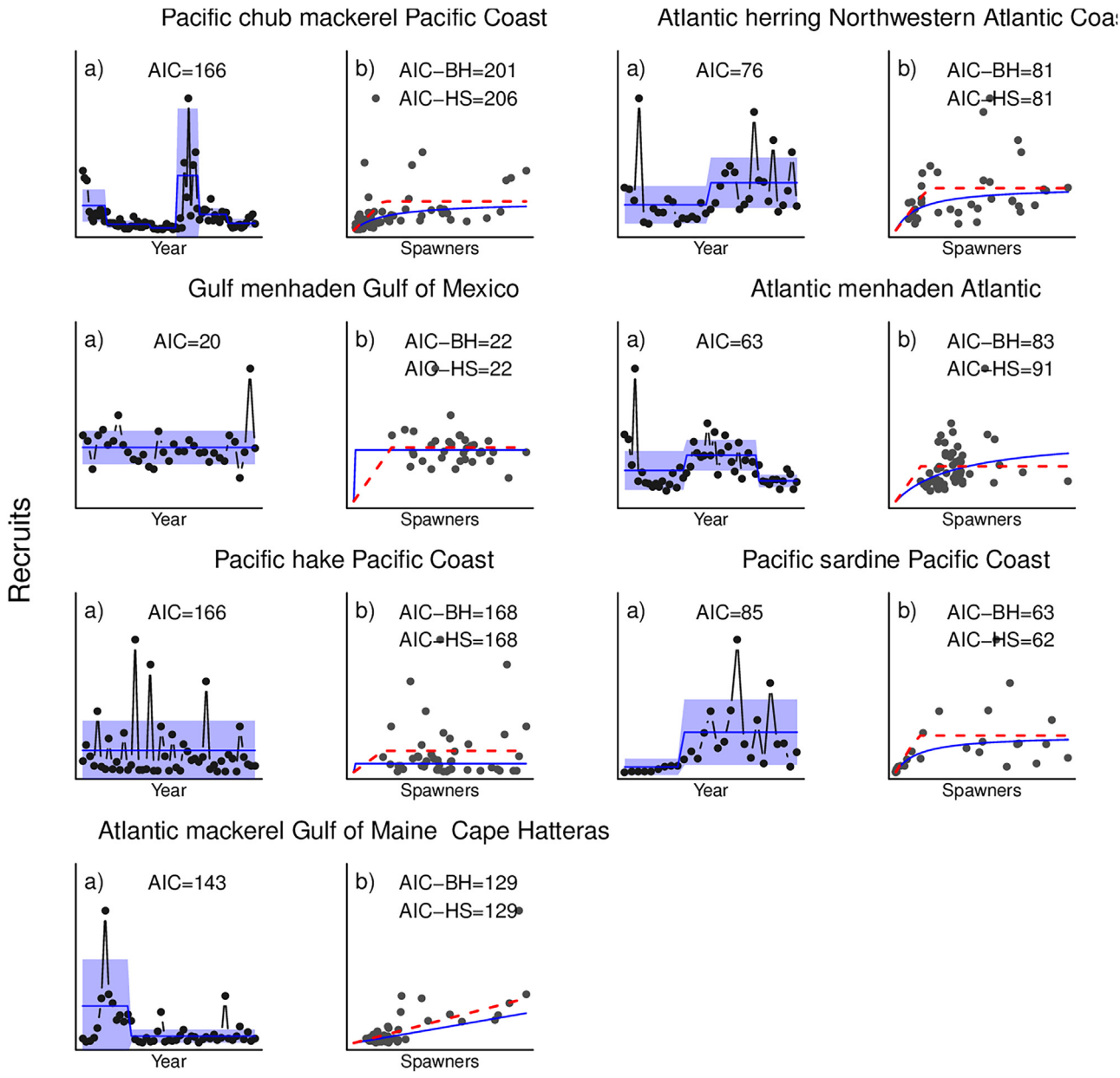


Fig. 4. Alternative models to explain recruitment variability: a regime-shift model, a Beverton-Holt stock-recruitment model and the hockey-stick model. The blue lines indicate the model maximum likelihood estimates. The purple polygons indicate the standard deviation in each regime identified by the changepoint analysis.

and each case must be examined on its own merits with respect to the impact of fishing on recruitment and the size preferences of the predators.

The diet of predators consists not only of the key species we examined here, but many other species, including juveniles of many larger species. Furthermore, the impact of fishing higher trophic level fishes has often caused forage species to be more abundant than they would be in the absence of fishing (Christensen et al., 2014; Kolding et al., 2016; Jennings and Collingridge, 2015).

4.4. Spatial distribution of forage fish

A major factor (though one which has been considered only qualitatively in this paper) is the relationship between the distribution of the forage fish, their abundance, and the location of breeding sites for dependent birds and mammals. Large fluctuations in abundance of the forage fish are accompanied by major changes in their distributional range – at high abundance the fish are found over a much larger area than at low abundance (MacCall, 1990). If there tend to be "core" areas where even at low overall abundance the forage fish can be found at high density, and these core areas are close to breeding sites of predators, predators would see far more stability in prey availability than indicated by total population size. On the other hand, if fisheries target prey hotspots or feeding areas close to breeding sites, then the impact of fishing may be larger than expected based on overall prey depletion.

This spatial dynamic is an important factor in modulating the response of pelican and sea lion abundance to fishing sardines and anchovy on the US West coast. Pelicans are more vulnerable to declines in sardine and anchovy because of a more restricted diet and more limited foraging area compared to sea lions (Punt et al., 2016). Spatial dynamics are especially important to consider when the distribution of forage fish shifts. Robinson et al. (2015) showed that decreases in the penguin population at Robben Island in South Africa were primarily due to changes in the distribution of sardines, not to the total sardine abundance.

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

Cury et al. (2011) showed a relationship between the abundance of key prey species and reproductive success of birds. However the index of forage fish abundance in half of the data sets they presented was not the total abundance of forage fish, but rather either local abundance measured around the nesting site, or amount of prey brought to the nest. Thus for those data sets, the relationship between total abundance of prey as influenced by fishing and reproductive success would be weaker than the relationship shown in the paper. Perhaps the best example of this is the data presented for three nesting sites for two bird species in Cook Inlet, Alaska (Piatt, 2002). Prey abundance around the nesting site was estimated by hydroacoustic surveys, and two of the sites generally showed good reproductive success associated with high prey abundance while one of the sites showed poor reproductive success and lower prey abundance. However, these results related to the same fish stock, subject to the same fishery, at all three sites.

The EwE models used in the Pikitch et al. and Smith et al. papers did not take the spatial structure of the forage fish populations into account, but instead assumed that total prey abundance, as influenced by fishing, was exactly what would determine the growth and survival of the predators. To evaluate the influence of fishing on the predators reliably, the changes in spatial distribution need to be considered. This is why both the Punt et al. (2016) and Robinson et al. (2015) papers estimate far less influence of fishing on predator populations than the simpler EwE models of Pikitch et al. and Smith et al. though some of the models used in the Smith et al. paper were ATLANTIS models that included some elements of spatial structure. Walters et al. (2016) also showed that the impact of fishing forage fish would depend greatly on how models were structured and that the conclusions of EwE models are very sensitive to model setup.

5. Conclusions

The purpose of this paper is to identify key factors that need to be included when analyzing the impacts of fishing on forage fish. We find several reasons to concur with the conclusion of Essington and Plaganyi (2013) that the models used in previous analysis were frequently inadequate for estimating impact of fishing forage species on their predators.

The most important feature that needs to be considered is the natural variability in forage fish population size. Their abundance is highly variable even in the absence of fishing, and a creditable analysis of the fishing impacts must consider how the extent of fishing-induced depletion compares with that of natural variability. As an example, Punt et al. (2016) estimated that the probability that brown pelicans would drop below 0.5 K with fishing was 5.3%, and without fishing was 4.5%. For marine fishes in general, "stochastic depletion" i.e. populations falling below 0.5 K, can be expected about 5% of the time even in the absence of fishing (Thorson et al., 2014). Models like EwE without stochasticity would suggest zero probability of such declines in the absence of fishing.

There is a need for a much more thorough analysis of the nature of recruitment trends in forage fish. That there are major environmentally-driven regime changes for many species is unarguable, but what exactly changes is unclear. It is unrealistic to assume that there is no relationship between spawning stock abundance and subsequent recruitment, so what is presumably changing with the environment is either the basic carrying capacity for forage fish, the basic productivity (recruits per spawner) or some combination of the two. The actual dynamics may not involve discrete regimes, but rather gradual changes in the spawner recruitment relationship. The harvest strategy that maximizes long-term fishery yield will depend greatly on exactly how the spawner recruit relationship is changing. If it is the carrying capacity that changes, then a constant fishing mortality rate will produce long-term yields that are very close to the theoretical optimum (Walters and Parma, 1996). If, however, it is the underlying productivity that changes, the fishing mortality rate may need to be respectively increased or decreased as productivity changes upwards or downwards.

The size distribution of both predator and prey and the size selectivity in diet need to be included in any analysis. In cases where recruitment is largely independent of spawning stock, and the predators take prey before they are fished, there is no influence of the fishery on availability of prey to predators. We identified numerous examples where this is the case (Fig. 3), but it is not universal. Some predators compete directly with the fishery for the same sizes of prey and such competition must be considered if we are to manage fisheries appropriately for both predators and prey.

We have found several examples of the importance of changes in spatial distribution of prey affecting the predators that suggest any analysis that does not consider such changes will not properly evaluate the impact of fishing forage fish on their predators. These include the South African penguin and sardine interaction and the Cook Inlet example (Piatt, 2002).

Our analysis of the relationship between predator rate of change and abundance of individual prey species suggests little evidence for strong connections. This is likely due to the many factors discussed above that mediate the link between fishing, prey abundance, spatial distribution and size, and predator population dynamics. The fact that few of the predator populations evaluated in this study have been decreasing under existing fishing policies suggests that current harvest strategies do not threaten the predators and there is no pressing need for more conservative management of forage fish. Hannesson (2013) showed that declines of Pacific sardine, Norwegian spring spawning herring, and Peruvian anchoveta had small impacts on their fish predators, although he relied on catches of the predators rather than direct measures of abundance. This is further evidence that general rules proposed by Pikitch et al. (2012) are not appropriate for all species and a case by case analysis is needed.

