Atlantic States Marine Fisheries Commission

Atlantic Striped Bass Management Board

October 24, 2016
3:00 – 5:00 p.m.
Bar Harbor, Maine

Agenda

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

1. Welcome/Call to Order (*J. Gilmore*) 3:00 p.m.

2. Board Consent 3:00 p.m.
   - Approval of Agenda
   - Approval of Proceedings from August 2016

3. Public Comment 3:05 p.m.

4. Review Technical Committee Report (*N. Lengyel*) 3:15 p.m.
   - Performance Evaluation of Addendum IV Regulatory Measures

5. Review the 2016 Atlantic Striped Bass Stock Assessment Update (*G. Nelson*) 3:45 p.m.

6. Consider Approval of the Advisory Panel Request to Submit Comment to the Mid-Atlantic Fishery Management Council on its Draft Squid Capacity Amendment (*J. Gilmore*) **Possible Action** 4:45 p.m.

7. Other Business/Adjourn 5:00 p.m.

The meeting will be held at the Harborside Hotel; 55 West Street; Bar Harbor, Maine; 207.288.5033

MEETING OVERVIEW

Atlantic Striped Bass Management Board Meeting
October 24, 2016
3:00 p.m. – 5:00 p.m.
Bar Harbor, Maine

Chair: Jim Gilmore (NY) Assumed Chairmanship: 02/16	Technical Committee Chair: Nicole Lengyel (RI)	Law Enforcement Committee Rep: Kurt Blanchard (RI)
Vice Chair: Russ Allan (NJ)	Advisory Panel Chair: Louis Bassano (NJ)	Previous Board Meeting: February 4, 2016
Voting Members: ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, DC, PRFC, VA, NC, NMFS, USFWS (16 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from February 2016

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

4. Review Technical Committee Report (3:15 – 3:35 p.m.)

Background

- Addendum IV (October 2014) implemented a suite of management measures to reduce harvest and bring fishing mortality (F) back down to the target level. The measures were predicted to reduce harvest in the ocean fisheries by 25% relative to 2013 harvest levels, and to reduce harvest in the Chesapeake Bay (Bay) fisheries by 20.5% relative to 2012 harvest levels. Measures were implemented prior to the 2015 fishing year.
- In August, the PRT conducted a preliminary analysis on the performance of these measures to determine whether the target reductions in harvest had been achieved.
- Results of the analysis indicated that commercial harvest reductions for both the ocean and Bay fisheries were close to the predicted reductions. However, the recreational fisheries in the ocean and the Bay diverged significantly from the predicted values.
- Following review, the Board directed the TC to look at a number of factors to explain the differences between the predicted and realized reductions (**Briefing Materials**).

Presentations

- Performance Evaluation of Addendum IV Regulatory Measures by N. Lengyel

5. Review the 2016 Atlantic Striped Bass Assessment Update (3:45 p.m. – 4:45 p.m.)
Background • The 2016 Atlantic Striped Bass Stock Assessment update was completed in October (**briefing materials)**
Presentations • 2016 Atlantic Striped Bass Stock Assessment Update by G. Nelson

6. Consider Approval of the Advisory Panel Request to Submit Comment to the Mid-Atlantic Fishery Management Council on its Draft Squid Capacity Amendment (4:45 p.m. – 5:00 p.m.) Possible Action
Background • The MAFMC is currently drafting a squid capacity amendment that address several management issues that could affect striped bass fishing opportunities near Martha's Vineyard and Nantucket. • As such, the Atlantic Striped Bass Advisory Panel is seeking approval to submit comment to the MAFMC on its Draft Squid Capacity Amendment.
Board Actions for Consideration • Consider approval of the Advisory Panel request to submit comment to the MAFMC on its Draft Squid Capacity Amendment

6. Other Business/Adjourn

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

ATLANTIC STRIPED BASS MANAGEMENT

The Westin Alexandria
Alexandria, Virginia
August 3, 2016

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ATTENDANCE

Board Members

Pat Keliher, ME (AA)
Rep. Jeffrey Pierce, ME, proxy for Sen. Langley (LA)
Terry Stockwell, ME, Administrative proxy
Steve Train, ME (GA)
G. Ritchie White, NH (GA)
Doug Grout, NH (AA)
Dennis Abbott, NH, proxy for Sen. Watters (LA)
Bill Adler, MA (GA)
David Borden, RI (GA)
Jason McNamee, RI, proxy for J. Coit (AA)
Eric Reid, RI, proxy for Sen. Sosnowski (LA)
David Simpson, CT (AA)
Rep. Craig Miner, CT (LA)
James Gilmore, NY (AA)
Emerson Hasbrouck, NY (GA)
John McMurray, NY, proxy for Sen. Boyle (LA)
Russ Allen, NJ, proxy for D. Chanda (AA)
Tom Fote, NJ (GA)
Adam Nowalsky, NJ, proxy for Asm. Andrzejczak (LA)
Andrew Shiels, PA, proxy for J. Arway (AA)
Loren Lustig, PA (GA)
Tom Moore, PA, proxy for Rep. Vereb (LA)
Roy Miller, DE (GA)
Craig Pugh, DE, proxy for Rep. Carson (LA)
Ed O'Brien, MD, proxy for Del. Stein (LA)
Mike Luisi, MD, proxy for D. Blazer (AA)
Rachel Dean, MD (GA)
Kyle Schick, VA, proxy for Sen. Stuart (LA)
Rob O'Reilly, VA, proxy for John Bull (AA)
Michelle Duval, NC, proxy for B. Davis (AA)
Martin Gary, PRFC
Derek Orner, NMFS
Sherry White, USFWS
Dan Ryan, DC

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

Ex-Officio Members

Staff

Robert Beal
Toni Kerns
Katie Drew
Max Appelman

Guests

Robert Boyles, Jr., SC DNR
Malcolm Rhodes, SC
Jim Estes, FL F&W
Spud Woodward, GA DNR
Wilson Laney, USFWS
Mike Millard, USFWS
Charles Lynch, NOAA
Topher Holmes, NOAA
Debra Lambert, NOAA
Roy Crabtree, NMFS
Jessica Coakley, MAFMC
Jeff Deem, VMRC
Justin Davis, CT DEEP
Peter Aarrestad, CT DEEP
Patrick Geer, GA DNR
Jack Travelstead, CCA
Dan McKiernan, MA DMF
Mike Luisi, MD DNR
Steve Heins, NYS DEC
Doug Christel, MA F & G
Aaron Kornbluth, PEW Trusts
Joseph Gordon, PEW Trusts
Raymond Kane, CHOIR
Louis Daniel, Morehead City, NC
Arnold Leo, Town of E. Hampton, NY

The Atlantic Striped Bass Management Board of the Atlantic States Marine Fisheries Commission convened in the Edison Ballroom of the Westin Hotel, Alexandria, Virginia, August 3, 2016, and was called to order at 1:36 o'clock p.m. by Chairman James J. Gilmore.

CALL TO ORDER

MR. JAMES J. GILMORE: Welcome everyone; I would like to call the Striped Bass Board to order. I am Jim Gilmore; I am the Administrative Commissioner from New York, and I will be chairing the meeting today. Welcome back, LGA folks. You've got to keep on time, guys, you know. We're running a tight ship here. I did want to just acknowledge my colleague from the state of Rhode Island for the phenomenal job he did this morning on menhaden, so a round of applause for Bob Ballou. (Applause)

I was so inspired I offered Bob the opportunity to run this meeting; but he repeated how much fun he had this morning. Let's get into it.

APPROVAL OF AGENDA

CHAIRMAN GILMORE: First off, we have approval of the agenda. It should be in your meeting package; any changes to the agenda? We are going to have one addition at the end. We do have an AP nomination, so we are going to add that to Other Business.

We'll put that change in and seeing none other; we'll consider that approved.

APPROVAL OF PROCEEDINGS

CHAIRMAN GILMORE: We also have the proceedings from the February, 2016 meeting. Are there any changes to those proceedings? Seeing none; we'll take those as adopted.

PUBLIC COMMENT

CHAIRMAN GILMORE: Before each meeting we offer the public an opportunity to comment on items not on the agenda.

There was no one signed up to make any comments, but by show of hands is there anyone in the audience that would like to make a public comment on items not on the agenda? Seeing none; we'll move right along.

REVIEW OF THE STRIPED BASS ADVISORY PANEL MEETING SUMMARY

CHAIRMAN GILMORE: Our first order of business is the review of the Striped Bass Advisory Panel meeting summary; and Max Appelman is going to do that for us.

MR. MAX APPELMAN: Typically, advisory panels meet at the direction of the board to provide feedback throughout the adaptive management process. However, there were several requests from advisory panel members for staff to conduct an informational meeting, and give the AP an opportunity to discuss a few striped bass fishery topics that are not currently being discussed at the board level. The AP met via conference call on April 29th, to receive an update from staff on those topics.

The first topic on the agenda was the EEZ Transit Zone Clarification and Access Act; so this is in relation to the Block Island Sound Transit Zone within the EEZ. For those who are unfamiliar with the Bill, the current language essentially reaffirms that the Secretary of Commerce in consultation with the commission may issue regulations to permit and regulate recreational fishing for striped bass within the transit zone. Summarizing the APs discussion about this, basically regardless of the outcome of the Bill, the AP does not support the use of legislative procedures to override the current fishery management framework. Back to what the AP was getting at is that they are and have always been in support of fishery management processes that are science driven; that are based on technical expertise, and provide ample opportunity for public comment.

The next item that was on the agenda was discussion of the western North Atlantic squid resource in Nantucket Sound and the surrounding area. Just a little bit of background there. Perhaps, to some of you this might be common knowledge, but squid are

considered a significant food source for striped bass; and Nantucket Sound typically supports large concentrations of both predator and prey during the summer months.

In recent years, some AP members and other fishermen have reported a decline in the availability of striped bass during the summer in that area, and also in recent years, there has been above average harvest of squid in and around that area, leading some AP members to the belief that this increased harvest may be a contributing factor to the decreased availability of striped bass in the Sound during that time.

Many of you are likely aware that the Mid-Atlantic Council is currently pursuing a Squid Capacity Amendment; which both directly and indirectly addresses a lot of the concerns of the AP regarding this issue. In short, that amendment considers options for a harvest buffer zone beyond state waters, south of Nantucket Sound, as well as other measures that address the potential for increased effort in the fishery.

The current timeline includes a public comment period on the draft amendment in early 2017. Moving forward, staff is going to continue to track the progress of that amendment and provide updates to the advisory panel as necessary. Moving forward, you know, again this was somewhat of a unique situation, as it was not board directed.

Basically, just making sure the board is aware that this meeting occurred, is aware of the outcomes that came from that meeting, and the discussions that took place; but in the future, if a similar request is made to hold an informational meeting, the board chair will be consulted first. This should help maintain transparency between the board and the AP and the rest of the commission stakeholders; and is also more in line with some of those new policy changes that went into the ISFMP Charter and some of the commissions guiding documents. I'll take any questions.

CHAIRMAN GILMORE: Any questions for Max?

MR. JOHN McMURRAY: Max, I recall a discussion about the Mid's Squid Capacity Amendment, and the AP agreeing to write a letter providing public comment in support of a full analysis of those buffer zone alternatives included in the draft amendment. Well, I guess it is not yet a draft amendment, it is just a PID. Is that recollection correct, and if so, was a letter written and sent? Because I don't think the council has seen it yet if it was.

MR. APPELMAN: That discussion did take place. What we decided to go with is for AP members to submit comment during the public comment period individually, as stakeholders interested in the fishery.

CHAIRMAN GILMORE: Other questions. Ritchie White.

MR. G. RITCHIE WHITE: Just to that point. I think the process would be the AP would bring that issue to the Striped Bass Board and then the Striped Bass Board, if deciding that letter should go, then it would go to the Policy Board. That would be the process for a formal letter to go to another entity on an issue.

CHAIRMAN GILMORE: Other questions?

MR. McMURRAY: Sorry, Jim, I don't mean to jam this up. If that's the case, and I kind of thought that would be the case during our AP meeting. That may be something the board would like to put on the agenda as a future item for discussion.

CHAIRMAN GILMORE: Yes, John, we'll do that. That is correct. Any other questions for Max before we move on?

2016 ATLANTIC STRIPED BASS FMP REVIEW AND STATE COMPLIANCE

CHAIRMAN GILMORE: Okay, seeing none; the next agenda item is to consider approval for the 2016 Atlantic Striped Bass FMP Review and State Compliance. Max is going to do an overview of this, and just let me say it for the first time; because hopefully, you hear it many times.

There is some surprises in this for some states. These

are preliminary MRIP numbers that haven't been gone through by the TC or anybody yet. I know I've gotten some comments from different states about going into this, but we're really going to reserve most of this for the annual meeting after the TC and the other folks have gotten it. We'll gladly discuss it, but the only motion we're going to be doing today is actually to accept the review. We're not going to get into beating up things, so Max.

MR. APPELMAN: Just a quick overview of the presentation today. We will cover the most recent stock status, status of the fishery, highlighting again that 2015 fishing year, status of management measures; including a preliminary review of the performance of Addendum IV. Then we'll wrap up with compliance and recommendations.

Based on the 2015 stock assessment update, the Atlantic Striped Bass stock is not overfished and overfishing is not occurring. Again, the 2016 stock assessment update will be available for review in October. In 2014, SSB was estimated at 63,918 metric tons; which is below the target and above the threshold, and F was estimated at 0.2, which is similarly below the threshold and above the target.

This is Figure 1 from the report, basically showing SSB estimates through time. The take home here is that SSB has steadily declined below the target towards the threshold level since about 2004. Also, on this figure are recruitment estimates, which are more or less variable across the time series but you can see that spike in 2012, which is likely that 2011 year class.

This figure is Figure 2 from the report; fishing mortality estimates over time. The take home here is basically over the last ten years or so. Fishing mortality has fluctuated back and forth across that threshold level; and in the terminal year has been estimated between the target and the threshold.

Just a quick look at some harvest numbers in 2015 compared to the previous year. These are total harvest, these are commercial landings plus recreational harvest; and this is according to MRIP. In 2015, total harvest was estimated at 1.96 million fish weighing 23 million pounds. This represents a 23 percent decrease by weight and by number; compared to last year, or 2014. Harvest was again dominated by the recreational sector, and accounted for 79 percent of the total harvest by weight. The commercial landings were estimated at 620,034 fish weighing 4.8 million pounds. That is a 19 percent decrease. Then recreational harvest was estimated at 1.3 million fish weighing 18 million pounds; a 24 percent decrease by weight and 25 percent by number.

Just a quick look at the Albemarle Sound and Roanoke River stock; this is Section 4 of the report. This latest stock status information comes from the 2013 North Carolina specific benchmark assessment, which similarly indicates that the stock is not overfished and overfishing is not occurring; and also stock status trends are very similar to the coastal stock.

In 2012 SSB was estimated at 835,462 pounds and fishing mortality estimated at 0.34. There will also be an updated assessment for the AR stock using catch and index data through 2015 as well, and that should be available for board review in October. Harvest from the Albemarle Sound and Roanoke River in 2015 was estimated at 240,445 pounds; 76 percent of that came from the Albemarle Sound Management Area and the rest from the Roanoke River.

REVIEW OF THE PERFORMANCE OF ADDENDUM IV

MR. APPELMAN: Moving on to status of management measures, this is Table 9 from the report showing coastal commercial quotas and harvest. A reminder that 2015 quota does reflect Addendum IV. In 2015, the total coastal quota was not exceeded; harvest was estimated at 1.9 million pounds. Rhode Island exceeded its quota by 6,903 pounds, and that has been subtracted from the 2016 quota, so Rhode Island's commercial fishery is currently operating under a reduced quota.

Same statistics for the Chesapeake Bay commercial quotas in the harvest, again reflecting Addendum IV. In 2015 the bay-wide quota was not exceeded.

Harvest was estimated at 2.9 million pounds; and each jurisdiction harvested below its quota; therefore, no deductions were applied to 2016 quotas in the Bay.

This is a review of juvenile abundance indices or JAIs. Addendum II defines recruitment failure as a value that is lower than 75 percent or the first quartile of all values in a fixed time series appropriate to each JAI. The PRT annually reviews JAIs from six different surveys, and if any surveys JAI falls below the respective Q1 for three consecutive years, then appropriate action should be recommended to the board.

For the 2016 JAI review the PRT evaluated the 2013, 2014 and 2015 JAI values, which triggered no management action. You can look into Section 5 of the report and Figure 8 for a more detailed discussion on those specific JAI reviews. Addendum 3 of the FMP requires all states with commercial fisheries to implement a commercial tagging program; and monitoring reports are due no less than 60 days prior to the start of their first commercial season.

These monitoring reports typically include a summary of the previous year's tagging program, tag descriptions for the upcoming season, as well as highlighting any issues that may have been encountered in the program thus far. In 2015 all states implemented commercial tagging programs consistent with the requirements of Addendum III.

No major issues stood out in those reports, and again, you can refer to Table 12 in the FMP review for a more detailed summary of each states program requirements. A couple slides here on Addendum IV, just as a little refresher. The Addendum established new fishing mortality reference points as recommended by the 2013 benchmark assessment. The results of that assessment also indicated that F was above the target for several consecutive years, and SSB below target for several years; which triggered management action. Accordingly, the addendum aims at reducing fishing mortality to a level at or below that new target.

To achieve this, prior to the 2015 fishing season all jurisdictions implemented regulations projected to reduce harvest by 25 percent from 2013 levels along the coast, and by 20.5 percent from 2012 levels in the Chesapeake Bay. More specifically, coastal commercial quotas were reduced by 25 percent from the Amendment VI allocations; coastal recreational fisheries implemented a one-fish bag limit, and a 28 inch minimum size limit or alternate measures approved by the board through the conservation equivalency process. Chesapeake Bay commercial quotas were reduced by 20.5 percent from that level harvested in 2012, and there was no standard measure laid out in the addendum for Chesapeake Bay recreational fisheries, so instead the Bay jurisdictions implemented measures that were subject to TC review and projected to reach the 20.5 percent reduction from those 2012 levels.

This is Table 7 from the report. It is simply comparing the 2015 harvest estimate again, these are based on MRIP compared to that number that was predicted by the TC this time last year. Looking at the totals in the bottom row there, the predicted harvest reduction was 25.8 percent and the realized reduction was 22.4 percent, which to me indicates really impressive work conducted by the Technical Committee.

The Chesapeake Bay recreational sector certainly sticks out with a 53 percent increase; but I'm very hesitant to make any interpretations from these numbers at this time for several reasons, but primarily because this is a very rudimentary evaluation. It does not provide any insight to the mechanisms effecting harvest in each of these regions or by sector.

The TC will dive into this a little bit more, a much more in-depth evaluation of the performance of Addendum IV. They will look at things like changes in effort between regions and sectors, and again, those impacts from different fishing sectors. Potential impacts from the emergence of that 2011 year class in the harvest data, and any other things of that nature. Again, that will be a TC evaluation which will be available for board review in October.

Another point to keep in mind is that the ultimate goal of this addendum is to reduce F to the target level. This evaluation doesn't provide any insight to what that F estimate is; again, that information available in October. To wrap up the presentation, no states requested de minimis status at this time, and all states were found to have implemented regulations consistent with the striped bass FMP. I'll take any questions.

CHAIRMAN GILMORE: Thanks, Max, great report. Do I have questions? I've got a few of them coming up. Okay I've got Mike Luisi, then Rob O'Reilly and Tom Fote.

MR. MICHAEL LUISI: I'll take your opening remarks as keep it short, and this doesn't mean a whole lot here. I think Max reiterated that too. I don't necessarily have a question. I don't know if this is the appropriate time. I would like to clarify a few things based on one of the statements that were made in the executive summary. If you want to take questions first, you can certainly do that. If you would like, I can give you my thoughts at this time about one of those statements that was made.

CHAIRMAN GILMORE: Why don't we just go to questions on the summary; if people just have questions on the summary, and then we'll go back to the implications of it? Okay, Rob O'Reilly.

MR. ROB O'REILLY: Max, a couple times you mentioned harvest reductions, and then towards the end, you mentioned the important reduction in fishing mortality rate. I would ask you whether it is the plan of the Technical Committee to make any estimation on the B2s that will be on the coast, a little bit now, more in 2016, more in 2017.

The reason I bring that up is there was a 680 percent increase in B2s just in Virginia in 2015 compared to 2012. The 22.5 percent is impressive, but I think we need some indication of the expectations of how many of the 2011 year class that were present in 2015, how many are expected in 2016/2017?

There are three different migration rates coming from the Bay. I guess the Rugolo-Jones one is still the one of choice, but I think everyone needs to know that; because it may not be a quick situation with the fact that those sub-legal's are going to be more prevalent on the coast, as they have been in the Bay.

MR. APPELMAN: Not sure if that was a question per se, but definitely will be something that the TC looks into. I've written down your comment and am happy to relay that.

MR. THOMAS P. FOTE: I'm thinking about what happened last year and a question I have. When you bring this information for the annual meeting, could you bring back the wave information to go along with this and the wave data on striped bass? The reason I'm asking that question is because we make calculations on what we see in the last previous four years.

I want to see if all this increase in New Jersey was in the last wave, because we had a fishery with Atlantic herring showing up for 25 miles and things. It is like Massachusetts this year projected what they would catch during this time of year. From what people are telling us, they're not going to catch that; so they're going to catch a huge figure in that two month wave. We call this an episodic event, but I would like to know what the reasons; and that is part of the reason we went over.

CHAIRMAN GILMORE: All right, Tom, I think when the TC does their review the wave data is going to be included in that; so you should have that for the materials in October.

MR. WHITE: Question on process, for the report in October the TC will be looking at the effects of conservation equivalency by state and making recommendations on any states that don't meet the conservation equivalency amount. Am I correct in that?

MR. APPELMAN: My understanding is that the TC will make the appropriate recommendations to the board on the effectiveness of those management measures.

MR. McMURRAY: My question is very similar to

Ritchie's. However, I am not clear on what the responsibility of the TC is, as far as interpreting and reacting to the overages, and whether or not the requirement in Addendum IV was to achieve that 25 percent reduction overall, or if it was to achieve the reduction in the Bay; and then also have the reduction on the coastal side. That is my question, was I clear as mud?

MR. APPELMAN: I highlighted this in the presentation. But the goal of the addendum was to reduce fishing mortality to a level at or below the target. We don't have that information yet, and my interpretation is that as a mechanism to get there, that is what the regulations set out to do, is achieve those reductions per sector per region. But the ultimate goal, the bottom line is where is F? We'll have that information in October.

CHAIRMAN GILMORE: Just to add, John. There are no compliance requirements. We had to hit the coastwide overall target. If a state went over theirs, there wasn't a compliance issue with it, so at this point it is just to hit that 25 percent target.

MR. McMURRAY: That's understood, but if the conservation equivalency is not working, I am assuming we would need to revisit it; correct?

CHAIRMAN GILMORE: Yes well, we would definitely talk about that in October; other questions on this? Okay, Mike, do you want to go ahead?

MR. LUISI: Yes thanks, absolutely. I think it ties nicely into John's questions regarding conservation equivalency. When the information was made available for this meeting I got some pretty heavy feedback, or some reaction I guess is what I should say, from stakeholders in our state and also board members here at the commission; regarding the statement in the executive summary that reads that, "Addendum IV regulatory measures achieved a 22.4 percent reduction in harvest compared to the reference harvest level. All sectors achieved their harvest reduction goal, except for the Chesapeake Bay recreational sector, which increased its harvest by 53.4 percent compared to the 2012 harvest levels". If I could, I would like to make a few comments regarding Maryland's perspective on the harvest that occurred in 2015, and just give everybody here, both members of the audience and commissioners, the perspective on our take; as to why those numbers were the way they were.

I went back into Addendum IV and looked at what the management measures were expected to achieve. Addendum IV states in its overview section that the measures were aimed at reducing fishing mortality to the target, beginning in 2015. I think it has been stated, it is pretty clear that reducing fishing mortality was the overarching goal of the management measures, and it wasn't just reducing harvest in numbers.

Fishing mortality is going to be the way that we figure out whether or not we're making progress to that goal. There were also two objectives stated in the overview section of the addendum. One was that the measures were intended to conserve the large 2011 year class that was in the Bay, focusing on the Chesapeake Bay.

The second objective was to conserve the female spawning stock biomass. I would argue that while our harvest increased from that 2012 baseline, we did achieve those objectives; conserving the 2011 year class and protecting the female spawning stock. The reason I can say that is because right now the Chesapeake Bay is in a very unique situation. We've mentioned many times before, and I am not going to belabor the points about how the Bay fishery is different from the coastal fishery.

But what I am going to focus on is one of the conditions that are occurring in the Bay right now that completely separates it from the coast. That has to do with the exploitable stock biomass that we have in the Chesapeake Bay.

Anyone who is paying attention to striped bass kind of has in their dreams the spawning stock biomass graph.

Most people focus on the last 10, 12 years. Their focus is on this steady decline of spawning stock biomass over the last decade. Well, given the

enormous fourth largest in history of the survey that is conducted the year class strength for that 2011 year class. We are seeing just the exact opposite in the Chesapeake Bay.

We are seeing an enormous group of fish growing into what is exploitable to fishermen. By having that condition in the Bay, the measures that we put in place and the measures that are being reported here, and the fact that our harvest increased from 2012, is not an indication I believe that Maryland or even Virginia in that case, Potomac River fisheries, didn't achieve the goal of what we were intending to do; which was to preserve that year class and to control the harvest of the spawning stock.

If you refer to Table 4 in the meeting materials, you'll see that harvest, and I'll speak specifically about Maryland, harvest in 2012 was 262,000 fish. It went up the next year to 477,000 fish. It increased the next year to 583,000 fish. In 2015 when the reductions were put into place, Maryland harvested 406,000 fish.

My perspective on that is had we not put the management measures in place that we did that we could have drastically overshot. There was a 30 percent reduction in our state, just based on MRIP information from 2014 to 2015. Had we not done anything, the potential for what we could have caught in 2015 would have indicated a 50 percent or greater increase in what the potential was.

Because like I said, we're at this point where the 2011 year class is just now, it is recruiting to the fishery. There was a reduction there, although compared to the baseline it is being reported that there wasn't. The trophy fishery, I won't get into details about that. You know we have access to the spawning stock for a few weeks, six to eight weeks a year.

Our records and our reports and our surveys indicate that we reduced as much as 30 percent from the previous year to 2015; regarding our take of that spawning stock, the female spawning stock, or just let's say spawning stock in this case. I wanted to lay that out there, Mr. Chairman. There was a pretty strong reaction, due to the numbers that were presented.

But I wanted everybody around the table to understand that we are experiencing something quite different from what is being experienced on the coast, and we're doing everything we can to control that harvest and mitigate the consequences of that harvest. I appreciate the time, thank you.

CHAIRMAN GILMORE: Other questions or comments? Rob, I'm looking at you, because I know you wanted to talk; so go ahead.

MR. O'REILLY: All right, my apologies for the second time around. Just to confirm what was said by Mike. I think the only thing we wait for is the Baranov catch equation. We wait to see if the catch was constrained enough. The abundance overall throughout the entire states increased enough that fishing mortality rate dropped. That is what we're really waiting for, and we'll wait for the October meeting.

CHAIRMAN GILMORE: Any other questions? John McMurray.

MR. McMURRAY: Just a quick question for Max. Those 2011s, when do we expect them to become part of the coastal stock, because it seems, and this is totally anecdotal, that we're seeing them now. I mean there is a ton of 20 to 24 inch fish around.

DR. KATIE DREW: I think now definitely is sort of like the beginning of that trickle out into the coast. I think we can go back and look at some of our emigration rates, but admittedly I think that is one of the areas that we definitely could use some more data on; in terms of the sex-specific and age-specific rates of emigration out of the Bay into the coast. I also think we don't have a good handle on whether the size of that year class would affect how soon they migrate. But I think starting now and moving into the future, you would expect to see those guys move out into the coastal fishery.

CHAIRMAN GILMORE: Any other questions? Okay seeing none; we're going to need a motion to accept these. Doug Grout.

MR. DOUGLAS E. GROUT: **Yes, I would like to move that we approve the Striped Bass FMP Review and State Compliance Reports.**

CHAIRMAN GILMORE: Second, Tom Fote. Is there any discussion on the motion? **Is there any objection to the motion; okay, seeing none, we'll consider those accepted and the motion is approved.**

ADVISORY PANEL NOMINATION

CHAIRMAN GILMORE: That moves us to our last item. We have an AP nomination and Tina is going to come up and give us an overview of that.

MS. TINA L. BERGER: Just to be quick, we have a new nomination from Massachusetts for Patrick Paquette to be added to the advisory panel. He would replace Chuck Casella who served on that panel for a very long time, but is no longer on it. Captain Paquette has experience in recreational for-hire and commercial industries. Thank you.

CHAIRMAN GILMORE: Okay, we're going to need a motion for that. Michelle.

DR. MICHELLE DUVAL: **I move that we appoint Patrick Paquette to the Striped Bass Advisory Panel.**

CHAIRMAN GILMORE: Thanks, Michelle and that is seconded by Adam Nowalsky**. Is there any discussion on the motion, any objection to the motion? Seeing** none; we will add Patrick to the advisory panel. Congratulations, Patrick if you're in the room. I thought I saw you before.

ADJOURNMENT

CHAIRMAN GILMORE: Any other business to come before the Striped Bass Board? Seeing none; I'll entertain a motion to adjourn.

CHAIRMAN GILMORE: So moved. We are adjourned, thank you.

(Whereupon, the meeting was adjourned at 2:12 o'clock p.m., August 3, 2016.)

Atlantic States Marine Fisheries Commission

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MEMORANDUM

October 5, 2016

To: **Atlantic Striped Bass Management Board**

From: **Atlantic Striped Bass Technical Committee**

RE: **Performance Evaluation of Addendum IV Regulatory Measures in 2015**

In August 2015, following implementation of Addendum IV which required states to implement regulations that will reduce harvest and bring fishing mortality down to the target-level, the Technical Committee estimated 2015 harvest based on the new state regulations (M15-062).

In August 2016, the Atlantic Striped Bass Plan Review Team conducted a preliminary analysis on the performance of Addendum IV regulatory measures by comparing actual harvest in 2015 to the reference period (2013 for the ocean and 2012 for the Chesapeake Bay). Results indicated that the estimated harvest was very close to the observed harvest for commercial fisheries and on a coastwide scale, however, the recreational fisheries in the ocean and in the Chesapeake Bay diverged significantly from the estimated values.

Following review, the Board directed the Technical Committee to investigate the impacts of a number of variables to shed light on the large differences between actual harvest and those estimated for the ocean and Bay recreational fisheries. Enclosed is the Technical Committee report evaluating the performance of Addendum IV regulatory measures in 2015.

Enclosed: Performance Evaluation of Addendum IV Regulatory Measures in 2015
CC: Striped Bass Technical Committee

Atlantic Striped Bass Addendum IV Performance Review

Introduction:

The 2013 benchmark stock assessment update for Atlantic striped bass found that while overfishing was not occurring and the stock was not overfished in 2012, fishing mortality (F) was above the F target and spawning stock biomass was below the SSB target. This triggered management action, and Addendum IV to the Atlantic Striped Bass Fishery Management Plan was adopted in October 2014.

The goal of Addendum IV is to bring F back down to the target level in 2016. Addendum IV required a 25% reduction in harvest from 2013 levels for the ocean[1] fisheries and a 20.5% reduction in harvest from 2012 levels for the Chesapeake Bay fisheries. To achieve this for the commercial sector, Amendment 6 quota allocations were reduced by 25% for the ocean fisheries, and the Chesapeake Bay commercial quota was set at 20.5% less than that harvested from the Bay in 2012. For the recreational sector, ocean fisheries implemented a one fish bag limit and a 28" minimum size limit. Chesapeake Bay recreational fisheries implemented a suite of management measures that were projected to achieve the F target. States could implement alternative measures for ocean recreational fisheries through the conservation equivalency process. States were required to implement the above regulations prior to the 2015 fishing season.

The anticipated reduction in harvest from these management changes was calculated by the Atlantic Striped Bass Technical Committee (TC) based on the available recreational harvest pattern data from 2011-2013 from MRIP and state programs (see memo M15-062). As 2015 was the first year under these new regulations, the Plan Review Team (PRT) reviewed the performance of these measures during the annual FMP review process to determine whether the target reductions in harvest had been achieved[2] in each region and sector.

On the coastwide level, the predicted harvest reduction for 2015 was nearly the same as the observed harvest; the estimated and realized reduction in harvest across all regions and fisheries was 25.8% and 25.9%, respectively. The commercial harvest reduction for both the ocean and Bay fisheries was close to the predicted reductions (Table 1). However, the recreational fisheries in the ocean and in the Chesapeake Bay diverged significantly from the predicted values (Table 2 and 3).

The estimated reductions for the recreational fisheries rely on the assumption that effort, angler behavior, and the size composition of fish available to anglers will remain constant. The TC looked at a number of factors to explain the difference between the predicted and realized reductions, including: (1) changes in effort, (2) changes in the proportion of fish released alive vs. retained,

[1] The "ocean" fishery includes harvest from Delaware Bay and other technically non-ocean locations, but the majority of removals are from ocean waters. It is referred to as the ocean fishery as opposed to the "coastal" fishery to distinguish it from the Chesapeake Bay fishery and avoid confusion with coastwide reference points.

[2] MRIP estimates have been updated since the release of the 2016 FMP Review. Based on the new estimates, all ocean recreational fisheries, including New Jersey, achieved the target harvest reduction in 2015 as described above.

and (3) changes in the size and age structure of the recreational catch. In addition, the Board requested an analysis of differences in harvest by mode, wave, and state to look at potential changes in angler behavior and the prosecution of the fishery.

Results:

Changes in Size and Age Structure of the Catch:

Age-4 fish make up a larger proportion of the harvest in both the Chesapeake Bay (Bay) and the ocean fisheries in 2015 than in their respective reference years (Figure 1). The unusually strong 2011 year class was not available to the fishery in 2012 and 2013, the reference years. At age 4 in 2015, they are nearly fully recruited to the Bay fisheries, but only partially recruited to the ocean fisheries as striped bass typically don't begin to migrate out of the Bay until age 3 or older, with older animals migrating farther along the coast.

Similarly, the recreational harvest length-frequency in the Bay showed a shift towards 20-inch fish in 2015 in both total numbers and proportions, away from the 18-19 inch peak in 2012 (Figure 2). Overall numbers of harvested fish were lower for almost all lengths in the ocean recreational length frequency. The proportion of fish in the 22-25 inch range was slightly higher in 2015 than in 2013, possibly reflecting the beginning of the coastal migrations of the 2011 year class.

Changes in Harvest Patterns by Wave and Mode:

Overall, there did not seem to be consistent patterns in the differences in harvest by wave or mode between 2015 and the reference period (Table and Table). Some states saw increases in some waves or modes, and some saw decreases.

Changes in Effort:

Overall, total effort in the Bay and ocean declined with 13% fewer angler-trips taken in 2015 relative to the reference periods (Table 6). Every state in the ocean recreational fishery also saw a decrease in the total number of trips targeting striped bass in 2015 compared to 2013 with the exception of New Jersey which experienced a 2% increase (Table 7). However, for the Chesapeake Bay recreational fishery, both Maryland and Virginia experienced an increase in the total number of trips targeting striped bass by 58% and 28% respectively (Table 7).

The number of trips taken in 2015 compared to the reference years where striped bass was a primary or secondary target, showed no distinct pattern by wave or by mode. Some states experienced an increase in the number of trips in some waves or modes, and some saw decreases (Table 8 and Table 9).

Changes in Proportions of Fish Released Alive:

Every state in both the ocean and Chesapeake Bay recreational fishery experienced an increase in the proportion of striped bass released alive vs. total catch in 2015 compared to the reference year with the exception of Maryland (Table 10). Maryland experienced a small decrease (<1%) in the proportion of released alive vs. total catch in the Chesapeake Bay. Additionally, Maine, Massachusetts, Connecticut, New Jersey and North Carolina in the ocean recreational fishery all experienced a change in the proportion of striped bass released alive vs. total catch of less than 10%. For these states, releases decreased equally in proportion to total catch. For the remaining

states, there was a larger change in total catch between the reference year and 2015 compared to fish releases alive.

Discussion:
The focus of this review is to identify the variables contributing to the difference in the 2015 harvest estimates for the ocean and Chesapeake Bay recreational fisheries from those estimated by the TC. Recreational fisheries in the ocean saw a greater reduction than estimated by the TC, while the recreational fisheries in the Bay experienced an increase in harvest relative to the reference period.

As noted throughout the development and implementation of Addendum IV, size and bag limit analyses are limited by the assumption that effort, angler behavior, catch-per-unit-effort, and the size composition and distribution of fish available to anglers will be the same in the future. If those assumptions are violated, the estimated changes in harvest may be different from what is observed once those management options are implemented.

Specifically, changes in effort and changes in the size, age structure, and the distribution of the 2011 year class along the coast relative to the Chesapeake Bay, are thought to be the most significant variables contributing to the large differences in the realized harvest compared to those estimated by the TC. The 2011 year class led to the largest recruitment event since 2004, and was nearly fully available to the Bay recreational fisheries in 2015 (age 4), whereas these fish were only partially available to the ocean recreational fisheries (i.e., due to age at first migration, there was a greater proportion of the 2011 year class in the Bay relative to the ocean in 2015). This, coupled with the length of those fish in 2015 relative to the Bay's and ocean's minimum size limits (Figure 1 and 2), led to increased catch rates of striped bass in the Bay.

Although total effort in the ocean and Bay decreased, the number of trips that targeted striped bass increased in the Bay, which may have also contributed to higher catch rates in that fishery. Differences in harvest in 2015 compared to the reference period by mode and wave by state did occur, but the changes were variable without trend; some states saw increased effort and harvest in particular waves or modes, while other states saw decreases.

The TC notes that the proportion of fish released alive to the total catch increased for about half of the state fisheries which is most likely due to due to the emergence of the 2011 year class in the catch data and the changes in regulations (i.e., bigger size limits, and smaller bag limits). Increased release mortality is always a concern with more restrictive regulations, but given the relatively high survival rate of striped bass, more releases likely still corresponds to lower removals.

Although the Bay recreational fisheries did not meet the target harvest reduction, the TC notes that the goal of Addendum IV was achieved; F in 2015 was estimated to be below the target level. The TC also notes that when considering the increasing trend in recreational harvest in 2012 (the lowest harvest estimate on record) to 2014, harvest in the Bay in 2015 was undoubtedly lower than it would have been had regulations remained status quo.

Table 1: Estimated and realized harvest reductions for striped bass commercial fisheries. Source: Annual state compliance reports.

Ocean (Commercial – Pounds of fish)							
	Amd. 6 2013 Quota	**2013 Harvest**	**Add. IV 2015 Quota**	**2015 harvest**	**Estimated Reduction from 2013 Quota**	**Actual Reduction from 2013 Quota**	**Actual Reduction from 2013 Harvest**
Ocean Total	3,806,275	2,532,870	2,854,706	1,902,363	-25.0%	-50.0%	-24.9%
Chesapeake Bay (Commercial – Pounds of fish)							
		2012 Harvest	**Add. IV 2015 Quota**	**2015 harvest**	**Estimated Reduction from 2012 Harvest**	**Actual Reduction from 2012 Harvest**	
Chesapeake Bay Total		3,924,372	3,120,247	2,940,291	-20.5%	-25.1%	

Table 2: Estimated and realized changes in removals for striped bass recreational fisheries. Removals includes angler harvest (A + B1) plus dead discards (9% of B2). Source: MRIP.

Recreational Fisheries (Numbers of fish)					
Region	**Reference Removals Estimate***	**2015 Removals Estimate**	**2015 Removals**	**Estimated Change in Removals**	**Actual Change in Removals**
Ocean	2,153,773	1,517,063	1,141,556	-29.6%	-47.0%
Chesapeake Bay	538,111	419,726	852,524	-22.1%	+58.4%

* 2013 for Ocean, 2012 for Bay

Table 3: Realized changes in removals for striped bass recreational fisheries. Source: MRIP.

Region	**Sector**	**Reference Level**	**2015 Removals**	**Change in Removals**
Chesapeake Bay	Recreational Harvest (A+B1)	330,380	500,465	+51%
	Recreational Release Mortality (9% B2)	207,731	352,059	+69%
Ocean	Recreational Harvest (A+B1)	1,618,015	735,438	-55%
	Recreational Release Mortality (9% B2)	535,758	406,118	-24%

Table 4: Changes in removals by state and wave. Increases in harvest relative to the reference year are highlighted. Source: MRIP. Some cases (e.g., charter boat estimates) have been excluded from the table due to insufficient sample sizes.

Ocean						
	Harvest (Type A+B1)			Release Mortality (9% B2)		
	2013	2015	Difference (2015-2013)	2013	2015	Difference (2015-2013)
Maine						
MARCH/APRIL	0	0	0	0	0	0
MAY/JUNE	5,307	2,884	-2,423	3,939	9,017	5,078
JULY/AUGUST	7,025	1,771	-5,254	12,338	8,902	-3,436
SEPTEMBER/OCTOBER	8,990	65	-8,925	20,548	1,338	-19,210
NOVEMBER/DECEMBER	0	0	0	0	0	0
New Hampshire						
MARCH/APRIL	0	0	0	0	0	0
MAY/JUNE	8,851	456	-8,395	1,943	1,183	-761
JULY/AUGUST	7,178	1,372	-5,806	2,279	3,720	1,441
SEPTEMBER/OCTOBER	196	0	-196	2,691	144	-2,548
NOVEMBER/DECEMBER	0	0	0	0	0	0
Massachusetts						
MARCH/APRIL	0	0	0	0	0	0
MAY/JUNE	135,827	77,849	-57,978	78,429	75,710	-2,719
JULY/AUGUST	138,573	53,820	-84,753	44,921	27,811	-17,110
SEPTEMBER/OCTOBER	24,545	39,102	14,557	28,500	35,628	7,128
NOVEMBER/DECEMBER	0	0	0	342	0	-342
Rhode Island						
MARCH/APRIL	0	0	0	0	0	0
MAY/JUNE	171,973	22,555	-149,418	19,517	35,829	16,312
JULY/AUGUST	24,130	8,358	-15,772	19,789	6,061	-13,729
SEPTEMBER/OCTOBER	14,531	8,944	-5,587	21,650	5,327	-16,322
NOVEMBER/DECEMBER	0	0	0	13,146	211	-12,935
Connecticut						
MARCH/APRIL	0	0	0	5,066	0	-5,066
MAY/JUNE	14,503	18,286	3,783	11,733	35,510	23,777
JULY/AUGUST	60,047	22,579	-37,468	25,473	4,583	-20,890
SEPTEMBER/OCTOBER	51,750	4,050	-47,700	19,719	9,754	-9,965
NOVEMBER/DECEMBER	0	0	0	3,737	1,245	-2,492
New York						
MARCH/APRIL	8,701	0	-8,701	1,130	0	-1,130
MAY/JUNE	215,951	40,640	-175,311	34,097	11,740	-22,357
JULY/AUGUST	186,884	18,483	-168,401	13,070	3,274	-9,796
SEPTEMBER/OCTOBER	75,066	15,931	-59,135	13,839	3,992	-9,847
NOVEMBER/DECEMBER	4,252	11,328	7,076	26,945	17,134	-9,812
New Jersey						
MARCH/APRIL	80,265	25,560	-54,705	9,367	9,122	-245
MAY/JUNE	39,789	55,045	15,256	8,076	2,682	-5,395
JULY/AUGUST	10,345	43,744	33,399	20,916	21,295	379
SEPTEMBER/OCTOBER	21,492	27,347	5,855	13,554	18,170	4,616
NOVEMBER/DECEMBER	151,596	132,561	-19,035	43,135	26,081	-17,054
Delaware						
MARCH/APRIL	1,827	646	-1,181	330	363	33
MAY/JUNE	4,249	306	-3,943	593	1,174	581
JULY/AUGUST	6,694	597	-6,097	1,579	272	-1,307
SEPTEMBER/OCTOBER	314	0	-314	3,119	1,599	-1,520
NOVEMBER/DECEMBER	6,437	1,551	-4,886	1,894	535	-1,360
Maryland						
MARCH/APRIL	0	0	0	0	0	0
MAY/JUNE	1,216	0	-1,216	32	0	-32
JULY/AUGUST	0	0	0	456	501	45
SEPTEMBER/OCTOBER	0	0	0	0	0	0
NOVEMBER/DECEMBER	8,654	1,761	-6,893	0	0	0
Virginia						
MARCH/APRIL	0	0	0	0	0	0
MAY/JUNE	761	0	-761	142	0	-142
JULY/AUGUST	0	0	0	87	0	-87
SEPTEMBER/OCTOBER	0	0	0	82	89	7
NOVEMBER/DECEMBER	0	0	0	0	0	0
North Carolina						
MARCH/APRIL	0	0	0	25	0	-25
MAY/JUNE	0	0	0	71	0	-71
JULY/AUGUST	0	0	0	0	0	0
SEPTEMBER/OCTOBER	0	0	0	0	0	0
NOVEMBER/DECEMBER	0	0	0	0	0	0

Chesapeake Bay						
	Harvest (A+B1)			Release Mortality (9% B2)		
	2012	2015	Difference (2015-2012)	2012	2015	Difference (2015-2012)
Maryland						
MARCH/APRIL	21,561	12,595	-8,966	18,270	1,476	-16,794
MAY/JUNE	72,516	133,322	60,806	27,580	30,863	3,283
JULY/AUGUST	71,973	97,392	25,419	76,752	47,316	-29,436
SEPTEMBER/OCTOBER	76,342	84,512	8,170	70,799	67,962	-2,838
NOVEMBER/DECEMBER	17,927	76,790	58,863	5,185	132,462	127,277
Virginia						
MARCH/APRIL	0	212	212	0	219	219
MAY/JUNE	1,065	10,340	9,275	1,653	2,674	1,021
JULY/AUGUST	0	1,750	1,750	3,929	5,066	1,137
SEPTEMBER/OCTOBER	3,686	13,340	9,654	768	11,463	10,695
NOVEMBER/DECEMBER	65,310	56,031	-9,279	2,794	49,658	46,864

Table 5: Changes in removals by state and mode. Increases in harvest from the reference year are highlighted. Source: MRIP.

Ocean						
	Harvest (Type A+B1)			Release Mortality (9% B2)		
	2013	2015	Difference (2015-2013)	2013	2015	Difference (2015-2013)
Maine						
CHARTER BOAT	1,953	355	-1,598	1,113	519	-594
PARTY BOAT	0	0	0	0	0	0
PRIVATE/RENTAL BOAT	11,387	3,739	-7,648	35,355	14,048	-21,307
SHORE	9,934	625	-9,309	1,470	4,689	3,219
New Hampshire						
CHARTER BOAT	1,045	857	-188	477	504	27
PARTY BOAT	132	0	-132	30	0	-30
PRIVATE/RENTAL BOAT	15,742	970	-14,772	5,752	4,160	-1,592
SHORE	350	0	-350	1,132	382	-750
Massachusetts						
CHARTER BOAT	58,491	21,236	-37,255	1,613	3,813	2,200
PARTY BOAT	0	0	0	33	2	-31
PRIVATE/RENTAL BOAT	231,716	97,845	-133,871	129,322	87,696	-41,626
SHORE	8,738	51,688	42,950	21,225	47,637	26,413
Rhode Island						
CHARTER BOAT	6,401	8,954	2,553	279	698	419
PARTY BOAT	0	0	0	0	0	0
PRIVATE/RENTAL BOAT	207,711	29,315	-178,396	25,557	16,971	-8,586
SHORE	2,922	1,587	-1,335	48,545	29,759	-18,786
Connecticut						
CHARTER BOAT	14,057	29,923	15,866	4,044	8,958	4,914
PARTY BOAT	541	393	-148	40	29	-11
PRIVATE/RENTAL BOAT	115,896	44,303	-71,593	56,643	47,571	-9,072
SHORE	9,863	217	-9,646	9,045	3,492	-5,554
New York						
CHARTER BOAT	333,695	67,924	-265,771	28,177	17,168	-11,010
PARTY BOAT	16,156	7,932	-8,224	567	585	18
PRIVATE/RENTAL BOAT	131,649	72,797	-58,852	30,150	27,573	-2,577
SHORE	9,355	5,652	-3,703	30,186	7,981	-22,205
New Jersey						
CHARTER BOAT	97,981	112,927	14,946	1,547	13,647	12,100
PARTY BOAT	6,650	2,667	-3,983	881	296	-585
PRIVATE/RENTAL BOAT	216,619	165,996	-50,623	57,420	58,224	804
SHORE	80,219	2,669	-77,550	36,747	5,181	-31,566
Delaware						
CHARTER BOAT	526	0	-526	23	46	23
PARTY BOAT	0	0	0	0	0	0
PRIVATE/RENTAL BOAT	17,586	3,100	-14,486	4,339	1,502	-2,837
SHORE	1,409	0	-1,409	3,152	2,394	-758
Maryland						
CHARTER BOAT	0	0	0	0	0	0
PARTY BOAT	0	0	0	0	0	0
PRIVATE/RENTAL BOAT	8,654	1,761	-6,893	456	473	17
SHORE	0	0	0	32	28	-4
Virginia						
CHARTER BOAT	0	0	0	0	0	0
PARTY BOAT	0	0	0	0	0	0
PRIVATE/RENTAL BOAT	0	0	0	0	0	0
SHORE	636	0	-636	311	89	-222
North Carolina						
CHARTER BOAT	0	0	0	1	0	-1
PARTY BOAT	0	0	0	0	0	0
PRIVATE/RENTAL BOAT	0	0	0	0	0	0
SHORE	0	0	0	94	0	-94

Chesapeake Bay						
	Harvest (A+B1)			Release Mortality (9% B2)		
	2012	2015	Difference (2015-2012)	2012	2015	Difference (2015-2012)
Maryland						
CHARTER BOAT	112,212	90,131	-22,081	11,315	13,360	2,044
PARTY BOAT	181	88	-93	709	73	-636
PRIVATE/RENTAL BOAT	134,615	268,454	133,839	140,929	240,386	99,457
SHORE	13,313	45,939	32,626	45,634	26,260	-19,374
Virginia						
CHARTER BOAT	2,360	14,181	11,821	104	2,900	2,796
PARTY BOAT	108	19	-89	0	1	1
PRIVATE/RENTAL BOAT	66,911	75,183	8,272	8,851	63,578	54,727
SHORE	682	6,471	5,789	190	5,502	5,312

Table 6: Percent change in effort by state. Increases in effort from the reference year are highlighted. Effort is defined as all angler trips. Source: MRIP.

Ocean			
Effort (All Angler Trips)			
	2013	2015	% Difference (2015-2013)/(2013)
Maine	596,091	414,195	-31%
New Hampshire	313,275	221,376	-29%
Massachusetts	2,938,627	2,180,865	-26%
Rhode Island	1,229,342	878,586	-29%
Connecticut	1,209,820	1,340,590	11%
New York	3,872,555	3,235,218	-16%
New Jersey	4,364,247	4,287,444	-2%
Delaware	764,697	495,481	-35%
Maryland	134,157	154,742	15%
Virginia	476,476	249,509	-48%
North Carolina	4,967,753	4,645,659	-6%
TOTAL	**20,867,040**	**18,103,665**	**-13%**

Chesapeake Bay			
Effort (All Angler Trips)			
	2012	2015	% Difference (2015-2012)/(2012)
Maryland	2,195,025	2,164,254	-1%
Virginia	2,373,563	1,832,869	-23%
TOTAL	**4,568,588**	**3,997,123**	**-13%**

Table 7: Percent change in directed effort by state. Increases in effort from the reference year are highlighted. Directed effort is defined as trips where striped bass was a primary or secondary target. Source: MRIP.

Ocean			
Effort (Trips Targeting Striped Bass)			
	2013	2015	% Difference (2015-2013)/(2013)
Maine	401,072	273,038	-32%
New Hampshire	137,416	92,617	-33%
Massachusetts	1,693,635	1,211,500	-28%
Rhode Island	624,801	285,635	-54%
Connecticut	547,782	516,750	-6%
New York	1,175,588	690,470	-41%
New Jersey	1,196,706	1,222,484	2%
Delaware	123,131	46,884	-62%
Maryland	21,614	18,185	-16%
Virginia	21,043	14,140	-33%
North Carolina	98,347	46,033	-53%
TOTAL	**6,041,135**	**4,417,736**	**-27%**

Chesapeake Bay			
Effort (Trips Targeting Striped Bass)			
	2012	2015	% Difference (2015-2012)/(2012)
Maryland	535,628	844,826	58%
Virginia	188,712	241,176	28%
TOTAL	**724,340**	**1,086,002**	**50%**

Table 8: Changes in effort by state and wave. Increases in effort from the reference year are highlighted. Effort includes trips where striped bass was a primary or secondary target. Source: MRIP.

Ocean			
Effort (Angler Trips)			
	2013	2015	Difference (2015-2013)
Maine			
MARCH/APRIL	0	0	0
MAY/JUNE	72,817	83,455	10,638
JULY/AUGUST	171,145	146,155	-24,990
SEPTEMBER/OCTOBER	157,111	43,428	-113,683
NOVEMBER/DECEMBER	0	0	0
New Hampshire			
MARCH/APRIL	0	0	0
MAY/JUNE	32,370	20,630	-11,740
JULY/AUGUST	38,258	59,140	20,882
SEPTEMBER/OCTOBER	66,787	12,847	-53,940
NOVEMBER/DECEMBER	0	0	0
Massachusetts			
MARCH/APRIL	8,172	14,545	6,373
MAY/JUNE	582,914	430,961	-151,953
JULY/AUGUST	696,144	458,215	-237,929
SEPTEMBER/OCTOBER	397,296	298,387	-98,909
NOVEMBER/DECEMBER	9,108	9,393	285
Rhode Island			
MARCH/APRIL	161	27,557	27,396
MAY/JUNE	335,692	110,473	-225,219
JULY/AUGUST	124,923	79,216	-45,707
SEPTEMBER/OCTOBER	131,834	64,969	-66,865
NOVEMBER/DECEMBER	32,191	3,421	-28,770
Connecticut			
MARCH/APRIL	9,381	76,247	66,866
MAY/JUNE	159,413	203,437	44,024
JULY/AUGUST	223,324	118,579	-104,745
SEPTEMBER/OCTOBER	124,680	108,215	-16,465
NOVEMBER/DECEMBER	30,984	10,272	-20,712
New York			
MARCH/APRIL	43,805	5,155	-38,650
MAY/JUNE	336,365	254,651	-81,714
JULY/AUGUST	356,875	153,066	-203,809
SEPTEMBER/OCTOBER	319,507	194,070	-125,437
NOVEMBER/DECEMBER	119,036	83,528	-35,508
New Jersey			
MARCH/APRIL	205,141	122,117	-83,024
MAY/JUNE	243,994	291,805	47,811
JULY/AUGUST	58,093	90,726	32,633
SEPTEMBER/OCTOBER	232,960	195,747	-37,213
NOVEMBER/DECEMBER	456,518	522,089	65,571
Delaware			
MARCH/APRIL	8,284	12,296	4,012
MAY/JUNE	27,135	15,895	-11,240
JULY/AUGUST	16,783	5,050	-11,733
SEPTEMBER/OCTOBER	30,874	4,313	-26,561
NOVEMBER/DECEMBER	40,055	9,330	-30,725
Maryland			
MARCH/APRIL	0	0	0
MAY/JUNE	224	0	-224
JULY/AUGUST	1,245	0	-1,245
SEPTEMBER/OCTOBER	9	1,049	1,040
NOVEMBER/DECEMBER	20,136	17,136	-3,000
Virginia			
MARCH/APRIL	0	0	0
MAY/JUNE	3,621	944	-2,677
JULY/AUGUST	939	0	-939
SEPTEMBER/OCTOBER	0	4,218	4,218
NOVEMBER/DECEMBER	16,482	8,978	-7,504
North Carolina			
JANUARY/FEBRUARY	13,770	14,467	697
MARCH/APRIL	21,125	2,735	-18,390
MAY/JUNE	0	708	708
JULY/AUGUST	7,568	590	-6,978
SEPTEMBER/OCTOBER	22,918	4,460	-18,458
NOVEMBER/DECEMBER	32,966	23,073	-9,893

Chesapeake Bay			
Effort (Angler Trips)			
	2012	2015	Difference (2015-2012)
Maryland			
MARCH/APRIL	71,934	55,536	-16,398
MAY/JUNE	144,479	233,684	89,205
JULY/AUGUST	128,003	166,949	38,946
SEPTEMBER/OCTOBER	128,631	156,851	28,220
NOVEMBER/DECEMBER	62,581	231,807	169,226
Virginia			
MARCH/APRIL	4,403	4,476	73
MAY/JUNE	10,817	37,103	26,286
JULY/AUGUST	3,928	2,659	-1,269
SEPTEMBER/OCTOBER	18,716	61,472	42,756
NOVEMBER/DECEMBER	150,849	135,465	-15,384

Table 9: Changes in effort by state and mode. Increases in effort from the reference year are highlighted. Effort includes trips where striped bass was a primary or secondary target. Source: MRIP.

Ocean			
Effort (Angler Trips)			
	2013	2015	Difference (2015-2013)
Maine			
SHORE	165,053	130,557	-34,496
PARTY BOAT	0	0	0
CHARTER BOAT	6,437	6,688	251
PRIVATE/RENTAL BOAT	229,583	135,793	-93,790
New Hampshire			
SHORE	68,722	46,459	-22,263
PARTY BOAT	2,486	10	-2,476
CHARTER BOAT	2,574	2,407	-167
PRIVATE/RENTAL BOAT	63,633	43,741	-19,892
Massachusetts			
SHORE	523,201	549,902	26,701
PARTY BOAT	1,263	424	-839
CHARTER BOAT	73,676	48,111	-25,565
PRIVATE/RENTAL BOAT	1,095,495	613,063	-482,432
Rhode Island			
SHORE	323,065	119,729	-203,336
PARTY BOAT	493	0	-493
CHARTER BOAT	12,614	12,600	-14
PRIVATE/RENTAL BOAT	288,629	153,307	-135,322
Connecticut			
SHORE	107,204	255,597	148,393
PARTY BOAT	8,190	9,240	1,050
CHARTER BOAT	37,784	26,549	-11,235
PRIVATE/RENTAL BOAT	394,604	225,364	-169,240
New York			
SHORE	495,140	220,106	-275,034
PARTY BOAT	44,271	16,840	-27,431
CHARTER BOAT	225,959	151,102	-74,857
PRIVATE/RENTAL BOAT	410,219	302,422	-107,797
New Jersey			
SHORE	747,020	567,845	-179,175
PARTY BOAT	33,918	21,308	-12,610
CHARTER BOAT	41,158	96,471	55,313
PRIVATE/RENTAL BOAT	374,609	536,860	162,251
Delaware			
SHORE	60,326	30,631	-29,695
PARTY BOAT	428	8	-420
CHARTER BOAT	1,133	238	-895
PRIVATE/RENTAL BOAT	61,244	16,007	-45,237
Maryland			
SHORE	648	911	263
PARTY BOAT	9	34	25
CHARTER BOAT	0	0	0
PRIVATE/RENTAL BOAT	20,958	17,239	-3,719
Virginia			
SHORE	20,565	13,018	-7,547
PARTY BOAT	0	0	0
CHARTER BOAT	49		-49
PRIVATE/RENTAL BOAT	429	1,122	693
North Carolina			
MAN-MADE	2,344	8,035	5,691
BEACH/BANK	3,159	116	-3,043
CHARTER BOAT	0	1,271	1,271
PRIVATE/RENTAL BOAT	92,843	36,610	-56,233

Chesapeake Bay			
Effort (Angler Trips)			
	2012	2015	Difference (2015-2012)
Maryland			
SHORE	85,972	110,750	24,778
PARTY BOAT	512	249	-263
CHARTER BOAT	68,417	62,415	-6,002
PRIVATE/RENTAL BOAT	380,728	671,413	290,685
Virginia			
SHORE	15,010	3,841	-11,169
PARTY BOAT	688	213	-475
CHARTER BOAT	2,947	22,503	19,556
PRIVATE/RENTAL BOAT	170,068	214,619	44,551

Table 10: Changes in the percent of striped bass released alive (B2) vs. total catch (A+B1+B2). Source: MRIP.

Ocean			
Percent of total catch released alive			
	2013	2015	Difference (2015-2013)
Maine	95%	98%	3%
New Hampshire	83%	97%	14%
Massachusetts	85%	90%	5%
Rhode Island	79%	93%	14%
Connecticut	85%	90%	5%
New York	67%	79%	12%
New Jersey	73%	75%	2%
Delaware	81%	93%	12%
Maryland	39%	76%	37%
Virginia	84%	100%	16%
North Carolina	86%	87%	1%

Chesapeake Bay			
Percent of total catch released alive			
	2012	2015	Difference (2015-2012)
Maryland	89%	88%	-1%
Virginia	59%	89%	30%

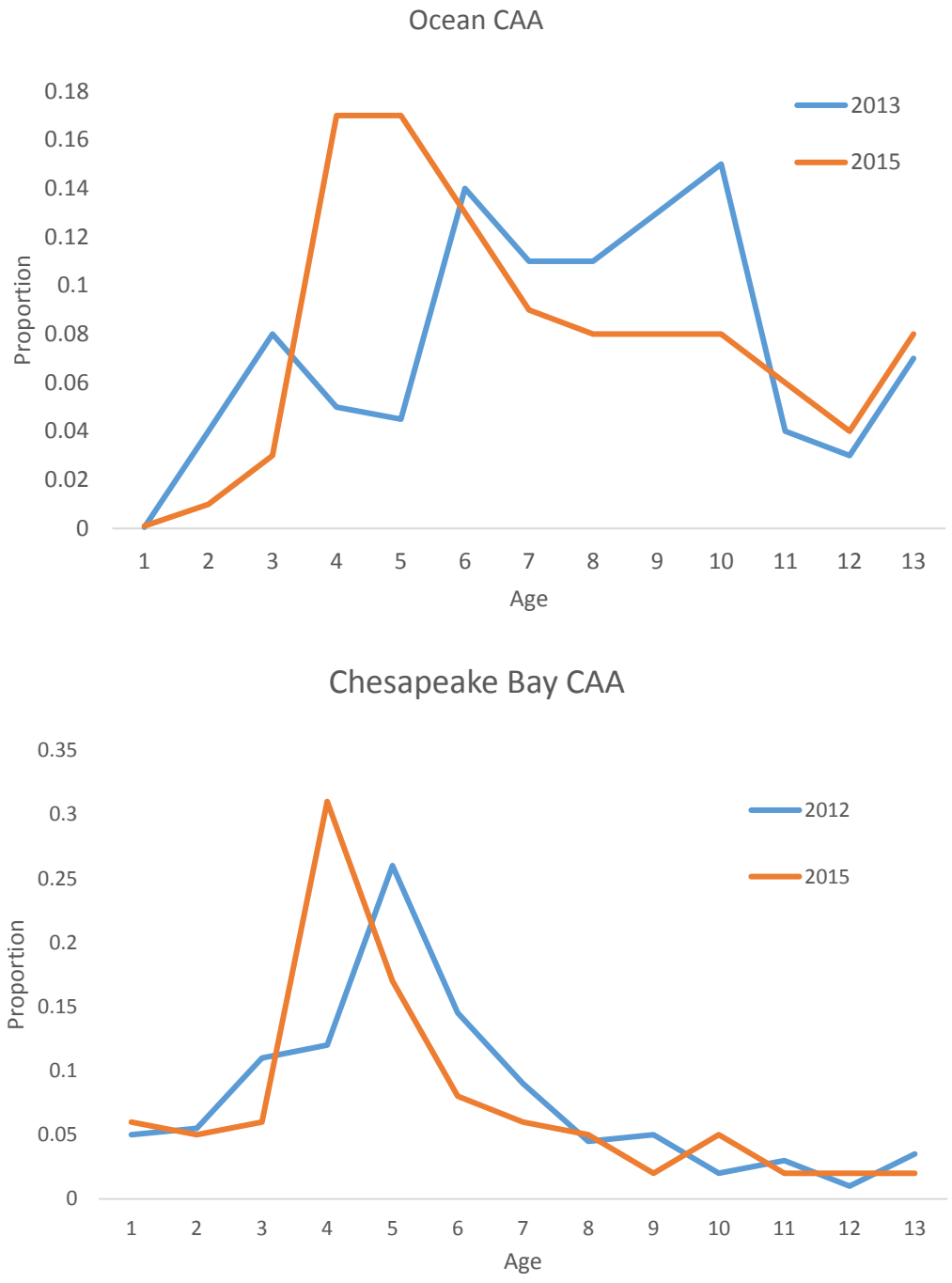

Figure 1: Proportions of catch-at-age by year for the ocean (top) and Bay (bottom) fisheries. Age-4 is the 2011 year class. Source: MRIP.

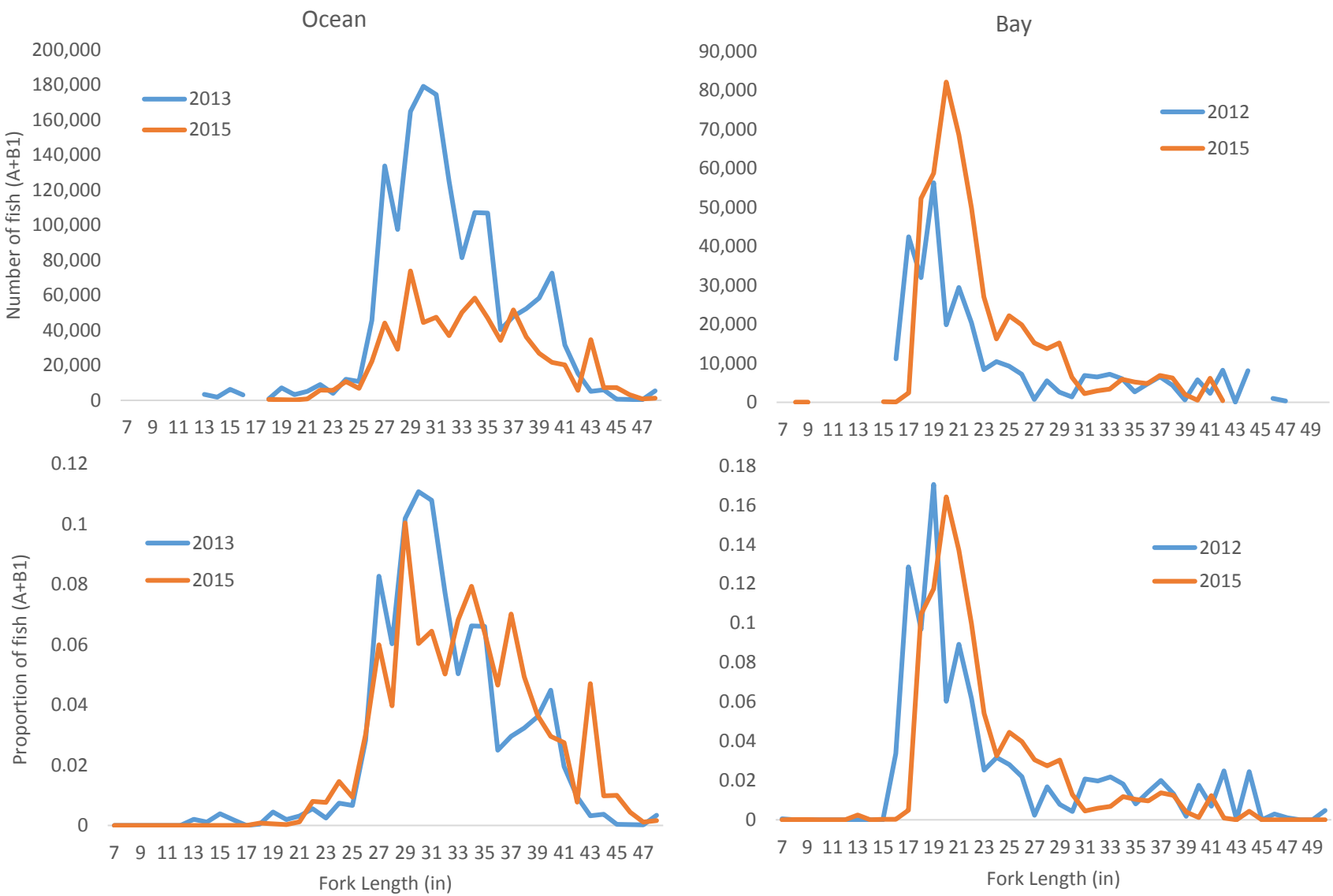

Figure 2: Total numbers and proportions of recreational harvest-at-length for the ocean (left) and Bay (right) fisheries. Source: MRIP.

Atlantic States Marine Fisheries Commission

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MEMORANDUM

October 5, 2016

To: **Atlantic Striped Bass Management Board**

From: **Atlantic Striped Bass Technical Committee**

RE: **2016 Atlantic Striped Bass Stock Assessment Update**

The 2016 Atlantic Striped Bass Stock Assessment Update utilizes catch and index data from 1982-2015.

In 2015, the Atlantic striped bass stock was not overfished or experiencing overfishing based on the point estimates of fully-recruited fishing mortality (F) and female spawning stock biomass (SSB) relative to the reference points defined in Atlantic Striped Bass Fishery Management Plan. SSB was estimated at 58,853 metric tons (129 million pounds) which is above the SSB threshold of 57,626 metric tons, but below the SSB target of 72,032 metric tons. Total F was estimated at 0.16 which is below the F threshold of 0.22 and below the F target of 0.18.

Commercial removals, i.e., landings plus dead discards, in 2015 were estimated at 917,264 fish. Recreational removals, i.e., angler harvest plus dead releases, in 2015 were estimated at 2,100,094 fish.

Total abundance (age 1+) increased to 195 million fish by 2012 due primarily to the abundant 2011 year-class from the Chesapeake Bay. Total abundance dropped in 2013 as the small 2012 year-class recruited to the population. Abundance increased slightly in 2014 to 127 million fish, and in 2015 total abundance was estimated at 180 million fish. Abundance of age 8+ fish has declined since 2012 and is expected to drop slightly in 2016.

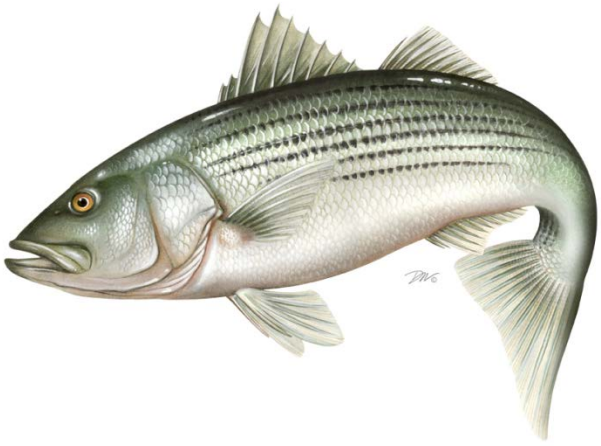
According to the projections model, if a constant catch of 3,017,358 fish, i.e., 2015 total removals, was maintained during 2016-2018, the probability of SSB falling below the threshold is 0.39 in 2016 and declines to 0.20 by 2018. The fully-recruited F is expected to decrease to 0.14 by 2018. The probability of F being above the F target is 0.08 by 2018 and there is little chance (near zero) that F would exceed the F threshold.

Enclosed: 2016 Atlantic Striped Bass Stock Assessment Update

CC: Atlantic Striped Bass Technical Committee
Atlantic Striped Bass Stock Assessment Subcommittee
Atlantic Striped Bass Advisory Panel

M16-088

Atlantic States Marine Fisheries Commission
Atlantic Striped Bass Stock Assessment Update
2016



Prepared by:
Atlantic Striped Bass Technical Committee

Sustainably Managing Atlantic Coastal Fisheries

Update of the Striped Bass Stock Assessment Using Data Through 2015

This document summarizes the striped bass assessment that uses catch and index data from 1982-2015.

Commercial Data Sources

Strict quota monitoring is conducted by states through various state and federal dealer and fishermen reporting systems. Landings are compiled annually from those sources by state biologists. Commercial harvest in some states is recorded in pounds and is converted to number of fish using conversion methods. Biological data (e.g., length, weight, etc.) and age structures (scales) from commercial harvest are collected from a variety of gear types through state-specific port sampling programs. Harvest numbers are apportioned to age classes using length frequencies and age-length keys derived from biological sampling.

Commercial Landings (Weight)

Historically, annual commercial harvest of striped bass peaked at almost 6,804 mt (15 million pounds) in 1973. Landings declined precipitously to 63 mt (140,000 pounds) by 1986. Commercial landings increased from 313 mt (690,039 pounds) in 1990 to 3,332 mt (7.3 million pounds) in 2004 following liberalization of fishery regulations. Since 2005, landings have fluctuated about an average of 3,162 mt (6.97 million pounds); however, landings have declined slightly in recent years (2011-2014) and further declined in 2015 as a result of quota reductions (Figure 1).

Commercial Landings (Numbers)

Commercial harvest of striped bass was over one million fish from 1997 through 2000 and near one million fish through 2006 (Table 1). Since 2007, numbers of fish landed have declined (Table 1). In 2015, only 617,698 fish were harvested and the Chesapeake Bay jurisdictions (Maryland, Virginia, and the Potomac River Fisheries Commission (PRFC)) accounted for 82% of the numbers of striped bass harvested (Table 1).

Commercial Landings Age Composition

The age structure of commercial harvest varies by state due to size regulations and season of the fisheries. The coast-wide time series of commercial-harvest age composition is provided in Table 2. In 2015, the commercial harvest was comprised primarily of ages 3-10 striped bass (Table 2). Harvest in Chesapeake Bay fisheries (Maryland, Virginia, and the PRFC) was comprised mostly of ages 3-8 (Table 3).

Commercial Discards

Discard estimates for fisheries in Chesapeake Bay, the Ocean and Delaware Bay are based on the ratio of tags reported from discarded fish in the commercial fishery to tags reported from discarded

fish in the recreational fishery, scaled by total recreational discards. Total commercial discards in 2015 were estimated to be 1.4 million fish.

Total discards are allocated to fishing gears based on the relative number of tags recovered by each gear. Discards by fishing gear were multiplied by gear specific release mortalities and summed to estimate total number of dead discards in a given year. The estimates of dead discards are 299,566 fish for 2015 (Table 4).

Age Composition of Commercial Dead Discards

Commercial discard proportions at age were obtained by applying age distributions from fishery dependent sampling or independent surveys that used comparable gear types. Gear specific proportions at age were applied to discard estimates by gear and the expanded estimates were summed across all gears. Most commercial discards since 2004 were fish of ages 3-7 (Table 4).

Total Removals by Commercial Fisheries

Total commercial striped bass removals (harvest plus dead discards) were 917,264 fish in 2015. Except for 2014, harvest has generally exceeded dead discards since the mid-1990s (Figure 2). Commercial losses in 2015 were dominated by the 2011 year-class (age 4).

Recreational Data Sources

Information on harvest and release numbers, harvest weights, and sizes of harvested bass from 1982-2003 come from the National Marine Fisheries Service's Marine Recreational Fisheries Statistics Survey (MRFSS/MRIP). The MRFSS/MRIP data collection consisted of a stratified intercept survey of anglers at fishing access sites that obtained numbers of fish harvested and released per angler trip, and a telephone survey that derived numbers of angler trips. Estimates of harvest and release numbers are derived on a bi-monthly basis.

In response to a peer review of the MRFSS program (National Resource Council 2006), NMFS established the Marine Recreational Information Program (MRIP) to improve recreational data collection and estimation methodologies. MRIP estimates are now calculated assuming intercepts at a site represent a cluster of samples, and sample sites are weighted by their probability of selection, which is a function of fishing pressure recommended by state advisors. The MRFSS estimation procedure assumed that each intercept was an independent observation and that all sites were equally likely to have been sampled. Re-estimation of catch and harvest from 2004-2010 using the new methodology occurred in 2011 and is the standard used presently. However, the additional site metadata needed to replicate the MRIP estimation method are not currently available prior to 2004; therefore, estimates of catch for 1982–2003 are based on the MRFSS methodology.

Anecdotal evidence had suggested that North Carolina, Virginia, and possibly other states had sizeable wave-1 fisheries beginning in 1996 (wave-1 sampling that began in 2004 in North Carolina waters and large wave-1 tag return data for North Carolina and Virginia supported this contention).

However, MRFSS/MRIP did not sample in January and February (wave-1) prior to 2004; therefore, there was little information for the winter fishery (Jan, Feb) that had developed off of North Carolina and Virginia. Harvest in wave 1 for these fisheries was estimated back to 1996 using observed relationships between landings and tag returns. For North Carolina, the ratio of estimated landings to tag returns in wave-1 of 2004 and annual tag returns in wave-1 were used to estimate annual landings from tag returns in January and February of 1996-2003. For Virginia waters, the 1996-2004 mean ratio of landings and tag returns in wave-6 and annual tag returns in wave-1 were used to estimate landings from tag returns in January and February of 1996-2004. For 2005-2012, MRFSS/MRIP wave-1 estimates of harvest for the winter fishery in Virginia waters were still unavailable; therefore, they were estimated. The approach used to estimate wave-1 harvest in prior years was abandoned because correlation between wave 6 harvest and tag returns off Virginia weakened significantly. In 2012, the regression method of Nelson (NEFSC, 2013) was updated to include the new MRIP NC wave 1 estimates of harvest and 2012 MRIP and tag data, and the wave 1 estimates from 2005-2012 were re-estimated. For 2015, the 2005-2012 regression was used to estimate Virginia wave-1 harvest. Dead releases for the winter recreational fishery in North Carolina and Virginia were not estimated.