Pikitch et al. (2012) argued forcefully that their analysis provided general conclusions that should be broadly applied. However, relevant factors are missing from the analysis contained in their work, and this warrants re-examination of the validity and generality of their conclusions. We have illustrated how consideration of several factors which they did not consider would weaken the links between impacts of fishing forage fish on the predator populations.

Smith et al. (2011) were much more reserved in their conclusions, ending primarily with the estimate that fishing mortality rates on forage fish could be well below F_{MSY} with only a 20% decrease in catch of forage fish while having appreciable benefits to their predators. All single species population models show little decrease in yield with fishing mortality rates less than F_{MSY} and this would be true for forage fish as well. The very simple logistic growth model suggests that a fishing morality rate of 0.5 F_{MSY} would produce 75% of MSY. However, the evidence presented here suggest that reductions in fishing mortality rate would benefit predators less than argued by Pikitch et al. (2012). Most of the issues we raised in this paper apply to most of the models used by Smith et al. (2011).

It must be remembered that small pelagic fish stocks are a highly important part of the human food supply, providing not only calories and protein, but micronutrients, both through direct human consumption and the use of small pelagics as food in aquaculture. Some of the largest potential increases in capture fisheries production would be possible by fishing low trophic levels much harder than currently (Garcia et al., 2012; Kolding et al., 2016). While fishing low trophic levels harder may reduce the abundance of higher level predators, that cost should be weighed against the environmental cost of increasing food production in other ways. As Sharpless and Evans (2013) point out, fish provide food without

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

substantial use of freshwater, fertilizer, antibiotics and soil erosion. Forage fish also have among the lowest carbon footprints of any form of protein production (Pelletier et al., 2011). Thus it is not clear that from a global environmental perspective that reductions in fishing mortality rates on forage fish would necessarily be precautionary.

We have used examples of predators and forage fish only from U.S. fisheries, which are widely recognized to be among the best managed in the world, and also have extensive legal protections for many higher trophic level birds and mammals. While the deficiencies we have identified in the existing models are general, the status and trends of predators and prey may be quite different in other parts of the world.

Acknowledgments

We thank Dr. A.D.M. Smith and two anonymous reviewers for constructive comments. RH, EB and RA were supported by donations to the University of Washington from 27 fishing groups and fishing companies in the United States. OPJ was supported by the Science Center for Marine Fisheries (SCeMFiS).

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.fishres.2017.01.008.

References

Caretta, J.V., Forney, K.A., Muto, M.M., Barlow, J., Baker, J., Hanson, B., Lowry, M.S., 2006. U.S. Pacific Marine Mammal Stock Assessments: 2005. NOAA Technical Memos: NOAA.
Christensen, V., Coll, M., Piroddi, C., Steenbeek, J., Buszowski, J., Pauly, D., 2014. A century of fish biomass decline in the ocean. Mar. Ecol. Prog. Ser. 512, 155–166.
Cury, P.M., Boyd, I.L., Bonhommeau, S., Anker-Nilssen, T., Crawford, R.J., Furness, R.W., Mills, J.A., Murphy, E.J., Österblom, H., Paleczny, M., 2011. Global seabird response to forage fish depletion—one-third for the birds. Science 334, 1703–1706, http://dx.doi.org/10.1126/science.1212928.
Essington, T.E., Plaganyi, E.E., 2013. Pitfalls and guidelines for recycling models for ecosystem-based fisheries management: evaluating model suitability for forage fish fisheries. ICES J. Mar. Sci., http://dx.doi.org/10.1093/icesjms/fst047.
Fournier, D.A., Skaug, H.J., Ancheta, J., Ianelli, J., Magnusson, A., Maunder, M.N., Nielsen, A., Sibert, J., 2012. AD Model Builder: using automatic differentiation for statistical inference of highly parameterized complex nonlinear models. Optim. Methods. Softw. 27, 233–249, http://dx.doi.org/10.1080/10556788.2011.597854.
Garcia, S.M., Kolding, J., Rice, J., Rochet, M.J., Zhou, S., Arimoto, T., Beyer, J.E., Borges, L., Bundy, A., Dunn, D., Fulton, E.A., Hall, M., Heino, M., Law, R., Makino, M., Rijnsdorp, A.D., Simard, F., Smith, A.D.M., 2012. Reconsidering the consequences of selective fisheries. Science 335, 1045–1047, http://dx.doi.org/10.1126/science.1214594.
Gilbert, D.J., 1997. Towards a new recruitment paradigm for fish stocks. Can. J. Fish. Aquat. Sci. 54, 969–977.
Hamre, J., 1994. Biodiversity and exploitation of the main fish stocks in the Norwegian-Barents Sea ecosystem. Biodivers. Conserv. 3, 473–492, http://dx.doi.org/10.1007/BF00115154.
Hannesson, R., 2013. Strictly for the birds?: On ecosystem services of forage fish. Mar. Policy 38, 109–115, http://dx.doi.org/10.1016/j.marpol.2012.05.026.
Hjermann, D.Ø., Ottersen, G., Stenseth, N.C., 2004. Competition among fishermen and fish causes the collapse of Barents Sea capelin. Proc. Natl. Acad. Sci. U. S. A. 101, 11679–11684, http://dx.doi.org/10.1073/pnas.0402904101.
Jennings, S., Collingridge, K., 2015. Predicting consumer biomass, size-structure, production, catch potential, responses to fishing and associated uncertainties in the world's marine ecosystems. PLoS One 10, e0133794.
Jensen, O.P., Branch, T.A., Hilborn, R., 2012. Marine fisheries as ecological experiments. Theor. Ecol. 5, 3–22.
Killick, R., Eckley, I., 2014. Changepoint: an R package for changepoint analysis. J. Stat. Softw. 58, 1–19, http://dx.doi.org/10.18637/jss.v058.i03.
Killick, R., Fearnhead, P., Eckley, I., 2012. Optimal detection of changepoints with a linear computational cost. J. Am. Stat. Assoc. 107, 1590–1598, http://dx.doi.org/10.1080/01621459.2012.737745.
Kolding, J., Bundy, A., van Zwieten, P.A., Plank, M.J., 2016. Fisheries, the inverted food pyramid. ICES J. Mar. Sci. 73, 697–1713, http://dx.doi.org/10.1093/icesjms/fsv225.
MacCall, A.D., 1990. Dynamic Geography of Marine Fish Populations Seattle. University of Washington Press, Washington.
Myers, R.A., Barrowman, N.J., 1996. Is fish recruitment related to spawner abundance? Fish. Bull. 94, 707–724.
Myers, R.A., Rosenberg, A.A., Mace, P.M., Barrowman, N., Restrepo, V.R., 1994. In search of thresholds for recruitment overfishing. ICES J. Mar. Sci. 51, 191–205, http://dx.doi.org/10.1006/jmsc.1994.1020.
Myers, R.A., Bowen, K.G., Barrowman, N.J., 1999. Maximum reproductive rate of fish at low population sizes. Can. J. Fish. Aquat. Sci. 56, 2404–2419, http://dx.doi.org/10.1139/f99-201.
Nelson, G.A., Chase, B.C., Stockwell, J.D., 2006. Population consumption of fish and invertebrate prey by striped bass (Morone saxatilis) from coastal waters of northern Massachusetts, USA. J. Northw. Atl. Fish. Sci. 36, 111–126, http://dx.doi.org/10.2960/J.v36.m576.
Pelletier, N., Audsley, E., Brodt, S., Garnett, T., Henriksson, P., Kendall, A., Kramer, K.J., Murphy, D., Nemecek, T., Troell, M., 2011. Energy Intensity of Agriculture and Food Systems.
Piatt, J.F., Response of seabirds to fluctuations in forage fish density: Exxon Valdez Oil Spill Trustee Council; 2002.
Pikitch, E., Boersma, P.D., Boyd, I., Conover, D., Cury, P., Essington, T., Heppell, S., Houde, E., Mangel, M., Pauly, D., 2012. Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs. Lenfest Ocean Program, Washington, DC, pp. 108.
Punt, A., MacCall, A.D., Essington, T.E., Francis, T.B., Hurtado-Ferro, F., Johnson, K.F., Kaplan, I.C., Koehn, L.E., Levin, P.S., Sydeman, W.J., 2016. Exploring the implications of the harvest control rule for Pacific sardine, accounting for predator dynamics: a MICE model. Ecol. Modell. 337, 79–95, http://dx.doi.org/10.1016/j.ecolmodel.2016.06.004.
R Core Team, 2014. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.
Ricard, D., Minto, C., Jensen, O.P., Baum, J.K., 2012. Examining the knowledge base and status of commercially exploited marine species with the RAM Legacy Stock Assessment Database. Fish Fish. 13, 380–398, http://dx.doi.org/10.1111/j. 1467-2979.2011.00435.x.
Robinson, W.M., Butterworth, D.S., Plagányi É, E., 2015. 2015. Quantifying the projected impact of the South African sardine fishery on the Robben Island penguin colony. Ices J. Mar. Sci. 72, 1822–1833, http://dx.doi.org/10.1093/icesjms/fsv035.
Rodionov, S., Overland, J.E., 2005. Application of a sequential regime shift detection method to the Bering Sea ecosystem. ICES J. Mar. Sci. 62, 328–332.
Schwartzlose, R.A., Alheit, J., Bakun, A., Baumgartner, T.R., Cloete, R., Crawford, R.J.M., Fletcher, W.J., Green-Ruiz, Y., Hagen, E., Kawasaki, T., Lluch-Belda, D., Lluch-Cota, S.E., MacCall, A.D., Matsuura, Y., Nevarez-Martinez, M.O., Parrish, R.H., Roy, C., Serra, R., Shust, K.V., Ward, M.N., Zuzunaga, J.Z., 1999. Worldwide large-scale fluctuations of sardine and anchovy populations. S. Afr. J. Mar. Sci. 21, 289–347, http://dx.doi.org/10.2989/025776199784125962.
Sharpless, A., Evans, S., 2013. The Perfect Protein: The Fish Lover's Guide to Saving the Oceans and Feeding the World. Rodale Press.
Smith, A.D., Brown, C.J., Bulman, C.M., Fulton, E.A., Johnson, P., Kaplan, I.C., Lozano-Montes, H., Mackinson, S., Marzloff, M., Shannon, L.J., 2011. Impacts of fishing low-trophic level species on marine ecosystems. Science 333, 1147–1150, http://dx.doi.org/10.1126/science.1209395.
Szuwalski, C.S., Hilborn, R., 2015. Environment drives forage fish productivity. Proc. Natl. Acad. Sci. 112, E3314–E3315.
Szuwalski, C.S., Vert-pre, K.A., Punt, A.E., Branch, T.A., Hilborn, R., 2014. Examining common assumptions about recruitment: a meta-analysis of recruitment dynamics for worldwide marine fisheries. Fish Fish. 16, 633–648, http://dx.doi.org/10.1111/faf.120831.
Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S., Roos, S., Bolton, M., Langston, R.H., Burton, N.H., 2012. Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biol. Conserv. 156, 53–61, http://dx.doi.org/10.1016/j.biocon.2011.12.009.
Thorson, J.T., Jensen, O.P., Hilborn, R., 2014. Probability of stochastic depletion: an easily interpreted diagnostic for stock assessment modelling and fisheries management. ICES J. Mar. Sci. 72, 428–435, http://dx.doi.org/10.1093/icesjms/fsu127.
Tummers, B., 2006. DataThief III (v. 1.1). URL http://www.datathief.org/.
Vert-pre, K.A., Amoroso, R.O., Jensen, O.P., Hilborn, R., 2013. Frequency and intensity of productivity regime shifts in marine fish stocks. Proc. Natl. Acad. Sci. U. S. A. 110, 1779–1784, http://dx.doi.org/10.1073/pnas.1214879110.
Walters, C., Parma, A.M., 1996. Fixed exploitation rate strategies for coping with effects of climate change. Can. J. Fish. Aquat. Sci. 53, 148–158.
Walters, C., Christensen, V., Fulton, B., Smith, A.D.M., Hilborn, R., 2016. Predictions from simple predator-prey theory about impacts of harvesting forage fishes. Ecol. Modell. 337, 272–280.
Walters, C.J., 1985. Bias in the estimation of functional relationships from time series data. Can. J. Fish. Aquat. Sci. 42, 147–149.
Waring, G., Josephson, E., Maze-Foley, K., Rosel, E., 2015. Trends in selected US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2014. NOAA Technical Memorandum NMFS-NE-231.