Most states use the length frequency distributions of harvested striped bass measured by the MRFSS. The MRFSS measurements are converted from fork length (inches) to total length (inches) using conversion equations. Proportions-at-length are calculated and multiplied by the MRFSS harvest numbers to obtain total number harvested-at-length. Data on sizes of released striped bass come mostly from state-specific sampling or volunteer angling programs. Proportions-at-length are calculated and multiplied by the number of MRFSS/MRIP dead releases to obtain the total number of dead releases-at-length. For those programs that do not collect data on released fish, the lengths of tagged fish released by anglers participating in the American Littoral Society's striped bass tagging program or from state-sponsored tagging programs are used. Details on calculations are given in the 2013 SARC document (NEFSC, 2013).

Many states collect scale samples during state sampling programs designed to collect information on harvest and released striped bass from the recreational fishery. Age-length keys are usually constructed and applied to harvest and dead release numbers-at-length. When sampling of the recreational fishery does not occur, age-length keys are constructed by using data on age-length from commercial sampling, fisheries-independent sampling or striped bass tagging programs. For those states that do not collect scale samples, age-length keys are usually borrowed from neighboring states.

Age composition of the January/February recreational fishery in North Carolina and Virginia was estimated from length-frequency data collected by MRFSS/MRIP and appropriate state age-length keys. Length-frequencies for the North Carolina winter harvest of 2004 came from data in wave-6 of 2003 and wave-1 of 2004. Length-frequencies for the winter harvests of 1996-2003 came from wave-6 of year t-1. Lengths were converted to age for North Carolina with a combined age-length key from New York and North Carolina. Length-frequencies for the Virginia winter harvest in 1996-2012 came from MRFSS/MRIP data in wave-6 of year t-1. The Virginia lengths were converted to age with a Virginia age-length key in 2013, and used the MD coast age distribution was used to

apportion wave-1 harvest to age classes in 2014 and 2015 (there was no coastal age data provided by VA).

Recreational Total Landings

Figure 1 traces the impressive growth of the Atlantic coast-wide recreational fisheries from 1982 through 2015. Harvest increased from 1,010 mt (2.2 million pounds) in 1990 to 14,082 mt (31 million pounds) in 2006 (Figure 1). Following the peak in 2006, harvest declined through 2012 to 8,740 mt (19 million pounds), increased in 2013 and 2014, and declined in 2015 due to changes in bag and size limits (Figure 1).

Recreational Landings in Numbers

Recreational harvest of striped bass was greater than 1.4 million fish from 1997 through 2006, and more than 2.4 million striped bass during 2003-2006 (Table 5). Harvest was generally highest in Virginia, Maryland, New Jersey, and Massachusetts (Table 5). Coast-wide harvest of striped bass declined to 1.5 million fish in 2012, increased to an average of 1.97 million fish in 2013-2014, and declined to 1.34 million fish (Table 5).

Age Composition of Recreational Landings

Time series of harvest numbers-at-age are given in Table 6. Coast-wide recreational harvest was dominated by the 2011 (age 4) and 2010 (age 5) year-classes in 2015 (Table 7). Ages 4-10 comprised about 79% of the coast-wide harvest in 2015, and ages 8+ comprised about 41% (Table 6). Recreational harvest from the ocean states (includes Delaware Bay) was comprised mostly (70%) of ages 5-10, while harvest in Chesapeake Bay (MD and VA) was dominated by ages 4-8 (70%) (Table 7).

Recreational Dead Releases

The number of striped bass that are caught and released (B2) is estimated by MRFSS/MRIP (Table 8). The releases have accounted for 85 to 90% of the annual catch in most years (Figure 2). The number of releases that die due to the capture and release process is estimated by multiplying the total release numbers (B2) by an estimate of hooking mortality. The overall 9% hooking mortality rate estimated by Diodati and Richards (1996) was used. Estimates of the number of dead releases are presented in Table 9. The numbers of fish released dead increased from 132 thousand fish in 1990 to 1.4 million fish in 1997. Releases remained around 1.2 million through 2003, but increased to the series maximum of 2.1 million fish in 2006. Releases declined substantially from 2006 through 2012 (Table 9). The number of dead releases increased to 768,599 fish in 2013, declined slightly to 655,429 fish in 2014, and increased to 755,771 fish in 2015. The numbers of fish that die due to the capture/release process are generally highest in Maryland, Massachusetts, New Jersey and New York (Table 9).

Age Composition of Dead Releases

Ages of coast-wide recreational dead releases ranged from 0 to 15+, but most dead releases were ages 1-6 (Table 10). The dead releases were dominated by ages 1-5 in MD and VA and 3-6 in ocean states (Table 10).

Total Removals by Recreational Fisheries

Total recreational striped bass removals (harvest and dead discards) in 2015 were 2.10 million fish (Figure 2). In 2015, the harvest and dead releases combined were dominated by ages 3-7 in Maryland and Virginia and ages 4-10 in ocean states.

Incidental Removals

Some states collect information on the number of striped bass killed for other purposes such as scientific research. These are tabulated by region, age and year in Table 11.

Total Removals

Comparison of the combined losses (commercial, recreational and incidental removals) showed that the recreational fishery removed the largest number of striped bass in 2015 (Figure 3). The recreational fishery has been the dominant source of fishing removals since 1991 (Figure 2). The above components were totaled by year to produce the overall catch at age matrices by region (Table 12). Estimated total removals in the Chesapeake Bay and the Ocean regions declined from 2006 through 2012 (Table 12; Figure 4). The total removals of striped bass in the Chesapeake Bay in 2015 declined by 9.6% compared to 2014 (Table 12; Figure 4). The total removals of striped bass in the Ocean region in 2015 decreased by 20% compared to 2014 (Table 12; Figure 4). Ages 3-7 in 2015 sustained the highest losses in the Chesapeake Bay and ages 4-8 in 2015 sustained the highest losses in the Ocean region.

Catch Weight at Age

Catch mean weight at age data, which is used to calculate total biomass and spawning stock biomass, was calculated for the period 1998-2002 using all available weight data from MA, NY, MD, VA, NH, and CT (1998-2001) and adding data from RI and DE in 2002 (NOAA 46th SAW Striped Bass Assessment Report - Appendix A5). Mean weights at age for the 2003-2014 striped bass catches were determined as a result of the expansion of catch and weight at age. Data came from Maine and New Hampshire recreational harvest and discards; Massachusetts recreational and commercial catch; Rhode Island recreational and commercial catch; Connecticut recreational catch; New York recreational catch and commercial landings; New Jersey recreational catch; and Delaware, Maryland, Virginia, and North Carolina recreational and commercial catch. Weighted mean weights at age were calculated as the sum of weight at age multiplied by the catch at age in numbers, divided by the sum of catch at age in numbers. Details of developing weights at age for 1982 to 1996 can be found in NEFSC Lab Ref. 98-03. Weights at age for 1982-2014 are presented in Table 13.

Indices of Relative Abundance

States provide age-specific and aggregate indices from fisheries-dependent and fisheries-independent sources that are assumed to reflect trends in striped bass relative abundance. Descriptions of the current survey indices are given below. A summary of index information is provided in Table 14.

Fishery-Independent Surveys

Connecticut Trawl Survey (CTTRL)

Connecticut provides an aggregate (ages 4-6) index of relative abundance from a bottom trawl survey. The Connecticut DEEP Marine Fisheries Division has conducted a fisheries–independent Trawl Survey in Long Island Sound since 1984. The Long Island Sound Trawl Survey (LISTS) provides fishery independent monitoring of important recreational species, as well as annual total counts and biomass for all finfish taken in the Survey. All finfish species are measured on all tows. The Long Island Sound Trawl Survey encompasses an area from New London, Connecticut (longitude 72^{o} 03') to Greenwich, Connecticut (longitude 73^{o} 39'). The sampling area includes Connecticut and New York state waters from 5 to 46 meters in depth and is conducted over mud, sand and transitional (mud/sand) sediment types. Long Island Sound is surveyed in the spring (April-June) and fall (September-October) periods with 40 sites sampled monthly for a total of 200 sites annually.

The sampling gear employed is a 14 m otter trawl with a 51 mm codend. To reduce the bias associated with day-night changes in catchability of some species, sampling is conducted during daylight hours only). The Long Island Sound Trawl Survey employs a stratified-random sampling design. The sampling area is divided into 1.85 x 3.7 km (1 x 2 nautical miles) sites, with each site assigned to one of 12 strata defined by depth interval (0 - 9.0 m, 9.1 - 18.2 m, 18.3 - 27.3 m or, 27.4+ m) and substrate type (i.e., mud, sand, or transitional). For each monthly sampling cruise, sites are selected randomly from within each stratum. The number of sites sampled in each stratum was determined by dividing the total stratum area by 68 km^2 (20 square nautical miles), with a minimum of two sites sampled per stratum. Discrete stratum areas smaller than a sample site are not sampled. The CTTRL index is computed as the stratified geometric mean number per tow.

New York Ocean Haul Seine Survey

New York provided age-specific geometric mean indices of relative abundance for striped bass generated from an ocean haul seine survey from 1987 - 2006. Since 1987, NY DEC sampled the mixed coastal stocks of striped bass by ocean haul seine. Sampling was conducted annually during the fall migration on the Atlantic Ocean facing beaches off the east end of Long Island. A crew of commercial haul seine fishermen was contracted to set and retrieve the gear, and assist department biologists in handling the catch. The survey seine measured approximately 1,800 feet long and was composed of two wings attached to a centrally located bunt and cod end. The area swept was approximately ten acres. The seine was fifteen feet deep in the wings and twenty feet deep in the bunt.

Under the original design, sampling dates were selected at random to create a schedule of thirty dates. For each date selected, two of ten fixed stations were chosen at random, without replacement, as the sampling locations for that day. Since this design was difficult to implement due to weather-related delays, the sampling design was altered in 1990. Instead of randomly selecting thirty days, sixty consecutive working days were identified during the fall. One station was randomly selected, without replacement, for each working day until six "rounds" of ten hauls had been scheduled. Hauls that were missed due to bad weather or equipment failure were added to the next scheduled sampling day. No more than three hauls were attempted for any given day so that sampling was evenly distributed over time. Sixty hauls were scheduled for each year.

Since 1995, the survey team was prohibited from gaining access to several of the fixed stations. Instead of the original ten stations, two of the original stations plus three alternate sites were used to complete the annual survey. These alternate stations occur within the geographic range of the original standard stations. Also since 1995, funding delays resulted in a one-month delay in the commencement of field sampling activities. Between 1987 and 1994 field sampling began in early September. Since 1995, sampling began in late September to early October. In addition, decreases in funding have led to reductions in annual sampling effort from sixty seine hauls to forty-five seine hauls per season since 1997. The time series of catch and catch-at-age has been standardized by date for the entire time series.

This survey (see below) ended in 2007 due to state changes in contract relationships with private fishermen. The index remains in the assessment because it provides abundance trends for 1987-2006.

NEFSC Trawl Survey

The original vessel for this survey was replaced in 2009 with a larger vessel that cannot sample the inshore strata where most striped bass were caught. The index is still used in the assessment because it provides abundance trends for 1991-2008. The Northeast Fisheries Science Center provided an aggregate (2-9) index of relative abundance from the spring stratified-random bottom trawl survey. The survey covers waters from the Gulf of Maine to Cape Hatteras, NC. Only data from inshore strata from 1991-2008 are used.

New Jersey Bottom Trawl Survey (NJTRL)

New Jersey provides age-specific (2-9+) geometric mean indices of relative abundance for striped bass from a stratified-random bottom trawl initiated in 1989. The survey area consists of NJ coastal waters from Ambrose Channel, or the entrance to New York harbor, south to Cape Henlopen Channel, or the entrance to Delaware Bay, and from about the 3 fathom isobath inshore to approximately the 15 fathom isobath offshore. This area is divided into 15 sampling strata. Latitudinal boundaries are identical to those which define the sampling strata of the National Marine Fisheries Service (NMFS) Northwest Atlantic groundfish survey. Exceptions are those strata at the extreme northern and southern ends of NJ. Where NMFS strata are extended into NY or DE waters, truncated boundaries were drawn which included only waters adjacent to NJ, except for the ocean

waters off the mouth of Delaware Bay, which are also included. Samples are collected with a three-in-one trawl, so named because all the tapers are three to one. The net is a two seam trawl with forward netting of 12 cm (4.7 inches) stretch mesh and rear netting of 8 cm (3.1 inches) stretch mesh. The codend is 7.6 cm stretch mesh (3.0 inches) and is lined with a 6.4 mm (0.25 inch) bar mesh liner. The headrope is 25 m (82 feet) long and the footrope is 30.5 m (100 feet) long. Trawl samples are collected by towing the net for 20 minutes. The total weight of each species is measured with hanging metric scales and the length of all individuals comprising each species caught, or a representative sample by weight for large catches, is measured to the nearest cm fork length and only data from April are used for striped bass.

Maryland Spawning Stock Survey (MDSSN)

Maryland provides spawning stock age-specific (2-13+) mean indices of relative abundance for striped bass in Chesapeake Bay from a gillnet survey initiated in 1985. Multi-panel experimental drift gill nets are deployed in spawning areas in the Potomac River and in the Upper Chesapeake Bay during the spring spawning season in April and May. There are generally 20-25 sampling days in a season. Ten mesh panels 150 feet long that range from 8 to 11.5 feet deep are used. The panels are constructed of multifilament nylon webbing in 3.00- to 10.00-inch stretch-mesh. In the Upper Bay, the entire suite of 10 meshes is fished simultaneously. In the Potomac River, two suites of 5 panels are fished simultaneously. Overall, soak times for each mesh panel range from 15 to 65 minutes. In both systems, all 10 meshes are fished twice daily (20 sets) unless weather or other circumstances prohibit a second soak. Sampling locations are assigned using a stratified random survey design. Each sampled spawning area is considered a stratum. One randomly chosen site per day is fished in each spawning area. The Potomac River sampling area consists of 40 0.5-square-mile quadrants and the Upper Bay sampling area consists of 31 1-square-mile quadrants. The Choptank River was also sampled from 1985-1996. A sub-sample of striped bass captured in the nets is aged. Scales are removed from two- three randomly chosen male striped bass per one cm length group, per week, for a maximum of ten scales per length group over the entire season. Scales are taken from all males over 700 mm TL and all females regardless of total length.

CPUEs for individual mesh sizes and length groups are calculated for each spawning area. Mesh-specific CPUEs ($CPUE_{i,j}$) are calculated by summing the catch in each length group across days and sets, and dividing the result by the total effort for each mesh. Sex-specific mesh selectivity coefficients are then used to correct the mesh-specific length group CPUE estimates. Sex-specific models are used to develop selectivity coefficients for fish sampled from the Potomac River and Upper Bay. Model building and hypothesis testing has determined that male and female striped bass possess unique selectivity characteristics, but no differences are evident between the Upper Bay and the Potomac River. Therefore, sex-specific selectivity coefficients for each mesh and length group are estimated by fitting a skew-normal model to spring data from 1990 to 2000 following the procedure presented in Helser and others. (1998). Model residuals are re-sampled 1,000 times to generate a population of 1,000 mesh- and size-class specific selectivity coefficients for each year, sample area, and sex. The CPUE for each size class and mesh is then divided by the appropriate selectivity coefficient to generate 1,000 replicate matrices of mesh- and length-specific corrected catch frequencies. A vector of selectivity-corrected length-group CPUEs for each spawning area and

sex is then developed. The selectivity-corrected CPUEs are averaged across meshes, using a mean that is weighted by the capture efficiency of the mesh. Finally, area- and sex-specific estimates of relative abundance are pooled to develop Bay-wide estimates of relative abundance.

Delaware Spawning Stock Electrofishing Survey (DESSN)

Delaware provides spawning stock age-specific (2-13+) mean indices of relative abundance for striped bass in the Delaware River from an electrofishing survey initiated in 1996. Striped bass are sampled in the Delaware River from the vicinity of Big Timber Creek and League Island near river kilometer 152 located between Central Philadelphia downstream to the Delaware Memorial Bridge below Wilmington, DE at river kilometer 110. A stratified-random sampling design is used and a Smith-Root model 18-E boat electrofisher is used to collect striped bass. Typically, sampling is conducted with the boat moving in the direction of the tidal flow and in a zigzag pattern. Only striped bass approximately >200 mm total length are collected. Sampling is conducted weekly during mid-April to May (two days per week) and seven 12-minute timed samples are made per day. Length, weight, and sex are recorded and scales are collected from each fish. Due to staffing problems, the DE SSN was not completed in 2014.

New York Young-of-the-Year and Yearling Survey (NYYOY and NY Age 1)

In 2014, New York proposed a change in the young-of-year striped bass sampling program for the Hudson River. Objectives were to 1) adopt a more efficient sampling design for the juvenile striped bass survey without compromising the integrity of the index, and 2) determine the time-period for the index that best measures the abundance of juvenile striped bass. In the original program, from 1979-2013, approximately 25 stations were sampled every other week beginning in August and continued through the remaining summer/fall months. Sites were selected from a suite of 36 fixed stations located in the brackish water portion of the Hudson River: Tappan Zee to Haverstraw Bay (rkm 35 – 63). Sampling occurred over two to three days. A minimum of a four person sampling crew was needed to perform the survey each sampling day due to gear constraints and the large amount of data recorded at each site.

The gear is a 71 m x 3 m beach seine with 0.64 mm mesh. Sampling occurs during the day. Fish captured by seine are sorted by species and life stage, counted, and returned to the river. Lengths of striped bass and selected other species are obtained from a subset of the catch. The gear and fish processing procedure has not changed.

The “old” index was based on a six week time-period dating back to the beginning of the survey in 1979, where sampling was conducted from late August through November. However, an in-river, July through November off-shore trawl survey conducted in the same reach, indicated that young-of-year striped bass were present in this nursery area well before the late August start date of the seine program. Subsequently in 1985, three additional weeks of sampling were added to the seine program, moving back the start of sampling to mid-July to create the “nine-week index”. For all years, both the “6-week” (beginning in 1979) and “9-week” (beginning in 1985) relative abundance indices were calculated as geometric means of catch per haul. Only those hauls that resulted in a

representative sample, i.e. no major loss due to obstructions or gear problems (tears, hangs, etc.) were included in the calculation. Both series were reported to ASMFC; however, the "6-week" was used as the primary Hudson index.

In the revised sampling program, in 2014, NY sought a more efficient sample design given staffing constraints and the desire to remove redundancies in effort. NY examined the existing 35 year time series, 1979 to 2013, to eliminate sites that compromised the safety of the crew or equipment, sampled redundant adjacent habitats, or presented other recurring sampling issues. This analysis whittled sampling sites down from 25 to 13. The "revised" index incorporates the "9-week" index (mid July through November) seasonal component, retains the broad geographical reach of the nursery area, and does not compromise the integrity of the abundance index as it correlates well with the original indices:

- 6-week 13 site subset (6-week13ss) vs original 6-week: $R = 0.979$, $R^2 = 0.956$, $p < 0.0001$
- 9-week 13 site subset (9-week13ss) vs original 9-week: $R = 0.984$, $R^2 = 0.968$, $p < 0.0001$

In addition to running this correlation to the original index, New York also revisited the validation procedure for the revised index. NY compared the nine week, 13 site subset survey with the Western Long Island Age 1 survey and to the Hudson Age 6-8 gill net (former shad fishery bycatch) index. The correlations met the significance level required by ASMFC for both surveys. The ASFMC Management Board accepted the revision of the index as recommended by the Technical Committee in May 2014.

During the 2014 field season, the sampling design had to be slightly altered due to the presence of a large, immovable hang in one of the 13 selected sites. An adjacent alternate site with similar habitat characteristics was selected as a replacement; recalculation of the index using the substituted site resulted in a slight change to the annual index values. This final revised index still met the validation significance level required by ASMFC. The geometric mean is used as the relative index.

New York also provides an index of relative abundance for yearling striped bass in western Long Island. The beach seine (61-m) survey samples fixed stations during May-October. The geometric mean is used as the relative index.

New Jersey Young-of-the-Year Survey (NJYOY)

New Jersey provides an index of relative abundance for young-of-the year striped bass in the Delaware River for years 1980 to present. A bagged beach seine is used at fixed and random stations, which are sampled biweekly from August-October. About 256 hauls are made each year. Relative abundance index for striped bass is calculated as the mean geometric number of young-of-the-year captured per seine haul.

Virginia Young-of-the-Year Survey (VAYOY)

Virginia provides an index of relative abundance for young-of-the-year bass in the Virginia portion of Chesapeake Bay. Starting in 1980, the fixed station survey is conducted in the James, York, and Rappahannock river systems. Eighteen index stations are sampled five times a year on a biweekly basis from mid-July through September. Twenty auxiliary stations provide geographically expanded coverage during years of unusual precipitation or drought when the normal index stations do not yield samples. A bagged beach seine (30.5 m long) is set by hand with one end fixed on the beach and the other fully extended perpendicular to the beach. The seine is swept with the current. Two hauls are made at each site. Abundance indices are computed as the geometric mean number of young-of-the-year or yearling bass per haul.

Maryland Young-of-the-Year and Yearlings Surveys (MDYOY and MD Age1)

Maryland provides an index of relative abundance for young-of-the-year and yearling striped bass in the Maryland portion of Chesapeake Bay. Begun in 1954, the fixed station survey is conducted in the Upper Bay, Choptank, Nanticoke, and Potomac Rivers. Each station is sampled once during each monthly round performed during July, August, and September. A bagless beach seine (30.5 m long) is set by hand with one end fixed on the beach and the other fully extended perpendicular to the beach. The seine is swept with the current. Two hauls are made at each site. Abundance indices are computed as the geometric mean number of young-of-the-year or yearling bass per haul.

Fisheries-Dependent Indices

Total Catch Rate Index

An aggregate index of relative abundance for 1988 to present is generated from MRFSS/MRIP intercept data. Generalized linear modeling (GLM; McCullagh and Nelder, 1989) is used to derive annual mean catch-per-hour estimates by adjusting the number of caught fish per trip for the classification variables of state, year, two-month sampling wave, number of days fished in the past 12 months (as a measure of avidity), and number of hours fished. In the analyses, only data from anglers who reported that they targeted striped bass is used to insure methods used among anglers are as consistent as possible and to identify those targeting anglers that did not catch striped bass (zero catches). Also, only data from private boats fishing in the Ocean during waves 3-5 are used.

A delta-lognormal model (Lo *et al.* 1992) was selected as the best approach to estimate year effects after examination of model dispersion (Terceiro, 2003) and standardized residual deviance versus linear predictor plots (McCullagh and Nelder, 1989). In the delta-lognormal model, catch data is decomposed into catch success/failure and positive catch per trip ($y > 0$) components. Each component is analyzed separately using appropriate statistical techniques and then the statistical models are recombined to obtain estimates of the variable of interest. The catch success/failure was modeled as a binary response to the categorical variables using multiple logistic regression. The *glm* function in R is used to estimate parameters, and goodness-of-fit was assessed using concordance measures and the Hosmer-Lemeshow test. Positive catches, transformed using the natural logarithm, is modeled assuming a normal error distribution using function *glm* in R. Any variable not significant at $\alpha=0.05$ with type-III (partial) sum of squares is dropped from the initial

GLM model and the analysis is repeated. First-order interactions were considered in the initial analyses but it was not always possible to generate annual means by the least-square methods with some interactions included (Searle and others 1980); therefore, only main effects are considered. The annual index of striped bass total catch rate is estimated by multiplying together the prediction of the probability of obtaining a positive catch and the least-squares mean estimate of the positive catch from the models.

Virginia Pound Net (VAPNET)

Since 1991, the Virginia Institute of Marine Science has conducted the Virginia pound net survey. The pound net survey takes place on the striped bass spawning grounds in the Rappahannock River between river miles 44-47. VIMS has the option of sampling up to four commercial nets. The upper and lower nets are used for this survey and the middle nets are used for tagging. VIMS alternates sampling between the upper and lower nets. The sampling occurs from March 30 to May 3, when the females are on the spawning ground. The pound nets are checked twice a week, but are fishing constantly. When the samples are collected, the fish are sexed and measured, scales are taken from every fish, and a subsample of fish have otoliths removed.

Comparison of Fisheries-Independent and Fisheries-Dependent Indices

Time series of each index used in the current assessment are shown in Table 15 and 16. The fishery-independent indices for combined ages generally indicated an increase in population abundance from the early 1990s through the mid-1990s, and relatively stable levels through 2007 (Figure 5). The New Jersey and Connecticut trawl indices showed declines through 2011, increases in 2012 and 2013, and declines thereafter (Figure 5) The Maryland gillnet survey showed a relatively stable spawning stock biomass population since the mid-1980s. The Delaware electrofishing index exhibited a slight decline in spawning stock through 2009, an increase through 2011 and a variable decline through 2015 (Figure 5).

The coast-wide MRFSS/MRIP index indicated that abundance declined from 1998 to 2003, rose steadily through 2006, declined through 2011, increased through 2013, declined slightly in 2014 and rose in 2015 (Figure 5). The VA pound net index showed variable but level trends prior to 1999, an increase in 1999 and 2000, a decline through 2002, an increase through 2004, and then a variable but level trend through 2010. A decline occurred in 2011 and the index has remained at about the same level during 2012-2014, but declined in 2015.

Young-of-the-year and age-1 indices in Chesapeake Bay were variable but declines were observed during 2004-2010 and in some years close to low values that had not been observed since 1990 (Figure 6). In Delaware River, recruitment of YOY increased from 2007 through 2009, declined slightly during 2010-2011, increased in 2013 and 2014 and decline slightly in 2015. Recruitment in the Hudson River declined from 2007-2013, but has since increased (Figure 6). Strong year-classes were evident in 1993, 1996, 2001, 2003, 2011 and 2015 in Chesapeake Bay (Maryland and Virginia), and in 1993, 1995, 1999, 2003, 2009 and 2014 in Delaware River, in 1997, 1999, 2001, 2003, 2010 and 2014 in Hudson River (Figure 6).

Age composition data for the age-specific indices are given in Table 17.

Model Description

See the 2013 SARC document for complete description of the striped bass statistical catch-at-age model. A summary of the model structure used in this assessment is listed in Table 18.

Data Inputs

Plus Group

As in the 2013 benchmark, an age 13+ plus-group was used for catch and indices data as an attempt to address the increase in scale-ageing bias after ages 12 or so.

Removals Data

Total removals (recreational and commercial harvest numbers plus number of discards that die due to handling and release and incidental removals) and the proportions of catch-at-age of striped bass fisheries are the primary data used in the model. The removals data were partitioned into three "fleets" in an attempt to account for more realistic patterns in fishing selectivity known to have occurred as management measures changed over time. All selectivity time blocks corresponded to Amendment changes. Removals data were split into *Chesapeake Bay*, *Ocean* and the *Commercial Dead Discards*. The latter was a separate fleet because commercial discards were from a multitude of gears that do not necessarily target striped bass and the mixed gear types may have a unique selectivity over time. In addition, the data prior to 1996 could not be separated into regions. The Chesapeake Bay fleet includes commercial and recreational harvest and recreational dead discards taken in the Bay by MD, VA, and the PRFC. The Ocean fleet includes commercial and recreational harvest and recreational dead discards taken in the ocean by ME, NH, MA, RI, CT, NY, NJ, DE (Delaware Bay and ocean), MD, VA and NC.

Young-of-the-Year and Age 1 Indices

All indices used in the benchmark assessment were used in the update. Each index was linked to a particular age (Table 19). Young-of-the-year indices were lagged one year ahead and linked to age 1.

Starting Values

Initial starting values for all parameters are given in Table 20. Based on the coast-wide age samples, the starting effective sample sizes for the age proportions in each fleet were set at 50.
The effective sample sizes from the 2015 assessment used as starting values in the current assessment.

Sex Proportions-at-age

Female sex proportions-at-age are used to apportion the numbers-at-age to female numbers-at-age for calculation of female spawning stock biomass. The sex proportions were derived from available state catch datasets. The proportions used were:

Age	1	2	3	4	5	6	7	8	9	10	11	12	13+
Prop	0.53	0.56	0.56	0.52	0.57	0.65	0.73	0.81	0.88	0.92	0.95	0.97	1.00

Female Maturity

The proportions mature-at-age for females were derived from literature values and field samples.

Age	1	2	3	4	5	6	7	8	9	10	11	12	13+
Prop	0.0	0.0	0.0	0.04	0.13	0.45	0.89	0.94	1.00	1.00	1.00	1.00	1.00

Natural Mortality

The age-specific M estimates used in the updated base model are:

Age	1	2	3	4	5	6	≥7
M	1.13	0.68	0.45	0.33	0.25	0.19	0.15

Model Specification
Model parameters were solved in phases. The parameters solved in each phase were:

1 Yr 1, Age 1 N or Avg N (log)
2 recruitment deviations and fishing mortality
3 stock-recruitment parameters
4 catch selectivity parameters
5 survey selectivity parameters
6 catchability coefficients of survey indices

Catch Selectivity Functions

The same four time blocks for catch selectivity estimations used in the 2013 benchmark were used in this update except 2015 was added to the last time block. The periods are listed in Table 18.

Stock-Recruitment Curve

Based on literature reviews and committee opinion, the Beverton-Holt equation was selected as the appropriate stock recruitment relationship for striped bass.

Data Weighting

Data weighting was accomplished by first running the model with all initial starting values, lambda weights = 1, and index CV weights = 1. The lambda weights for the total removal data were increased to 2 for the Bay, Ocean, and Commercial Discards to force the model to better fit the data in these early years (1982-1984). Based on recommendations by the SARC panel, the initial effective sample sizes were first adjusted once by using the Francis (Francis 2011) multipliers and the model was re-run. After the model was re-run, the index CV weights were adjusted to obtain index RMSE values close to 1.0. The estimated RMSE values were used as the CV weights and this allowed the resulting RMSE values to be near 1.0. The model was re-run to make small adjustments in the RMSE values. Since the MRFSS and MDSSN indices have considerable influence on the model results, the CV weights for these indices were then adjusted until the RMSE values were nearly identical to balance the influence of each index.

Results

Resulting RMSE for fleet catch and survey indices and effective sample sizes for age compositions are given in Table 21. Resulting contributions to total likelihood are listed in Table 22. The converged total likelihood was 11006.9. Estimates of fully-recruited fishing mortality for each fleet, total fishing mortality, recruitment, parameters of the selectivity functions for the selectivity periods, catchability coefficients for all surveys, and parameters of the survey selectivity functions are given in Table 23 and are shown graphically in Figures 7-9. Graphs depicting the observed and predicted values and residuals for the catch age composition, survey indices, and survey compositions are given in Appendix A. The model fit the observed total catches (Figure 7) and catch age compositions of all fleets well, except for ages 1 and 13+ for the Ocean and Commercial Discard fleets (Appendix A), and the YOY, age 1, CTTRL, and NEFSC indices reasonably well (Appendix A). The predicted trends matched the observed trends in age composition survey indices (except MDSSN and NYOHS), and predicted the survey age composition reasonably well (MDSSN) to poorly (NJ Trawl) (Appendix A).

Estimates of the catch selectivity patterns for each fleet showed that, although the patterns varied over time with changes in regulation, selectivity was dome-shaped for Chesapeake Bay and Commercial Discard fleets and primarily flat-topped for the Ocean over time (Figure 8).

Fishing Mortality

Partial fully-recruited fishing mortality in 2015 for the Bay, Ocean and Commercial Discard fleets was 0.058, 0.118, and 0.013, respectively (total fully-recruited F_{2015} =0.156) (Table 23; Figure 9). The maximum total F-at-age in 2015 was 0.156 at age 11 (Table 24). Fishing mortality-at-age in 2015 for the three fleets is shown in Figure 10. Fishing mortality-at-age peaked at age 5 in the Chesapeake Bay, age 13+ in the Ocean fleet and at age 5 in the Commercial Discards fleets (Table 24).

Population Abundance (January 1)

Striped bass abundance (1+) increased steadily from 1982 through 1997 when it peaked around 249 million fish (Table 25; Figure 11). Total abundance fluctuated without trend through 2004. From

2005-2009, age 1+ abundance declined to about 131 million fish. Total abundance increased to 192 million fish by 2012 (Figure 11). The increase in 2012 was due primarily to the abundant 2011 year class from Chesapeake Bay (Table 25). Total abundance dropped in 2013 as the very small 2012 year-class from Chesapeake Bay recruited to the population (Figure 11). Abundance increased slightly in 2014 to 127 million fish and increased to 180 million fish in 2015. Abundance of striped bass age 8+ increased steadily through 2004 to 11.3 million fish, but declined to 7.6 million fish through 2010 (Table 25; Figure 11). A small increase in 8+ abundance occurred in 2011 as the 2003 year class became age 8 (Figure 11). Abundance of age 8+ fish has declined since 2012 (Figure 11) and is expected to drop slightly in 2016. The model estimated age-1 abundance in 2015 (the 2014 year-class) to be large and it appears to be the largest year-class since 2003 (however recruitment estimates in the terminal year of the model tend to be highly uncertain).

Spawning Stock Biomass and Total Biomass

Weights-at-age used to calculate female spawning stock biomass (SSB) were generated from catch weights-at-age and the Rivard algorithm described in the NEFSC's VPA/ADAPT program. Female SSB grew steadily from 1982 through 2003 when it peaked at about 77 thousand metric tons (Table 26, Figure 12A). Female SSB has since declined and was estimated at 58,853 metric tons (95% CI: 44,755-72,952) in 2015 (Table 26; Figure 12A). The estimate of SSB in 2015 remained above the threshold level of 57,626 thousand metric tons and indicates that striped bass were not overfished. However, given the error associated with the 2015 values, there is a probability of 0.41 that the female spawning stock biomass in 2015 was below the threshold. The spawning stock numbers (Figure 12B) declined more rapidly than the spawning stock biomass.

Exploitable biomass (January 1) increased from 1,399 metric tons in 1982 to its peak at 27 thousand metric tons in 2006 (Figure 12C). Exploitable biomass has since declined to 13,171 metric tons in 2015 (Figure 12C).

Retrospective Analysis

Retrospective analysis plots and percent difference plots between the 2015 and peels of the retrospective analysis are shown in Figure 13. Small retrospective bias was evident in the more recent estimates of fully-recruited total F, SSB, and age 8+ abundance of SCA (Figure 13). The general retrospective pattern suggests that fishing mortality is likely slightly over-estimated (between 2 and 13% since 2007) and could decrease with the addition of future years of data, while female spawning biomass appears under-estimated and could increase with the addition of future years of data. Similar retrospective trends have been observed in the previous assessments of striped bass using the ADAPT VPA (ASMFC 2005), the 2007 benchmark, 2013 benchmark and 2015 assessment.

Comparison of Results from the 2016 Updated Assessment with 2015 Assessment

Fully-recruited fishing mortality and female spawning stock biomass estimates from the 2016 update and 2015 assessment are shown in Figure 14. The updated assessment produced just slightly higher

fully-recruited fishing mortality and slightly lower female spawning stock biomass estimates than the 2015 assessment (Figure 14).

Comparison of Results from the 2016 Updated Assessment with Results from a Run using Separate Fleet-Selectivity Time Blocks for 2015

When fleet selectivities in 2015 were modeled as separate time blocks, only very minor differences in estimates of spawning stock biomass or fully-recruited fishing mortality were found (Figure 15).

Status of the Stock

In 2015, the Atlantic striped bass stock was not overfished and was not experiencing overfishing based on the point estimates of fully-recruited fishing mortality and female spawning stock biomass relative to the reference points defined in Addendum IV to the Fishery Management Plan for Atlantic Striped Bass. Female spawning stock biomass was estimated at 58,853 metric tons (129 million pounds) which was above the SSB threshold of 57,626 metric tons, but below the SSB target of 72,032 metric tons. Total fishing mortality was estimated at 0.16 which was below the F threshold of 0.22 and also below the F target of 0.18 (Figure 14). However, because of error associated with these estimates, there is a probability of 0.41 that the 2015 female SSB estimates was below or equal to the SSB threshold, or conversely, a probability of 0.59 that the 2015 female SSB is above the threshold. There is a probability of 0.01 that the 2015 fully-recruited fishing mortality is above or equal the fishing mortality threshold, or conversely, a 0.99 chance that the 2015 fully-recruited recruited is below the fishing mortality threshold. If the estimates of SSB and fully-recruited F are adjusted for the average retrospective bias in the last five years, the probability of the 2015 female SSB estimates being below or equal to the SSB threshold declines to 0.25, while the probability of the 2015 fully-recruited fishing mortality being above or equal the fishing mortality threshold is very close to zero.

Projections

Three scenarios were run to investigate changes in female SSB over three-year projections. In the first scenario, the changes in SSB and fishing mortality relative to their threshold and target reference points were examined by projecting the population assuming the catch taken in 2015 (3,017,358 fish) was also taken during 2016-2018. In the second scenario, the population was projected assuming the fishing mortality observed in 2015 (0.156) was the same in 2016-2018. In the third scenario, the population was projected assuming fishing mortality in 2016-2018 was equal to F target of 0.18. In all scenarios, additional runs were made with the estimates of abundance and fishing mortality adjusted for average retrospective bias.

For each scenario, the model begins in year 2015 with known January-1 abundance-at-age data with associated standard errors from the SCA model, the fully-recruited fishing mortality estimate in 2015 (F=0.156), selectivity-at-age in 2015, Rivard weights in 2015, natural mortality, female sex proportions-at-age, and female maturity-at-age are used to calculate female spawning biomass as modeled in the SCA model. For 2016, the January-1 abundance-at-age is calculated from the known

values of 2015 abundance-at-age, selectivity and fully-recruited fishing mortality. For the remaining years, the Jan-1 abundance-at-age is projected and is calculated by using the previous year's abundance-at-age, selectivity, fishing mortality and natural mortality following the standard exponential decay model. In the constant catch scenario, the fully-recruited fishing mortality in 2016-2018 is estimated by using an iterative approach in which catch-at-age is calculated by using the catch equation given a January-1 abundance-at-age, starting fishing mortality and selectivity-at-age from 2015. The sum of age-specific catches are then compared to the assumed constant catch for 2016-2018. This procedure is repeated by changing fully-recruited F until the square of the log difference between predicted catch and total catch is minimized. Given the value of fully-recruited F, spawning stock biomass for the current year is then calculated. For the constant F scenarios, total catch is calculated each year from the January-1 abundances and the current year fishing mortality rates.

For each iteration of the simulation, the abundance-at-age in 2015 is randomly drawn from a normal distribution parameterized with the 2015 estimates of January-1 abundance–at-age and associated standard errors from the stock assessment model. For the remaining years, abundance of age-1 recruits is randomly selected from the 1990-2015 recruitment estimates. An age 13 plus-group is assumed. For years 2016-2018, selectivity-at-age assumed equal to the average selectivity for years 2011-2015. Female spawning stock biomass was calculated by using average Rivard weight estimates from 2011-2015, sex proportions-at-age, and female maturity-at-age.

For each year of the projection, the probability of SSB being equal to or lower than the SSB reference point was calculated from the 10,000 simulations by using function *pgen* in R package *fishmethods*. The SSB reference point was the 1995 SSB estimate (57,626 metric tons) and the error of the estimates of current SSB and SSB reference point were incorporated in the calculation of probability. Similarly, the probability of current F being greater than or equal to the F reference point (F=0.219) was calculated from 10,000 simulations as well. The CV of the F reference point was assumed equal to the average value for the 2011-2015 fully-recruited F estimates.