Please cite this article in press as: Hilborn, R., et al., When does fishing forage species affect their predators? Fish. Res. (2017), http://dx.doi.org/10.1016/j.fishres.2017.01.008

2017 REVIEW OF THE FISHERY MANAGEMENT PLAN AND STATE COMPLIANCE FOR THE 2016 ATLANTIC MENHADEN *(Brevoortia tyrannus)* FISHERY

Prepared by:

The Atlantic Menhaden Plan Review Team
Megan Ware, Chair Atlantic States Marine Fisheries Commission
Ellen Cosby, Potomac River Fisheries Commission
Nicole Lengyel, Rhode Island Department of Environmental Management
Krista Shipley, Florida Fish and Wildlife Conservation Commission

April 2017

2017 REVIEW OF THE FISHERY MANAGEMENT PLAN AND STATE COMPLIANCE FOR ATLANTIC MENHADEN *(Brevoortia tyrannus)*

Management Summary

Date of FMP:	Original FMP: August 1981
Amendments:	Plan Revision: September 1992 Amendment 1: July 2001 Amendment 2: December 2012 Amendment 3: Draft in progress
Management Unit:	Maine through Florida
States With Declared Interest:	Maine – Florida
Additional Jurisdictions:	Potomac River Fisheries Commission, National Marine Fisheries Service, United States Fish and Wildlife Service
Active Boards/Committees:	Atlantic Menhaden Management Board, Advisory Panel, Technical Committee, Stock Assessment Subcommittee, Plan Review Team, Plan Development Team, Biological Ecological Reference Point Work Group
Stock Status:	Not overfished, and overfishing is not occurring (benchmark assessment; SEDAR 2015)

I. Status of the Fishery Management Plan

Atlantic menhaden management authority is vested in the states because the vast majority of landings come from state waters. All Atlantic coast states and jurisdictions, with the exception of the District of Columbia, have declared an interest in the Atlantic menhaden management program.

The first coastwide fishery management plan (FMP) for Atlantic menhaden was passed in 1981 (ASMFC 1981). The 1981 FMP did not recommend or require specific management actions, but provided a suite of options should they be needed. In 1992, the plan was revised to include a suite of objectives intended to improve data collection and promote awareness of the fishery and its research needs (ASMFC 1992).

DRAFT

Amendment 1, passed in 2001, provided specific biological, social/economic, ecological, and management objectives for Atlantic menhaden. No recreational or commercial management measures were implemented as a result of Amendment 1; however, subsequent addenda instituted a harvest cap on the reduction fishery in the Chesapeake Bay, based on average landings from 2001-2005. Two addenda (Addendum I and V) revised the biological reference points for menhaden and specified that stock assessments are to occur every three years.

Amendment 2, approved in December 2012, established a 170,800 metric ton (mt) total allowable catch (TAC) for the commercial fishery beginning in 2013. This TAC represented a 20% reduction from average landings between 2009 and 2011. The 2009-2011 time period was also used to allocate the TAC among the jurisdictions. In addition, the Amendment established requirements for timely reporting and required states to be accountable for their respective quotas by paying back any overages the following year. The amendment included provisions that allowed for the transfer of quota between jurisdictions and a bycatch allowance of 6,000 pounds per trip for non-directed fisheries that operate after a jurisdiction's quota has been landed. Further, it reduced the Chesapeake Bay reduction fishery harvest cap by 20% to 87,216 metric tons.

At its May 2015 meeting, the Board established a 187,880 mt TAC for the 2015 and 2016 fishing years. This represented a 10% increase from the 2013 and 2014 TAC. In October 2016, the Board approved a TAC of 200,000 mt for the 2017 fishing year, representing a 6.45% increase from the 2015 and 2016 fishing years.

In August 2016, the Board approved Addendum I which added flexibility to the current bycatch provision by allowing two licensed individuals to harvest up to 12,000 pounds of menhaden bycatch when working together from the same vessel using stationary multi-species gear. The intent of this Addendum was to accommodate cooperative fishing practices that traditionally take place in the Chesapeake Bay.

In May 2013, the Board approved Technical Addendum I which established an episodic events set aside program. This program set aside 1% of the coastwide TAC for the New England states (ME, NH, MA, RI, CT) to harvest Atlantic menhaden when they occur in higher abundance than normal. In order to participate in the program, a state must reach its individual quota prior to September 1, implement daily trip level harvester reporting, restrict harvest to state waters, and implement a daily trip limit no greater than 120,000 pounds/vessel. At its October 2013 meeting, the Board extended the episodic event set aside program through 2015, adding a provision that re-allocated unused set aside as of October 31 to the coastwide states based on the same allocation percentages included in Amendment 2. At its May 2016 meeting, the Board again extended the episodic events program until final action on Amendment 3 and added New York as an eligible state to harvest under the program.

DRAFT

At its February 2014 meeting, the Board passed a motion to manage cast net fisheries for Atlantic menhaden under the bycatch allowance for 2014 and 2015, with the states bearing responsibility for reporting. At its November 2015 meeting, the Board approved a motion to continue the management of cast net fisheries under the bycatch allowance for 2016. In February 2017, the Board extended management of the cast net fishery under the bycatch provision until implementation of Amendment 3.

II. Status of the Stock

Threshold reference points are the basis for determining stock status. When the fishing mortality rate (*F*) exceeds the *F*-threshold, overfishing is occurring. When the reproductive output measure, in this case population fecundity (*FEC*), falls below its threshold, then the stock is overfished, meaning there is insufficient egg production to replenish the stock.

Amendment 2 (2013) implemented maximum spawning potential (MSP) based reference points that relate current stock conditions as a percent of unfished conditions. Considering the modeling and data input changes that occurred in the 2015 Benchmark Stock Assessment, the TC and Peer Review Panel recommended new MSP based reference points that are applicable to the results of the assessment (SEDAR 2015). These new reference points were accepted by the Board in 2015.

As recommended by the Peer Review Panel, and accepted by the TC, the value of fishing mortality reference points is to be the geometric mean of fishing mortality on ages-2 to -4. These ages represent the fully selected fishing mortality rates depending upon the year and fishery (i.e., bait and reduction). The fecundity (FEC) reference points match the F reference points meaning they are equal to the fecundity estimated when F reaches equilibrium at its target and threshold MSP levels, respectively.

As a result, the fishing mortality reference points are *F*-target ($F_{57\% MSP}$) = 0.38 and *F*-threshold ($F_{26\% MSP}$) = 1.26. Associated reference points for population fecundity are *FEC*-target ($FEC_{57\%MSP}$) = 189,270 (billions of eggs), and *FEC*-threshold ($FEC_{26\%MSP}$) = 86,821 (billions of eggs). Based on the 2015 stock assessment, overfishing is not occurring because fishing mortality for the terminal year (2013) is estimated to be $F = 0.22$ ($F_{70\%MSP}$), below both the target and the threshold. Additionally, the stock is not overfished because fecundity for 2013 is estimated to be *FEC* = 170,536 billion eggs, above the threshold and just below the target.

The next stock assessment will be an update assessment in 2017.

III. Progress of the Biological Ecological Reference Point Work Group

The Biological Ecological Reference Point Work Group (BERP Work Group) has been tasked with developing menhaden-specific ecosystem reference points that account for the abundance of menhaden and the species role as a forage fish. An Ecosystem Management Objectives Workshop (EMOW) was held in 2015 to identify management goals and performance measures

for the menhaden-specific ERPs. With these objectives in mind, the BERP Work Group is currently evaluating a suite of multispecies models to determine which models should be pursued and forwarded to peer review. These candidate models include a Bayesian surplus production model with a time-varying population growth rate, a Steele-Henderson model which permits non-fisheries effects (predation and environment) to be quantified and incorporated into the single species stock assessments, and a multispecies statistical catch-at-age model in which single species models are linked to provide a predator-prey feedback between the population models. An Ecopath with Ecosim model is also being evaluated; however, the application of this model is for strategic planning (to explore tradeoffs), not quota setting advice.

In 2016, the BERP Work Group met in-person in July for a modeling workshop which focused on the Steel-Henderson model. In December, the group met via conference call to review changes made to the Steel-Henderson model and receive updates on the other modeling approaches. It is expected that a peer-review of the menhaden-specific ERP models, as well as a review of the current single-species model, will be conducted in the Fall of 2019.

IV. Development of Amendment 3

At their May 2015 meeting, the Board initiated the development of Amendment 3 to the Atlantic Menhaden FMP to pursue the development of ecological reference points (ERPs) and revisit allocation methods.

As a part of the 2015 Benchmark Stock Assessment, the peer review report listed the development of ERPs as a high priority for Atlantic menhaden management. Menhaden serve an important role in the marine ecosystem as they convert phytoplankton into protein and, in turn, provide a food source to a variety of species including larger fish (e.g., weakfish, striped bass, bluefish, cod), birds (e.g., bald eagles, osprey), and marine mammals (e.g., humpback whales, bottlenose dolphin). As a result, changes in the abundance of menhaden may have implications for the marine ecosystem. ERPs provide a method to assess the status of menhaden not only in regard to their own sustainability, but also in regard to their interactions with predators and the status of other prey species. The benefit of this approach is that it allows fishery managers to consider the harvest of menhaden within a broad ecosystem context, which includes other fish, birds, mammals, and humans who utilize and depend on marine resources.

In addition to ERPs, the Board also initiated Amendment 3 to revisit the allocation methods prescribed in Amendment 2 given concerns that the approach may not strike a balance between gear types and regions. Specifically, some states have expressed concern that under the current allocation method, increases in the TAC result in limited benefits to small-scale fisheries. In addition, concerns have been expressed that the current allocation method does not provide a balance between the present needs of the fishery and future growth opportunities. Given improvements in the condition of the Atlantic menhaden stock, the three-

year period of historical catch on which allocation is based may limit states who currently have minimal quota from participating in the growing fishery. Some states have also found evidence of unreported landings during the reference period, meaning the quota system may have reduced their fisheries to a greater extent than originally intended.

A Public Information Document (PID) for Amendment 3 was approved by the Board in October 2016 and public comment was collected between November and December 2016. In February 2017, the Board reviewed the comments provided on the PID and tasked the Plan Development Team with drafting Amendment 3. It is expected that Draft Amendment 3 will be approved by the Board in August 2017 and the Board will take final action on the document in November 2017.

V. Status of the Fishery

Recreational

Menhaden are important bait in many recreational fisheries; some recreational fishermen employ cast nets to capture menhaden or snag them with hook and line for use as bait, both dead and live. Recreational harvest is not well captured by the Marine Recreational Information Program (MRIP) because there is not a known identified direct harvest for menhaden, other than for bait. MRIP intercepts typically capture the landed fish from recreational trips as fishermen come to the dock or on the beach. Since menhaden caught by recreational fishermen are used as bait during their trip, they will not be a part of the catch that is typically seen by the surveyor completing the intercept.

The preliminary MRIP estimate of Atlantic menhaden harvest in 2016 is 1,863,159 pounds. This is significantly higher than the 931,921 pounds that were recreationally harvested in 2015.

Commercial

Total commercial Atlantic menhaden landings in 2016 (preliminary), including reduction, bait, bycatch, and episodic event set aside (EESA) landings, was 398.33 million pounds. The bycatch landings[1] of 2.18 million pounds do not count toward the coastwide commercial TAC of 414.2 mil pounds. The non-bycatch landings total was 396.15 million pounds, representing a 4.4% underage of the coastwide TAC in 2016, and a 3.6% decrease from the 410.8 mil pounds landed in 2015.

Reduction Fishery

The 2016 harvest for reduction purposes was 302.9 million pounds. This represents a 4.2% decrease from 2015 reduction landings, and a 6% decrease from the previous 5-year (2011-2015) average of 321.9 mil pounds (Figure 1). Omega Protein's plant in Reedville, Virginia, is the only active Atlantic menhaden reduction factory on the Atlantic coast.

[1] Landed under the 6,000 pound bycatch allowance

Bait Fishery
The preliminary estimate of the coastwide directed bait harvest for 2016 is 95.4 million pounds; this is a 5.6% decrease from the 2015 bait harvest, and a 10.1% decrease from the average harvest of the previous five years (2011-2015), 106.1 mil pounds (Figure 1). New Jersey (48%), Virginia (33%), Maryland (5.5%), Maine (4.7%), and Massachusetts (3.2%) landed the five largest shares.

Bycatch Landings
Bycatch landings in 2016 totaled 2.2 million pounds, which represents a 63% decrease from 2015 bycatch landings. The 2016 bycatch landings accounted for approximately 0.55% of the coastwide landings, but do not count towards the coastwide TAC. In 2016, the states of Maryland, Virginia, New York, and Maine comprised 78% of the bycatch landings with Rhode Island, New Jersey, Delaware, PRFC, and Florida accounting for the remaining 22% (Table 1). The predominant gears used from 2013-2016 include pound nets (61%) and anchored/staked gill nets (23%), which together accounted for 84% of the average landings from 2013 through 2016 (Table 1).

A total of 1908 trips landed bycatch of Atlantic menhaden in 2016. A majority of the bycatch trips (69%) landed less than 1,000 pounds from 2013 through 2016 (Table 2).

Episodic Events Set Aside Program
One percent of the TAC is set aside for episodic events. Episodic events are defined as any instance when a qualified state has reached its individual state quota, prior to September 1, and has information indicating the presence of unusually large amounts of menhaden in its state waters. In 2016, New York, Rhode Island, and Maine declared participation in the set aside. While not a New England state, New York was approved by the Board in May 2016 to harvest under the set aside program. In total, 3.81 million pounds were harvested under the set aside. The remaining roughly 331,895 pounds were re-allocated to all the coastal states on November 1, 2016 using the allocation percentages from Amendment 2.

VI. Status of Research and Monitoring

Commercial fisheries monitoring
Reduction fishery - The NMFS Southeast Fisheries Science Center Beaufort Laboratory in Beaufort, North Carolina, continues to monitor and process landings and bio sample data collected from the Atlantic menhaden purse-seine reduction fishery. The Beaufort Laboratory processes and ages all reduction samples collected on the East Coast. In addition, the purse-seine reduction fishery continues to provide Captains Daily Fishing Reports (CDFRs) to the Beaufort Laboratory where NMFS personnel enter data into a database for storage and analysis.

DRAFT

Bait fishery - Per Amendment 2, states are required to implement a timely quota monitoring system in order to maintain menhaden harvest within the TAC and minimize the potential for overages. The SAFIS daily electronic dealer reporting system allows near real time data acquisition for federally permitted bait dealers in the Mid-Atlantic and Northeast. Landings by Virginia's purse-seine for-bait vessels (snapper rigs) in Chesapeake Bay are tabulated (at season's end) using CDFRs maintained on each vessel during the fishing season. A bait-fishery sampling program for size and age composition has been conducted since 1994. The Beaufort Laboratory, and some states, age the bait samples collected. See *Section VII: Implementation for FMP Compliance Requirements for 2016* for further information on age and length sampling requirements.

Atlantic menhaden research

The following studies relevant to menhaden assessment and management have been published within the last year:

- *Simpson, C. A., Wilberg, M. J., Bi, H., Schueller, A. M., Nesslage, G. M., and H. J. Walsh. 2016. Trends in Relative Abundance and Early Life Survival of Atlantic Menhaden during 1977-2013 from Long-Term Ichthyoplankton Programs. Transactions of the American Fisheries Society, 145(5): 1139-1151.*
    - Larval data from two large-scale sampling programs which span Nova Scotia, Canada to Cape Hatteras, North Carolina were used to develop an index of menhaden larval abundance. Overall, menhaden larval abundance increased from 1977 to 2013 and the trend closely corresponds to adult spawning stock biomass. In contrast, menhaden juvenile indices have declined during this time period. This study suggests that the decline in the juvenile abundance is not the result of reduced larval supply but is rather a result of limited survival between the larval and juvenile life stages.
- *Hilborn, R., Amoroso, R. O., Bogazzi, E., Jensen, O. P., Parma, A. M., Szuwalski, C., and C. J. Walters. In press. Fisheries Research.*
    - Literature on 11 forage species were reviewed to explore the impact of harvesting low trophic level species on predators such as fish, birds, and marine mammals. The paper contends that the impact of harvesting forage fish on predator species is less than previously estimated as current models do not account for the population variability of forage fish, the critical role of the environment in recruitment, the size distribution of forage fish, and the spatial distribution of these lower trophic species.
- *Houde, E. D., Annis, E. R., Harding, L. W., Malonee, M. E., and M. J. Wilberg. 2016. Factors affecting the abundance of age-0 Atlantic menhaden (Brevoortia tyrannus) in Chesapeake Bay. ICES Journal of Marine Science, 73(9): 2238-2251.*
    - The abundance of age-0 menhaden from seine and trawl surveys was analyzed to determine the impact of primary productivity and environmental variables on young of year menhaden. Results showed a positive relationship between recruit abundance and primary productivity between 1989 and 2004 but a negative

relationship between the lengths of age-0 menhaden and abundance. This suggests that food and density-dependent factors may influence menhaden recruitment.

- *Buchheister, A., Miller, T. J., Houde, E. D., Secor, D. H., and R. J. Latour. 2016. Spatial and temporal dynamics of Atlantic menhaden (Brevoortia tyrannus) recruitment in the Northwest Atlantic Ocean. ICES Journal of Marine Science, 73(4): 1147-1159.*
    - Young of year indices from 1959 to 2013 were used to investigate spatial and temporal variability in menhaden recruitment. The study found two geographic groups, one in the Chesapeake Bay and one in Southern New England. The Atlantic Multidecadal Oscillation was the best predictor of menhaden recruitment trends in both regions.
- *Anstead, K. W., Schaffler, J. J., and C. M. Jones. 2016. Coast-Wide Nursery Contribution of New recruits to the Population of Atlantic Menhaden. Transactions of the American Fisheries Society, 145(3): 627-636.*
    - Otolith chemistry was used to evaluate the relative importance of menhaden nursery grounds to the overall population. The Chesapeake Bay, while still contributing the highest proportion of age-1 recruits, showed a decline in recruitment over the last 20 years. In contrast, contributions from nursery grounds in New England have increased over time.

VII. Implementation of FMP Compliance Requirements for 2016

All states are required to submit annual compliance reports by April 1.

Quota Results

The final state quotas for 2016 include an adjustment from the reallocation of unused episodic event set aside that occurred on November 1, as well as eight inter-state quota transfers (Table 3). Massachusetts transferred 35,986 pounds to Rhode Island. A second transfer of 100,000 pounds was made from Massachusetts to Rhode Island to allow for the harvest of menhaden in the fall, but since this transfer was not used, the full 100,000 pounds was transferred back to Massachusetts. North Carolina transferred 85,000 pounds to Florida, 492,823 pounds to New York (occurred over two transfers), and 300,000 pounds to Maine. Virginia transferred 1.5 million pounds to Maine. Table 3 contains state specific quotas and harvest that occurred in 2016. Table 4 displays the breakdown in directed versus bycatch landings by jurisdiction.