If the constant catch of 3,017,358 fish was maintained during 2016-2018, the probability of being below the SSB threshold reference point decreases to 0.20 by 2018 (Figure 16). The fully-recruited F is expected to decrease to 0.15 by 2018 and there is little chance that the fully-recruited F would exceed the F reference point in any year (Figure 16). If the numbers-at-age were adjusted for average (2010-2014) retrospective bias, the probabilities of being below the SSB reference point are reduced (Figure 16). The probability of being below the SSB threshold reference point decreases to 0.09 by 2018 (Figure 16). The fully-recruited F is expected to decrease to 0.14 by 2018 and the chance that the fully-recruited F would exceed the F reference point in any year is close to zero. Projections run to estimate the probability of SSB being less than or equal to the SSB target (=72,032 mt), and F being equal to or greater than the F_{target} (=0.18) reference points showed the probability of being below the SSB target reference point decreases to 0.95 by 2018 (Figure 17). The probability of fully-recruited F being at or above the F_{target} is expected to decline as fully-recruit F drops (Figure 17). If the numbers-at-age in 2015 are adjusted for average (2010-2014) retrospective bias, the probability of being at or below the SSB target declines to 0.88 by 2018 (Figure 17). The fully-

recruited F is expected to decrease and the probability of F being at or below the F_{target} drops to 0.08 by 2018.

If the total fully-recruited fishing mortality was assumed equal to the 2015 value during 2016-2018, the probability of being below the SSB reference point decreases to 0.15 by 2018 (Figure 18). Catch is expected to decline in 2016, but then increase to about 3.2 million fish by 2018. If the 2015 numbers-at-age and fully-recruited F were adjusted for average (2010-2014) retrospective bias, the probabilities of being below the SSB reference point are reduced to 0.05 by 2018 (Figure 18), but catch in 2018 would be slightly less (3.1 million fish) than catch estimated from the unadjusted values. Projections run to estimate the probability of SSB being less than or equal to the SSB target (=72,032 mt) reference point showed the probability of being below the SSB target reference point decreases to 0.95 by 2018 (Figure 18). If the numbers-at-age in 2015 were adjusted for average (2010-2014) retrospective bias, the probability of being at or below the SSB target declines to 0.85 by 2018 (Figure 18).

If the total fully-recruited fishing mortality was assumed equal to the F_{target} of 0.18 during 2016-2018, the probability of being below the SSB threshold reference point decreases to 0.40 by 2018 (Figure 19). Catch is expected to decline in 2016, but then increase to about 3.5 million fish by 2018. If the 2015 numbers-at-age and fully-recruited F were adjusted for average (2010-2014) retrospective bias, the probabilities of being below the SSB reference point are reduced to 0.19 by 2018 (Figure 19), but catch in 2018 would be slightly less (3.4 million fish) than catch estimated with the unadjusted values. Projections run to estimate the probability of SSB being less than or equal to the SSB target (=72,032 mt) reference point showed the probability of being below the SSB target reference point decreases to 0.99 by 2018 (Figure 19). If the numbers-at-age in 2015 were adjusted for average (2010-2014) retrospective bias, the probability of being at or below the SSB target declines to 0.96 by 2018 (Figure 19).

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Table 1. Commercial harvest (numbers) by state and year.

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD	PRFC	VA	NC	Total
1982			26,183	52,896	207	74,935		12,794	189,089	54,421	14,905	3,200	428,630
1983			9,528	48,173	83	66,334		5,806	147,079	63,171	15,962	1,405	357,541
1984			5,838	8,878	192	70,472		12,832	392,696	372,924	6,507	532	870,871
1985	90		7,601	7,173	350	52,048		1,359		82,550	23,450		174,621
1986			3,797	2,668						10,965	251		17,681
1987			3,284	23						9,884	361		13,552
1988			3,388							19,334	10,588		33,310
1989			7,402										7,402
1990			5,927	784		11,784		698	534	38,884	56,222	803	115,636
1991			9,901	3,596		15,426		3,091	31,880	44,521	44,970	413	153,798
1992			11,532	9,095		20,150		2,703	119,286	23,291	42,912	1,745	230,714
1993			13,099	6,294		11,181		4,273	211,089	24,451	39,059	3,414	312,860
1994			11,066	4,512		15,212		4,886	208,914	25,196	32,382	5,275	307,443
1995			44,965	19,722		43,704		5,565	280,051	29,308	88,274	23,325	534,914
1996			38,354	18,570		39,707		20,660	415,272	46,309	184,495	3,151	766,518
1997			44,841	7,061		37,852		33,223	706,847	87,643	165,583	25,562	1,108,612
1998			43,315	8,835		45,149		31,386	790,154	93,299	204,911	16,040	1,233,089
1999			40,838	11,559		49,795		34,841	650,022	90,575	205,143	21,040	1,103,812
2000			40,256	9,418		54,894		25,188	627,777	91,471	202,227	6,480	1,057,712
2001			40,248	10,917		58,296		34,373	549,896	87,809	148,346	22,936	952,820
2002			48,926	11,653		47,142		30,440	296,635	80,300	127,211	15,784	658,091
2003			61,262	15,497		68,354		31,531	439,482	83,091	161,777	13,823	874,817
2004			66,556	15,867		70,367		28,406	461,064	91,888	147,998	31,014	913,160
2005			65,332	14,949		70,560		26,336	569,964	80,615	119,244	26,573	973,572
2006			75,062	15,429		73,528		30,212	655,951	92,288	109,396	2,799	1,054,664
2007			57,634	13,934		78,287		31,090	598,495	86,695	140,602	16,621	1,023,358
2008			65,330	16,616		73,263		31,866	594,655	81,720	134,603	12,903	1,010,955
2009			63,875	20,725		82,574		21,590	618,076	89,693	138,303	8,675	1,043,512
2010			65,277	17,256		81,896		19,830	584,554	90,258	159,197	12,670	1,030,938
2011			63,309	14,344		87,349		20,517	490,969	96,126	148,063	10,814	931,490
2012			66,394	14,953		66,897		15,738	472,517	90,616	111,891	323	839,329
2013			62,570	13,825		76,206		17,679	399,118	78,006	117,697	0	765,101
2014			60,619	10,468		52,903		14,894	370,661	81,429	175,324	0	766,298
2015			42,974	12,213		44,809		10,990	300,928	69,981	135,804	0	617,698

Table 2. Total commercial harvest (numbers) by age and year.

	Age													
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
1982	0	45,129	200,221	117,158	22,927	5,035	3,328	2,861	1,871	4,407	5,837	7,639	12,217	428,630
1983	0	54,348	120,639	120,999	38,278	7,416	1,954	677	607	1,690	1,314	2,375	7,245	357,541
1984	0	478,268	270,140	55,598	30,580	21,688	6,441	1,744	1,020	771	146	279	4,196	870,871
1985	0	53,699	45,492	7,545	9,448	19,248	21,569	6,581	3,692	1,514	466	607	4,760	174,621
1986	0	639	6,020	3,207	180	703	1,425	1,199	546	182	105	220	3,255	17,681
1987	0	0	3,087	4,265	1,618	252	1,104	1,075	448	233	95	273	1,102	13,552
1988	0	0	2,086	3,961	15,491	6,469	2,803	539	541	218	266	108	828	33,310
1989	0	0	0	0	0	139	1,111	959	1,007	631	475	164	2,916	7,402
1990	0	650	12,551	48,024	29,596	15,122	3,111	2,357	1,147	519	272	130	2,157	115,636
1991	0	2,082	22,430	44,723	41,048	21,614	8,546	4,412	4,816	1,163	269	125	2,570	153,798
1992	0	640	32,277	58,009	46,661	41,581	22,186	11,514	8,746	6,314	1,062	464	1,260	230,714
1993	0	1,848	21,073	93,868	87,447	42,112	32,485	13,829	8,396	6,420	3,955	763	664	312,860
1994	0	1,179	22,873	71,614	101,512	48,269	28,530	14,886	8,902	5,323	2,513	1,250	592	307,443
1995	0	6,726	35,190	114,519	134,709	98,471	38,918	34,191	37,324	21,827	8,364	3,166	1,509	534,914
1996	0	557	50,102	127,825	179,031	161,361	120,693	51,995	29,907	18,864	11,663	9,674	4,847	766,518
1997	0	1,843	37,754	342,867	213,454	206,836	102,034	76,149	54,989	30,373	17,813	13,813	10,686	1,108,612
1998	0	6,124	54,375	267,791	411,067	184,209	94,726	75,915	63,592	31,809	19,948	12,110	11,423	1,233,089
1999	0	7,591	94,342	211,645	264,460	221,773	92,992	66,837	63,357	35,916	20,939	14,180	9,780	1,103,812
2000	0	244	51,876	203,457	284,772	194,336	121,949	72,841	51,768	37,496	19,263	11,391	8,320	1,057,712
2001	0	165	86,190	189,602	241,867	140,555	89,963	95,580	34,026	31,547	22,172	12,853	8,300	952,820
2002	0	184	39,914	133,965	130,689	107,219	68,875	45,032	56,146	28,715	20,386	12,252	14,713	658,091
2003	0	3,932	59,027	156,836	171,626	132,005	96,662	76,612	70,049	59,722	20,916	15,944	11,484	874,817
2004	1,221	18,069	83,780	173,546	123,717	102,815	94,480	97,849	73,246	57,207	43,534	22,876	20,818	913,160
2005	0	145	43,488	239,748	252,020	102,076	57,072	56,939	75,306	50,440	41,629	25,937	28,771	973,572
2006	0	81	90,820	192,639	335,889	150,133	48,304	43,705	46,313	61,550	39,664	23,017	22,550	1,054,664
2007	0	0	4,711	305,597	207,826	190,053	78,099	51,494	64,579	51,397	32,964	20,498	16,141	1,023,358
2008	0	0	12,506	233,419	311,903	125,702	92,605	60,928	42,177	41,351	35,246	29,726	25,394	1,010,955
2009	0	69	19,745	190,560	356,448	191,280	68,995	69,342	41,636	31,813	27,531	18,630	27,461	1,043,512
2010	0	7,178	46,448	219,450	247,340	177,935	133,809	58,962	45,183	30,091	21,540	17,394	25,606	1,030,938
2011	0	788	49,592	127,860	199,887	198,523	118,074	93,069	45,488	42,628	15,586	12,507	27,489	931,490
2012	0	7,574	52,373	100,268	247,767	138,058	93,514	54,667	60,289	25,132	25,512	14,275	19,900	839,329
2013	0	465	56,877	130,722	149,660	148,739	70,319	57,246	50,022	53,178	14,798	12,540	20,534	765,101
2014	0	469	58,072	108,014	194,079	133,322	87,856	49,620	41,178	38,606	26,715	9,220	19,147	766,298
2015	0	0	11,880	181,537	109,099	78,162	62,399	49,541	28,815	42,146	20,796	16,265	17,060	617,699

Table 3. Age composition of commercial harvest in 2015 by state.

2015

State	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
MA	0	0	0	2	31	166	1,155	4,177	5,667	8,017	9,078	6,206	8,475	42,974
RI	0	0	0	203	1,142	1,327	1,234	1,292	1,681	1,785	1,408	811	1,329	12,213
NY	0	0	0	354	4,866	10,172	9,945	8,510	6,081	3,277	1,112	367	126	44,809
DE	0	0	0	0	631	2,375	4,058	2,292	1,355	56	112	56	56	10,990
MD Bay	0	0	424	126,886	64,304	35,241	29,698	23,299	6,845	9,316	2,022	273	19	298,327
MD Cst	0	0	0	0	0	14	25	425	480	559	417	621	60	2,601
PRFC	0	0	0	153	17,649	21,178	11,203	4,451	1,535	13,659	0	153	0	69,981
VA Bay	0	0	11,456	53,926	20,476	7,607	5,009	4,850	4,626	4,606	5,362	6,679	4,903	129,500
VA Cst	0	0	0	12	0	82	72	245	546	872	1,285	1,099	2,092	6,304
NC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	11,880	181,537	109,099	78,162	62,399	49,541	28,815	42,146	20,796	16,265	17,060	617,699

Table 4. Commercial discards (numbers) by age and year.

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
1982	0	31645	3644	11456	5623	1291	2397	1014	369	92	85	0	0	7	0	57,624
1983	0	24067	1453	2878	7761	2311	610	610	262	174	0	0	0	0	0	40,127
1984	0	33575	1611	5812	9734	11272	2815	117	586	66	0	52	0	0	0	65,639
1985	0	7728	30472	5939	10891	3395	2742	1045	261	131	131	0	0	0	0	62,734
1986	0	5841	20758	100067	27989	13315	4295	1415	346	0	0	0	0	0	0	174,024
1987	0	4206	14382	28597	51389	16940	6520	1319	1011	395	111	86	111	0	0	125,066
1988	0	6142	22593	36616	70959	71694	23232	9116	3110	1653	218	195	24	0	0	245,552
1989	0	13854	50240	49029	83396	82757	33479	15502	6342	705	1409	1409	663	41	0	338,827
1990	0	14526	68713	80935	111888	115702	71600	36256	5948	1539	1401	1503	0	0	0	510,011
1991	79	12632	37009	64210	77335	56894	36912	24857	6610	4071	6542	16	0	0	0	327,167
1992	117	3698	34218	36746	44412	34688	14798	11179	3398	2356	991	0	0	0	0	186,601
1993	0	7449	50160	79011	95116	63487	20941	15351	9270	4606	1651	536	260	0	0	347,839
1994	0	31770	47169	45081	88122	84570	39229	12524	6223	3674	712	415	30	0	0	359,518
1995	0	72822	75520	53551	94158	121592	61447	19083	7569	4269	2290	2346	807	0	0	515,454
1996	0	27133	114085	76336	61884	58787	30835	14916	6148	3989	159	502	50	0	0	394,824
1997	476	7108	64352	61871	30602	20951	14002	6592	1963	4309	2658	801	1060	0	0	216,745
1998	0	13233	53899	98510	83288	29197	12970	12591	7860	4372	3891	2419	3311	124	367	326,032
1999	984	58076	49894	43744	55740	14477	5213	3704	1980	1304	648	612	240	3	0	236,619
2000	196	178457	189933	157291	62699	33918	26938	7831	4111	3876	801	863	41	17	25	666,997
2001	0	2638	58079	77958	88808	29410	18877	11613	9664	6371	4778	1957	737	10	0	310,900
2002	1700	20888	42641	21409	28791	23720	12381	6854	5645	2255	1522	149	173	33	43	168,201
2003	1512	6227	28061	54464	56728	19866	30850	18633	16410	13572	8164	3207	2894	165	1222	261,974
2004	2943	52811	80744	76790	62580	48683	52231	41378	23549	9829	10381	2365	446	899	14	465,642
2005	432	11513	103930	245644	169860	68808	54397	43911	43609	23102	16147	8477	5238	2009	1466	798,544
2006	0	555	25769	28836	36995	27669	15055	16698	12693	13187	7392	4430	5245	0	0	194,524
2007	284	6302	18190	89608	97557	139873	78655	48521	42665	30644	22419	19979	11902	0	0	606,599
2008	0	109	2928	45076	71474	58005	44675	21699	13857	13043	12619	14253	10978	0	0	308,715
2009	0	1661	80748	166818	123878	91220	30653	38426	20517	16384	15706	7675	18258	0	0	611,944
2010	0	1379	16212	76208	64148	46221	19637	9510	6534	4079	3116	1792	6007	0	0	254,841
2011	0	3880	61564	109748	131320	80575	54479	49187	37502	30917	15468	11281	9401	9127	13006	617,457
2012	0	9118	50673	116560	205853	136385	109776	38433	41328	17081	22239	17148	2808	10723	14736	792,861
2013	0	4502	70746	116465	100230	73842	44949	32774	22008	20188	7357	10847	10143	2065	9465	525,581
2014	0	21	37916	108024	233435	180063	148881	62830	47609	50812	33159	6274	7234	4291	10842	931,391
2015	0	15	8707	89382	49169	29661	27396	20369	15407	14502	14448	17612	4416	2234	6248	299,566

Table 5. Recreational harvest (numbers) by state and year (includes wave 1 estimated harvest for Virginia).

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	NC	Total
1982	929	0	83,933	1,757	50,081	21,278	58,294	0	984	0	0	217,256
1983	7,212	4,576	39,316	1,990	42,826	43,731	127,912	135	31,746	0	0	299,444
1984	0	0	3,481	1,230	5,678	57,089	13,625	16,571	16,789	0	0	114,463
1985	11,862	0	66,019	670	15,350	23,107	13,145	0	2,965	404	0	133,522
1986	0	0	29,434	3,291	1,760	27,477	36,999	0	14,077	1,585	0	114,623
1987	0	90	10,807	2,399	522	14,191	9,279	0	4,025	2,442	0	43,755
1988	0	647	21,050	5,226	2,672	20,230	12,141	0	133	24,259	367	86,725
1989	738	0	13,044	4,303	5,777	12,388	1,312	0	0	0	0	37,562
1990	2,912	617	20,515	4,677	6,082	24,799	44,878	2,009	736	56,017	0	163,242
1991	3,265	274	20,799	17,193	4,907	54,502	38,300	2,741	77,873	42,224	391	262,469
1992	6,357	2,213	57,084	14,945	9,154	45,162	41,426	2,400	99,354	21,118	967	300,180
1993	612	1,540	58,511	17,826	19,253	78,560	64,935	4,055	104,682	78,481	264	428,719
1994	3,771	3,023	74,538	5,915	16,929	87,225	34,877	4,140	199,378	127,945	7,426	565,167
1995	2,189	3,902	73,806	29,997	38,261	155,821	254,055	15,361	355,237	149,103	11,450	1,089,182
1996	1,893	6,461	68,300	60,074	62,840	225,428	127,952	22,867	337,415	244,746	17,136	1,175,112
1997	35,259	13,546	199,373	62,162	64,639	236,902	67,800	19,706	334,068	518,483	96,189	1,648,127
1998	38,094	5,929	207,952	44,890	64,215	166,868	88,973	18,758	391,824	383,786	45,773	1,457,062
1999	21,102	4,641	126,755	56,320	55,805	195,261	237,010	8,772	263,191	411,873	65,658	1,446,388
2000	62,186	4,262	181,295	95,496	53,191	270,798	402,302	39,543	506,462	389,126	20,452	2,025,113
2001	59,947	15,291	288,032	80,125	54,165	189,714	560,208	41,195	382,557	355,020	58,873	2,085,127
2002	71,907	12,857	308,749	78,190	51,060	202,075	416,455	29,149	282,429	411,248	109,052	1,973,171
2003	57,765	24,878	407,100	115,471	95,983	313,761	391,842	29,522	525,191	455,812	127,727	2,545,052
2004	48,816	8,386	445,745	83,990	102,844	263,096	424,208	25,429	368,682	548,768	230,783	2,550,747
2005	83,617	24,940	340,743	110,490	141,290	376,894	411,532	20,438	533,929	293,161	104,904	2,441,938
2006	75,347	13,521	314,987	75,811	115,214	367,835	509,606	20,159	669,140	547,482	79,023	2,788,125
2007	53,694	6,348	315,409	101,400	118,549	474,062	289,656	8,465	765,169	353,372	37,376	2,523,500
2008	59,152	5,308	377,959	51,191	108,166	685,589	309,411	26,934	415,403	401,155	25,750	2,466,018
2009	62,153	8,587	344,401	71,427	60,876	356,311	283,024	19,539	501,845	326,867	5,650	2,040,680
2010	17,396	5,948	341,045	70,108	92,806	538,374	320,413	16,244	457,898	102,405	23,778	1,986,415
2011	18,105	32,704	255,507	88,635	63,288	674,844	393,194	18,023	445,171	146,603	94,182	2,230,256
2012	11,624	14,498	377,931	61,537	64,573	424,522	168,629	25,399	262,143	134,758	0	1,545,614
2013	23,143	17,657	298,945	218,236	143,373	490,855	345,008	19,520	477,295	118,686	0	2,152,718
2014	20,750	6,415	277,138	103,516	86,763	409,342	225,910	8,774	583,028	67,486	0	1,789,122
2015	4,720	1,828	170,770	39,857	70,644	262,181	284,257	3,101	406,371	100,593	0	1,344,322

Table 6. Recreational harvest (numbers) by age and year (includes wave 1 for Virginia).

	Age													
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
1982	0	5,721	36,125	81,725	24,916	10,963	16,943	11,960	8,970	5,980	4,983	5,980	2,990	217,257
1983	4,617	25,001	50,976	62,840	95,870	27,371	15,035	3,338	1,799	1,799	2,699	2,699	5,398	299,443
1984	2,021	22,316	24,474	15,610	16,528	15,288	8,034	2,548	0	849	849	0	5,945	114,463
1985	225	3,305	13,315	22,732	36,208	19,572	18,593	9,786	1,957	1,957	0	0	5,872	133,522
1986	11,002	5,426	9,354	12,136	12,339	13,473	12,285	18,427	7,020	4,387	2,632	877	5,265	114,623
1987	1,083	1,370	3,822	2,596	4,838	3,756	3,756	2,817	3,756	1,878	939	1,878	11,267	43,756
1988	1,023	8,195	5,116	5,120	6,135	11,214	10,191	12,225	9,169	3,056	3,056	3,056	9,169	86,725
1989	0	0	3,130	2,087	4,174	6,260	7,304	4,174	2,087	2,087	1,043	0	5,217	37,562
1990	627	7,933	17,317	39,534	22,708	22,980	16,657	15,810	7,680	3,009	1,797	899	6,290	163,242
1991	1,368	21,382	38,339	61,798	27,957	13,322	24,432	26,848	23,268	9,293	4,159	937	9,367	262,470
1992	1,881	15,923	61,295	52,925	54,507	20,325	13,805	23,488	23,613	18,849	3,854	1,943	7,771	300,179
1993	2,209	18,044	53,461	93,539	68,083	49,704	18,614	20,458	36,054	35,685	19,855	4,461	8,552	428,719
1994	2,112	43,976	138,180	95,461	91,957	47,419	29,827	23,833	34,809	29,999	13,650	8,815	5,128	565,167
1995	562	134,922	222,570	183,276	105,211	164,461	64,387	81,839	59,042	34,224	24,276	6,888	7,523	1,089,181
1996	531	129,149	257,038	214,669	109,367	116,156	137,033	80,275	58,041	27,210	18,534	19,437	7,673	1,175,113
1997	1,837	2,837	74,549	240,321	185,350	213,594	217,940	290,961	183,150	120,586	58,005	32,037	26,958	1,648,125
1998	0	20,368	133,541	229,441	168,884	164,613	134,977	153,529	163,905	96,099	87,690	41,837	62,180	1,457,063
1999	0	2,307	39,471	141,735	166,527	282,809	200,750	168,942	155,988	108,584	87,820	42,054	49,400	1,446,388
2000	0	503	37,950	255,084	402,268	367,123	423,409	201,142	120,257	97,670	53,095	28,375	38,237	2,025,112
2001	1,036	559	60,048	169,642	340,240	403,155	379,607	314,763	150,791	92,207	80,417	44,978	47,683	2,085,127
2002	0	1,530	33,823	141,000	266,095	405,275	334,964	249,670	237,566	107,817	86,338	46,611	62,481	1,973,171
2003	0	36,600	76,642	198,625	295,548	362,028	463,663	336,910	275,724	218,321	123,058	72,670	85,263	2,545,052
2004	427	214	94,601	207,895	211,670	268,011	301,427	435,274	331,997	265,634	210,003	103,959	119,632	2,550,745
2005	0	322	40,333	245,135	337,585	282,138	285,659	240,402	308,962	233,801	232,352	100,482	134,766	2,441,938
2006	0	8,326	112,441	209,402	372,824	335,684	245,484	289,948	249,576	341,499	248,790	158,204	215,948	2,788,125
2007	0	73	25,068	333,424	269,399	403,913	267,964	239,743	269,469	267,806	182,806	133,849	129,988	2,523,500
2008	0	246	7,036	74,691	340,359	211,584	473,211	359,388	200,562	243,217	197,085	156,271	202,367	2,466,018
2009	0	970	15,868	103,386	228,968	429,381	221,964	309,080	169,576	122,503	132,590	111,295	195,097	2,040,680
2010	0	8,973	25,576	141,402	156,928	288,769	487,688	201,524	215,001	155,490	81,649	79,440	143,974	1,986,415
2011	0	8,101	33,913	89,551	176,608	330,321	360,990	542,248	186,305	174,692	84,284	63,411	179,831	2,230,256
2012	880	5,750	37,455	51,034	138,448	166,043	230,082	267,495	275,475	91,442	91,694	60,174	129,641	1,545,614
2013	0	24,441	91,051	168,967	140,260	348,574	240,079	233,810	264,731	340,962	81,245	69,275	149,323	2,152,718
2014	0	425	113,852	179,894	226,704	179,158	203,847	129,816	180,710	203,607	147,676	76,302	147,129	1,789,122
2015	0	3,005	23,855	207,931	242,432	169,185	128,184	120,008	92,874	112,647	82,032	53,430	108,738	1,344,321

Table 7. Age composition of recreational harvest in 2015 by state.

2015	Age													
State	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
ME	0	0	0	126	931	1,204	856	611	390	280	194	104	24	4,720
NH	0	0	0	50	345	430	333	203	139	126	97	60	46	1,828
MA	0	0	491	7,135	25,470	23,825	19,192	25,132	23,590	20,555	14,185	3,912	7,284	170,770
RI	0	0	0	193	2,368	2,876	4,004	4,731	6,275	6,246	4,699	2,681	5,784	39,857
CT	0	279	650	158	10,534	19,395	14,286	7,983	6,685	4,196	3,301	1,560	1,617	70,644
NY	0	0	0	11,459	34,247	46,767	31,815	16,631	16,323	20,534	19,629	15,784	48,992	262,181
NJ	0	0	772	52,384	57,749	30,877	22,298	23,926	21,586	27,043	19,128	7,315	21,180	284,257
DE	0	0	5	152	179	215	120	259	287	320	821	205	537	3,100
MD Bay	0	0	0	84,740	104,426	41,329	32,359	35,468	16,100	31,071	18,040	19,827	21,250	404,610
MD Cst	0	0	0	0	0	145	114	326	209	260	151	379	178	1,761
VA Bay	0	2,726	21,937	51,536	6,183	1,620	2,412	3,608	566	1,111	1,264	286	1,225	94,473
VA Cst	0	0	0	0	0	504	396	1,132	726	903	524	1,316	618	6,120
NC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	3,005	23,855	207,931	242,432	169,186	128,185	120,010	92,874	112,645	82,032	53,429	108,736	1,344,321

Table 8. Recreational releases by state and year.

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	NC	Total
1982	687	0	6,441	2,551	643,187	12,297	87,648	0	30,376	0	0	783,187
1983	0	0	34,018	5,444	0	1,469	117,807	0	213,487	11,997	0	384,222
1984	1,887	0	98,405	85,135	31,176	40,469	52,930	0	104,095	8,775	0	422,872
1985	81,153	93	12,360	40,567	26,946	57,540	5,524	702	147,103	2,598	0	374,586
1986	4,379	0	442,298	2,014	10,494	123,842	0	0	390,063	7,528	0	980,618
1987	18,106	435	93,660	63,849	78,434	253,986	56,697	16,988	118,395	7,611	0	708,161
1988	4,528	6,699	209,632	23,347	25,532	92,611	486,306	2,455	132,250	5,631	0	988,991
1989	16,028	4,822	193,067	38,007	125,370	365,712	265,958	4,807	114,269	72,766	0	1,200,806
1990	12,542	15,518	339,511	67,509	89,490	265,099	254,384	14,411	420,084	175,046	0	1,653,594
1991	67,490	6,559	448,735	30,975	301,476	756,663	166,198	38,334	1,036,011	208,350	256	3,061,047
1992	31,177	27,613	779,814	120,410	292,259	799,149	413,506	36,932	749,959	115,899	679	3,367,397
1993	373,064	14,979	833,566	100,993	271,318	694,107	308,253	89,543	1,556,848	100,374	1,524	4,344,569
1994	363,703	43,501	2,102,514	138,989	489,967	1,132,707	568,047	103,992	2,785,392	197,022	5,005	7,930,839
1995	505,758	285,486	3,280,882	356,324	507,124	1,209,585	694,889	115,363	2,401,277	370,949	16,225	9,743,862
1996	1,626,705	292,820	3,269,746	314,336	1,051,612	1,436,091	776,165	99,372	2,545,238	759,916	116,667	12,288,668
1997	1,417,976	279,298	5,417,751	606,746	722,708	1,018,892	736,734	130,073	4,019,987	1,232,323	135,853	15,718,341
1998	691,378	243,301	7,184,358	613,421	1,026,192	884,626	488,319	185,016	2,641,680	796,372	173,704	14,928,367
1999	649,816	145,730	4,576,208	360,121	704,025	1,228,628	1,152,682	105,696	2,387,615	940,755	263,445	12,514,721
2000	942,593	209,606	7,382,031	541,516	926,367	1,373,069	885,289	151,838	3,244,731	1,022,040	129,729	16,808,809
2001	870,522	164,336	5,410,899	377,474	1,107,707	824,278	965,650	162,677	2,890,054	620,947	49,953	13,444,497
2002	1,392,200	238,003	5,718,984	530,402	696,976	588,155	715,099	114,650	2,928,589	706,729	63,269	13,693,056
2003	846,708	260,167	4,361,710	448,707	843,037	1,083,808	925,885	169,012	4,652,800	970,554	48,945	14,611,333
2004	693,400	225,777	4,979,075	525,936	826,724	2,709,246	1,502,694	155,655	3,479,634	1,732,890	222,302	17,053,333
2005	2,985,203	572,633	3,988,679	633,871	1,761,628	1,412,191	1,218,893	251,049	3,855,552	1,295,768	103,432	18,078,899
2006	4,000,309	460,615	7,809,777	834,953	986,700	1,722,386	1,890,294	247,653	3,711,343	1,655,007	24,262	23,343,299
2007	1,115,068	257,372	5,331,470	677,851	984,638	1,677,717	1,789,294	248,689	3,064,928	949,158	13,838	16,110,023
2008	465,003	77,237	3,649,415	416,373	3,104,779	1,346,385	1,309,453	260,677	1,338,728	532,161	10,776	12,510,987
2009	263,512	57,443	2,282,601	398,686	1,161,278	1,073,467	800,510	145,586	1,423,332	358,991	5,407	7,970,813
2010	193,743	51,833	1,671,437	183,112	670,534	1,068,672	690,340	65,048	1,508,647	134,350	20,365	6,258,081
2011	142,505	98,693	973,192	214,302	612,367	1,506,080	884,013	110,085	1,127,511	153,582	110,150	5,932,480
2012	214,185	64,226	989,509	247,075	264,927	586,044	406,096	109,960	2,206,518	101,736	1,615	5,191,891
2013	422,598	84,015	1,691,026	826,280	778,250	989,783	1,107,218	83,494	2,387,276	168,989	1,057	8,539,986
2014	277,209	78,612	1,826,412	163,239	303,836	726,137	1,051,323	185,166	2,415,192	254,795	626	7,282,547
2015	213,964	56,065	1,546,094	526,982	684,657	551,730	859,435	43,803	3,117,552	797,174	0	8,397,456

Table 9. Recreational dead releases (numbers) by state and year (using 0.09 release mortality).

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	NC	Total
1982	62	0	580	230	57,887	1,107	7,888	0	2,734	0	0	70,487
1983	0	0	3,062	490	0	132	10,603	0	19,214	1,080	0	34,580
1984	170	0	8,856	7,662	2,806	3,642	4,764	0	9,369	790	0	38,058
1985	7,304	8	1,112	3,651	2,425	5,179	497	63	13,239	234	0	33,713
1986	394	0	39,807	181	944	11,146	0	0	35,106	678	0	88,256
1987	1,630	39	8,429	5,746	7,059	22,859	5,103	1,529	10,656	685	0	63,734
1988	408	603	18,867	2,101	2,298	8,335	43,768	221	11,903	507	0	89,009
1989	1,443	434	17,376	3,421	11,283	32,914	23,936	433	10,284	6,549	0	108,073
1990	1,129	1,397	30,556	6,076	8,054	23,859	22,895	1,297	37,808	15,754	0	148,823
1991	6,074	590	40,386	2,788	27,133	68,100	14,958	3,450	93,241	18,752	23	275,494
1992	2,806	2,485	70,183	10,837	26,303	71,923	37,216	3,324	67,496	10,431	61	303,066
1993	33,576	1,348	75,021	9,089	24,419	62,470	27,743	8,059	140,116	9,034	137	391,011
1994	32,733	3,915	189,226	12,509	44,097	101,944	51,124	9,359	250,685	17,732	450	713,776
1995	45,518	25,694	295,279	32,069	45,641	108,863	62,540	10,383	216,115	33,385	1,460	876,948
1996	146,403	26,354	294,277	28,290	94,645	129,248	69,855	8,943	229,071	68,392	10,500	1,105,980
1997	127,618	25,137	487,598	54,607	65,044	91,700	66,306	11,707	361,799	110,909	12,227	1,414,651
1998	62,224	21,897	646,592	55,208	92,357	79,616	43,949	16,651	237,751	71,673	15,633	1,343,553
1999	58,483	13,116	411,859	32,411	63,362	110,577	103,741	9,513	214,885	84,668	23,710	1,126,325
2000	84,833	18,865	664,383	48,736	83,373	123,576	79,676	13,665	292,026	91,984	11,676	1,512,793
2001	78,347	14,790	486,981	33,973	99,694	74,185	86,909	14,641	260,105	55,885	4,496	1,210,005
2002	125,298	21,420	514,709	47,736	62,728	52,934	64,359	10,319	263,573	63,606	5,694	1,232,375
2003	76,204	23,415	392,554	40,384	75,873	97,543	83,330	15,211	418,752	87,350	4,405	1,315,020
2004	62,406	20,320	448,117	47,334	74,405	243,832	135,242	14,009	313,167	155,960	20,007	1,534,800
2005	268,668	51,537	358,981	57,048	158,547	127,097	109,700	22,594	347,000	116,619	9,309	1,627,101
2006	360,028	41,455	702,880	75,146	88,803	155,015	170,126	22,289	334,021	148,951	2,184	2,100,897
2007	100,356	23,163	479,832	61,007	88,617	150,995	161,036	22,382	275,844	85,424	1,245	1,449,902
2008	41,850	6,951	328,447	37,474	279,430	121,175	117,851	23,461	120,486	47,894	970	1,125,989
2009	23,716	5,170	205,434	35,882	104,515	96,612	72,046	13,103	128,100	32,309	487	717,373
2010	17,437	4,665	150,429	16,480	60,348	96,180	62,131	5,854	135,778	12,092	1,833	563,227
2011	12,825	8,882	87,587	19,287	55,113	135,547	79,561	9,908	101,476	13,822	9,913	533,923
2012	19,277	5,780	89,056	22,237	23,843	52,744	36,549	9,896	198,587	9,156	145	467,270
2013	38,034	7,561	152,192	74,365	70,043	89,080	99,650	7,514	214,855	15,209	95	768,599
2014	24,949	7,075	164,377	14,692	27,345	65,352	94,619	16,665	217,367	22,932	56	655,429
2015	19,257	5,046	139,148	47,428	61,619	49,656	77,349	3,942	280,580	71,746	0	755,771

Table 10. Recreational dead releases (numbers) in 2015 by age and state.

2015	Age														
State	0	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
ME	0	0	53	1,248	8,691	7,282	1,310	188	161	96	96	65	39	27	19,257
NH	0	0	22	420	2,281	1,668	343	100	72	42	38	29	18	14	5,046
MA	0	0	440	8,334	46,502	38,499	12,491	6,075	4,593	5,893	6,198	5,040	3,407	1,676	139,148
RI	0	0	1,068	7,654	24,835	7,526	1,441	703	642	768	722	722	514	832	47,428
CT	0	19	1,725	5,324	26,123	9,435	5,497	2,805	2,037	2,014	1,883	1,742	1,206	1,810	61,620
NY	0	465	6,180	6,704	22,683	7,416	3,068	888	566	478	433	368	227	178	49,656
NJ	33	1,124	2,830	5,265	29,395	17,741	6,791	3,739	2,479	2,490	2,175	1,834	791	664	77,349
DE	97	0	207	164	456	1,081	650	609	184	58	177	131	52	76	3,942
MD Bay	0	67,092	62,560	21,926	94,247	17,471	4,423	1,570	1,121	593	1,996	2,652	3,510	918	280,078
MD Cst	0	0	1	1	57	120	142	16	43	26	25	17	40	13	501
VA Bay	0	17,128	6,050	31,102	9,975	4,371	1,051	303	86	264	309	374	510	134	71,657
VA Cst	0	0	0	0	10	21	25	3	8	5	4	3	7	3	89
NC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	129	85,828	81,137	88,143	265,254	112,630	37,233	17,000	11,993	12,726	14,056	12,977	10,322	6,345	755,772

Table 11. Age composition of incidental removals.

Bay	Age													
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	63	194	1250	730	289	86	65	42	25	26	19	24	12	2825
2000	39	96	2125	3439	1255	355	195	101	61	40	33	9	8	7756
2001	0	15	337	956	660	120	63	56	50	51	21	10	4	2343
2002	0	9	62	408	508	156	84	36	27	17	7	1	1	1317
2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 11 cont.

Ocean	Age													
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	1	4	271	203	107	136	26	3	0	0	0	0	0	752
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	1	29	6	6	15	21	25	10	6	2	0	0	121
2005	0	20	5	5	11	13	15	23	19	8	4	1	1	125
2006	0	0	0	1	0	0	0	0	0	0	0	0	0	1
2007	0	3	8	11	8	5	0	0	0	0	0	0	0	35
2008	0	0	0	1	0	0	0	0	0	0	0	0	0	1
2009	0	0	17	15	0	0	0	0	0	0	0	0	0	32
2010	0	0	17	14	1	0	0	0	0	0	0	0	0	32
2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 12. Total removals and associated coefficients of variation and age proportions of total removals of striped bass split into Chesapeake Bay, Ocean, and Commercial Discard fleets, 1982-2015. Age-0 fish are not included.