At their Annual meeting, the Board set the 2017 TAC at 200,000 mt (440.9 million pounds), a 6.45% increase from the 2016 TAC. State-specific quotas for the 2017 fishing year are displayed in Table 3. Florida's 2017 quota will be reduced by the amount of their overage in 2016 unless an inter-state quota transfer is processed.

Quota Monitoring

Menhaden purse seine and bait seine vessels (or snapper rigs) are required to submit Captain's Daily Fishing Reports (CDFRs). Maine and Virginia fulfilled this requirement in 2016. New Jersey

did not require purse seine vessels to fill out the specific CDFR but did require monthly trip level reporting on state forms that include complementary data elements to the CDFR. Rhode Island purse seine vessels must call in daily reports to RI DFW and fill out daily trip level logbooks. Massachusetts requires trip level reporting for all commercial fishermen.

Through Amendment 2, the Board approved timely quota monitoring programs for each state that were intended to minimize the potential for quota overages. Table 5 contains a summary of each state's approved quota monitoring system. Several states did exceed their quota and many pursued quota transfers to ameliorate this overage. In most cases, quota overages resulted from the fact that there was a high and/or variable volume of landings over a short period of time relative to the size of the quota.

Biological Monitoring Requirements

Amendment 2 implemented monitoring requirements for non *de minimis* states as follows:

- One 10-fish sample (age and length) per 300 metric tons landed for bait purposes for ME, NH, MA, RI, CT, NY, NJ, and DE; and
- One 10-fish sample (age and length) per 200 metric tons landed for bait purposes for MD, PRFC, VA, and NC.

Table 6 provides the number of 10-fish samples required for 2016. These are based on the best available 2016 total bait landings data (including bycatch and episodic events) provided to the Commission by the states. Table 6 also provides the number of ages and lengths collected by the states in 2016, and an indication of the gear type sampled during collections. All states met the biological monitoring requirements of Amendment 2 in 2016.

Adult CPUE Index Requirement

Amendment 2 required that, at a minimum, each state with a pound net fishery must collect catch and effort data elements for Atlantic menhaden as follows; total pounds landed per day, number of pound nets fished per day. These are harvester trip level ACCSP data requirements. In May of 2013, the Board approved North Carolina's request to omit this information on the basis that it does not have the current reporting structure to require a quantity of gear field by harvesters or dealers. All other states with a pound net fishery met this requirement.

Chesapeake Bay Reduction Fishery Cap

Amendment 2 implemented a change to the Chesapeake Bay Cap for the reduction fishery, starting in 2013 and continuing indefinitely. The cap is set at 87,216 metric tons (a 20% reduction from 109,020 mt which was the average landings from 2001-2005). Harvest for reduction purposes shall be prohibited within the Chesapeake Bay when 100% of the cap is harvested from the Chesapeake Bay. A maximum of 10,976 mt of un-landed fish under the Cap can be rolled over into the subsequent year.

DRAFT

Reported reduction landings from the Chesapeake Bay for 2016 was less than 45,000 metric tons, which is below the Cap. As a result, the 2017 Chesapeake Bay Cap for the reduction fishery is 98,192 metric tons. The rollover applies to the following year only, and will not be carried for multiple years.

De Minimis Status
To be eligible for *de minimis* status, a state's bait landings must be less than 1% of the total coastwide bait landings for the most recent two years. State(s) with a reduction fishery are not eligible for *de minimis* consideration. If granted *de minimis* status by the Board, states are exempt from implementing biological sampling as well as pound net catch and effort data reporting. The Board also approved a *de minimis* exemption for New Hampshire, South Carolina and Georgia from implementation of timely reporting

The states of New Hampshire, Pennsylvania, South Carolina, Georgia, and Florida requested and qualify for *de minimis* status for the 2017 fishing season. As a result, the PRT recommends that New Hampshire, Pennsylvania, South Carolina, Georgia, and Florida be granted *de minimis* status.

VIII. Plan Review Team Recommendations

Management Recommendations

- That the Board approve the *de minimis* requests from New Hampshire, Pennsylvania, South Carolina, Georgia, and Florida.
- That jurisdictions which repeatedly, or grossly, exceed their quota implement more frequent reporting to avoid overages.

DRAFT

IX. Literature Cited

Atlantic States Marine Fisheries Commission (ASMFC). 1981. Fishery Management Plan for Atlantic Menhaden. 146 pp.

ASMFC. 1992. Fishery Management Plan for Atlantic Menhaden 1992 Revision. 170 pp.

---------. 2001. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. 146 pp.

---------. 2004. Addendum I to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. 52 pp.

---------. 2011. Addendum V to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Menhaden. 17 pp.

---------. 2012. Amendment 2 to the Interstate Fishery Management Plan for Atlantic Menhaden. 114 pp.

---------. 2013. Technical Addendum I to Amendment 2 to the Interstate Fishery Management Plan for Atlantic Menhaden. 4 pp.

---------. 2016. Addendum I to Amendment 2 to the Interstate Fishery Management Plan for Atlantic Menhaden. 12 pp.

Southeast Data, Assessment, and Review (SEDAR). 2015. SEDAR 40 – Atlantic Menhaden Stock Assessment Report. SEDAR, North Charleston SC. 643 pp.

DRAFT

Table 1. Average landings under the bycatch allowance from 2013–2016 by gear type (stationary and mobile) and jurisdiction. Highlighted cells represent the gear type with the highest landings within a jurisdiction. (C) = confidential landings, and (-) = no landings. Total confidential landings are 183,747 pounds (i.e., the sum of all C's in the table below). Note that sum of pounds and percent of total columns do not include confidential data.

State/Jurisdiction	ME	RI	CT	NY	NJ	DE	MD	PRFC	VA	FL	Sum lbs (NonConf)	% of Total
Stationary Gears While Fishing												
Pound net	-	47,907	-	96,176	C	-	1,943,711	688,428	112,609	-	2,888,830	61.36%
Anchored/stake gill net	-	C	913	0	79,850	23,227	19,722	1,704	966,832	C	1,092,248	23.20%
Pots	-	-	-	C	-	C	C	-	-	C	-	0.00%
Fyke nets	-	-	-	-	C	-	C	26	77	-	103	0.00%
Mobile Gears While Fishing											-	
Cast Net	-	C	-	152,669	C	-	C	-	-	150,585	303,253	6.44%
Drift Gill net	-	-	-	24,443	83,697	53,381	12,061	-	62,189	-	235,771	5.01%
Purse Seine	C	-	-	-	-	-	-	-	-	-	-	0.00%
Seines Haul/Beach	-	-	-	177,173	-	-	C	35	3,840	-	181,048	3.85%
Trawl	-	C	C	6,565	C	-	-	-	-	-	6,565	0.14%
Hook & Line	-	C	C	-	-	-	C	-	-	C	-	0.00%
Sum lbs (NonConf)	-	47,907	913	457,025	163,547	76,608	1,975,494	690,193	1,145,547	150,585	4,707,818	
% of Total	0.00%	1.02%		9.71%	3.47%	1.63%	41.96%	14.66%	24.33%	3.20%		

Table 2. Total number of bycatch trips by year from 2013-2016 separated into 1,000 pound landings bins.

Bins (LBS)	2013 Trips	2014 Trips	2015 Trips	2016 Trips	Total Trips	% of Total Trips 2013-2016
1-1000	1,875	3,673	3,163	1,450	10,161	69%
1001-2000	252	517	582	148	1,499	10%
2001-3000	148	318	316	73	855	6%
3001-4000	110	190	139	48	487	3%
4001-5000	131	206	132	48	517	4%
5001-6000	158	265	196	108	727	5%
6000+	130	109	140	33	412	3%
Total	**2,804**	**5,278**	**4,668**	**1,908**	**14,658**	

DRAFT

Table 3. Results of 2016 quota accounting in pounds. Note, in this table, the 2016 landings do not include bycatch landings because they do not count towards the TAC. Unused episodic events set aside quota that was re-allocated to the states totaled 331,895 pounds. The 2017 quotas account for overages which occurred in the 2016 fishery.

State	2016 Quota	Returned Set Aside	Transfers	Total 2016 Quota	2016 Landings	Overage	2017 Quota
ME	161,466	131	1,800,000	1,961,597	1,090,050		171,882
NH	123	0		123	0		131
MA	3,438,630	2,783	(35,986)	3,405,427	3,069,433		3,660,454
RI	73,457	59	35,986	109,502	109,443		78,195
CT	71,537	58		71,595	66,957		76,152
NY	227,365	184	492,823	720,372	720,372		242,032
NJ	45,893,335	37,145		45,930,480	45,630,950		48,853,880
DE	54,153	44		54,197	54,153		57,646
MD	5,628,568	4,556		5,633,123	4,328,016		5,991,662
PRFC	2,545,595	2,060		2,547,655	2,399,154		2,709,809
VA	349,873,884	283,180	(1,500,000)	348,657,064	333,848,603		372,443,990
NC	2,020,645	1,635	(877,823)	1,144,457	860,761		2,150,995
SC	-	-		-	0		-
GA	-	-		-	0		-
FL	72,030	60	85,000	157,090	161,260	4,170	74,279
Total	410,060,788	331,895	-	410,392,683	392,339,152	4,170	

DRAFT

Table 4. Directed, bycatch, and episodic landings (pounds) for 2016 by jurisdiction.

	Directed	Bycatch	Episodic
ME	1,090,050	C	C
NH			
MA	3,069,433		
RI	109,443	C	C
CT	66,957		
NY	720,372	C	C
NJ	45,630,950	195,523	
DE	54,153	21,085	
MD	4,328,016	870,638	
PRFC	2,399,154	105,669	
VA	333,848,603	296,861	
NC	860,761		
SC			
GA			
FL	161,260	111,165	
Total	392,339,414	2,175,736	3,810,145

DRAFT

Table 5: State quota reporting timeframes in 2016. The **bold** text indicates which reporting program (dealer or harvesters) the states use to monitor its quotas.