	Chesapeake Bay		Age Proportions												
Year	Total	CV	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	262,133	0.857	0.00507	0.12678	0.59014	0.23839	0.03160	0.00498	0.00099	0.00089	0.00012	0.00000	0.00029	0.00047	0.00029
1983	277,824	0.224	0.01104	0.28325	0.36483	0.28873	0.03398	0.00918	0.00351	0.00307	0.00086	0.00028	0.00016	0.00032	0.00078
1984	798,853	0.444	0.00557	0.61276	0.33834	0.03751	0.00495	0.00013	0.00068	0.00005	0.00001	0.00000	0.00000	0.00000	0.00000
1985	122,842	0.447	0.01132	0.52144	0.40241	0.04234	0.01142	0.00471	0.00483	0.00153	0.00000	0.00000	0.00000	0.00000	0.00000
1986	56,504	0.516	0.09360	0.28059	0.46742	0.10997	0.01729	0.00595	0.01951	0.00567	0.00000	0.00000	0.00000	0.00000	0.00000
1987	23,170	0.489	0.05059	0.17128	0.40184	0.24355	0.07494	0.00375	0.02876	0.02530	0.00000	0.00000	0.00000	0.00000	0.00000
1988	42,211	0.887	0.02643	0.20139	0.10296	0.10244	0.36728	0.14152	0.05660	0.00138	0.00000	0.00000	0.00000	0.00000	0.00000
1989	16,791	0.285	0.06463	0.56728	0.15406	0.10122	0.07011	0.02801	0.01070	0.00400	0.00000	0.00000	0.00000	0.00000	0.00000
1990	205,740	0.333	0.01873	0.14393	0.18579	0.32698	0.17722	0.10363	0.02839	0.00924	0.00457	0.00152	0.00000	0.00000	0.00000
1991	352,428	0.171	0.00255	0.15667	0.24267	0.25941	0.15361	0.07895	0.05201	0.02952	0.01372	0.00641	0.00448	0.00000	0.00000
1992	383,546	0.156	0.00530	0.09234	0.22350	0.24898	0.18261	0.12646	0.06779	0.03110	0.01392	0.00612	0.00188	0.00000	0.00000
1993	597,071	0.152	0.00278	0.11137	0.16410	0.27782	0.20806	0.11027	0.06903	0.02844	0.01566	0.00797	0.00363	0.00087	0.00000
1994	859,681	0.158	0.00841	0.08882	0.17138	0.19982	0.23514	0.13061	0.08229	0.04048	0.02364	0.01201	0.00506	0.00235	0.00000
1995	1,133,791	0.132	0.00447	0.14701	0.20492	0.22479	0.16855	0.14799	0.04925	0.03082	0.01229	0.00383	0.00414	0.00097	0.00099
1996	1,465,451	0.137	0.00036	0.09842	0.26089	0.18188	0.16817	0.14229	0.08644	0.03241	0.01535	0.00720	0.00462	0.00121	0.00076
1997	1,998,211	0.117	0.02075	0.04500	0.07404	0.32221	0.18116	0.15894	0.08528	0.05664	0.02819	0.01457	0.00648	0.00427	0.00247
1998	1,934,786	0.099	0.00169	0.03597	0.14993	0.25242	0.27003	0.12710	0.06030	0.03604	0.02901	0.01880	0.00978	0.00517	0.00377
1999	1,726,756	0.107	0.00123	0.01763	0.15538	0.22930	0.22668	0.19522	0.07263	0.03593	0.02879	0.01361	0.01137	0.00630	0.00593
2000	2,019,358	0.092	0.01360	0.05297	0.06707	0.24036	0.27401	0.16615	0.09269	0.04241	0.01809	0.01515	0.00751	0.00515	0.00486
2001	1,695,685	0.089	0.02650	0.05998	0.11749	0.19551	0.23594	0.13129	0.08764	0.06882	0.02137	0.01887	0.01455	0.01317	0.00888
2002	1,311,055	0.096	0.01116	0.10412	0.10416	0.19271	0.18460	0.15229	0.10087	0.04483	0.05433	0.01364	0.01389	0.00794	0.01547
2003	2,052,319	0.075	0.00000	0.10428	0.13637	0.17148	0.14837	0.12365	0.09679	0.06315	0.05577	0.05495	0.01998	0.01202	0.01319
2004	1,825,612	0.076	0.03768	0.04394	0.20312	0.20733	0.11058	0.09403	0.08510	0.06536	0.04986	0.03511	0.03521	0.01488	0.01780
2005	1,963,065	0.088	0.00404	0.12303	0.06758	0.24029	0.21357	0.08748	0.05656	0.03891	0.05310	0.03768	0.03703	0.02214	0.01857
2006	2,329,278	0.072	0.01351	0.05082	0.17163	0.17673	0.24904	0.11652	0.04082	0.03479	0.03336	0.04266	0.02650	0.01715	0.02646
2007	2,134,342	0.100	0.00347	0.03161	0.03894	0.34255	0.18042	0.15994	0.05946	0.03628	0.03861	0.03262	0.03410	0.01809	0.02391
2008	1,548,345	0.081	0.01419	0.01321	0.04745	0.17432	0.34241	0.09064	0.09039	0.05106	0.02367	0.03694	0.03197	0.04284	0.04091
2009	1,702,422	0.082	0.00349	0.03330	0.04027	0.22943	0.25108	0.19254	0.03551	0.05209	0.04212	0.02027	0.02750	0.02219	0.05020
2010	1,482,203	0.111	0.00349	0.00724	0.13179	0.16251	0.23568	0.19246	0.14358	0.03569	0.03282	0.01731	0.00698	0.00878	0.02166
2011	1,378,058	0.088	0.01078	0.02751	0.04607	0.28452	0.15229	0.17340	0.12382	0.08052	0.02371	0.02888	0.01392	0.00895	0.02563
2012	1,198,075	0.108	0.05011	0.05544	0.10794	0.11923	0.25603	0.14501	0.08838	0.03531	0.05086	0.01895	0.02779	0.00991	0.03504
2013	1,363,533	0.081	0.00092	0.06761	0.14675	0.24527	0.17454	0.16533	0.06290	0.03869	0.02743	0.03883	0.00938	0.01235	0.01000
2014	1,492,601	0.112	0.00325	0.01253	0.21758	0.19752	0.25472	0.12027	0.07659	0.03177	0.02626	0.02042	0.02401	0.00270	0.01238
2015	1,348,627	0.114	0.06245	0.05290	0.06439	0.31251	0.17416	0.08338	0.06121	0.05404	0.02264	0.04602	0.02203	0.02316	0.02110

Table 12 cont.

	Ocean		Age Proportions												
Year	Total	CV	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	454,241	0.366	0.00192	0.09698	0.22097	0.32694	0.09921	0.03720	0.04890	0.03454	0.02380	0.02287	0.02365	0.02971	0.03331
1983	413,741	0.699	0.00653	0.04616	0.19767	0.25603	0.30420	0.07791	0.03870	0.00765	0.00524	0.00825	0.00959	0.01205	0.03003
1984	224,539	0.450	0.00973	0.11611	0.15973	0.20421	0.19731	0.16935	0.06206	0.01893	0.00451	0.00722	0.00443	0.00124	0.04517
1985	219,014	0.679	0.00017	0.01728	0.11977	0.13099	0.20756	0.17460	0.18067	0.07387	0.02579	0.01585	0.00213	0.00277	0.04854
1986	164,055	0.324	0.04844	0.02205	0.15063	0.18503	0.12483	0.10479	0.08366	0.13130	0.04612	0.02785	0.01669	0.00669	0.05193
1987	97,873	0.265	0.01071	0.03159	0.17315	0.19850	0.15288	0.08658	0.06610	0.04540	0.05458	0.02157	0.01056	0.02198	0.12638
1988	166,833	0.326	0.00637	0.10903	0.12105	0.13938	0.13371	0.12561	0.09128	0.09001	0.06513	0.01963	0.01991	0.01897	0.05992
1989	136,245	0.276	0.00021	0.11817	0.22478	0.13368	0.16919	0.10076	0.08498	0.04536	0.03088	0.01995	0.01114	0.00120	0.05969
1990	221,962	0.126	0.00071	0.08812	0.14014	0.20822	0.11709	0.12640	0.10339	0.09868	0.04569	0.01956	0.00932	0.00463	0.03806
1991	339,335	0.144	0.00138	0.07349	0.13753	0.21154	0.10729	0.05437	0.10331	0.11826	0.10193	0.03752	0.01508	0.00313	0.03518
1992	450,413	0.106	0.00216	0.03819	0.25005	0.17186	0.16916	0.06228	0.04469	0.08125	0.08000	0.06316	0.01181	0.00534	0.02005
1993	535,519	0.119	0.00479	0.03264	0.12837	0.21235	0.16552	0.12198	0.04575	0.04911	0.08234	0.08233	0.04671	0.01088	0.01721
1994	726,704	0.074	0.00071	0.08875	0.30239	0.15930	0.15848	0.06702	0.03408	0.03328	0.05852	0.05144	0.02245	0.01571	0.00787
1995	1,367,251	0.099	0.00003	0.18718	0.15586	0.13456	0.08978	0.13697	0.05718	0.08427	0.07277	0.04281	0.02543	0.00738	0.00578
1996	1,582,160	0.067	0.00033	0.03773	0.20362	0.19814	0.14332	0.11791	0.12558	0.06498	0.04515	0.02287	0.01586	0.01732	0.00721
1997	2,173,177	0.055	0.00106	0.07183	0.09794	0.14617	0.10018	0.09920	0.10283	0.14866	0.09919	0.06575	0.03218	0.01912	0.01587
1998	2,098,919	0.064	0.00589	0.05958	0.10075	0.14372	0.15136	0.11133	0.08738	0.09777	0.09259	0.04866	0.04597	0.02207	0.03292
1999	1,953,346	0.062	0.00039	0.00743	0.07537	0.10786	0.11237	0.19360	0.12586	0.10795	0.09818	0.06923	0.05035	0.02498	0.02644
2000	2,584,015	0.064	0.00356	0.02137	0.04529	0.15533	0.15168	0.16933	0.19966	0.09557	0.05935	0.04518	0.02493	0.01290	0.01586
2001	2,554,609	0.045	0.00170	0.01553	0.04076	0.07805	0.16409	0.18713	0.17640	0.15741	0.07048	0.03981	0.03448	0.01607	0.01810
2002	2,553,899	0.052	0.00317	0.03562	0.05083	0.07920	0.11422	0.20629	0.14982	0.12079	0.10372	0.05129	0.03890	0.02117	0.02498
2003	2,682,570	0.047	0.00035	0.04553	0.07122	0.06428	0.11528	0.12142	0.17520	0.13276	0.10143	0.07438	0.04304	0.02630	0.02881
2004	3,173,119	0.063	0.00127	0.01806	0.12858	0.09754	0.08148	0.09566	0.09711	0.15098	0.10876	0.08659	0.06406	0.03374	0.03617
2005	3,079,601	0.055	0.00434	0.08402	0.06446	0.13414	0.12610	0.09345	0.09115	0.08397	0.10216	0.07424	0.06973	0.02901	0.04321
2006	3,614,394	0.051	0.00081	0.02834	0.20945	0.06263	0.12243	0.10721	0.06851	0.08024	0.06795	0.09247	0.06733	0.04167	0.05098
2007	2,862,392	0.052	0.00062	0.03268	0.09830	0.12323	0.09599	0.13814	0.09448	0.08547	0.09679	0.09560	0.05763	0.04446	0.03661
2008	3,054,618	0.059	0.00321	0.01403	0.05737	0.06605	0.15785	0.09098	0.16941	0.12409	0.07045	0.08173	0.06487	0.04276	0.05720
2009	2,099,071	0.055	0.00088	0.03088	0.02788	0.05193	0.07758	0.24108	0.10273	0.15564	0.08113	0.05836	0.05782	0.04468	0.06941
2010	2,098,391	0.058	0.00022	0.01035	0.04893	0.02783	0.05848	0.13228	0.26271	0.10345	0.11146	0.08251	0.04706	0.04250	0.07222
2011	2,317,689	0.054	0.00390	0.01838	0.03177	0.05015	0.03966	0.13735	0.15787	0.24812	0.08807	0.08143	0.03775	0.02870	0.07686
2012	1,654,349	0.074	0.00144	0.03236	0.03716	0.03177	0.07348	0.09537	0.14922	0.18255	0.17587	0.05969	0.05344	0.03946	0.06820
2013	2,322,884	0.083	0.00053	0.04376	0.08175	0.05137	0.04516	0.14030	0.10623	0.11100	0.12871	0.15534	0.03757	0.02908	0.06918
2014	1,718,249	0.072	0.00027	0.00728	0.10278	0.06659	0.07649	0.09272	0.11313	0.08143	0.11062	0.12741	0.08378	0.04897	0.08856
2015	1,369,036	0.062	0.00117	0.00935	0.02705	0.17038	0.16748	0.12573	0.09133	0.07937	0.07588	0.07800	0.06288	0.03563	0.07574

Table 12 cont.

	Commercial Discards		Age Proportions												
Year	Total	CV	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	57,624	0.350	0.00000	0.54917	0.06325	0.19881	0.09759	0.02240	0.04160	0.01760	0.00640	0.00160	0.00148	0.00000	0.00012
1983	40,127	0.350	0.00000	0.59977	0.03620	0.07172	0.19342	0.05759	0.01521	0.01521	0.00652	0.00435	0.00000	0.00000	0.00000
1984	65,639	0.350	0.00000	0.51151	0.02455	0.08854	0.14829	0.17173	0.04288	0.00179	0.00893	0.00100	0.00000	0.00079	0.00000
1985	62,734	0.350	0.00000	0.12319	0.48574	0.09467	0.17361	0.05411	0.04371	0.01665	0.00416	0.00208	0.00208	0.00000	0.00000
1986	174,024	0.350	0.00000	0.03356	0.11928	0.57502	0.16084	0.07651	0.02468	0.00813	0.00199	0.00000	0.00000	0.00000	0.00000
1987	125,066	0.350	0.00000	0.03363	0.11499	0.22866	0.41089	0.13545	0.05213	0.01055	0.00808	0.00315	0.00089	0.00069	0.00089
1988	245,552	0.350	0.00000	0.02501	0.09201	0.14912	0.28898	0.29197	0.09461	0.03713	0.01267	0.00673	0.00089	0.00079	0.00010
1989	338,827	0.350	0.00000	0.04089	0.14828	0.14470	0.24613	0.24425	0.09881	0.04575	0.01872	0.00208	0.00416	0.00416	0.00208
1990	510,011	0.350	0.00000	0.02848	0.13473	0.15869	0.21938	0.22686	0.14039	0.07109	0.01166	0.00302	0.00275	0.00295	0.00000
1991	327,167	0.350	0.00024	0.03861	0.11312	0.19626	0.23638	0.17390	0.11282	0.07598	0.02020	0.01244	0.02000	0.00005	0.00000
1992	186,601	0.350	0.00063	0.01982	0.18337	0.19692	0.23801	0.18589	0.07930	0.05991	0.01821	0.01263	0.00531	0.00000	0.00000
1993	347,839	0.350	0.00000	0.02142	0.14421	0.22715	0.27345	0.18252	0.06020	0.04413	0.02665	0.01324	0.00475	0.00154	0.00075
1994	359,518	0.350	0.00000	0.08837	0.13120	0.12539	0.24511	0.23523	0.10911	0.03484	0.01731	0.01022	0.00198	0.00115	0.00008
1995	515,454	0.350	0.00000	0.14128	0.14651	0.10389	0.18267	0.23589	0.11921	0.03702	0.01468	0.00828	0.00444	0.00455	0.00156
1996	394,824	0.350	0.00000	0.06872	0.28895	0.19334	0.15674	0.14889	0.07810	0.03778	0.01557	0.01010	0.00040	0.00127	0.00013
1997	216,745	0.350	0.00220	0.03279	0.29690	0.28546	0.14119	0.09666	0.06460	0.03041	0.00906	0.01988	0.01226	0.00370	0.00489
1998	326,032	0.350	0.00000	0.04059	0.16532	0.30215	0.25546	0.08955	0.03978	0.03862	0.02411	0.01341	0.01193	0.00742	0.01166
1999	236,619	0.350	0.00416	0.24544	0.21086	0.18487	0.23557	0.06118	0.02203	0.01565	0.00837	0.00551	0.00274	0.00259	0.00103
2000	666,997	0.350	0.00029	0.26755	0.28476	0.23582	0.09400	0.05085	0.04039	0.01174	0.00616	0.00581	0.00120	0.00129	0.00012
2001	310,900	0.350	0.00000	0.00849	0.18681	0.25075	0.28565	0.09460	0.06072	0.03735	0.03108	0.02049	0.01537	0.00629	0.00240
2002	168,201	0.350	0.01011	0.12418	0.25351	0.12728	0.17117	0.14102	0.07361	0.04075	0.03356	0.01340	0.00905	0.00089	0.00148
2003	261,974	0.350	0.00577	0.02377	0.10711	0.20790	0.21654	0.07583	0.11776	0.07112	0.06264	0.05181	0.03116	0.01224	0.01634
2004	465,642	0.350	0.00632	0.11341	0.17340	0.16491	0.13439	0.10455	0.11217	0.08886	0.05057	0.02111	0.02229	0.00508	0.00292
2005	798,544	0.350	0.00054	0.01442	0.13015	0.30761	0.21271	0.08617	0.06812	0.05499	0.05461	0.02893	0.02022	0.01062	0.01091
2006	194,524	0.350	0.00000	0.00285	0.13247	0.14824	0.19018	0.14224	0.07739	0.08584	0.06525	0.06779	0.03800	0.02277	0.02696
2007	606,599	0.350	0.00047	0.01039	0.02999	0.14772	0.16083	0.23059	0.12967	0.07999	0.07034	0.05052	0.03696	0.03294	0.01962
2008	308,715	0.350	0.00000	0.00035	0.00948	0.14601	0.23152	0.18789	0.14471	0.07029	0.04489	0.04225	0.04088	0.04617	0.03556
2009	611,944	0.350	0.00000	0.00271	0.13195	0.27260	0.20243	0.14907	0.05009	0.06279	0.03353	0.02677	0.02567	0.01254	0.02984
2010	254,841	0.350	0.00000	0.00541	0.06361	0.29904	0.25172	0.18137	0.07706	0.03732	0.02564	0.01601	0.01223	0.00703	0.02357
2011	617,457	0.350	0.00000	0.00628	0.09971	0.17774	0.21268	0.13049	0.08823	0.07966	0.06074	0.05007	0.02505	0.01827	0.05107
2012	792,861	0.350	0.00000	0.01150	0.06391	0.14701	0.25963	0.17202	0.13846	0.04847	0.05212	0.02154	0.02805	0.02163	0.03565
2013	525,581	0.350	0.00000	0.00857	0.13460	0.22159	0.19070	0.14050	0.08552	0.06236	0.04187	0.03841	0.01400	0.02064	0.04124
2014	931,391	0.350	0.00000	0.00002	0.04071	0.11598	0.25063	0.19333	0.15985	0.06746	0.05112	0.05456	0.03560	0.00674	0.02402
2015	299,566	0.350	0.00000	0.00005	0.02906	0.29837	0.16413	0.09901	0.09145	0.06800	0.05143	0.04841	0.04823	0.05879	0.04306

Table 13. Catch weights-at age (kilograms).

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.13	0.64	1.09	1.54	2.42	3.75	4.83	5.79	6.20	8.68	10.80	11.20	14.05
1983	0.20	0.55	0.94	1.37	2.37	3.29	3.77	5.36	6.01	8.10	9.57	10.39	11.11
1984	0.24	0.60	1.69	1.62	2.67	3.39	5.07	5.65	6.76	7.76	8.41	12.65	12.38
1985	0.06	0.61	1.07	1.66	2.19	3.59	4.91	5.46	6.77	7.45	9.00	10.69	13.91
1986	0.14	0.57	1.27	2.40	2.44	3.12	3.95	5.05	5.44	6.09	7.75	9.16	12.78
1987	0.20	0.77	1.41	2.11	2.50	2.91	3.61	4.74	5.52	6.49	7.77	9.78	13.15
1988	0.31	0.91	1.10	1.98	3.12	4.02	4.38	4.70	5.24	5.62	8.58	10.40	13.27
1989	0.16	0.83	1.22	2.23	3.06	4.53	5.37	6.23	6.04	8.68	8.94	9.74	13.36
1990	0.08	0.89	1.14	2.05	2.35	3.83	4.91	5.96	5.70	5.97	7.44	9.08	12.60
1991	0.21	0.92	1.29	2.17	2.62	3.17	4.81	5.64	6.46	6.24	9.46	8.30	14.22
1992	0.10	0.69	1.31	1.93	2.81	3.67	4.90	5.79	6.96	8.15	9.77	12.44	13.97
1993	0.07	0.76	1.31	1.99	2.77	3.58	4.80	6.11	7.03	8.01	9.53	10.76	14.55
1994	0.24	1.05	1.69	2.21	2.85	3.50	4.94	6.20	6.80	7.53	9.73	10.69	12.73
1995	0.28	0.70	1.35	2.18	2.77	3.65	5.38	6.16	7.27	8.86	7.57	9.73	16.66
1996	0.14	1.05	1.47	2.32	3.23	4.52	6.39	7.11	7.81	9.20	9.31	10.10	13.70
1997	0.13	0.62	1.18	2.46	2.81	3.64	4.51	5.07	6.73	9.17	9.94	10.24	14.78
1998	0.39	0.77	1.20	1.62	2.25	2.95	4.69	5.66	6.82	7.03	7.76	9.87	11.87
1999	0.62	0.90	1.11	1.44	1.91	2.51	3.36	5.03	6.56	7.85	8.69	9.76	11.98
2000	0.37	0.55	1.10	1.45	1.96	2.79	3.89	5.09	7.11	7.37	9.70	10.70	13.55
2001	0.16	0.38	1.12	1.75	2.21	3.25	4.12	5.02	6.36	7.79	8.65	8.29	10.87
2002	0.12	0.31	1.06	1.51	2.18	3.17	4.19	5.48	6.03	7.56	9.09	9.75	11.52
2003	0.10	0.60	1.00	1.40	2.20	3.20	4.10	5.20	6.10	7.20	8.50	9.40	11.00
2004	0.23	0.33	0.84	1.40	2.43	3.11	4.14	5.17	6.07	7.12	8.18	9.03	10.71
2005	0.13	0.50	1.14	1.64	2.22	3.23	4.18	5.64	6.38	7.21	8.51	10.00	12.19
2006	0.18	0.38	0.81	1.35	1.96	2.80	3.84	5.35	6.70	7.41	8.58	9.40	12.05
2007	0.10	0.46	0.94	1.30	2.10	3.07	4.31	5.32	6.89	7.84	9.39	10.12	12.77
2008	0.21	0.45	1.04	1.43	2.14	3.47	5.05	5.51	6.69	8.26	9.19	9.82	12.00
2009	0.26	0.62	1.03	1.41	1.92	3.29	4.49	5.74	6.87	7.73	8.81	9.47	12.24
2010	0.16	0.70	1.11	1.41	1.99	3.34	4.27	5.21	6.27	7.65	8.97	9.15	11.59
2011	0.20	0.52	1.04	1.55	2.00	3.08	4.10	5.13	6.41	7.54	8.20	9.98	13.08
2012	0.08	0.48	1.01	1.67	2.30	3.25	4.44	5.88	6.57	8.31	9.05	10.41	13.84
2013	0.19	0.49	0.96	1.39	2.27	3.38	4.14	5.30	6.69	7.55	9.26	10.44	13.14
2014	0.49	0.55	0.89	1.27	2.15	3.07	4.28	5.30	6.99	8.43	9.17	11.91	14.29
2015	0.15	0.29	0.92	1.59	2.50	3.75	4.56	5.69	6.97	7.69	8.95	10.54	14.12

Table 14. Description and characteristics of fishery-independent and –dependent indices.

State	Index	Design	Time of Year	What Stock?	Ages
Marine Recreational Fisheries Survey	Total Catch Rate Index	Stratified Random	May-Dec	Mixed	Aggregate (3-13+)
Connecticut Trawl Survey	Mean number per tow	Stratified Random	April-June	Mixed	Aggregate (4-6)
NEFSC Trawl Survey	Mean number per tow	Stratified Random	March-May	Mixed	Aggregate (2-9)
New Jersey Trawl Survey	Mean number per tow	Stratified Random	April	Mixed	2-13+
New York Ocean Haul Seine Survey	Mean number per haul	Random	Sept-Nov	Mixed	2-13+
Delaware Electrofishing Survey	Mean number per hour	Lattice	April-May	Delaware	2-13+
New York YOY Seine Survey	Mean number per haul	Fixed	July-Nov	Hudson	0
New York W. Long Island Seine Survey	Mean number per haul	Fixed	May-Oct	Hudson	1
New Jersey YOY Seine Survey	Mean number per haul	Fixed/Random	Aug-Oct	Delaware	0
Virginia YOY Seine Survey	Mean number per haul	Fixed	July-Sept	Chesapeake	0
Maryland YOY and Age 1 Seine Survey	Mean number per haul	Fixed	July-Sept	Chesapeake	0-1
Maryland Gillnet Survey	Mean number per set	Stratified Random	April-May	Chesapeake	2-13+
Virginia Pound Net Survey	Mean number per set	Fixed	March-May	Chesapeake	1-13+

Table 15. Index and coefficients of variation for fishery-independent and –dependent indices.

	Aggregate						Age-specific									
	MRIP		NEFSC		CTTRL		NYOHS		NJTRL		MD SSN		DE SSN		VAPNET	
Year	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV
1982																
1983																
1984					0.02	1.00										
1985					0.01	1.00					4.88	0.25				
1986					0.01	1.00					10.07	0.25				
1987					0.05	0.40	3.83	0.11			7.15	0.25				
1988	0.40	0.79			0.04	0.50	3.60	0.10			3.27	0.25				
1989	0.30	0.85			0.06	0.33	2.58	0.13	0.23	0.61	3.96	0.25				
1990	0.25	0.77			0.16	0.27	3.50	0.18	1.13	0.60	5.04	0.25				
1991	0.32	0.38	0.23	0.17	0.15	0.21	3.28	0.19	1.41	0.67	4.61	0.25			18.75	0.25
1992	0.90	0.24	0.24	0.34	0.22	0.25	3.00	0.19	0.65	0.70	6.29	0.25			8.45	0.25
1993	0.67	0.21	0.48	0.21	0.27	0.16	3.32	0.11	0.67	0.53	6.25	0.25			21.72	0.25
1994	1.07	0.16	1.39	0.22	0.30	0.19	2.90	0.15	1.47	0.40	5.13	0.25			13.87	0.25
1995	1.32	0.14	0.95	0.20	0.60	0.13	2.84	0.18	4.21	0.14	4.62	0.25			14.52	0.25
1996	1.64	0.12	0.60	0.20	0.63	0.14	5.11	0.10	5.66	0.20	7.59	0.25	3.38	0.10	12.30	0.25
1997	1.59	0.13	1.18	0.13	0.85	0.13	4.84	0.14	5.82	0.21	3.87	0.25	4.10	0.09	20.10	0.25
1998	2.03	0.10	0.73	0.15	0.97	0.13	5.01	0.15	5.01	0.10	4.79	0.25	3.73	0.12	14.85	0.25
1999	2.00	0.11	0.45	0.23	1.10	0.12	3.46	0.16	3.51	0.12	3.97	0.25	2.59	0.12	29.89	0.25
2000	1.76	0.12	1.27	0.19	0.84	0.14	4.36	0.11	5.31	0.13	3.52	0.25	2.05	0.16	39.70	0.25
2001	1.42	0.12	0.62	0.26	0.61	0.15	3.47	0.15	1.58	0.36	2.83	0.25	1.88	0.18	18.63	0.25
2002	1.23	0.14	0.98	0.14	1.30	0.10	3.23	0.20	2.13	0.17	4.00	0.25	1.60	0.15	5.23	0.25
2003	1.06	0.15	0.77	0.24	0.87	0.09	4.24	0.19	6.83	0.10	4.55	0.25	2.47	0.12	15.65	0.25
2004	1.17	0.14	0.33	0.25	0.56	0.09	4.88	0.09	6.05	0.15	6.11	0.25	2.89	0.12	31.64	0.25
2005	1.52	0.14	0.29	0.20	1.17	0.10	3.91	0.14	6.41	0.12	4.96	0.25	1.77	0.14	18.14	0.25
2006	1.61	0.13	0.63	0.29	0.61	0.09	4.37	0.14	2.61	0.28	4.92	0.25	2.22	0.18	22.14	0.25
2007	0.93	0.15	0.74	0.13	1.02	0.10			3.50	0.32	2.14	0.25	1.78	0.33	31.52	0.25
2008	0.81	0.15	0.65	0.17	0.57	0.09			1.38	0.33	4.37	0.25	1.72	0.12	18.32	0.25
2009	0.80	0.15			0.60	0.10			2.24	0.34	5.70	0.25	1.25	0.17	22.96	0.25
2010	0.76	0.15			0.40	0.21			0.73	0.53	4.53	0.25	2.69	0.21	34.89	0.25
2011	0.68	0.15			0.48	0.21			2.07	0.28	4.58	0.25	3.25	0.20	8.96	0.25
2012	1.10	0.15			0.43	0.17			3.48	0.09	2.64	0.25	1.94	0.19	17.48	0.25
2013	1.72	0.15			0.67	0.13			2.51	0.10	4.41	0.25	2.10	0.07	10.60	0.25
2014	1.15	0.15			0.41	0.20			0.31	0.19	5.57	0.25			13.01	0.25
2015	1.33	0.15			0.20	0.24			0.29	0.31	7.34	0.25	0.86	0.13	7.26	0.25

Table 16. Young-of-the-year and age-1 fishery-independent indices of relative abundance.

Unlagged

	YOY								Age 1			
	NY		NJ		MD		VA		NY		MD	
Year	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV
1969					2.81	0.34					0.25	0.50
1970					12.52	0.26					0.13	0.50
1971					4.02	0.28					1.36	0.38
1972					3.26	0.30					0.46	0.42
1973					2.32	0.34					0.46	0.34
1974					2.63	0.32					0.26	0.38
1975					2.81	0.28					0.22	0.46
1976					1.58	0.30					0.13	0.70
1977					1.60	0.30					0.06	0.76
1978					3.75	0.26					0.18	0.46
1979	3.54	0.30			1.78	0.28					0.29	0.46
1980	10.01	0.24			1.02	0.28					0.18	0.44
1981	14.57	0.22			0.59	0.32					0.02	1.02
1982	23.30	0.19	0.10	1.22	3.57	0.27	2.71	0.50			0.02	1.16
1983	26.72	0.23	0.07	1.48	0.61	0.33	3.40	0.40			0.32	0.40
1984	24.67	0.20	0.37	0.71	1.64	0.28	4.47	0.46			0.01	2.00
1985	2.20	0.54	0.03	2.05	0.91	0.36	2.41	0.41	0.61	1.20	0.16	0.50
1986	4.65	0.49	0.32	0.55	1.34	0.32	4.74	0.37	0.30	1.00	0.03	0.94
1987	28.36	0.57	0.53	0.47	1.46	0.33	15.74	0.34	0.21	1.11	0.06	0.92
1988	49.28	0.37	0.35	0.41	0.73	0.39	7.64	0.32	0.81	0.90	0.07	0.58
1989	35.37	0.44	1.07	0.36	4.87	0.34	11.23	0.29	1.78	0.70	0.19	0.48
1990	35.53	0.46	1.05	0.32	1.03	0.29	7.34	0.31	0.37	0.84	0.33	0.42
1991	6.00	0.52	0.47	0.26	1.52	0.32	3.76	0.33	1.26	0.67	0.20	0.44
1992	16.93	0.37	1.18	0.23	2.34	0.32	7.35	0.36	1.34	0.66	0.15	0.52
1993	21.99	0.48	1.78	0.24	13.97	0.25	18.11	0.23	0.75	0.70	0.19	0.50
1994	23.61	0.38	0.96	0.24	6.40	0.27	10.48	0.27	1.43	0.76	0.78	0.36
1995	19.03	0.35	1.98	0.25	4.41	0.24	5.45	0.32	1.29	0.68	0.12	0.56
1996	12.12	0.40	1.70	0.23	17.61	0.25	23.00	0.29	1.54	0.75	0.08	0.78
1997	27.11	0.49	1.01	0.24	3.91	0.25	9.35	0.30	1.00	0.84	0.26	0.46
1998	16.10	0.43	1.31	0.26	5.50	0.25	13.25	0.29	2.10	0.79	0.17	0.50
1999	30.67	0.39	1.90	0.23	5.34	0.30	2.80	0.34	2.05	0.59	0.37	0.36
2000	6.88	0.54	1.78	0.26	7.42	0.23	16.18	0.31	1.56	0.74	0.26	0.40
2001	28.90	0.54	1.20	0.23	12.57	0.28	14.17	0.32	2.16	0.60	0.32	0.36
2002	14.72	0.37	0.53	0.29	2.20	0.27	3.98	0.37	2.53	0.53	0.79	0.32
2003	29.78	0.50	2.47	0.24	10.83	0.26	22.89	0.28	1.19	0.53	0.07	0.66
2004	8.73	0.38	1.13	0.26	4.85	0.25	12.70	0.27	2.41	0.53	0.74	0.36
2005	11.28	0.54	1.22	0.22	6.91	0.25	9.09	0.28	0.64	0.89	0.28	0.44
2006	5.83	0.44	0.67	0.25	1.78	0.29	10.10	0.28	2.02	0.62	0.28	0.42
2007	42.65	0.42	1.41	0.21	5.12	0.27	11.96	0.30	0.58	0.80	0.07	0.60
2008	19.04	0.39	1.26	0.24	1.26	0.31	7.97	0.33	1.24	0.65	0.31	0.40
2009	13.92	0.47	1.92	0.24	3.92	0.23	8.42	0.30	0.33	0.79	0.12	0.54
2010	25.62	0.46	1.30	0.21	2.54	0.25	9.07	0.35	0.45	0.76	0.17	0.45
2011	12.16	0.53	1.41	0.26	9.57	0.24	27.09	0.26	2.00	0.66	0.02	1.02
2012	9.85	0.49	0.34	0.24	0.49	0.32	2.68	0.29	0.90	0.60	0.35	0.34
2013	5.07	0.41	0.90	0.13	3.42	0.21	10.94	0.29	0.56	0.68	0.05	0.74
2014	24.60	0.38	1.65	0.08	4.06	0.29	11.30	0.29	0.82	0.61	0.12	0.57
2015	21.68	0.44	0.94	0.12	10.67	0.22	12.00	0.26	3.16	0.56	0.23	0.39

Table 17. Age composition of age-specific survey indices.

NYOHS

	Age												
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1987		0.0318	0.1949	0.3591	0.2787	0.0883	0.0349	0.0067	0.0017	0.0000	0.0006	0.0000	0.0028
1988		0.2255	0.2687	0.1945	0.1660	0.0851	0.0218	0.0144	0.0039	0.0021	0.0007	0.0000	0.0137
1989		0.1833	0.2690	0.1478	0.1596	0.1025	0.0936	0.0217	0.0030	0.0020	0.0030	0.0020	0.0108
1990		0.0608	0.2957	0.3063	0.1139	0.0985	0.0557	0.0444	0.0158	0.0058	0.0010	0.0000	0.0023
1991		0.2070	0.3666	0.2439	0.0519	0.0166	0.0253	0.0416	0.0230	0.0063	0.0020	0.0036	0.0115
1992		0.0792	0.4166	0.2577	0.1211	0.0329	0.0143	0.0170	0.0250	0.0175	0.0032	0.0058	0.0096
1993		0.1563	0.3868	0.2908	0.0701	0.0328	0.0094	0.0090	0.0115	0.0131	0.0070	0.0025	0.0082
1994		0.1410	0.2705	0.1562	0.1346	0.0832	0.0546	0.0375	0.0222	0.0406	0.0127	0.0241	0.0203
1995		0.2450	0.2695	0.2542	0.0720	0.0658	0.0352	0.0123	0.0054	0.0123	0.0115	0.0031	0.0084
1996		0.0832	0.7475	0.1142	0.0328	0.0094	0.0073	0.0027	0.0013	0.0007	0.0000	0.0005	0.0003
1997		0.2063	0.2425	0.4508	0.0669	0.0184	0.0037	0.0037	0.0039	0.0017	0.0007	0.0009	0.0006
1998		0.1876	0.2969	0.1714	0.2855	0.0366	0.0091	0.0058	0.0029	0.0002	0.0010	0.0015	0.0011
1999		0.0697	0.6277	0.1722	0.0594	0.0438	0.0050	0.0032	0.0046	0.0035	0.0039	0.0007	0.0046
2000		0.1273	0.1930	0.4338	0.1541	0.0364	0.0368	0.0041	0.0039	0.0016	0.0018	0.0010	0.0044
2001		0.0524	0.4553	0.1474	0.2129	0.0735	0.0274	0.0194	0.0032	0.0039	0.0011	0.0000	0.0025
2002		0.3225	0.2261	0.1843	0.0805	0.0735	0.0572	0.0198	0.0198	0.0013	0.0048	0.0018	0.0057
2003		0.2022	0.3647	0.1251	0.0922	0.0406	0.0646	0.0506	0.0227	0.0177	0.0126	0.0009	0.0049
2004		0.0501	0.5698	0.2734	0.0628	0.0222	0.0076	0.0061	0.0036	0.0011	0.0014	0.0017	0.0002
2005		0.2444	0.1280	0.4126	0.1370	0.0336	0.0138	0.0035	0.0090	0.0065	0.0035	0.0037	0.0045
2006		0.0639	0.6359	0.0728	0.1610	0.0424	0.0144	0.0057	0.0025	0.0003	0.0010	0.0000	0.0000

NJ Trawl

	Age												
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1989	0.0000	0.2780	0.4440	0.0060	0.1370	0.0520	0.0110	0.0160	0.0000	0.0560	0.0000	0.0000	0.0000
1990	0.0000	0.0610	0.1820	0.0200	0.4140	0.1320	0.0290	0.0970	0.0050	0.0610	0.0000	0.0000	0.0000
1991	0.0000	0.2770	0.2840	0.0210	0.0200	0.1480	0.1320	0.0170	0.0340	0.0460	0.0210	0.0000	0.0000
1992	0.0000	0.2580	0.4780	0.0610	0.0640	0.0550	0.0740	0.0100	0.0000	0.0000	0.0000	0.0000	0.0000
1993	0.0000	0.2380	0.3530	0.1500	0.0870	0.1230	0.0240	0.0250	0.0000	0.0000	0.0000	0.0000	0.0000
1994	0.0000	0.2870	0.3700	0.1550	0.0900	0.0480	0.0310	0.0100	0.0090	0.0000	0.0000	0.0000	0.0000
1995	0.0000	0.6580	0.1720	0.0670	0.0450	0.0320	0.0120	0.0070	0.0040	0.0030	0.0000	0.0000	0.0000
1996	0.0000	0.1620	0.5800	0.1600	0.0610	0.0210	0.0130	0.0040	0.0000	0.0000	0.0000	0.0000	0.0000
1997	0.0000	0.1870	0.4090	0.2360	0.1130	0.0350	0.0120	0.0050	0.0010	0.0030	0.0000	0.0000	0.0000
1998	0.0000	0.4420	0.1930	0.0430	0.1300	0.0860	0.0540	0.0250	0.0140	0.0110	0.0020	0.0010	0.0000
1999	0.0000	0.0770	0.3200	0.1810	0.2560	0.1150	0.0320	0.0110	0.0050	0.0030	0.0000	0.0010	0.0000
2000	0.0000	0.1520	0.1400	0.1570	0.2740	0.1670	0.0730	0.0270	0.0060	0.0020	0.0010	0.0000	0.0000
2001	0.0000	0.1480	0.1670	0.1990	0.2990	0.1030	0.0420	0.0230	0.0130	0.0060	0.0010	0.0000	0.0000
2002	0.0000	0.0050	0.0230	0.0710	0.2060	0.3590	0.2300	0.0760	0.0240	0.0040	0.0000	0.0000	0.0000
2003	0.0000	0.3040	0.2380	0.0410	0.1260	0.0970	0.1220	0.0490	0.0150	0.0060	0.0010	0.0010	0.0000
2004	0.0000	0.1820	0.5190	0.0900	0.0400	0.0580	0.0430	0.0360	0.0210	0.0080	0.0040	0.0010	0.0000
2005	0.0000	0.4928	0.2179	0.0610	0.1055	0.0473	0.0418	0.0193	0.0090	0.0025	0.0018	0.0004	0.0007
2006	0.0000	0.0605	0.1003	0.0549	0.2475	0.2560	0.1001	0.0690	0.0456	0.0447	0.0129	0.0073	0.0012
2007	0.0000	0.0287	0.0405	0.2849	0.1571	0.2686	0.0905	0.0325	0.0250	0.0232	0.0204	0.0193	0.0101
2008	0.0000	0.0126	0.0542	0.1013	0.4130	0.0979	0.1441	0.0902	0.0269	0.0158	0.0110	0.0196	0.0118
2009	0.0000	0.1092	0.0085	0.0339	0.1526	0.4425	0.0972	0.0936	0.0374	0.0169	0.0039	0.0034	0.0008
2010	0.0000	0.0272	0.0165	0.0035	0.0448	0.1776	0.4689	0.0912	0.0955	0.0532	0.0212	0.0004	0.0000
2011	0.0000	0.0998	0.0867	0.0706	0.0215	0.0954	0.1651	0.2748	0.0888	0.0472	0.0258	0.0059	0.0183
2012	0.0029	0.1942	0.0929	0.0413	0.0819	0.0460	0.1051	0.1715	0.2066	0.0473	0.0084	0.0018	0.0000
2013	0.0000	0.5249	0.1973	0.0071	0.0177	0.0622	0.0470	0.0417	0.0394	0.0529	0.0075	0.0024	0.0000
2014	0.0000	0.0661	0.5814	0.1700	0.0191	0.0435	0.0389	0.0231	0.0272	0.0116	0.0116	0.0075	0.0000
2015	0.0714	0.1429	0.1857	0.6000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 17 cont.