State	Dealer Reporting	Harvester Reporting	Notes
ME	monthly	**monthly/daily**	Harvesters landing greater than 6,000 lbs must report daily during episodic event
NH	**weekly**	monthly	Exempt from timely reporting. Implemented weekly, trip level reporting for state dealers.
MA	**weekly**	monthly/daily	Harvesters landing greater than 6,000 lbs must report daily
RI	**twice weekly**	quarterly/daily	Harvesters using purse seines must report daily
CT	**weekly/monthly**	monthly	No directed fisheries for Atlantic menhaden
NY	**Weekly**	monthly	Capability to require weekly harvester reporting if needed
NJ	**weekly**	monthly	All menhaden sold or bartered must be done through a licensed dealer
DE	—	**monthly/daily**	Harvesters landing menhaden report daily using IVR
MD	monthly	**monthly/daily**	PN harvest is reported daily, while other harvest is reported monthly.
PRFC	—	**weekly**	Trip level harvester reports submitted weekly. When 70% of quota is estimated to be reached, then pound netters must call in weekly report of daily catch.
VA	—	**monthly/weekly/daily**	Purse seines submit weekly reports until 97% of quota, then daily reports. Monthly for all other gears until 90% of quota, then reporting every 10 days.
NC	**monthly (combined reports)**		Single trip ticket with dealer and harvester information submitted monthly. Larger dealers (>50,000 lbs of landings annually) can report electronically, updated daily.
SC	**monthly (combined reports)**		Exempt from timely reporting. Single trip ticket with dealer and harvester information.
GA	**monthly (combined reports)**		Exempt from timely reporting. Single trip ticket with dealer and harvester information.
FL	**monthly/weekly (combined reports)**		Monthly until 50% fill of quota triggers implementation of weekly.

DRAFT

Table 6. Biological monitoring results in 2016. Note that total bait landings includes bycatch landings.

State	#10-fish samples required	#10-fish samples collected	Age samples collected	Length samples collected	Gear/Comments
ME	7	9	9	9	purse seine
MA	5	7	7	7	purse seine (2), cast net (5)
RI	0	5	60	60	floating fish trap
CT	0	1	5	5	gill nets
NY	2	9	90	90	seines
NJ	69	113	1130	1130	purse seine (100), and other gears (13)
DE	0	5	50	50	drift gill net
MD	12	19	247	732	pound net
PRFC	6	9	90	90	pound net
VA	71	82	820	820	pound net (16), gill net (64), haul seine (2)
NC	2	6	60	60	gillnet, seine
Total	116	**265**	**2,568**	**3,053**	

DRAFT

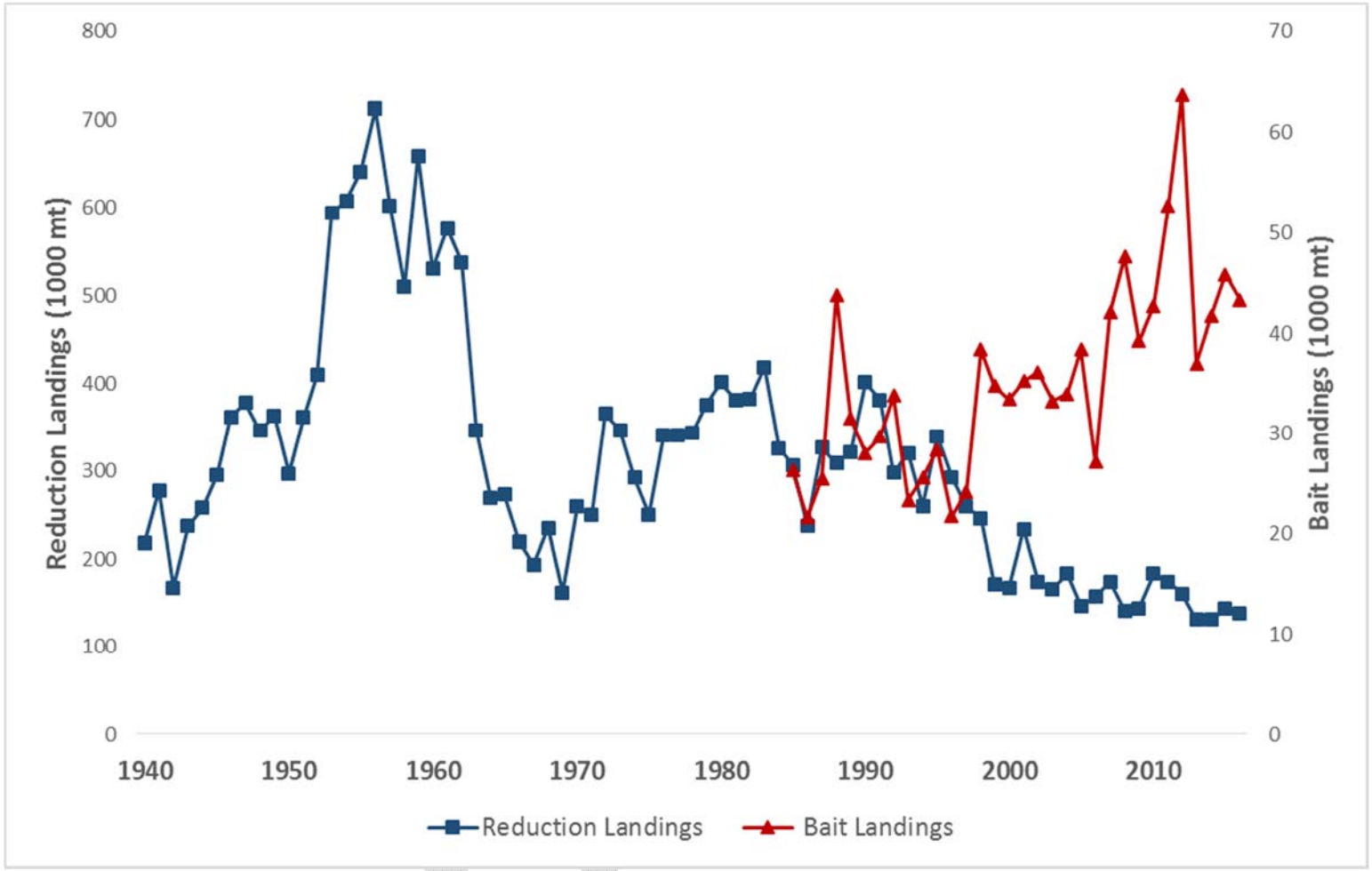


Figure 1. Landings from the reduction purse seine fishery (1940–2016) and bait fishery (1985–2016) for Atlantic menhaden. Note: there are two different scales on the y-axes.

LIVINGBIRD

CORNELL LAB OF ORNITHOLOGY

SPRING 2017 VOL. 36, ISSUE 2

CONSERVATION

Lessons from the Osprey Garden

Six decades ago, a dwindling Osprey population in Connecticut told the story of DDT contamination in an ecosystem. Today one conservation scientist says abundant Osprey reflect the success of environmental regulations–and the need to manage a critical coastal fishery.

STORY BY ANNE SEMMES; PHOTOS BY MELISSA GROO

Much of biologist-naturalist Paul Spitzer's life has moved in time with the seasonal rhythms of one bird, the Osprey, and one place—the "Osprey garden."

In late spring he paddles his canoe into the Great Island saltmarsh, 500 acres of prime Osprey habitat where the Connecticut River flows into Long Island Sound. In this marshy inlet, Spitzer checks for action in nests among 35 Osprey platforms that have been erected here since the late 1950s. As he disembarks, the resident Ospreys take to anxious flight. He raises a pole topped with a mirror over a platform nest. These days, he sees abundant breeding success in the mirror's reflection—three healthy young birds with ragged crests and brown-spangled wings. But it wasn't always this way.

Spitzer first stepped onto Great Island nearly 60 years ago, as an 11-year-old boy in 1957. That year, he accompanied birding legend Roger Tory Peterson on a Christmas Bird Count. Thus began a mentorship that set Spitzer onto a career path to becoming a ecologist.

When Spitzer graduated from college, Peterson urged him to take up the question of what was causing a sudden and drastic decline among the Ospreys.

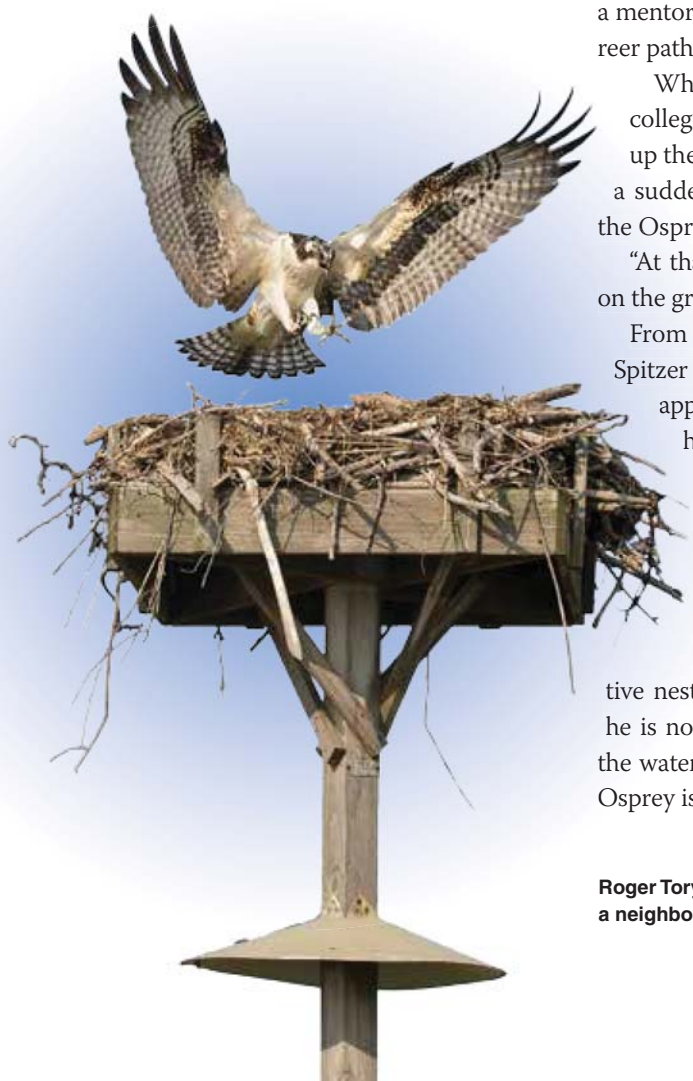
"At that time, the curtain was rising on the great DDT drama," says Spitzer.

From the 1960s through the 1970s, Spitzer watched Ospreys almost disappear from Connecticut, and he pioneered experiments that helped establish DDT as a cause of their decline. He has also seen Ospreys make a triumphant recovery in the Connecticut River estuary. And with more than 300 active nests recorded in the state today, he is now turning his attention below the water, where the next challenge for Osprey is a vanishing fish.

Ecologist Paul Spitzer has been watching the Ospreys in the Connecticut River estuary for almost 60 years.

PETERSON TRACKED THE DECLINE OF LOCAL OSPREYS from 150 in the 1950s to just 13 in 1965. He and his wife Barbara tried to help the Ospreys by building dozens of nest platforms to protect their nests from predators such as raccoons. But the birds still weren't bringing forth fledglings. Food didn't seem to be a problem—there was no shortage of menhaden, the large-headed bait fish that is one of the Osprey's primary food sources in Long Island Sound. Spitzer had spent hours watching the fish hawks rising from the water with menhaden nearly a foot long in their oversized talons.

"Roger began to suspect DDT," Spitzer says. In the 1940s and 50s, DDT was used to control mosquito popu-



Roger Tory Peterson and his wife Barbara raised the first platforms in the "Osprey garden," a neighborhood of artificial nesting structures in the Great Island saltmarsh.

lations in residential areas, especially along coasts and near wetlands. "He had a hunch the Ospreys were ingesting the DDT from fish. Rachel Carson's findings were informing our discouraging field studies, and I was cutting my teeth as an ecologist studying this new paradigm of environmental toxicology."

During nest checks, Spitzer found thin-shelled, collapsing eggs and was reminded of a British study that showed similar thinning in Peregrine Falcon eggs.

Shortly after receiving his biology degree from Wesleyan University, Spitzer had the idea to isolate local ecological effects in Connecticut by switching eggs in Osprey nests there with eggs from a healthy population of breeding Osprey near Chesapeake Bay.

"Not nearly as much DDT was applied to Maryland saltmarshes, and it was probably diluted in the far larger Chesapeake system," says Spitzer. By performing the switch, he could isolate whether the problem was with local environmental conditions or intrinsic to the Connecticut eggs.

The Patuxent Wildlife Research Center in Maryland signed on to Spitzer's idea and provided staff to collect eggs.

From the outset, Spitzer saw the Maryland eggs hatch healthy chicks in Connecticut, but not vice versa.

"The embryos in Connecticut eggs died, and we found the shells to be thin by simple measurement," he says. "We also found dented or collapsed eggs in some Connecticut nests." None of these problems affected the Maryland eggs.

Next, he arranged transfers of young nestlings from Maryland to Connecticut, to look beyond egg problems. The results were the same: "Virtually all the Maryland nestlings fledged in Connecticut, [so there were] no problems with food at this time. The failure was egg viability," Spitzer says. Later lab tests revealed DDE (a breakdown product of DDT) as well as PCBs and another organochloride, dieldrin, at much higher concentrations in the Connecticut eggs compared to the Maryland eggs.

"All signs pointed to Roger's hunch being right, that it was DDT," he says.

DDT was banned in Connecticut in 1972, and two years later Osprey numbers on Great Island bottomed out, with just a single nest remaining as the vestiges of DDT made their way out of the ecosystem.

Today, there are approximately 100 active nests at Great Island and the overflow is helping populations at nearby Gardiners Island and eastern Long Island grow. Statewide, the Connecticut Audubon Society's Osprey Nation monitoring project recorded 337 active nests in 2016, and 490 fledged young throughout the state—a rate nearly double that which Spitzer had calculated was necessary for a stable Osprey population.

Numbers like these, along with steady positive trends along Breeding Bird Survey routes, help explain why breeding Ospreys are now abundant and widespread in Connecticut and throughout the eastern United States. Spitzer points to a combination of factors including an increase in artificial nest sites, a decrease in harmful residues in their food sources, and continued high levels of food availability, particularly Atlantic menhaden.

FOR THE LAST THREE SUMMERS the Connecticut Audubon Society has sponsored Spitzer's ongoing work in the Connecticut River estuary, but the aim

Spitzer uses a mirror attached to a telescopic pole to check on Osprey nests (left). Back in the 1960s, he would often see collapsed eggs in the mirror's reflection. Today he typically sees healthy eggs (middle) or nestlings (right). Photos by Anne Semmes.

of the research has now shifted to monitoring the relationship between Osprey and menhaden.

As in the 1960s, Spitzer's attention is again focused on Great Island, now fittingly protected as a Roger Tory Peterson Wildlife Area. During June and July, Spitzer has documented that the Ospreys' diet is 95 percent to 100 percent menhaden. Spitzer says the story is much the same from Connecticut to Virginia, with menhaden-fueled Osprey nesting colonies experiencing a revival.

"Over 50 years of Osprey study, we have moved from the sad story of DDT-induced egg failure and a declining population to the happy story of abundant Ospreys," Spitzer says. "Our ongoing legacy from Osprey study must be the management of the East Coast ecosystem for abundant menhaden. We have to leave enough menhaden in the water to perform their precious and essential economic and ecological functions."

Rich in oils and fat, menhaden live in Atlantic coastal waters ranging from Nova Scotia to northern Florida, but reach peak abundance in and around the Chesapeake Bay. In addition to serving as the primary food source for breeding Ospreys and their chicks along the New England coast, menhaden are also a main food source for striped bass and bluefish. And, they constitute a significant fishery for people—second only to pollock among the ranks of fish harvested by volume in the United States. But people don't eat menhaden for dinner. They process it into other forms, mostly pills.

Most of the nearly 200,000-metric-ton annual menhaden catch is rendered into omega-3 fatty acid fish oil for the health supplement industry. And most of that catch comes via purse-seine fishing, in which two fishing boats circle around a single school of fish and enclose it within a gigantic net. These operations are extremely efficient at catching huge volumes of fish. Only one state (Virginia) currently allows purse-seine fishing of menhaden, but the fish caught in the Chesapeake Bay and Virginia waters account for 85 percent of the total menhaden harvest.

Because a large share of the range-wide menhaden population is clustered in the mid-Atlantic region, harvests there have a significant effect on the population as a whole. As the fish-oil market boomed in the 1990s and 2000s, menhaden populations began to dwindle. In 2010 stocks hit a 54-year low. In 2013 the Atlantic States Marine Fisheries Commission reduced the quota of commercial menhaden harvest by 20 percent. Spitzer attributes the recent robust East Coast Osprey populations to the renewed health of the menhaden fishery following these new rules.

"It was a huge win," says Spitzer.

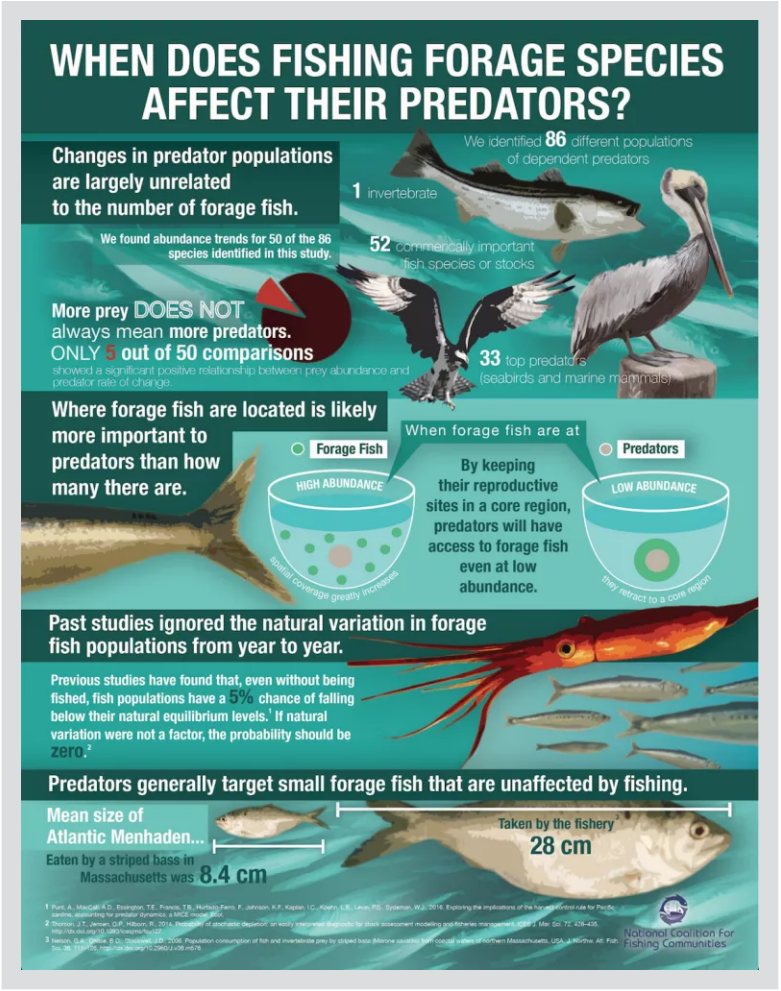
But now, many ocean conservationists say menhaden are once again coming under intense fishing pressure. In 2015 and 2016, the quota was increased by about 10 percent, and the menhaden quota for 2017 has been increased by about 6 percent from 2016. Some industry representatives are suggesting that the menhaden quota could be raised by up to 30 percent without harming the overall fishery.

Spitzer thinks the ASMFC should be more conservative in what it allows so that the menhaden population doesn't crash again, as it did earlier this decade. He also thinks the continued abundance of menhaden is critical to the continued abundance of Ospreys.

"It is a great blessing to have been able to study Ospreys for 50 years and counting. I have observed so many positive outcomes for these birds over the years," Spitzer says. "Decisions about menhaden now will affect not only fish, but birds, coastal ecosystems and, in the end, every one of us."

Ospreys soar above the waters of the Great Island saltmarsh and swoop down to snatch Atlantic menhaden.

NEW STUDY CHALLENGES EARLIER FINDINGS REGARDING LINK BETWEEN PREDATORS, FORAGE FISH



WASHINGTON (Saving Seafood) – April 3, 2017 – A new study published today in *Fisheries Research* finds that fishing forage fish may have a smaller impact on their predators than previously thought. The study, authored by a team of marine scientists led by renowned University of Washington fisheries expert Dr. Ray Hilborn, calls into question previous forage fish research that may have overestimated the effect of fishing of forage fish on their predators.