MDSSN

	Age												
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1985		0.2879	0.6259	0.0653	0.0098	0.0027	0.0045	0.0001	0.0008	0.0001	0.0001	0.0008	0.0020
1986		0.2286	0.2593	0.4942	0.0040	0.0053	0.0020	0.0029	0.0028	0.0000	0.0000	0.0000	0.0009
1987		0.1989	0.3609	0.1610	0.2463	0.0250	0.0031	0.0036	0.0003	0.0000	0.0000	0.0000	0.0009
1988		0.1246	0.2370	0.2178	0.1741	0.2279	0.0040	0.0000	0.0001	0.0133	0.0000	0.0000	0.0011
1989		0.0837	0.3908	0.2034	0.1150	0.1233	0.0831	0.0004	0.0002	0.0001	0.0000	0.0000	0.0000
1990		0.1550	0.3140	0.2391	0.0959	0.0681	0.0636	0.0592	0.0017	0.0002	0.0002	0.0010	0.0020
1991		0.1593	0.4148	0.1351	0.1023	0.0580	0.0566	0.0418	0.0231	0.0009	0.0033	0.0000	0.0049
1992		0.0435	0.3515	0.2440	0.0932	0.1111	0.0682	0.0463	0.0218	0.0111	0.0052	0.0000	0.0039
1993		0.0655	0.2112	0.2994	0.1411	0.0816	0.0830	0.0593	0.0361	0.0118	0.0050	0.0014	0.0047
1994		0.0523	0.2016	0.1908	0.2296	0.1159	0.0662	0.0835	0.0343	0.0167	0.0061	0.0024	0.0006
1995		0.1082	0.2538	0.1457	0.1319	0.1122	0.0871	0.0543	0.0429	0.0252	0.0210	0.0076	0.0101
1996		0.0052	0.4852	0.1346	0.0458	0.0916	0.0849	0.0557	0.0467	0.0221	0.0200	0.0062	0.0021
1997		0.1050	0.1197	0.3477	0.1189	0.0560	0.0510	0.0668	0.0577	0.0319	0.0311	0.0097	0.0046
1998		0.0753	0.2983	0.0684	0.3118	0.0675	0.0276	0.0387	0.0362	0.0314	0.0190	0.0207	0.0052
1999		0.0177	0.4392	0.2019	0.1432	0.0890	0.0287	0.0166	0.0279	0.0132	0.0128	0.0067	0.0031
2000		0.0290	0.1437	0.3053	0.1427	0.1652	0.0773	0.0399	0.0229	0.0225	0.0220	0.0138	0.0157
2001		0.0167	0.1384	0.1852	0.1826	0.0822	0.1007	0.1345	0.0466	0.0421	0.0348	0.0196	0.0166
2002		0.2407	0.1037	0.0961	0.2081	0.0849	0.0747	0.0790	0.0568	0.0185	0.0102	0.0135	0.0138
2003		0.0390	0.2418	0.1051	0.0815	0.1352	0.1248	0.0676	0.0604	0.0756	0.0217	0.0232	0.0240
2004		0.0512	0.2932	0.1992	0.0671	0.0539	0.0719	0.0761	0.0609	0.0432	0.0447	0.0133	0.0254
2005		0.1353	0.2111	0.1477	0.1941	0.0486	0.0516	0.0434	0.0548	0.0408	0.0350	0.0226	0.0152
2006		0.0174	0.5259	0.0817	0.0969	0.0599	0.0297	0.0253	0.0366	0.0425	0.0265	0.0212	0.0366
2007		0.0376	0.1067	0.3553	0.0691	0.0710	0.0626	0.0343	0.0417	0.0464	0.0742	0.0371	0.0640
2008		0.0074	0.1989	0.2486	0.2574	0.0385	0.0520	0.0445	0.0254	0.0272	0.0227	0.0317	0.0457
2009		0.0704	0.0739	0.2684	0.0905	0.2425	0.0370	0.0398	0.0547	0.0158	0.0277	0.0212	0.0579
2010		0.0166	0.3305	0.1113	0.1435	0.1115	0.1212	0.0148	0.0307	0.0225	0.0088	0.0113	0.0777
2011		0.0500	0.1600	0.2700	0.0990	0.1250	0.0830	0.0980	0.0220	0.0200	0.0170	0.0170	0.0390
2012		0.0574	0.1965	0.0876	0.0895	0.0674	0.0872	0.0854	0.0946	0.0281	0.0624	0.0512	0.0926
2013		0.0166	0.3305	0.1113	0.1435	0.1115	0.1212	0.0148	0.0307	0.0225	0.0088	0.0113	0.0777
2014		0.0500	0.1600	0.2700	0.0990	0.1250	0.0830	0.0980	0.0220	0.0200	0.0170	0.0170	0.0390
2015		0.0260	0.0100	0.6246	0.0632	0.0687	0.0331	0.0288	0.0215	0.0309	0.0266	0.0279	0.0388

DE SSN

	Age												
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1996		0.0060	0.4170	0.1920	0.0610	0.0850	0.0760	0.0640	0.0580	0.0150	0.0090	0.0090	0.0090
1997		0.0930	0.0740	0.3910	0.1370	0.0510	0.0640	0.0730	0.0320	0.0300	0.0230	0.0090	0.0230
1998		0.0400	0.0870	0.0980	0.3470	0.0900	0.0610	0.1050	0.0950	0.0340	0.0250	0.0080	0.0110
1999		0.0000	0.1050	0.1440	0.1770	0.2350	0.0720	0.0540	0.0760	0.0580	0.0510	0.0140	0.0140
2000		0.0360	0.0360	0.2100	0.1710	0.1380	0.2230	0.0660	0.0300	0.0390	0.0320	0.0100	0.0100
2001		0.0060	0.1150	0.1000	0.1850	0.1100	0.1400	0.2000	0.0500	0.0150	0.0400	0.0200	0.0200
2002		0.0340	0.0710	0.1910	0.1780	0.1570	0.1130	0.0890	0.0970	0.0260	0.0160	0.0100	0.0180
2003		0.0200	0.0970	0.0970	0.1340	0.0890	0.1110	0.1250	0.1050	0.1210	0.0340	0.0280	0.0380
2004		0.0070	0.1660	0.2310	0.0980	0.0680	0.0540	0.1120	0.0780	0.0810	0.0440	0.0140	0.0470
2005		0.0960	0.1570	0.1680	0.1980	0.0810	0.0460	0.0300	0.0360	0.0610	0.0360	0.0460	0.0460
2006		0.0595	0.2007	0.0967	0.1413	0.1413	0.0706	0.0520	0.0409	0.0483	0.0483	0.0372	0.0632
2007		0.0061	0.0887	0.3700	0.1804	0.1009	0.0734	0.0306	0.0245	0.0306	0.0275	0.0398	0.0275
2008		0.0299	0.0329	0.1257	0.3024	0.1467	0.1317	0.0449	0.0359	0.0359	0.0269	0.0449	0.0419
2009		0.1296	0.1014	0.0930	0.1803	0.1352	0.0901	0.0789	0.0366	0.0338	0.0169	0.0282	0.0761
2010		0.1469	0.2041	0.1204	0.1143	0.1224	0.0898	0.0469	0.0429	0.0245	0.0224	0.0204	0.0449
2011		0.0220	0.0550	0.1890	0.1720	0.1300	0.0950	0.1140	0.0950	0.0450	0.0300	0.0120	0.0410
2012		0.1538	0.2985	0.2062	0.0308	0.0338	0.0185	0.0677	0.0338	0.0185	0.0154	0.0554	0.0677
2013		0.0382	0.0795	0.0572	0.0684	0.1701	0.1590	0.1335	0.1145	0.0636	0.0334	0.0270	0.0556
2014													
2015		0.0496	0.0780	0.1560	0.2199	0.1064	0.0922	0.0426	0.0213	0.0638	0.0851	0.0355	0.0496

Table 17 cont.

VA Poundnet

	Age												
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1991	0.0231	0.0182	0.1970	0.4403	0.1469	0.0919	0.0275	0.0138	0.0275	0.0000	0.0000	0.0138	0.0000
1992	0.0245	0.0613	0.0736	0.1963	0.3374	0.1411	0.0368	0.0491	0.0245	0.0552	0.0000	0.0000	0.0000
1993	0.0056	0.0267	0.0487	0.1678	0.4470	0.1710	0.0305	0.0197	0.0272	0.0216	0.0342	0.0000	0.0000
1994	0.0000	0.1082	0.0361	0.0999	0.3449	0.1668	0.0864	0.0443	0.0391	0.0248	0.0248	0.0248	0.0000
1995	0.0029	0.2184	0.3448	0.0718	0.1609	0.0489	0.0431	0.0489	0.0287	0.0057	0.0201	0.0057	0.0000
1996	0.0000	0.0426	0.3314	0.2387	0.1361	0.1052	0.0743	0.0309	0.0309	0.0075	0.0000	0.0000	0.0025
1997	0.0000	0.0306	0.1990	0.4133	0.0638	0.0026	0.0357	0.0408	0.0765	0.0510	0.0510	0.0179	0.0179
1998	0.0000	0.0132	0.1492	0.4393	0.1027	0.0028	0.0361	0.0486	0.0541	0.0618	0.0618	0.0153	0.0153
1999	0.0000	0.0269	0.3932	0.3918	0.0951	0.0037	0.0170	0.0147	0.0109	0.0123	0.0133	0.0147	0.0065
2000	0.0000	0.0008	0.3964	0.4604	0.0848	0.0028	0.0127	0.0127	0.0102	0.0074	0.0094	0.0013	0.0013
2001	0.0000	0.0038	0.1471	0.4020	0.2303	0.0054	0.0311	0.0467	0.0467	0.0435	0.0242	0.0140	0.0054
2002	0.0000	0.0000	0.0975	0.2753	0.2639	0.0478	0.1300	0.0784	0.0535	0.0363	0.0115	0.0000	0.0057
2003	0.0000	0.0000	0.0486	0.1917	0.2128	0.0236	0.1169	0.0895	0.1086	0.0914	0.0722	0.0211	0.0236
2004	0.0000	0.0000	0.1111	0.1783	0.1889	0.1120	0.0714	0.1332	0.0746	0.0535	0.0320	0.0352	0.0099
2005	0.0000	0.0034	0.1037	0.3076	0.1569	0.0402	0.0436	0.0958	0.0958	0.0533	0.0391	0.0323	0.0283
2006	0.0000	0.0041	0.3606	0.2925	0.1449	0.0064	0.0233	0.0416	0.0393	0.0535	0.0105	0.0091	0.0142
2007	0.0000	0.0010	0.0799	0.2713	0.1957	0.0362	0.0355	0.0479	0.0600	0.0850	0.1206	0.0225	0.0444
2008	0.0000	0.0093	0.2402	0.3930	0.1779	0.0278	0.0328	0.0311	0.0158	0.0235	0.0235	0.0251	0.0000
2009	0.0000	0.0031	0.0826	0.2215	0.3028	0.0939	0.0533	0.0533	0.0520	0.0520	0.0293	0.0162	0.0402
2010	0.0000	0.0069	0.0787	0.1945	0.3121	0.1266	0.0458	0.0308	0.0380	0.0530	0.0329	0.0209	0.0598
2011	0.0000	0.0090	0.0516	0.1211	0.1547	0.1076	0.0886	0.0987	0.1076	0.1166	0.0706	0.0280	0.0460
2012	0.0000	0.0000	0.0824	0.1882	0.2235	0.1247	0.0612	0.0541	0.0753	0.0494	0.0565	0.0259	0.0588
2013	0.0000	0.0000	0.1557	0.1642	0.1802	0.0783	0.0283	0.0245	0.0283	0.1066	0.0368	0.0821	0.1151
2014	0.0000	0.0000	0.2575	0.2037	0.0315	0.0000	0.0046	0.0361	0.0500	0.1038	0.1176	0.0407	0.1545
2015	0.0000	0.0000	0.0854	0.4394	0.1570	0.0138	0.0193	0.0138	0.0000	0.0716	0.0455	0.0592	0.0950

Table 18. Model structure, equation, and data inputs used in this assessment.

General Definitions	Symbol	Description/Definition
Year Index	y	y = {1982,..,2014} for catch. y = {1970,..,2014} for indices.
Age Index	a	a = {1,..,13+}
Fleet Index	f	f = {1: Chesapeake Bay, 2: Coast, 3: Commercial Dead Discards}
Indices Index:	t	t = {1,..,14}
Input Data	**Symbol**	**Description/Definition**
Observed Fleet Catch	$C_{f,y}$	Reported number of striped bass killed each year (y) by fleet (f)
Coefficient of Variation for Fleets	$CV_{f,y}$	Calculated from MRIP harvest and releases estimates with associated proportional standard errors (commercial harvest from census – no error)
Observed Fleet Age Compositions	$P_{f,y,a}$	Proportion-at-age (a) for each year (y) and fleet (f)
Observed Total Indices of Relative Abundance	$I_{t,y}$	Reported by various states. YOY and Age 1 Indices: 6 Age-aggregated Indices: 3 (1 fishery-dependent; 2 fishery-independent) Indices with Age Composition: 5 (all fishery-independent)
Coefficient of Variation for Indices	$CV_{t,y}$	Calculated from indices and associated standard errors
Observed Age Compositions of Indices of Relative Abundance	$P_{t,y,a}$	Proportion-at-age (a) for each year (y) and index (t)
Effective Sample Size	$\hat{\tilde{n}}$	Starting Values Fleets: Bay – 32, Ocean – 47, Commercial Discards - 23 Indices: NYOHS – 19, NJ Trawl – 5.0, MDSSN – 18, DESSN – 25, VAPNET – 8. The multiplier from equation 1.8 method of Francis (2011) is used to adjust the starting values.

Table 18 cont.

Population Model	Symbol	Equation
Age-1 numbers	$\hat{N}_{y,1}$	$\hat{N}_{y,1} = \exp\left(\log_e(\hat{\alpha}) + \log_e(SSB_{y-1}) - \log_e\left(1 + \frac{SSB_{y-1}}{\hat{\beta}}\right) + \hat{e}_y - 0.5\hat{\sigma}_R^2\right)$ $\hat{\sigma}_R = \sqrt{\frac{\sum_y (\hat{e}_y - \bar{\hat{e}})^2}{n-1}}$ where e_y are independent and identically distributed normal random variables with zero mean and constant variance and are constrained to sum to zero over all years
Abundance-at-Age	$\hat{N}_{y,a}$	First year (ages 2-A in 1970): $\hat{N}_{y,a} = \hat{N}_{y,a-1} \exp^{-\hat{F}_{1982,a-1} - M_{1982,a-1}}$ Rest of years (ages 2-12): $\hat{N}_{y,a} = \hat{N}_{y-1,a-1} \exp^{-\hat{F}_{y-1,a-1} - M_{y-1,a-1}}$
Plus-group abundance-at-age	$\hat{N}_{y,A}$	$\hat{N}_{y,A} = \hat{N}_{y-1,A-1} \exp^{-\hat{F}_{y-1,A-1} - M_{y-1,A-1}} + \hat{N}_{y-1,A} \exp^{-\hat{F}_{y-1,A} - M_{y-1,A}}$
Fishing Mortality	$\hat{F}_{f,y,a}$	$\hat{F}_{f,y,a} = \hat{F}_{f,y} \cdot \hat{s}_{f,a}$ where $F_{f,y}$ and $s_{f,a}$ are estimated parameters
Total Mortality	$\hat{Z}_{y,a}$	$Z_{y,a} = F_{y,a} + M_{y,a}$
Fleet Selectivity	$\hat{s}_{f,a}$	Fleet 1 (Chespeake Bay): 1982-1984, 1985-1989, 1990-1995, 1996-2015 Fleet 2 (Coast): 1982-1984 Fleet 3 (Commercial Dead Discards): 1985-1989,1990-1996,1997-2002, 2003-2015 $\hat{s}_a = \frac{1}{1-\hat{\gamma}} \cdot \left(\frac{1-\hat{\gamma}}{\hat{\gamma}}\right)^{\hat{\gamma}} \frac{\exp^{\hat{\alpha}\hat{\gamma}(\hat{\beta}-a)}}{1+\exp^{\hat{\alpha}(\hat{\beta}-a)}}$ Fleet 2 (Coast): 1985-1989, 1990-1996, 1997-2015 $\hat{s}_a = \exp^{(-\exp^{-\hat{\beta}(a-\hat{\alpha})})}$ Fleet 3 (Commercial Dead Discards): 1982-1984 $\hat{s}_a = \alpha \exp^{\beta a}$
Predicted Catch-At-Age	$\hat{C}_{f,y,a}$	$\hat{C}_{f,y,a} = \frac{\hat{F}_{f,y,a}}{\hat{F}_{f,y,a} + M_{y,a}} \cdot (1 - \exp^{-\hat{F}_{y,a} - M_{y,a}}) \cdot \hat{N}_{y,a}$

Table 18 cont.

Population Model	Symbol	Equation
Predicted Total Catch	$\hat{C}_{f,y}$	$\hat{C}_{f,y} = \sum_a \hat{C}_{f,y,a}$
Predicted Proportions of Catch-At-Age	$\hat{P}_{f,y,a}$	$\hat{P}_{f,y,a} = \frac{\hat{C}_{f,y,a}}{\sum_a \hat{C}_{f,y,a}}$
Predicted Aggregated Indices of Relative Abundance	$\hat{I}_{t,y,\sum a}$	$\hat{I}_{t,y,\Sigma a} = \hat{q}_t \cdot \sum_a \hat{N}_{y,a} \cdot \exp^{-p_t \cdot Z_{y,a}}$ where q_t is the estimated catchability coefficient of index t and p_t is the fraction of the year when the survey takes place.
Predicted Age-Specific Indices of Relative Abundance	$\hat{I}_{t,y,a}$	$\hat{I}_{t,y,a} = \hat{q}_t \cdot \hat{s}_{t,a} \cdot \hat{N}_{y,a} \cdot \exp^{-p_t \cdot \hat{Z}_{y,a}}$
Predicted Total Indices of Relative Abundance with Age Composition Data	$\hat{I}_{t,y}$	$\hat{I}_{t,y} = \hat{q}_t \sum_a \hat{s}_{t,a} \cdot \hat{N}_{y,a} \cdot \exp^{-p_t \cdot \hat{Z}_{y,a}}$
Predicted Age Composition of Survey	$\hat{U}_{t,y,a}$	$\hat{U}_{t,y,a} = \frac{\hat{I}_{t,y,a}}{\sum_a \hat{I}_{t,y,a}}$
Female Spawning Stock Biomass (metric tons)	SSB_y	$SSB_y = \sum_{a=1}^{A} N_{y,a} \cdot sr_a \cdot m_a \cdot w_{y,a} / 1000$

Table 18 cont.

Likelihood	Symbol	Equation
Concentrated Lognormal Likelihood for Fleet Catch (F) and Indices of Relative Abundance (T)	$-L_F$; $-L_T$	$-L_F = 0.5 * \sum_f n_f * \ln\left(\frac{\sum_f RSS_f}{\sum_f n_f}\right)$; $-L_T = 0.5 * \sum_t n_t * \ln\left(\frac{\sum_t RSS_t}{\sum_t n_t}\right)$ where $RSS_f = \lambda_f \sum_y \left(\frac{\ln\left(C_{f,y}+1e^{-5}\right)-\ln\left(\hat{C}_{f,y}+1e^{-5}\right)}{\delta_f \cdot CV_{f,y}}\right)^2$ $RSS_t = \lambda_t \sum_y \left(\frac{\ln\left(I_{t,y}+1e^{-5}\right)-\ln\left(\hat{I}_{t,y}+1e^{-5}\right)}{\delta_t \cdot CV_{t,y}}\right)^2$ $CV_{f,y}$ and $CV_{t,y}$ are the annual coefficient of variation for the observed total catch (f) and index (t) in year y, δ_f and δ_t is the CV weights for total catch f and index t, and λ_t and λ_f are relative weights.
Multinomial fleet catch (FC) and index (TC) age compositions	$-L_{FC}$; $-L_{TC}$	$-L_{FC} = \lambda_f \sum_y -n_{f,y} \sum_a P_{f,y,a} \cdot \ln\left(\hat{P}_{f,y,a}+1e^{-7}\right)$ $-L_{TC} = \lambda_t \sum_y -n_{t,y} \sum_a U_{t,y,a} \cdot \ln\left(\hat{U}_{t,y,a}+1e^{-7}\right)$ where λ_f and λ_t are a user-defined weighting factors and n_y are the effective sample sizes.
Constraints Added To Total Likelihood	P_{n1}, P_{rdev}, P_{fadd}	$P_{n1} = \lambda_{n1}(\hat{N}_{y,1} - N^e_{y,1})^2$ - forces $N_{1,1}$ to follow S-R curve $P_{rdev} = \lambda_R \sum_y \log_e(\hat{\sigma}_R) + \frac{\hat{e}_y^2}{2\hat{\sigma}_R^2}$ - for bias correction to constrain deviations $P_{f_{add}} = \begin{cases} \text{phase} < 3, & 10 \cdot \sum_y (F_{f,y} - 0.15)^2 \\ \text{phase} \geq 3, & 0.000001 \cdot \sum_y (F_{f,y} - 0.15)^2 \end{cases}$ - avoid small F values at start

Table 18 cont.

Diagnostics	Symbol	Equation
Standardized residuals (lognormal – catch and surveys)	$r_{f,y,a}$ or $r_{t,y,a}$	$r_{t,y} = \frac{\log I_{t,y} - \log \hat{I}_{t,y}}{\sqrt{\log_e((\delta_t CV_{t,y})^2 + 1)}}$ $r_{f,y} = \frac{\log C_{f,y} - \log \hat{C}_{f,y}}{\sqrt{\log_e(CV_{f,y}^2 + 1)}}$
Standardized residuals (age compositions – catch and surveys)	$ra_{f,y,a}$ or $ra_{t,y,a}$	$ra_{f,y,a} = \frac{P_{f,y,a} - \hat{P}_{f,y,a}}{\sqrt{\frac{\hat{P}_{f,y,a}(1-\hat{P}_{f,y,a})}{\hat{n}_f}}}$ $ra_{t,y,a} = \frac{P_{t,y,a} - \hat{P}_{t,y,a}}{\sqrt{\frac{\hat{P}_{t,y,a}(1-\hat{P}_{t,y,a})}{\hat{n}_t}}}$
Root mean square error	$RMSE$	Total catch $RMSE_f = \sqrt{\frac{\sum_y r_{f,y}^2}{n_f}}$ Index $RMSE_t = \sqrt{\frac{\sum_y r_{t,y}^2}{n_t}}$

Table 19. The fraction of total mortality (p) that occurs prior to the survey and ages to which survey indices are linked.

Survey	p	Linked Ages
Age-specific		
NY YOY	0	1 (January 1st)
NJ YOY	0	1 (January 1st)
MD YOY	0	1 (January 1st)
VA YOY	0	1 (January 1st)
MD Age 1	0	2 (January 1st)
NY Age 1	0	2 (January 1st)
Aggregate		
MRFSS	0.5	3-13+
NEFSC	0.333	2-9
CT Trawl	0.333	4-6
Indices with age composition		
NY OHS	0.75	2-13+
NJ Trawl	0.25	2-13+
MD SSN	0.25	2-13+
DE SSN	0.25	2-13+
VA Poundnet	0.25	1-13+

Table 20. Starting values used in the SCA model.

Parameter(s)	Equation	ADMB Name	Phase	Start Value	Lower Bound	Upper Bound
Yr 1, Age 1 N or Avg N (log)		log_R	1	10	0.27	25
R Deviation (log)		log_R_dev	2	0	-20	20
Fishing Mortality (log)		log_F	2	-1.6	-12	2.31
Aggregate qs (log)		agg_qs	6	-16	-50	0
AgeComp qs (log)		ac_qs	6	-16	-50	0
Catch Selectivity	Gompertz	flgom_a	4	3	-20	150
Catch Selectivity	Gompertz	flgom_b	4	1	-20	150
Catch Selectivity	Thompson	flthom_a	4	-3.81	-20	0
Catch Selectivity	Thompson	flthom_b	4	3	0	150
Catch Selectivity	Thompson	flthom_c	4	0.9	1.00E-28	0.999
Catch Selectivity	Exponential	flexp_a	4	0.1	-150	150
Catch Selectivity	Exponential	flexp_b	4	1	-150	150
AC Selectivity	Gompertz	acgom_a	5	3	-20	150
AC Selectivity	Gompertz	acgom_b	5	1	-20	150
AC Selectivity	Gamma	acgam_a	5	3	0	150
AC Selectivity	Gamma	acgam_b	5	1	0	150
AC Selectivity	Thompson	acthom_a	5	-3.81	-20	0
AC Selectivity	Thompson	acthom_b	5	3	0	150
AC Selectivity	Thompson	acthom_c	5	0.9	1.00E-28	0.999
AC Selectivity	User-Defined	userparms	5	0.6	0	1
S-R Equation	Beverton	BH_a	3	10000	0	100000
S-R Equation	Beverton	BH_b	3	11000	0	100000

Table 21. RMSE and effective sample size estimates for the fleet catch, relative abundance indices, and age compositions.

				Percentile	
Index	n	Weight	RMSE	0.025	0.975
NYYOY	36	2.65	0.987	0.771	1.236
NJYOY	33	1.45	1.002	0.761	1.245
MDYOY	46	1.85	0.993	0.799	1.211
VAYOY	33	1.40	0.980	0.761	1.245
NYAge1	30	1.35	1.010	0.748	1.256
MDAge1	46	1.25	1.006	0.799	1.211
MRFSS	28	1.83	1.009	0.738	1.263
CTTRL	32	3.30	1.015	0.757	1.248
NEFSC	18	1.30	0.996	0.669	1.318
NYOHS	20	2.80	1.039	0.687	1.304
NJTRAWL	27	4.30	1.005	0.733	1.268
MDSSN	31	2.82	0.990	0.752	1.252
DESSN	19	2.90	1.012	0.678	1.311
VAPNET	25	2.00	0.993	0.722	1.277

Age Composition

Fleet/Index	n_{eff}
Bay Fleet	32.5
Ocean Fleet	48.7
Commercial Discards	22.5
NYOHS	19.1
NJTRAWL	4.7
MDSSN	17.7
DESSN	25.4
VAPNET	9.3

Table 22. Likelihood components with respective contributions from the base model run.

Likelihood Components		
Concentrated Log-likelihood	Weight	RSS
Bay Total Catch:	2	20.04
Ocean Total Catch:	2	0.57
Comm Discards Total Catch:	2	0.12
Aggregate Abundance Indices		
NY YOY	1	24.50
NJ YOY	1	26.50
MD YOY	1	39.68
VA YOY	1	28.76
NY Age 1	1	26.46
MD Age 1	1	34.18
MRFSS/MRIP	1	26.93
CTTRL	1	22.36
NEFSC	1	15.76
Age Comp Abundance Indices		
NYOHS	1	20.35
NJ Trawl	1	18.08
MD SSN	1	24.69
DE SSN	1	18.15
VA PNET	1	21.99
Total RSS		369.14
No. of Obs		526.00
Conc. Likel.		-93.13
Age Composition Data		Likelihood
Bay Age Comp:	1	2142.44
Ocean Age Comp:	1	3827.52
Comm Discards Age Comp:	1	1565.91
NYOHS	1	635.96
NJ Trawl	1	250.80
MD SSN	1	1109.57
DE SSN	1	1098.21
VA PNET	1	504.09
log_R constraint:	1	0.29
Recr Devs :	1	14.55
Total Likelihood :		11006.90
AIC :		22431.90

Table 23. Parameter estimates and associated standard deviations of base model configuration.

	Bay			Ocean			Commercial Discards			Total					
Year	Full F	SD	CV	Full F	SD	CV	Full F	SD	CV	Full F	SD	CV	Recruitment	SD	CV
1982	0.817	0.119	0.15	0.158	0.003	0.02	0.010	0.003	0.35	0.873	0.118	0.13	18,937,700	2,184,800	0.115
1983	0.068	0.045	0.66	0.120	0.007	0.05	0.006	0.005	0.77	0.155	0.049	0.31	45,647,100	4,145,160	0.091
1984	0.137	0.003	0.02	0.061	0.005	0.08	0.008	0.018	2.16	0.161	0.044	0.27	40,602,600	3,826,390	0.094
1985	0.009	0.013	1.55	0.095	0.003	0.03	0.017	0.006	0.34	0.099	0.045	0.45	39,613,900	3,645,120	0.092
1986	0.004	0.048	13.48	0.056	0.006	0.10	0.031	0.006	0.18	0.062	0.017	0.27	31,837,100	3,185,880	0.100
1987	0.001	0.002	1.30	0.026	0.006	0.22	0.017	0.022	1.33	0.030	0.007	0.23	42,430,500	3,832,180	0.090
1988	0.002	0.043	18.12	0.036	0.006	0.17	0.030	0.001	0.05	0.046	0.008	0.18	55,693,500	4,594,430	0.082
1989	0.001	0.019	23.21	0.024	0.008	0.31	0.038	0.006	0.16	0.048	0.010	0.21	62,026,500	4,969,340	0.080
1990	0.015	0.002	0.15	0.017	0.006	0.34	0.057	0.019	0.34	0.086	0.014	0.17	82,973,200	6,074,540	0.073
1991	0.023	0.003	0.11	0.022	0.006	0.26	0.032	0.004	0.14	0.073	0.009	0.13	68,115,600	5,436,900	0.080
1992	0.021	0.044	2.11	0.026	0.003	0.10	0.016	0.004	0.26	0.058	0.006	0.10	69,594,600	5,662,710	0.081
1993	0.029	0.005	0.17	0.027	0.006	0.22	0.025	0.022	0.85	0.077	0.008	0.10	90,178,800	6,770,640	0.075
1994	0.040	0.001	0.03	0.034	0.015	0.44	0.023	0.002	0.10	0.091	0.008	0.09	179,709,000	10,302,200	0.057
1995	0.048	0.018	0.38	0.057	0.001	0.02	0.031	0.005	0.16	0.125	0.011	0.09	114,180,000	7,952,840	0.070
1996	0.056	0.009	0.16	0.056	0.005	0.09	0.010	0.015	1.52	0.115	0.008	0.07	124,405,000	8,427,760	0.068
1997	0.066	0.000	0.01	0.158	0.014	0.09	0.005	0.005	0.95	0.191	0.017	0.09	153,781,000	9,400,610	0.061
1998	0.060	0.008	0.13	0.143	0.002	0.01	0.008	0.006	0.75	0.173	0.016	0.09	98,373,300	7,159,260	0.073
1999	0.051	0.004	0.09	0.123	0.004	0.03	0.005	0.016	3.03	0.149	0.014	0.09	100,528,000	7,115,250	0.071
2000	0.058	0.001	0.02	0.155	0.012	0.08	0.015	0.002	0.15	0.188	0.017	0.09	79,407,400	6,210,780	0.078
2001	0.051	0.011	0.21	0.151	0.001	0.01	0.008	0.005	0.69	0.177	0.015	0.09	117,650,000	7,845,320	0.067
2002	0.041	0.007	0.18	0.149	0.004	0.03	0.004	0.019	4.18	0.170	0.015	0.09	137,115,000	8,624,990	0.063
2003	0.068	0.000	0.00	0.158	0.015	0.10	0.009	0.006	0.66	0.196	0.016	0.08	75,886,100	6,181,140	0.081
2004	0.060	0.006	0.11	0.192	0.004	0.02	0.016	0.005	0.35	0.230	0.021	0.09	165,979,000	9,927,350	0.060
2005	0.064	0.010	0.15	0.192	0.004	0.02	0.026	0.015	0.56	0.241	0.022	0.09	94,659,300	7,179,380	0.076
2006	0.078	0.003	0.04	0.234	0.014	0.06	0.007	0.008	1.19	0.275	0.026	0.09	87,635,000	6,871,180	0.078
2007	0.071	0.002	0.03	0.191	0.002	0.01	0.020	0.006	0.30	0.239	0.023	0.10	65,002,600	5,900,970	0.091
2008	0.054	0.015	0.27	0.209	0.003	0.02	0.011	0.023	2.12	0.242	0.025	0.10	84,421,500	7,125,200	0.084
2009	0.064	0.003	0.05	0.148	0.013	0.09	0.023	0.006	0.25	0.195	0.018	0.09	60,278,400	6,007,460	0.100
2010	0.060	0.003	0.05	0.152	0.001	0.01	0.010	0.007	0.71	0.188	0.019	0.10	73,808,000	7,202,880	0.098
2011	0.060	0.008	0.14	0.176	0.005	0.03	0.026	0.018	0.69	0.223	0.023	0.10	94,237,700	8,676,700	0.092
2012	0.054	0.003	0.05	0.131	0.014	0.11	0.036	0.010	0.29	0.185	0.020	0.11	123,892,000	12,810,900	0.103
2013	0.063	0.003	0.05	0.192	0.002	0.01	0.025	0.006	0.26	0.239	0.027	0.11	31,214,800	5,058,120	0.162
2014	0.067	0.004	0.06	0.148	0.004	0.03	0.043	0.015	0.34	0.213	0.025	0.12	69,750,600	8,529,480	0.122
2015	0.058	0.004	0.06	0.118	0.018	0.15	0.013	0.003	0.23	0.156	0.018	0.11	122,739,000	12,780,400	0.104

Table 23 cont.

Catch Selectivtiy Parameters

Bay				Ocean				Commercial Discards			
	Estimate	SD	CV		Estimate	SD	CV		Estimate	SD	CV
1982-1984				1982-1984				1982-1984			
α	-5.630	0.425	0.08	α	-2.480	0.331	0.133	α	0.017	0.008	0.49
β	2.259	0.063	0.03	β	3.364	0.248	0.073	β	1.239	0.196	0.16
ϒ	0.922	0.020	0.02	ϒ	0.990	0.022	0.023				
1985-1989				1985-1989				1985-1989			
α	-3.819	0.473	0.12	α	5.111	0.596	0.116	α	-2.135	0.245	0.12
β	2.011	0.124	0.06	β	0.436	0.064	0.145	β	4.098	0.391	0.10
ϒ	0.951	0.022	0.02					ϒ	0.879	0.067	0.08
1990-1995				1990-1995				1990-1995			
α	-2.288	0.226	0.10	α	3.106	0.173	0.055	α	-1.906	0.159	-0.08
β	3.467	0.244	0.07	β	0.915	0.108	0.118	β	4.673	0.372	0.08
ϒ	0.890	0.037	0.04					ϒ	0.816	0.063	0.08
1996-2015				1997-2015				1996-2002			
α	-1.893	0.111	-0.059	α	5.366	0.244	0.045	α	-2.744	0.513	0.19
β	3.764	0.140	0.04	β	0.429	0.028	0.065	β	2.814	0.284	0.10
ϒ	0.942	0.016	0.02					ϒ	0.958	0.028	0.03
								2003-2015			
								α	-2.430	0.298	0.12
								β	3.703	0.187	0.05
								ϒ	0.982	0.015	0.02

Survey Selectivity Parameters			
NYOHS	Estimate	SD	CV
α	-5.691	0.087	0.02
β	2.288	0.034	0.02
ϒ	0.963	0.006	0.01
NJ Trawl			
α	3.372	0.591	0.18
β	0.584	0.132	0.23
DE SSN			
α	3.392	0.194	0.06
β	0.753	0.103	0.14
MDSSN			
s_2	0.136	0.021	0.16
VAPNET			
α	2.916	0.126	0.04
β	1.269	0.158	0.12

Catchability Coefficients			
Survey	Estimate	SD	CV
NYYOY	2.96E-07	4.11E-08	0.14
NJYOY	1.28E-08	8.26E-10	0.06
MDYOY	4.36E-08	3.30E-09	0.08
VAYOY	1.09E-07	7.73E-09	0.07
NYAge1	4.54E-08	3.86E-09	0.08
MDAge1	9.48E-09	8.11E-10	0.09
MRFSS	3.20E-08	1.87E-09	0.06
CTTRL	3.49E-08	2.66E-09	0.08
NEFSC	1.01E-08	1.02E-09	0.10
NYOHS	1.60E-07	1.40E-08	0.09
NJTRAWL	8.67E-08	1.32E-08	0.15
MDSSN	1.28E-07	1.45E-08	0.11
DESSN	8.12E-08	9.59E-09	0.12
VAPNET	5.25E-07	5.79E-08	0.11

Table 24. Total fishing mortality-at-age and fishing mortality-at-age by fleet.

Total Fishing Mortality

Age

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.0028	0.2506	0.8727	0.6820	0.5137	0.3898	0.3072	0.2525	0.2160	0.1912	0.1740	0.1618	0.1551
1983	0.0009	0.0258	0.1092	0.1543	0.1549	0.1437	0.1345	0.1274	0.1220	0.1175	0.1138	0.1105	0.1078
1984	0.0010	0.0446	0.1615	0.1504	0.1268	0.1057	0.0911	0.0811	0.0742	0.0693	0.0657	0.0629	0.0611
1985	0.0006	0.0077	0.0195	0.0380	0.0575	0.0697	0.0793	0.0866	0.0918	0.0953	0.0974	0.0986	0.0993
1986	0.0004	0.0042	0.0136	0.0353	0.0542	0.0588	0.0605	0.0616	0.0622	0.0623	0.0621	0.0617	0.0613
1987	0.0002	0.0019	0.0065	0.0178	0.0273	0.0292	0.0295	0.0297	0.0297	0.0295	0.0293	0.0290	0.0287
1988	0.0003	0.0031	0.0104	0.0291	0.0444	0.0461	0.0455	0.0447	0.0440	0.0432	0.0424	0.0416	0.0409
1989	0.0003	0.0021	0.0093	0.0311	0.0477	0.0466	0.0428	0.0395	0.0369	0.0347	0.0329	0.0314	0.0301
1990	0.0005	0.0037	0.0192	0.0532	0.0861	0.0848	0.0687	0.0545	0.0441	0.0365	0.0311	0.0272	0.0243
1991	0.0004	0.0039	0.0210	0.0522	0.0731	0.0708	0.0598	0.0501	0.0428	0.0374	0.0335	0.0306	0.0284
1992	0.0003	0.0036	0.0194	0.0449	0.0577	0.0560	0.0495	0.0437	0.0391	0.0357	0.0332	0.0313	0.0299
1993	0.0005	0.0046	0.0247	0.0590	0.0770	0.0738	0.0636	0.0546	0.0476	0.0425	0.0386	0.0358	0.0337
1994	0.0006	0.0057	0.0311	0.0726	0.0905	0.0860	0.0748	0.0650	0.0574	0.0516	0.0473	0.0441	0.0417
1995	0.0007	0.0079	0.0429	0.0988	0.1252	0.1212	0.1076	0.0954	0.0858	0.0786	0.0732	0.0692	0.0661
1996	0.0007	0.0078	0.0406	0.0881	0.1125	0.1149	0.1113	0.1063	0.1014	0.0968	0.0926	0.0888	0.0854
1997	0.0009	0.0065	0.0313	0.0815	0.1215	0.1446	0.1616	0.1742	0.1827	0.1877	0.1901	0.1907	0.1902
1998	0.0008	0.0062	0.0305	0.0767	0.1127	0.1332	0.1483	0.1594	0.1668	0.1710	0.1730	0.1734	0.1728
1999	0.0007	0.0052	0.0252	0.0644	0.0954	0.1133	0.1265	0.1362	0.1427	0.1465	0.1484	0.1488	0.1484
2000	0.0009	0.0074	0.0368	0.0859	0.1228	0.1446	0.1609	0.1729	0.1810	0.1856	0.1878	0.1882	0.1876
2001	0.0008	0.0059	0.0290	0.0720	0.1070	0.1291	0.1460	0.1587	0.1675	0.1729	0.1758	0.1769	0.1769
2002	0.0007	0.0050	0.0239	0.0611	0.0936	0.1160	0.1339	0.1476	0.1573	0.1635	0.1671	0.1689	0.1695
2003	0.0009	0.0061	0.0295	0.0841	0.1272	0.1507	0.1675	0.1799	0.1882	0.1930	0.1953	0.1957	0.1950
2004	0.0009	0.0063	0.0309	0.0889	0.1369	0.1660	0.1883	0.2052	0.2169	0.2243	0.2283	0.2300	0.2302
2005	0.0009	0.0067	0.0339	0.1001	0.1522	0.1813	0.2029	0.2190	0.2300	0.2367	0.2401	0.2412	0.2408
2006	0.0011	0.0077	0.0368	0.1032	0.1598	0.1953	0.2226	0.2434	0.2578	0.2669	0.2719	0.2742	0.2746
2007	0.0010	0.0070	0.0345	0.1005	0.1526	0.1813	0.2024	0.2182	0.2288	0.2351	0.2383	0.2392	0.2386
2008	0.0008	0.0062	0.0296	0.0840	0.1319	0.1641	0.1897	0.2095	0.2235	0.2326	0.2380	0.2408	0.2418
2009	0.0009	0.0060	0.0304	0.0899	0.1344	0.1563	0.1715	0.1825	0.1896	0.1935	0.1951	0.1950	0.1938
2010	0.0008	0.0056	0.0276	0.0788	0.1197	0.1424	0.1591	0.1714	0.1797	0.1846	0.1870	0.1877	0.1872
2011	0.0009	0.0063	0.0318	0.0943	0.1429	0.1695	0.1890	0.2036	0.2135	0.2194	0.2223	0.2232	0.2227
2012	0.0008	0.0055	0.0291	0.0896	0.1327	0.1521	0.1652	0.1746	0.1805	0.1836	0.1846	0.1841	0.1827
2013	0.0009	0.0067	0.0334	0.0983	0.1498	0.1788	0.2005	0.2168	0.2280	0.2347	0.2382	0.2394	0.2392
2014	0.0009	0.0065	0.0346	0.1068	0.1574	0.1791	0.1932	0.2031	0.2092	0.2122	0.2128	0.2118	0.2099
2015	0.0007	0.0051	0.0253	0.0735	0.1095	0.1268	0.1384	0.1467	0.1520	0.1548	0.1557	0.1554	0.1543

Chesapeake Bay

Age

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.0017	0.2429	0.8169	0.5353	0.3455	0.2229	0.1439	0.0928	0.0599	0.0387	0.0250	0.0161	0.0127
1983	0.0001	0.0201	0.0677	0.0444	0.0286	0.0185	0.0119	0.0077	0.0050	0.0032	0.0021	0.0013	0.0011
1984	0.0003	0.0407	0.1370	0.0898	0.0579	0.0374	0.0241	0.0156	0.0101	0.0065	0.0042	0.0027	0.0021
1985	0.0003	0.0052	0.0086	0.0073	0.0061	0.0050	0.0042	0.0035	0.0029	0.0024	0.0020	0.0016	0.0014
1986	0.0001	0.0021	0.0036	0.0030	0.0025	0.0021	0.0017	0.0014	0.0012	0.0010	0.0008	0.0007	0.0006
1987	0.0000	0.0009	0.0014	0.0012	0.0010	0.0008	0.0007	0.0006	0.0005	0.0004	0.0003	0.0003	0.0002
1988	0.0001	0.0015	0.0024	0.0020	0.0017	0.0014	0.0012	0.0010	0.0008	0.0007	0.0006	0.0005	0.0004
1989	0.0000	0.0005	0.0008	0.0007	0.0006	0.0005	0.0004	0.0003	0.0003	0.0002	0.0002	0.0002	0.0001
1990	0.0002	0.0011	0.0066	0.0154	0.0150	0.0120	0.0094	0.0073	0.0057	0.0044	0.0034	0.0027	0.0021
1991	0.0002	0.0016	0.0096	0.0226	0.0221	0.0176	0.0137	0.0107	0.0083	0.0065	0.0050	0.0039	0.0030
1992	0.0002	0.0015	0.0090	0.0211	0.0206	0.0165	0.0128	0.0100	0.0078	0.0060	0.0047	0.0037	0.0028
1993	0.0003	0.0021	0.0125	0.0294	0.0288	0.0230	0.0179	0.0139	0.0108	0.0084	0.0066	0.0051	0.0040
1994	0.0004	0.0029	0.0169	0.0397	0.0388	0.0310	0.0241	0.0188	0.0146	0.0114	0.0088	0.0069	0.0053
1995	0.0005	0.0034	0.0202	0.0475	0.0465	0.0371	0.0289	0.0225	0.0175	0.0136	0.0106	0.0082	0.0064
1996	0.0005	0.0029	0.0146	0.0419	0.0562	0.0544	0.0494	0.0443	0.0397	0.0356	0.0319	0.0286	0.0256
1997	0.0006	0.0034	0.0171	0.0490	0.0656	0.0636	0.0577	0.0518	0.0464	0.0416	0.0373	0.0334	0.0299
1998	0.0005	0.0031	0.0155	0.0445	0.0597	0.0578	0.0524	0.0471	0.0422	0.0378	0.0339	0.0304	0.0272
1999	0.0005	0.0027	0.0132	0.0380	0.0509	0.0493	0.0447	0.0401	0.0360	0.0322	0.0289	0.0259	0.0232
2000	0.0005	0.0031	0.0152	0.0436	0.0585	0.0566	0.0514	0.0461	0.0414	0.0371	0.0332	0.0298	0.0267
2001	0.0005	0.0027	0.0133	0.0382	0.0513	0.0496	0.0450	0.0404	0.0362	0.0325	0.0291	0.0261	0.0234
2002	0.0004	0.0022	0.0108	0.0309	0.0415	0.0401	0.0364	0.0327	0.0293	0.0263	0.0235	0.0211	0.0189
2003	0.0006	0.0035	0.0176	0.0504	0.0676	0.0655	0.0594	0.0533	0.0478	0.0428	0.0384	0.0344	0.0308
2004	0.0005	0.0031	0.0155	0.0444	0.0595	0.0577	0.0523	0.0470	0.0421	0.0377	0.0338	0.0303	0.0271
2005	0.0006	0.0033	0.0166	0.0477	0.0639	0.0619	0.0561	0.0504	0.0452	0.0405	0.0363	0.0325	0.0291
2006	0.0007	0.0041	0.0202	0.0579	0.0776	0.0751	0.0681	0.0612	0.0548	0.0491	0.0440	0.0395	0.0354
2007	0.0006	0.0037	0.0184	0.0527	0.0706	0.0683	0.0620	0.0557	0.0499	0.0447	0.0401	0.0359	0.0322
2008	0.0005	0.0028	0.0140	0.0400	0.0536	0.0519	0.0471	0.0423	0.0379	0.0340	0.0304	0.0273	0.0244
2009	0.0006	0.0034	0.0167	0.0478	0.0641	0.0621	0.0563	0.0505	0.0453	0.0406	0.0364	0.0326	0.0292
2010	0.0006	0.0032	0.0157	0.0450	0.0603	0.0584	0.0530	0.0476	0.0427	0.0382	0.0343	0.0307	0.0275
2011	0.0005	0.0031	0.0156	0.0447	0.0599	0.0580	0.0526	0.0473	0.0424	0.0380	0.0340	0.0305	0.0273
2012	0.0005	0.0028	0.0142	0.0406	0.0544	0.0527	0.0478	0.0429	0.0385	0.0345	0.0309	0.0277	0.0248
2013	0.0006	0.0033	0.0164	0.0470	0.0630	0.0610	0.0553	0.0497	0.0445	0.0399	0.0358	0.0320	0.0287
2014	0.0006	0.0035	0.0174	0.0498	0.0667	0.0646	0.0586	0.0526	0.0471	0.0423	0.0379	0.0339	0.0304
2015	0.0005	0.0031	0.0152	0.0436	0.0584	0.0566	0.0513	0.0461	0.0413	0.0370	0.0332	0.0297	0.0266

Table 24 cont.

Ocean

Year	Age 1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.0005	0.0057	0.0488	0.1368	0.1584	0.1570	0.1534	0.1497	0.1461	0.1426	0.1391	0.1358	0.1325
1983	0.0004	0.0043	0.0369	0.1035	0.1198	0.1188	0.1160	0.1133	0.1105	0.1079	0.1053	0.1027	0.1002
1984	0.0002	0.0022	0.0187	0.0523	0.0606	0.0600	0.0587	0.0573	0.0559	0.0545	0.0532	0.0519	0.0507
1985	0.0003	0.0020	0.0080	0.0195	0.0345	0.0500	0.0636	0.0742	0.0821	0.0876	0.0913	0.0938	0.0955
1986	0.0001	0.0012	0.0047	0.0115	0.0203	0.0294	0.0374	0.0437	0.0483	0.0515	0.0537	0.0552	0.0562
1987	0.0001	0.0006	0.0022	0.0053	0.0094	0.0136	0.0173	0.0202	0.0223	0.0238	0.0249	0.0255	0.0260
1988	0.0001	0.0008	0.0031	0.0074	0.0131	0.0190	0.0242	0.0282	0.0312	0.0333	0.0347	0.0357	0.0363
1989	0.0001	0.0005	0.0021	0.0050	0.0089	0.0128	0.0163	0.0190	0.0210	0.0224	0.0234	0.0240	0.0245
1990	0.0000	0.0011	0.0056	0.0109	0.0142	0.0158	0.0165	0.0168	0.0169	0.0170	0.0170	0.0170	0.0170
1991	0.0000	0.0014	0.0075	0.0144	0.0188	0.0209	0.0218	0.0222	0.0223	0.0224	0.0224	0.0224	0.0224
1992	0.0000	0.0016	0.0085	0.0165	0.0214	0.0238	0.0249	0.0253	0.0255	0.0255	0.0256	0.0256	0.0256
1993	0.0000	0.0018	0.0091	0.0176	0.0229	0.0255	0.0266	0.0270	0.0272	0.0273	0.0273	0.0274	0.0274
1994	0.0000	0.0022	0.0114	0.0220	0.0286	0.0318	0.0332	0.0338	0.0340	0.0341	0.0341	0.0342	0.0342
1995	0.0001	0.0036	0.0189	0.0366	0.0476	0.0530	0.0553	0.0562	0.0566	0.0567	0.0568	0.0568	0.0568
1996	0.0001	0.0036	0.0186	0.0360	0.0470	0.0522	0.0545	0.0554	0.0558	0.0559	0.0560	0.0560	0.0560
1997	0.0003	0.0024	0.0105	0.0273	0.0511	0.0768	0.1001	0.1190	0.1332	0.1434	0.1504	0.1552	0.1584
1998	0.0002	0.0022	0.0094	0.0246	0.0460	0.0692	0.0903	0.1073	0.1202	0.1293	0.1356	0.1399	0.1428
1999	0.0002	0.0019	0.0081	0.0213	0.0397	0.0597	0.0779	0.0926	0.1037	0.1116	0.1171	0.1208	0.1232
2000	0.0002	0.0023	0.0102	0.0268	0.0500	0.0752	0.0981	0.1167	0.1306	0.1405	0.1474	0.1521	0.1552
2001	0.0002	0.0023	0.0099	0.0260	0.0486	0.0730	0.0952	0.1132	0.1267	0.1364	0.1431	0.1476	0.1506
2002	0.0002	0.0023	0.0098	0.0257	0.0480	0.0722	0.0942	0.1120	0.1254	0.1349	0.1415	0.1460	0.1490
2003	0.0003	0.0024	0.0104	0.0272	0.0508	0.0764	0.0997	0.1185	0.1327	0.1428	0.1498	0.1545	0.1577
2004	0.0003	0.0029	0.0126	0.0330	0.0618	0.0929	0.1211	0.1440	0.1612	0.1735	0.1820	0.1878	0.1916
2005	0.0003	0.0029	0.0127	0.0332	0.0620	0.0932	0.1216	0.1445	0.1618	0.1741	0.1827	0.1884	0.1923
2006	0.0004	0.0035	0.0155	0.0404	0.0755	0.1135	0.1481	0.1760	0.1971	0.2121	0.2225	0.2295	0.2342
2007	0.0003	0.0029	0.0126	0.0330	0.0617	0.0928	0.1211	0.1439	0.1611	0.1734	0.1819	0.1876	0.1915
2008	0.0003	0.0032	0.0138	0.0361	0.0675	0.1015	0.1324	0.1574	0.1762	0.1896	0.1989	0.2052	0.2094
2009	0.0002	0.0022	0.0098	0.0255	0.0477	0.0717	0.0935	0.1112	0.1244	0.1339	0.1405	0.1449	0.1479
2010	0.0002	0.0023	0.0100	0.0262	0.0490	0.0737	0.0962	0.1143	0.1280	0.1377	0.1445	0.1490	0.1521
2011	0.0003	0.0027	0.0116	0.0304	0.0568	0.0853	0.1113	0.1323	0.1481	0.1594	0.1672	0.1725	0.1760
2012	0.0002	0.0020	0.0087	0.0227	0.0424	0.0637	0.0831	0.0988	0.1106	0.1190	0.1249	0.1288	0.1315
2013	0.0003	0.0029	0.0127	0.0331	0.0619	0.0931	0.1215	0.1444	0.1616	0.1740	0.1825	0.1883	0.1921
2014	0.0002	0.0022	0.0097	0.0255	0.0476	0.0716	0.0934	0.1110	0.1242	0.1337	0.1403	0.1447	0.1477
2015	0.0002	0.0018	0.0078	0.0203	0.0380	0.0572	0.0746	0.0887	0.0993	0.1068	0.1121	0.1156	0.1180

Commercial Discards

Year	Age 1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.0006	0.0020	0.0070	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099
1983	0.0004	0.0013	0.0046	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
1984	0.0005	0.0017	0.0058	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083
1985	0.0001	0.0005	0.0028	0.0112	0.0169	0.0147	0.0115	0.0089	0.0069	0.0053	0.0041	0.0032	0.0024
1986	0.0001	0.0009	0.0053	0.0209	0.0314	0.0273	0.0214	0.0165	0.0128	0.0099	0.0076	0.0059	0.0045
1987	0.0001	0.0005	0.0029	0.0112	0.0169	0.0147	0.0115	0.0089	0.0069	0.0053	0.0041	0.0032	0.0024
1988	0.0001	0.0008	0.0050	0.0197	0.0296	0.0257	0.0201	0.0156	0.0120	0.0093	0.0072	0.0055	0.0043
1989	0.0002	0.0011	0.0065	0.0255	0.0383	0.0333	0.0261	0.0202	0.0156	0.0120	0.0093	0.0072	0.0055
1990	0.0003	0.0015	0.0070	0.0269	0.0568	0.0569	0.0428	0.0305	0.0215	0.0151	0.0107	0.0075	0.0053
1991	0.0002	0.0009	0.0040	0.0153	0.0323	0.0323	0.0243	0.0173	0.0122	0.0086	0.0061	0.0043	0.0030
1992	0.0001	0.0004	0.0019	0.0074	0.0157	0.0157	0.0118	0.0084	0.0059	0.0042	0.0029	0.0021	0.0015
1993	0.0001	0.0007	0.0031	0.0120	0.0253	0.0254	0.0191	0.0136	0.0096	0.0067	0.0048	0.0034	0.0024
1994	0.0001	0.0006	0.0028	0.0110	0.0231	0.0232	0.0174	0.0124	0.0088	0.0062	0.0043	0.0031	0.0022
1995	0.0002	0.0008	0.0038	0.0147	0.0311	0.0312	0.0235	0.0167	0.0118	0.0083	0.0058	0.0041	0.0029
1996	0.0001	0.0013	0.0074	0.0101	0.0093	0.0083	0.0074	0.0066	0.0059	0.0052	0.0047	0.0042	0.0037
1997	0.0001	0.0007	0.0038	0.0052	0.0048	0.0043	0.0038	0.0034	0.0030	0.0027	0.0024	0.0022	0.0019
1998	0.0001	0.0010	0.0055	0.0076	0.0070	0.0063	0.0056	0.0050	0.0044	0.0039	0.0035	0.0031	0.0028
1999	0.0001	0.0007	0.0038	0.0052	0.0048	0.0043	0.0039	0.0034	0.0031	0.0027	0.0024	0.0022	0.0019
2000	0.0002	0.0020	0.0113	0.0155	0.0143	0.0128	0.0114	0.0101	0.0090	0.0080	0.0072	0.0064	0.0057
2001	0.0001	0.0010	0.0057	0.0078	0.0072	0.0064	0.0057	0.0051	0.0045	0.0041	0.0036	0.0032	0.0029
2002	0.0000	0.0006	0.0032	0.0044	0.0041	0.0037	0.0033	0.0029	0.0026	0.0023	0.0021	0.0018	0.0016
2003	0.0000	0.0002	0.0015	0.0065	0.0088	0.0088	0.0084	0.0081	0.0077	0.0074	0.0071	0.0068	0.0065
2004	0.0000	0.0003	0.0027	0.0114	0.0156	0.0155	0.0149	0.0142	0.0136	0.0131	0.0125	0.0120	0.0115
2005	0.0001	0.0005	0.0046	0.0193	0.0263	0.0262	0.0252	0.0241	0.0231	0.0221	0.0212	0.0203	0.0194
2006	0.0000	0.0001	0.0012	0.0049	0.0067	0.0067	0.0064	0.0062	0.0059	0.0057	0.0054	0.0052	0.0050
2007	0.0000	0.0004	0.0035	0.0149	0.0203	0.0202	0.0194	0.0186	0.0178	0.0170	0.0163	0.0156	0.0150
2008	0.0000	0.0002	0.0019	0.0079	0.0108	0.0107	0.0103	0.0099	0.0094	0.0090	0.0086	0.0083	0.0079
2009	0.0000	0.0004	0.0040	0.0166	0.0227	0.0226	0.0217	0.0208	0.0199	0.0190	0.0182	0.0174	0.0167
2010	0.0000	0.0002	0.0018	0.0076	0.0104	0.0103	0.0099	0.0095	0.0091	0.0087	0.0083	0.0080	0.0076
2011	0.0001	0.0005	0.0046	0.0193	0.0263	0.0262	0.0251	0.0241	0.0230	0.0221	0.0211	0.0202	0.0194
2012	0.0001	0.0007	0.0063	0.0263	0.0359	0.0357	0.0343	0.0328	0.0314	0.0301	0.0288	0.0276	0.0264
2013	0.0000	0.0005	0.0043	0.0182	0.0249	0.0247	0.0238	0.0228	0.0218	0.0209	0.0200	0.0191	0.0183
2014	0.0001	0.0008	0.0075	0.0316	0.0432	0.0429	0.0412	0.0395	0.0378	0.0362	0.0347	0.0332	0.0318
2015	0.0000	0.0002	0.0023	0.0096	0.0131	0.0130	0.0125	0.0120	0.0115	0.0110	0.0105	0.0101	0.0096

Table 25. Estimates of population abundance by age.

	Age													
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total	8+
1982	18,937,700	5,844,810	4,235,230	2,456,170	597,337	197,508	168,737	114,695	87,977	99,003	77,782	153,578	79,516	33,050,042	612,550
1983	45,647,100	6,100,700	2,304,620	1,128,340	892,786	278,312	110,602	106,820	76,692	61,016	70,385	56,254	171,045	57,004,672	542,212
1984	40,602,600	14,732,200	3,012,110	1,317,490	695,173	595,520	199,343	83,220	80,941	58,430	46,693	54,065	175,532	61,653,316	498,880
1985	39,613,900	13,103,400	7,138,020	1,634,200	814,930	476,927	443,061	156,637	66,046	64,682	46,923	37,633	185,823	63,782,183	557,745
1986	31,837,100	12,789,100	6,587,420	4,463,560	1,131,050	599,209	367,829	352,289	123,635	51,860	50,615	36,639	174,171	58,564,477	789,209
1987	42,430,500	10,280,500	6,451,940	4,143,780	3,097,570	834,392	467,232	298,010	285,098	99,995	41,939	40,940	170,653	68,642,550	936,636
1988	55,693,500	13,703,900	5,198,420	4,087,440	2,926,640	2,347,390	670,182	390,454	248,997	238,208	83,562	35,056	176,964	85,800,713	1,173,241
1989	62,026,500	17,985,600	6,921,510	3,280,280	2,854,310	2,180,330	1,853,710	551,196	321,362	205,088	196,356	68,936	175,149	98,620,327	1,518,087
1990	82,973,200	20,031,500	9,092,900	4,372,470	2,285,970	2,119,340	1,720,960	1,528,690	456,035	266,586	170,504	163,543	203,782	125,385,480	2,789,140
1991	68,115,600	26,790,000	10,110,700	5,687,860	2,980,640	1,633,500	1,610,180	1,382,950	1,245,940	375,598	221,230	142,266	308,170	120,604,634	3,676,154
1992	69,594,600	21,994,200	13,519,100	6,312,800	3,881,000	2,157,720	1,258,490	1,305,430	1,132,120	1,027,450	311,407	184,148	376,570	123,055,035	4,337,125
1993	90,178,800	22,474,200	11,102,900	8,454,580	4,339,010	2,853,080	1,687,210	1,030,900	1,075,600	937,026	853,296	259,283	468,198	145,714,083	4,624,303
1994	179,709,000	29,117,400	11,334,100	6,906,570	5,729,910	3,128,760	2,191,470	1,362,750	840,198	882,709	772,968	706,605	604,962	243,287,402	5,170,192
1995	114,180,000	58,020,000	14,668,000	7,005,760	4,617,690	4,076,200	2,374,210	1,750,310	1,099,160	682,853	721,532	634,557	1,081,410	210,911,682	5,969,822
1996	124,405,000	36,858,100	29,162,700	8,959,640	4,562,820	3,173,070	2,986,010	1,835,020	1,369,470	868,242	543,297	577,187	1,380,900	216,681,456	6,574,116
1997	153,781,000	40,160,000	18,527,900	17,855,000	5,898,310	3,175,530	2,339,070	2,299,490	1,420,100	1,065,060	678,367	426,274	1,545,890	249,171,991	7,435,181
1998	98,373,300	49,631,800	20,214,300	11,449,500	11,831,900	4,068,100	2,272,470	1,712,860	1,662,780	1,018,220	759,846	482,801	1,403,300	204,881,177	7,039,807
1999	100,528,000	31,751,100	24,988,100	12,502,300	7,623,430	8,232,610	2,944,480	1,686,420	1,257,100	1,211,360	738,609	550,093	1,365,540	195,379,142	6,809,122
2000	79,407,400	32,450,900	16,002,500	15,536,700	8,427,230	5,396,720	6,078,680	2,233,310	1,266,710	938,102	900,506	548,070	1,421,280	170,608,108	7,307,978
2001	117,650,000	25,627,400	16,319,600	9,835,500	10,250,500	5,804,660	3,861,930	4,454,540	1,617,000	909,809	670,643	642,375	1,404,890	199,048,847	9,699,257
2002	137,115,000	37,975,400	12,906,400	10,108,800	6,579,710	7,172,980	4,218,970	2,872,520	3,271,280	1,177,110	658,734	484,177	1,476,430	226,017,511	9,940,251
2003	75,886,100	44,263,900	19,143,500	8,035,480	6,837,010	4,666,500	5,281,990	3,176,320	2,133,160	2,405,920	860,349	479,723	1,424,570	174,594,522	10,480,042
2004	165,979,000	24,492,300	22,289,000	11,851,100	5,311,030	4,688,470	3,319,280	3,845,110	2,283,730	1,521,060	1,707,300	609,161	1,348,400	249,244,941	11,314,761
2005	94,659,300	53,570,200	12,330,400	13,780,400	7,795,730	3,607,220	3,284,190	2,366,610	2,695,530	1,582,310	1,046,180	1,169,550	1,338,490	199,226,110	10,198,670
2006	87,635,000	30,549,800	26,957,500	7,600,040	8,963,050	5,214,020	2,488,440	2,307,700	1,636,270	1,843,290	1,074,850	708,256	1,696,360	178,674,576	9,266,726
2007	65,002,600	28,278,400	15,358,100	16,567,600	4,928,160	5,949,520	3,546,700	1,714,320	1,557,160	1,088,310	1,214,920	704,869	1,572,950	147,483,609	7,852,529
2008	84,421,500	20,977,500	14,227,000	9,460,290	10,771,500	3,294,890	4,104,050	2,493,230	1,186,320	1,066,190	740,451	824,013	1,544,100	155,111,034	7,854,304
2009	60,278,400	27,248,300	10,562,300	8,806,610	6,253,430	7,352,560	2,312,380	2,921,890	1,740,310	816,570	727,233	502,340	1,601,070	131,123,393	8,309,413
2010	73,808,000	19,455,400	13,721,800	6,533,210	5,786,760	4,257,580	5,200,510	1,676,690	2,095,470	1,239,200	579,159	515,004	1,491,030	136,359,813	7,596,553
2011	94,237,700	23,823,300	9,800,980	8,511,700	4,340,850	3,998,250	3,053,400	3,817,930	1,215,850	1,506,950	886,774	413,450	1,431,620	157,038,754	9,272,574
2012	123,892,000	30,415,600	11,993,800	6,053,810	5,568,490	2,930,370	2,790,930	2,175,430	2,680,750	845,316	1,041,530	611,101	1,270,870	192,269,997	8,624,997
2013	31,214,800	39,990,800	15,324,600	7,428,220	3,979,370	3,797,920	2,081,370	2,036,390	1,572,490	1,926,260	605,525	745,352	1,348,730	112,051,827	8,234,747
2014	69,750,600	10,074,200	20,125,700	9,450,390	4,840,210	2,668,080	2,626,430	1,465,940	1,411,080	1,077,580	1,311,090	410,707	1,418,870	126,630,877	7,095,267
2015	122,739,000	22,511,300	5,070,610	12,395,900	6,105,670	3,220,470	1,844,660	1,863,510	1,029,860	985,268	750,176	912,171	1,276,070	180,704,665	6,817,055

Table 26. Estimate of female spawning stock biomass-at-age by year.

	Age														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total	SD
1982	0	0	0	59	87	195	476	465	418	720	754	1,548	1,047	5,770	1,314
1983	0	0	0	27	128	230	254	399	378	400	588	539	1,789	4,731	1,111
1984	0	0	0	34	106	502	556	305	429	370	349	585	2,056	5,292	1,183
1985	0	0	0	51	112	434	1,216	603	355	408	364	346	2,436	6,325	1,293
1986	0	0	0	163	170	467	872	1,272	560	282	349	307	2,105	6,548	1,208
1987	0	0	0	143	522	636	1,003	975	1,285	542	276	348	2,130	7,860	1,281
1988	0	0	0	138	562	2,292	1,631	1,239	1,061	1,162	602	312	2,226	11,225	1,455
1989	0	0	0	114	532	2,460	5,701	2,270	1,521	1,369	1,409	599	2,220	18,195	1,939
1990	0	0	0	146	359	2,090	5,086	6,397	2,216	1,392	1,188	1,362	2,438	22,675	2,162
1991	0	0	0	195	498	1,311	4,497	5,432	6,578	1,999	1,681	1,057	4,159	27,406	2,504
1992	0	0	0	205	694	1,989	3,403	5,206	6,237	6,893	2,451	1,969	4,992	34,037	2,940
1993	0	0	0	281	744	2,622	4,653	4,296	6,004	6,318	7,043	2,505	6,462	40,927	3,312
1994	0	0	0	248	1,009	2,813	6,130	5,706	4,632	5,691	6,447	6,746	7,299	46,721	3,528
1995	0	0	0	265	815	3,796	7,017	7,323	6,376	4,919	4,896	5,660	17,033	58,101	4,261
1996	0	0	0	336	901	3,446	10,143	8,724	8,356	6,531	4,475	4,963	17,852	65,728	4,543
1997	0	0	0	715	1,065	3,038	6,422	8,797	7,968	8,062	5,867	3,861	21,335	67,129	4,696
1998	0	0	0	317	1,837	3,214	6,094	6,532	8,673	6,094	5,463	4,331	15,581	58,137	4,093
1999	0	0	0	319	944	5,462	5,847	5,958	6,562	7,921	5,423	4,611	15,340	58,387	4,173
2000	0	0	0	390	1,031	3,709	12,895	7,298	6,794	5,772	7,351	5,043	17,988	68,269	4,786
2001	0	0	0	284	1,376	4,509	8,795	14,964	8,011	5,961	4,951	5,023	14,279	68,154	4,594
2002	0	0	0	263	918	5,642	10,121	10,466	15,534	7,341	5,123	4,159	15,915	75,481	5,074
2003	0	0	0	194	922	3,671	12,348	11,137	10,412	14,232	6,297	4,048	14,626	77,887	5,191
2004	0	0	0	282	757	3,613	7,818	13,318	10,930	8,921	11,954	4,888	13,431	75,911	5,226
2005	0	0	0	353	1,036	2,928	7,725	8,759	13,355	9,344	7,516	10,023	15,159	76,197	5,638
2006	0	0	0	182	1,128	3,711	5,534	8,209	8,571	11,217	7,769	5,833	18,927	71,080	5,642
2007	0	0	0	353	623	4,405	8,316	5,960	8,244	7,016	9,493	6,170	18,666	69,244	5,849
2008	0	0	0	225	1,370	2,725	11,103	9,168	6,138	7,200	5,774	7,211	17,213	68,127	5,795
2009	0	0	0	213	751	5,876	5,917	11,557	9,298	5,228	5,590	4,275	18,293	66,997	5,876
2010	0	0	0	158	712	3,354	12,661	5,995	10,572	7,932	4,442	4,229	16,141	66,196	5,810
2011	0	0	0	224	535	2,982	7,216	13,283	6,067	9,294	6,319	3,627	17,429	66,976	6,209
2012	0	0	0	166	781	2,282	6,878	8,324	13,618	5,659	7,993	5,432	16,436	67,569	6,671
2013	0	0	0	176	562	3,146	4,916	7,322	8,338	12,013	4,818	6,767	16,468	64,527	6,713
2014	0	0	0	207	627	2,050	6,427	5,186	7,549	7,349	10,136	4,151	18,896	62,578	7,200
2015	0	0	0	316	870	2,851	4,647	7,051	5,529	6,378	5,888	8,440	16,886	58,854	7,193

Figure 1. Time series of coast-wide commercial and recreational harvest in metric tons.

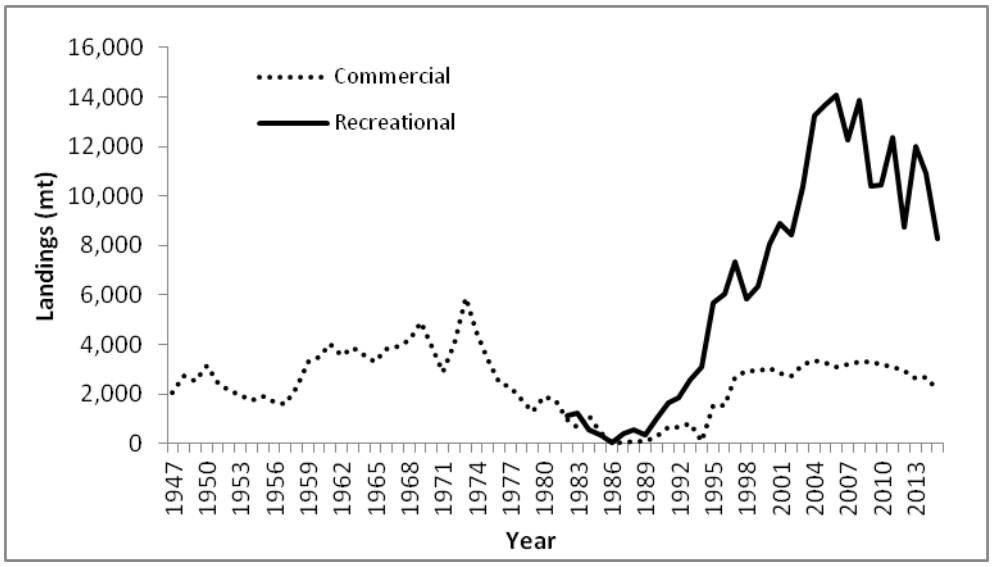


Figure 2. Time series of harvest and dead release/discard numbers from the coast-wide commercial and recreational fisheries during 1982-2015.

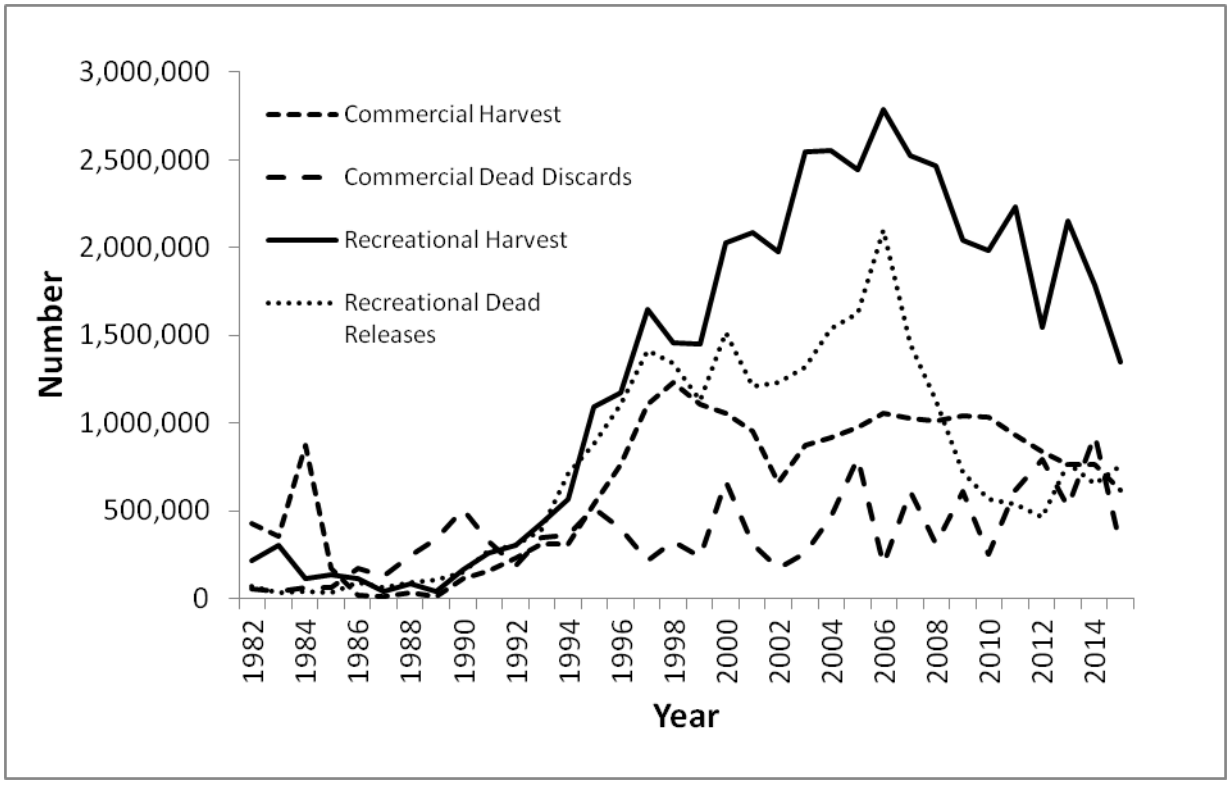


Figure 3. Percentage of total removals by fishery component in 2015.

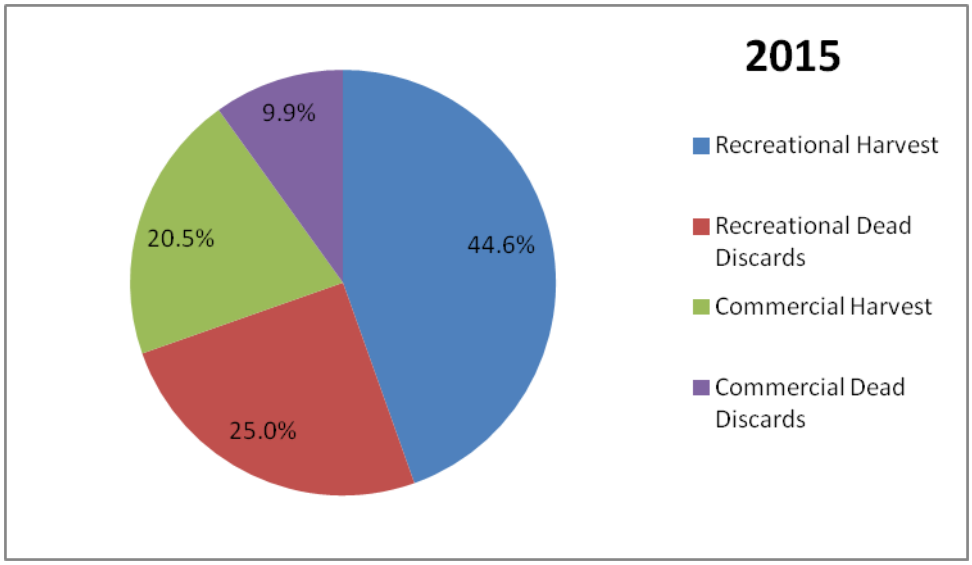


Figure 4. Total removals (numbers) of striped bass by regional fleets.