The study, "When does fishing forage species affect their predators?," finds that changes in predator populations are largely unrelated to the abundance of forage fish. It also shows that the distribution of forage fish is more important to predators than their overall abundance, and that many predators prefer smaller forage fish that are largely unaffected by fishing. Based on these results, the authors recommend that forage fishing policies be created on a case-by-case basis.

The paper's findings point to issues with previous forage fish research, most notably a five-year-old study funded by the Lenfest Ocean Program, managed by The Pew Charitable Trusts, which it says failed to consider important variables like the spatial distribution of forage fish. Arguably the largest oversight in past research was the high natural variability of forage fish populations, even in the absence of fishing, the authors write.

"There is little evidence for a strong connection between forage fish abundance and the rate of change in the abundance of predators," the authors write. "The fact that few of the predator populations evaluated in this study have been decreasing under existing fishing policies suggests that current harvest strategies do not threaten the predators and there is no pressing need for more conservative management of forage fish."

The authors suggest that the lack of a strong relationship between forage fish and their predators is the result of "diet flexibility" – the idea that predators can switch between prey species, helping them defend against the high natural variability of forage fish populations.

This finding contradicts the widely reported conclusions of the Lenfest Forage Fish Task Force in 2012. The study, "Little Fish, Big Impact," claimed that forage fish are twice as valuable to humans when they are left in the water, rather than fished, because of their great importance to predator species. Based on this conclusion, the Lenfest group recommended cutting forage fish catch rates across the board by 50 to 80 percent.

But Dr. Hilborn and his coauthors advocate for a more nuanced approach, writing that previous models "were frequently inadequate for estimating impact of fishing forage species on their predators" and that "a case by case analysis is needed." The team explicitly calls into question the Lenfest study's recommendations, which it says are "not appropriate for all species."

"Relevant factors are missing from the analysis contained in [the Lenfest] work, and this warrants re-examination of the validity and generality of their conclusions," the authors write. "We have illustrated how consideration of several factors which they did not consider would weaken the links between impacts of fishing forage fish on the predator populations."

These missing elements include how fishing mortality compares with the natural variability of forage species, the spatial structure of forage fish populations, and the overlap between the sizes of forage fish eaten by predators and size taken by the fishery.

"It must be remembered that small pelagic fish stocks are a highly important part of the human food supply, providing not only calories and protein, but micronutrients, both through direct human consumption and the use of small pelagics as food in aquaculture," the paper concludes. "Some of the largest potential increases in capture fisheries production would be possible by fishing low trophic levels much harder than currently."

Read an infographic about the study here

Watch a video about the study here

PAUL RANDOLPH SPITZER: Osprey Scientific Research Summary, 1968-2017, 50 Years

My initial round of osprey research was 1968-1978. **The first focus** was demonstrating the role of food-chain DDE (and locally dieldrin, such as the Connecticut River Estuary, "CRE") in excessive adult mortality and egg hatching failure, resulting in population crash. This work included the egg transfer experiments of 1968-69, MD to CT; and 1973, VA to eastern Long Island ("ELI").

Several resulting publications documented DDE impact, including one on eggshell thinning, in Ogden 1972 (sometimes cited as 1977). This culminated in our 1978 multiauthor Science paper on osprey reproductive recovery in ELI-CT as DDE residues declined very substantially.

My second focus was population dynamics, as reported in my 1980 Cornell U. PhD thesis (under Tom Cade). Beginning with a 1969 nest survey, I learned that the remaining ospreys breeding between NYC and Boston, perhaps 10% of the pre-DDT population, were now a discrete population of ~140 active nests. Over the following decade, in painstaking field studies, I measured (or recorded from other informants) key population parameters such as total annual breeding population size, annual natality, annual adult survival rate, ages at first breeding, and fledging-to-breeding dispersal. This empirical data enabled me to create a model that estimated Replacement Rate to be ~0.8 young fledged/active nest, in a population artificially depressed relative to available resources. The subsequent decades of North American osprey population explosion, both in range and density, have demonstrated this low replacement rate. (This quantitative relationship may well hold in Europe, too.)

My third round of field research, beginning in 1982, was primarily located on the MD Eastern Shore of Chesapeake Bay. I built on the extensive scientific population study publications and unpublished nestling banding studies of Jan Reese locally, and Mitchell Byrd south across the Bay in tidewater VA. I trapped 136 banded breeding ospreys, thus birds of known age and origin. Using my PhD thesis model equation, I made what I consider to be definitive statements about population regulation via competition for good quality nest sites and mates in this stable Eastern Shore population. Here, mean age at first breeding was at least two years higher than my depressed 1970's thesis population study to the north. This delay in a key reproductive parameter brought natality and mortality into balance, resulting in a stable population. Presumably, this delayed reproduction is also current in the expanding menhaden-fueled CRE, CT, population, where limited predator-proof nest platforms force extensive tree-nesting, and even (completely unsuccessful) ground-nesting at Great Island state wildlife management area, the social core of this famous, historical colony. Density-dependent population regulation has become operative, despite abundant food.

A second fascinating finding of the Chesapeake MD banded-breeder trapping study (N=136) was the extreme conservatism of male dispersal from fledging site to breeding site. 83% of males moved 10 km or less, and none moved more than 50 km. None of Byrd's male fledglings crossed the Bay to enter my trapped male breeder sample (N=41). However, 21% of my large sample (N=95) of trapped female breeders moved more than 50 km, and most of those had crossed the Bay from Byrd's long-term VA study. I even trapped one female that ***I*** had banded as a nestling up in faraway CT! These findings were entirely consistent with a smaller dispersal sample (N=72, 33 males, 39 females) from my 1970's northern thesis population. These results were a major justification for hacking fledgling ospreys in food-rich habitats far from their current geographic nesting locales. Such projects have often proved very successful.

The **fourth focus** of my work has been food limitation of osprey reproductive success, nesting density, and breeding population size--with a particular focus on the varying abundance and local distribution of migratory adult **Menhaden** *Brevoortia tyrannus* as a fundamental prey base species. As early as 1970-75, a period of reduced menhaden abundance, brood size reduction due to nestling starvation was evident at the famous historic Gardiners Island, NY, colony (mean y/an 0.55). In 1973, I placed VA eggs in Gardiners nests: 10 of them hatched, but only 4 fledged, similar to nestling starvation losses among young that originated on Gardiners. **Gardiners has been the anomaly among post-DDT osprey recovery: It is a paradigm for food limitation.** I hypothesize it is currently a "Menhaden Colony", surrounded by miles of open bay water, historically prime menhaden habitat, but somewhat deficient in other prey. Gardiners reproduction and subsequent nest count recovery (affected by local replacement rate and conservative male dispersal) lagged until a period of renewed migratory adult menhaden abundance 1976-1993. Then Gardiners reproduction rose well above replacement rate (mean y/an 1.04), and nest numbers increased to a peak of 71 in 1994. This was followed by another 18 years, 1994-2011, of depressed menhaden, and Gardiners gradually declined to only 22 active nests, with mean annual reproduction below replacement rate (0.69 y/an). Finally, with active menhaden management 2013-2016, the nest count has doubled to 44, with mean annual reproduction of 1.25 young/active nest. If management for menhaden abundance continues, Gardiners could approach 100 nests in 5 years, and then begin to approach historic nest counts well above that in a decade. This revealing 48-year time-series of Gardiners data, which I began in 1969 and collected through 1978, has been maintained by Michael Scheibel of TNC since 1977. His faithful tenacity, and the constant interest and goodwill of the owners, continues to yield a classic, world-class set of ecological data. Of course, it's also a lot of fun to visit this grand island colony and learn the annual results.

The **fifth focus** of my work has been the population ecology of the neotropical osprey subspecies Ridgway's Osprey, a four-year project 2014-2017, in cooperation with my 40+ year colleague Alan Poole. These non-migratory birds lack most of the distinctive mask, and their plumage is paler, possibly a combination of genetic differences and constant sun-bleaching? They are sparsely and locally distributed around the Caribbean and the Bahamas, always at low density, with weak reproduction and small brood sizes. We have focused our study on the 150-mile coastline of offshore Belize, 18 degrees to 16 degrees North, because it is accessible, and there are enough nests to permit our survey. These are the southernmost osprey nests in the New World, except for some recent anecdotal extralimital reports in temperate South America.

Currently, we have visited 25 active nests in 2014-2016, and estimate their cumulative reproductive rate at very roughly 0.35 young/active nest. Although this would be a recipe for population crash among North American migratory ospreys, subspecies *carolinensis*, it is possible that the *ridgwayi* subspecies can eke out stability at this level. Entering 90% annual adult survival and mean age at first breeding of 3 years into my old thesis equation, 0.35 y/an works as a replacement rate. More Belize survey and a larger multiyear sample size is needed to evaluate the situation.

A further local condition: Virtually all nests are in mangroves, often dead, and gumbo limbos, relatively unstable nest sites that face tropical storms. So nest site limitation is probably part of Belize osprey population ecology, and also contributes to nest failures. We hope to encourage placement of stable nest platforms: high and over water. This would be the latest osprey experiment, if we can pull it off. We know how very well it has succeeded at many sites in North America.

PRS February 9, 2017 (very!) Windy Hill on the Choptank, MD

Megan Ware

From: Comments
Sent: Friday, March 31, 2017 1:00 PM
To: Megan Ware
Subject: FW: Menhaden
Attachments: PastedGraphic-6.pdf; ATT00001.htm

Follow Up Flag: Follow up
Flag Status: Completed

From: Jack Irvin [mailto:jirvin0721@gmail.com]
Sent: Tuesday, March 21, 2017 5:01 PM
To: Comments <comments@asmfc.org>
Subject: Menhaden

I feel that is criminal the amount of menhaden you allow omega protiens to steal from our oceans, so much of our coastal wildlife rely on this resource yet you allow a corporate conglomerate to indiscriminately rape this resource purely for profit. It is shameful and you must be held accountable for this crime against nature

Jack Irvin
jirvin0721@gmail.com

Megan Ware

From: dgsdiehard@aol.com
Sent: Sunday, February 05, 2017 9:10 PM
To: Megan Ware
Subject: Menhaden stocks

All nets should be banned in the United States. You guys are five years behind the curve when it comes to endangered species. By the time you figure it out their already in jeopardy but the powers that be just turn a blind eye....I have fished the east coast for thirty years so let's just kill all the tuna, Cobia, Rockfish and whatever else is left out there and be done with it!!!
So sad, so very sad!
757 237 3760

Sent from my iPhone