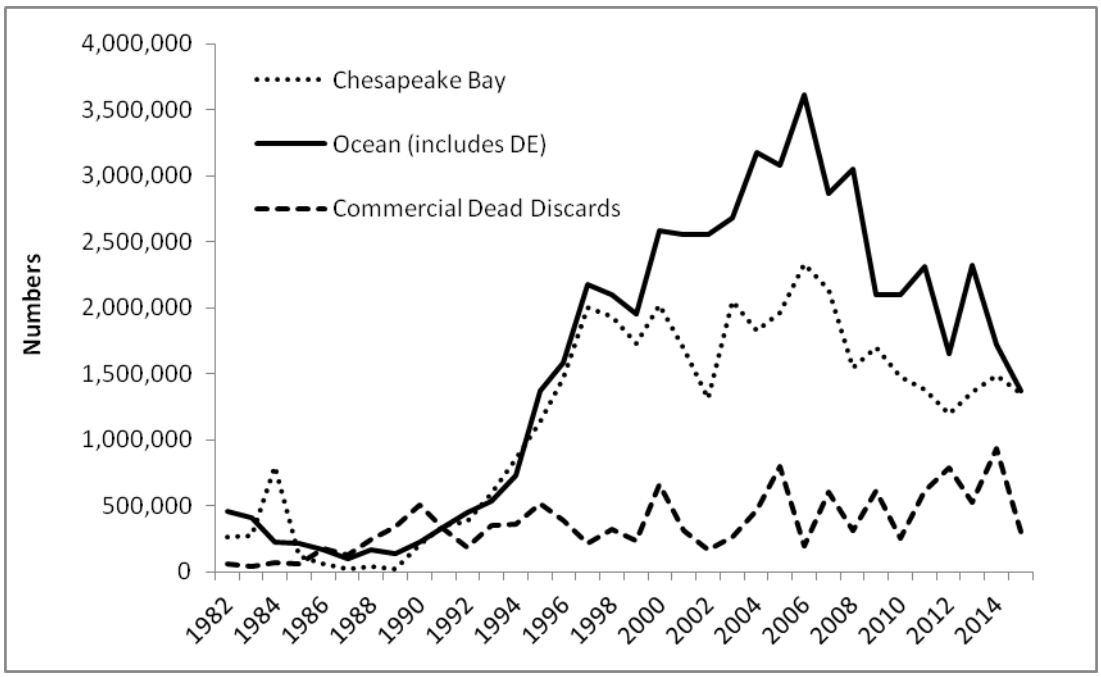


Figure 5. Fishery-independent and –dependent indices of relative abundance.

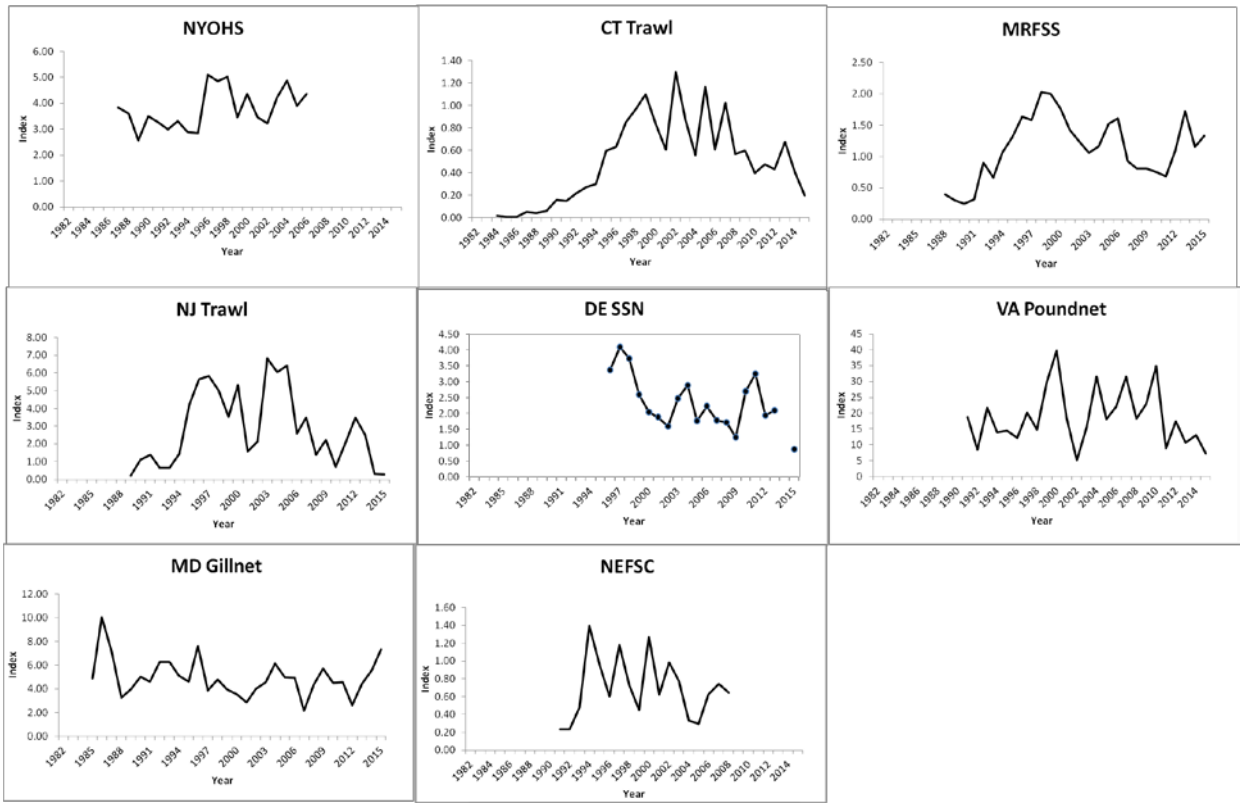


Figure 6. Young-of-the-year and age-1 indices of relative abundance.

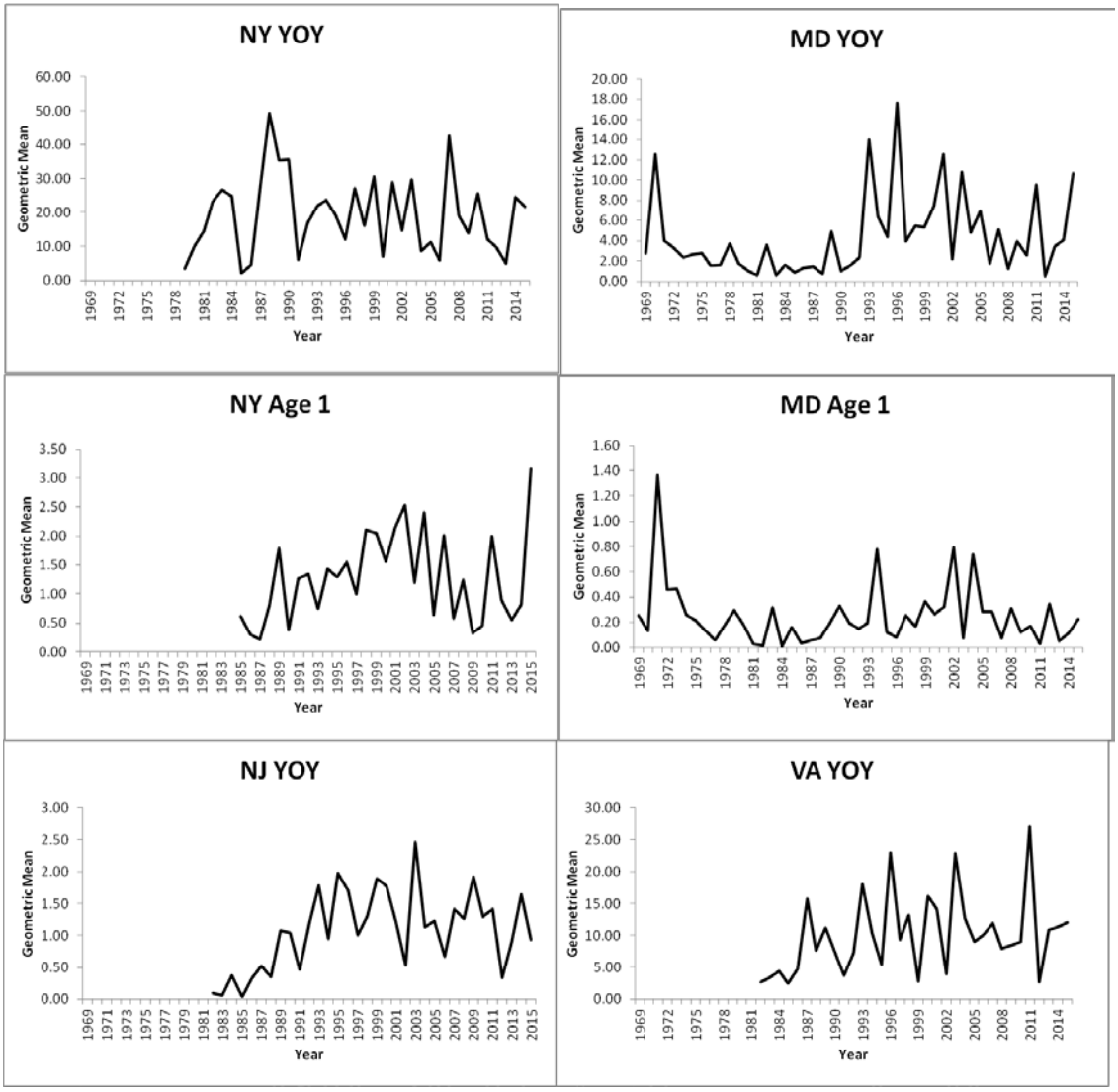


Figure 7. Observed and predicted total catch and standardized residuals by fleet (Fleet 1 = Bay, Fleet 2 = Ocean, Fleet 3 = Commercial Discards).

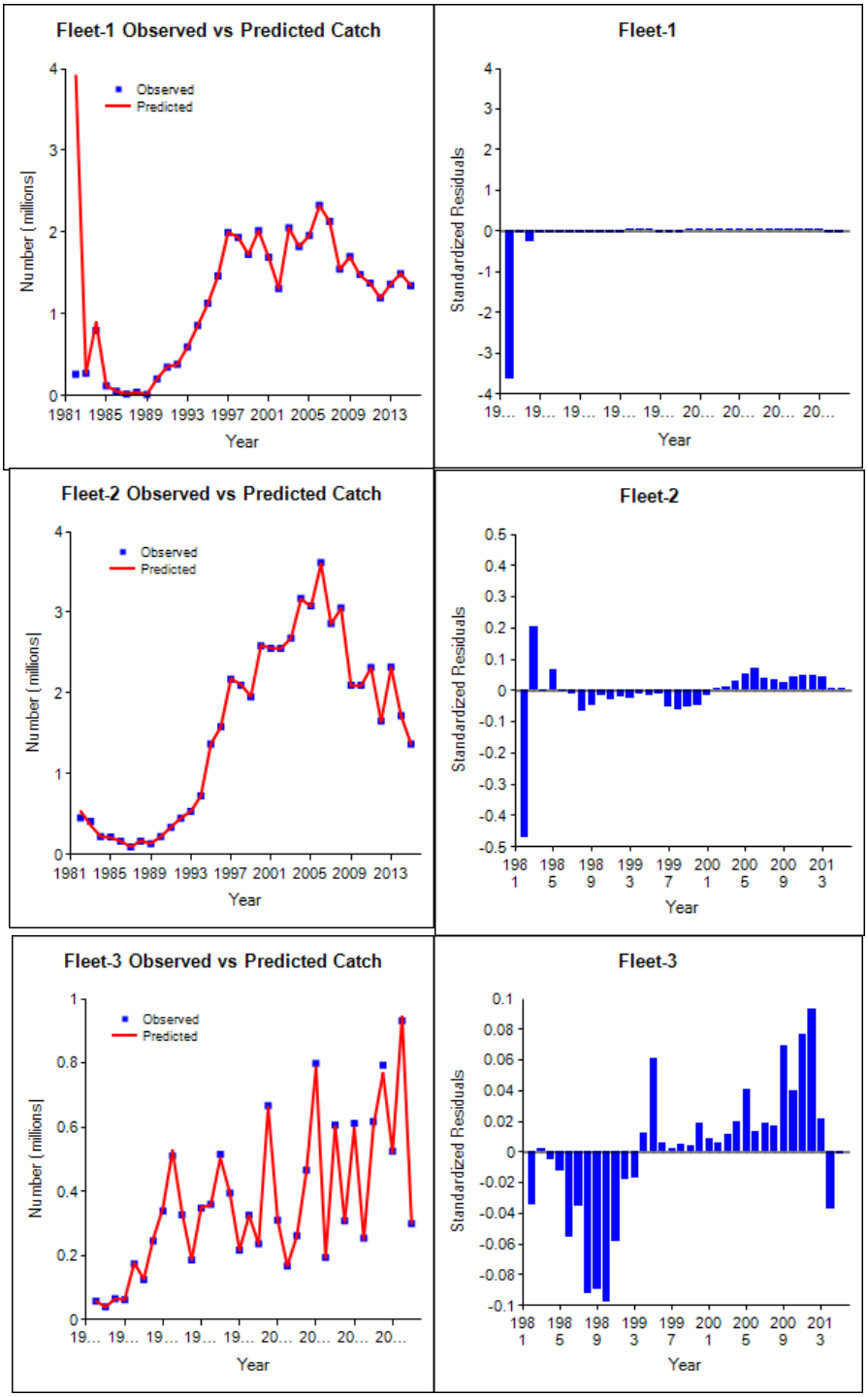


Figure 8. Catch selectivity patterns by fleet (Fleet 1 = Bay, Fleet 2 = Ocean, Fleet 3 = Commercial Discards).

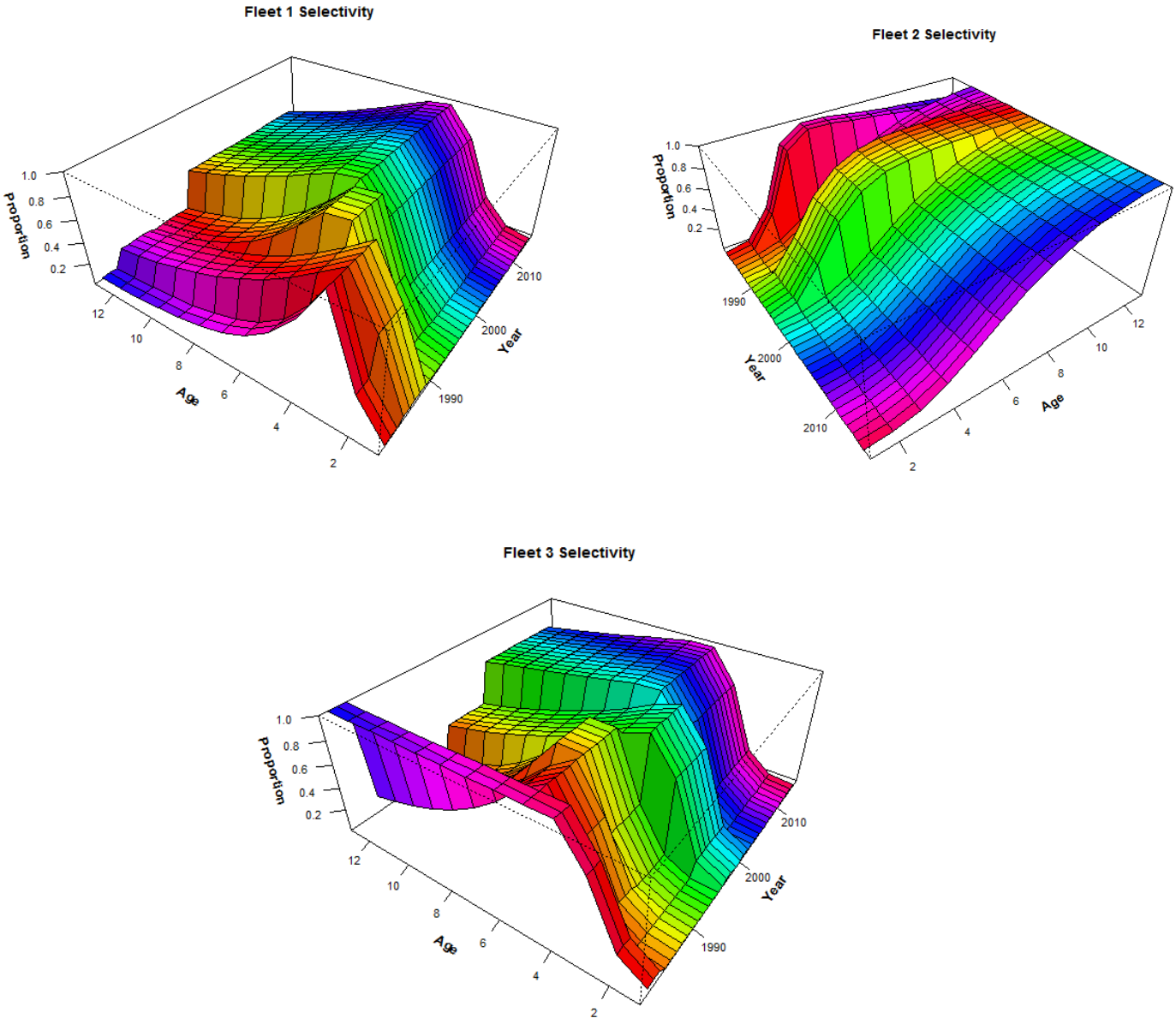
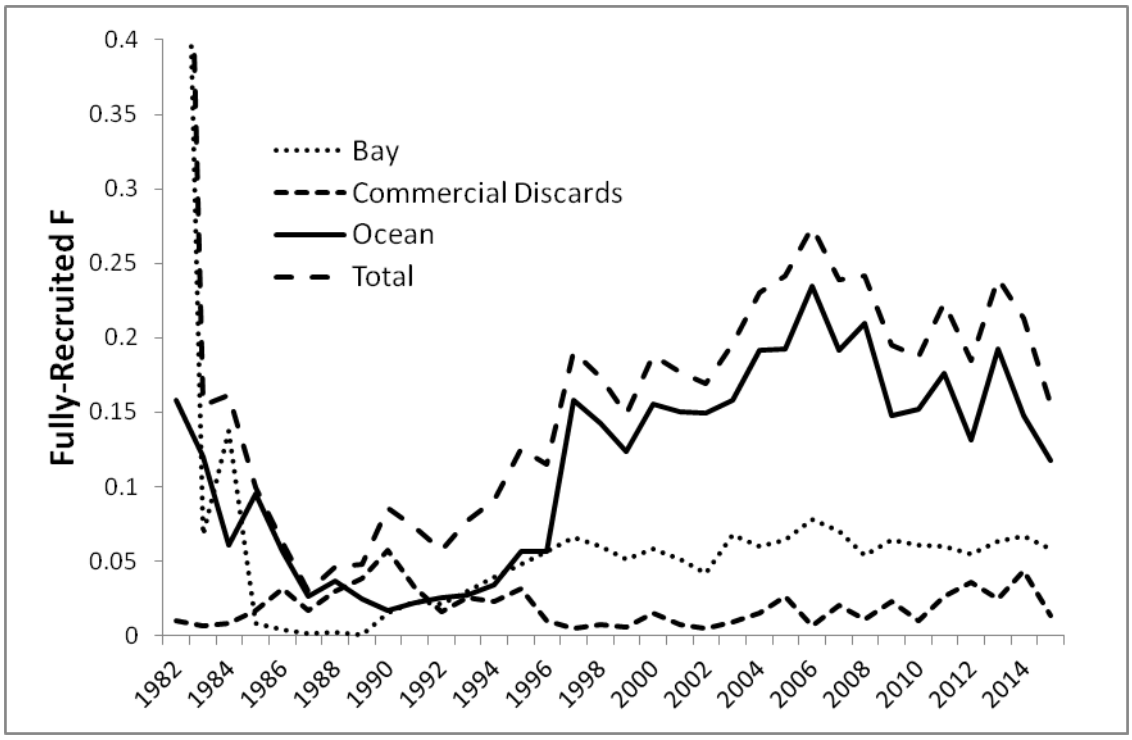


Figure 9. Estimates of total and fleet-specific fully-recruited fishing mortality and from the SCA base model run.



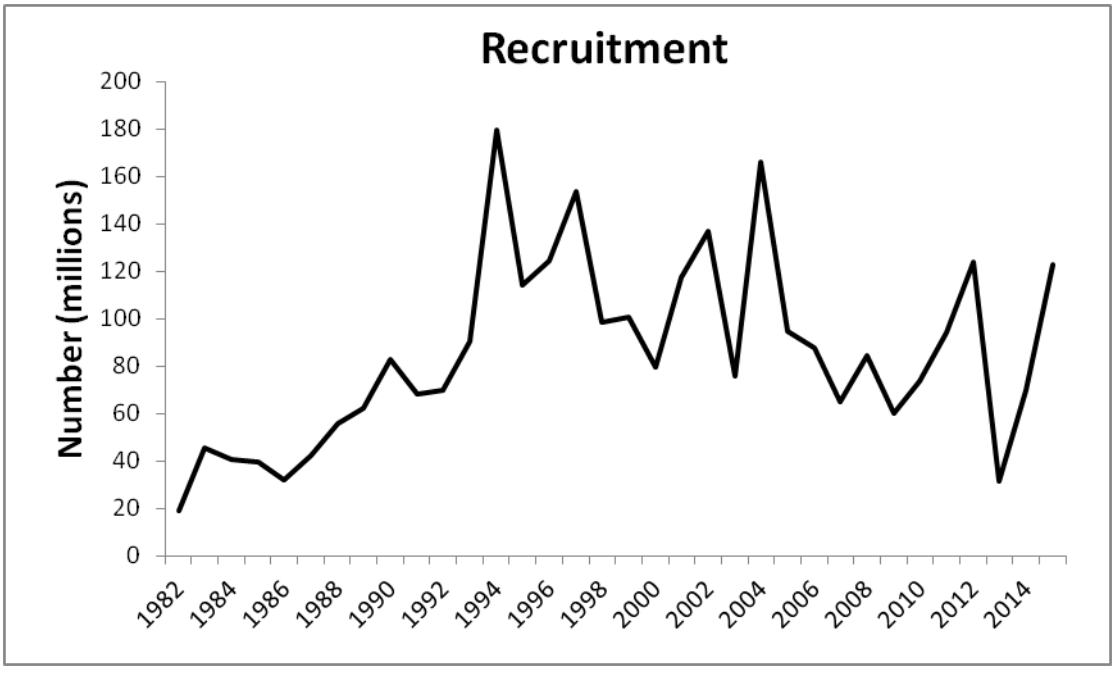


Figure 10. Comparison of fishing mortality-at-age in 2015 from the SCA model partitioned into fleets.

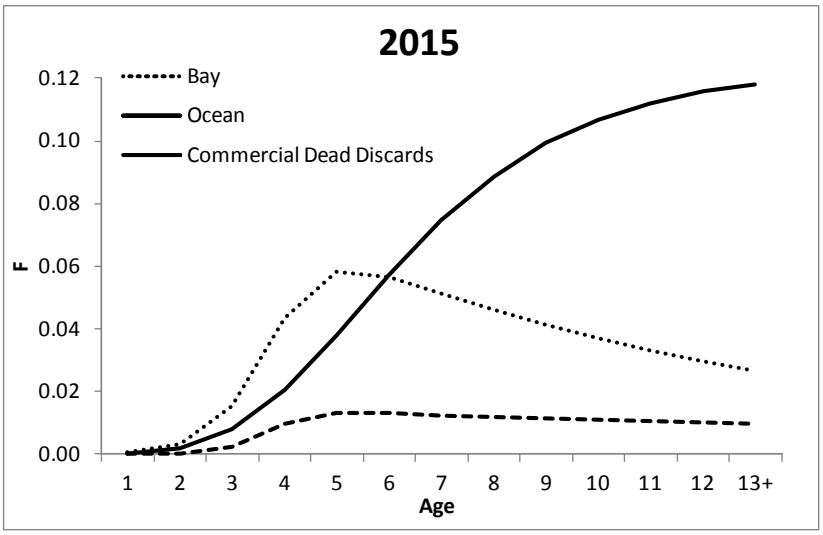


Figure 11. Estimates of January-1 total (age 1+) and 8+ abundance for 1982-2016. January-1 abundance for age 1 in 2016 was estimated from the 2015 observed values of the YOY indices and SCA model catchability coefficients, while older ages were projected from January-1 abundances and fishing and natural mortalities-at-age for 2015.

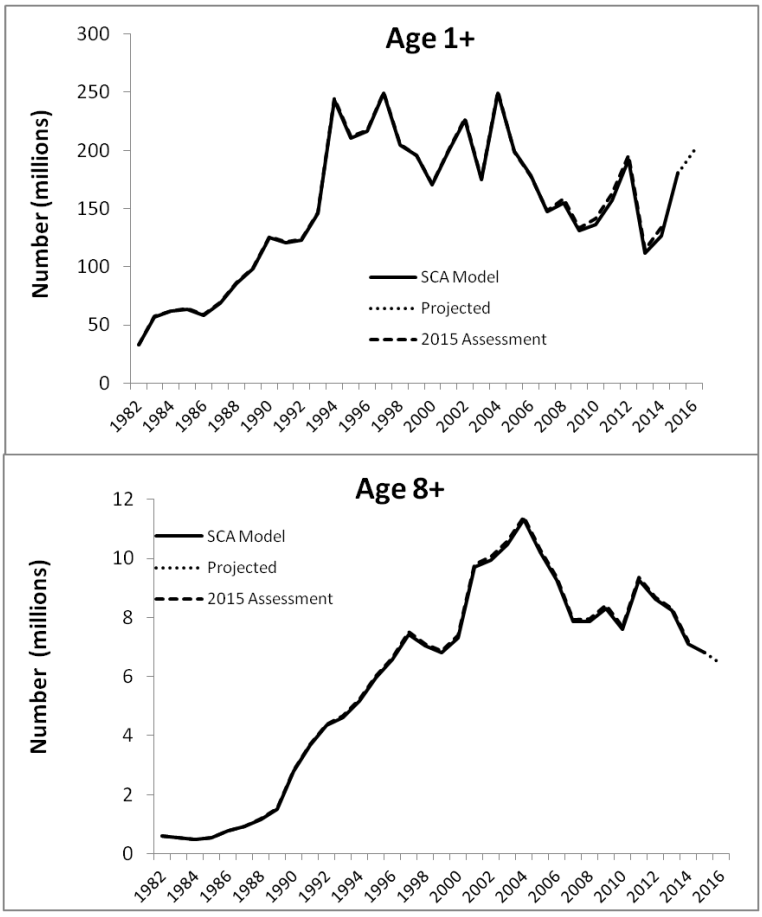


Figure 12. Estimates of A) female spawning stock biomass by year (solid line), B) female spawning stock numbers, and C) exploitable biomass. Dotted lines equal 95% confidence intervals. Dashed line is the female spawning stock reference point (1995 value).

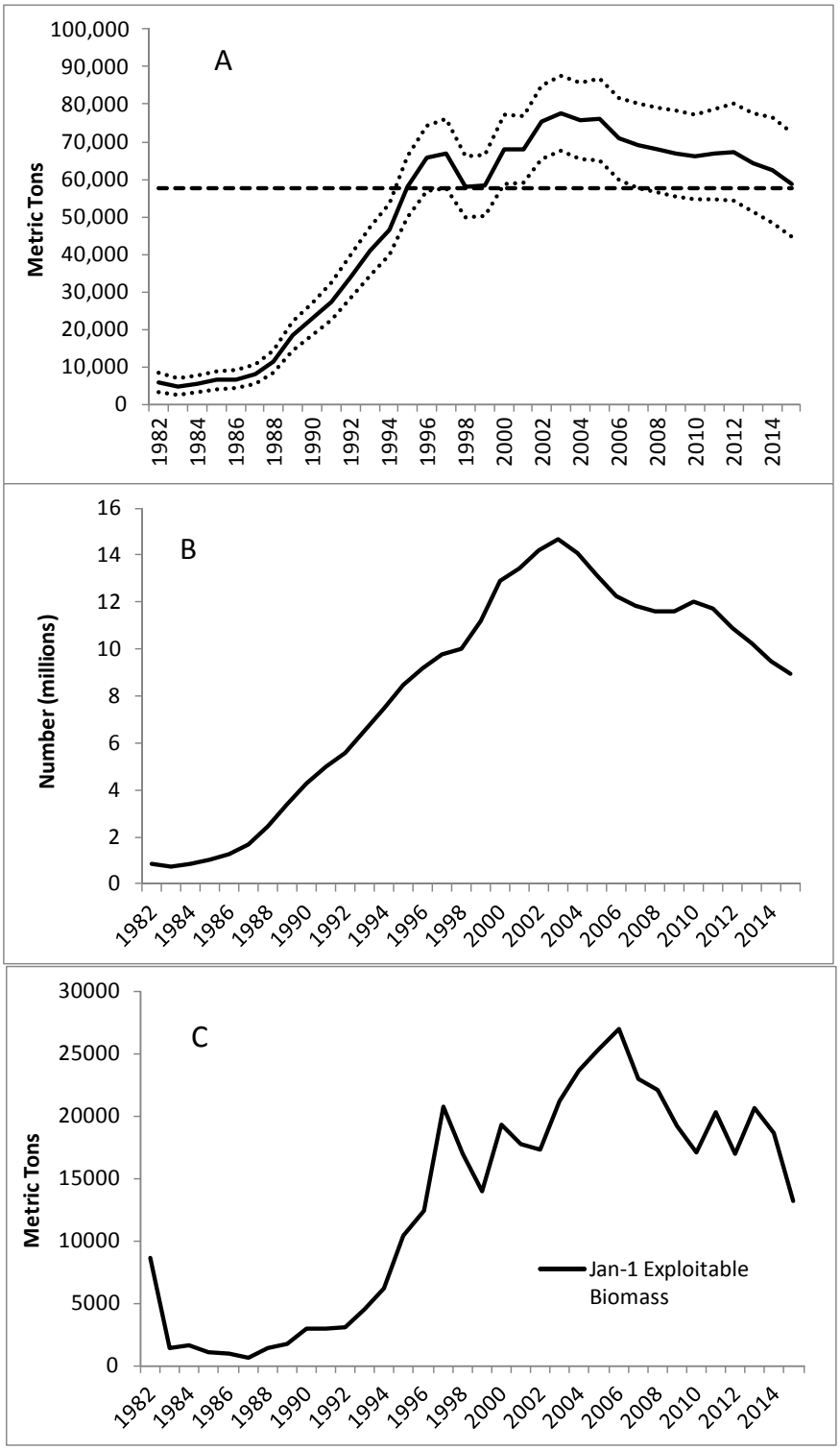


Figure 13. Retrospective analysis of fully-recruited F, female spawning stock biomass, 8+ abundance and Age 1 recruits.

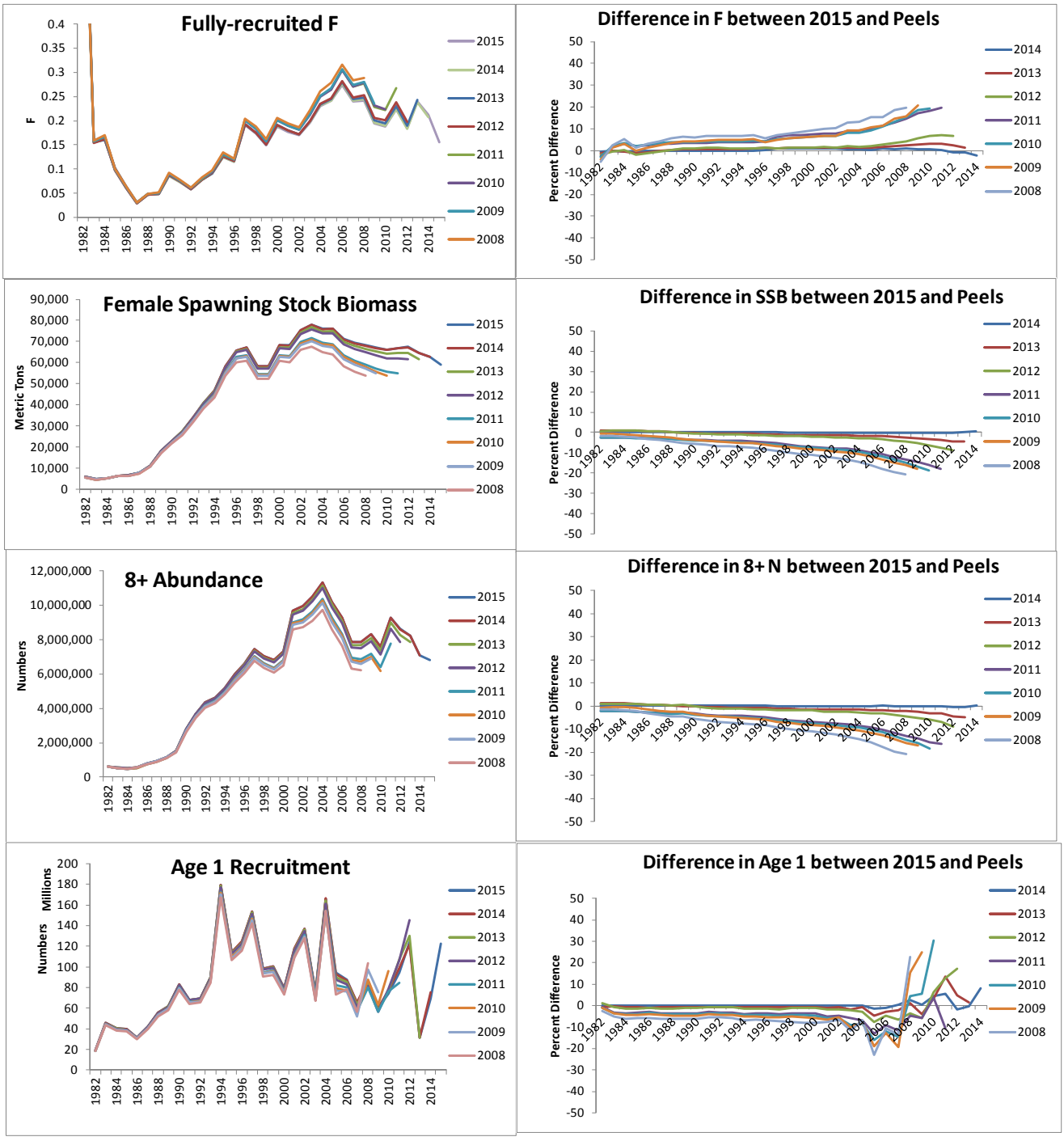


Table 14. Comparison of coast-wide fully-recruited (age-11) fishing mortality and female spawning stock biomass estimates between the 2016 and 2015 assessments.

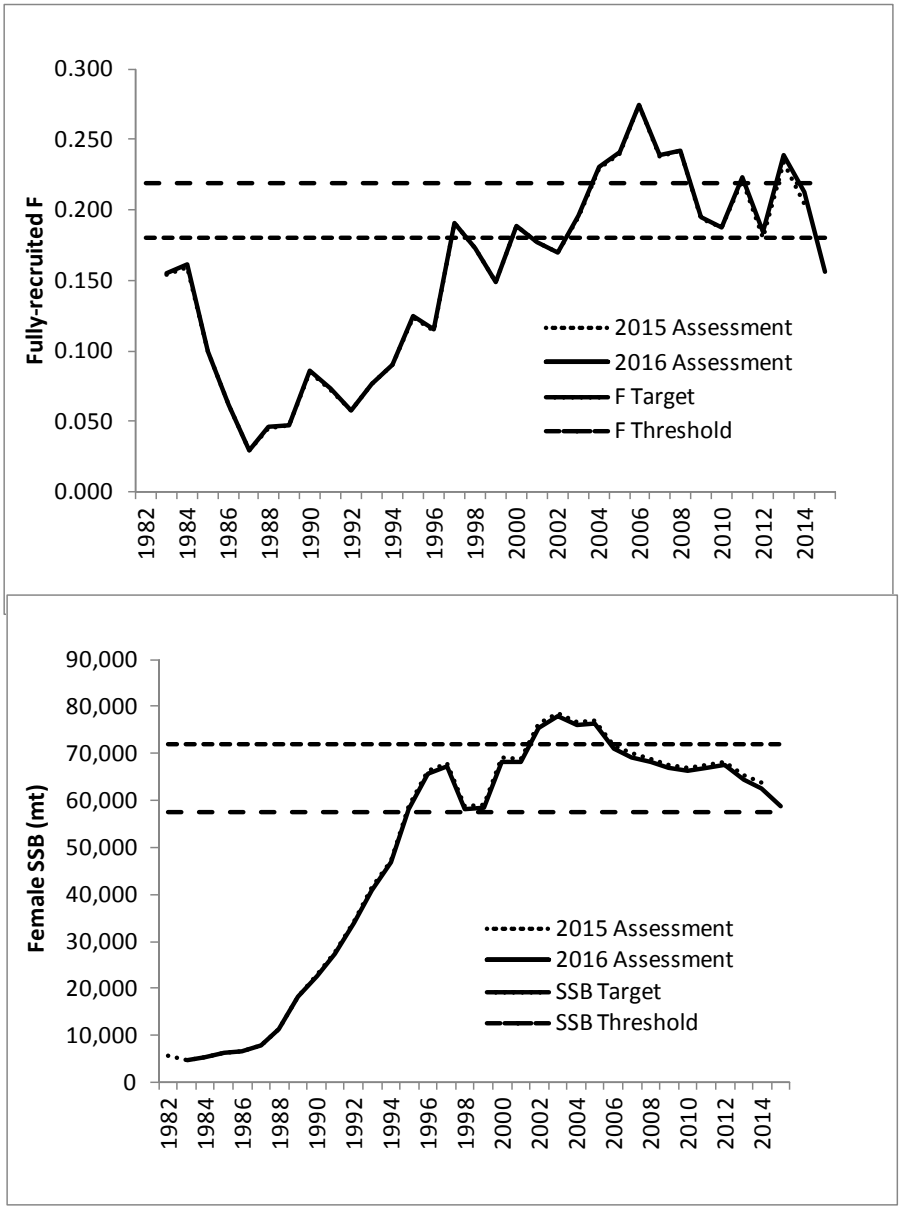


Figure 15. Comparison of estimates of total fully-recruited fishing mortality and spawning stock biomass from the 2016 update assessment with estimates from a model run using separate fleet selectivity time blocks for 2015.

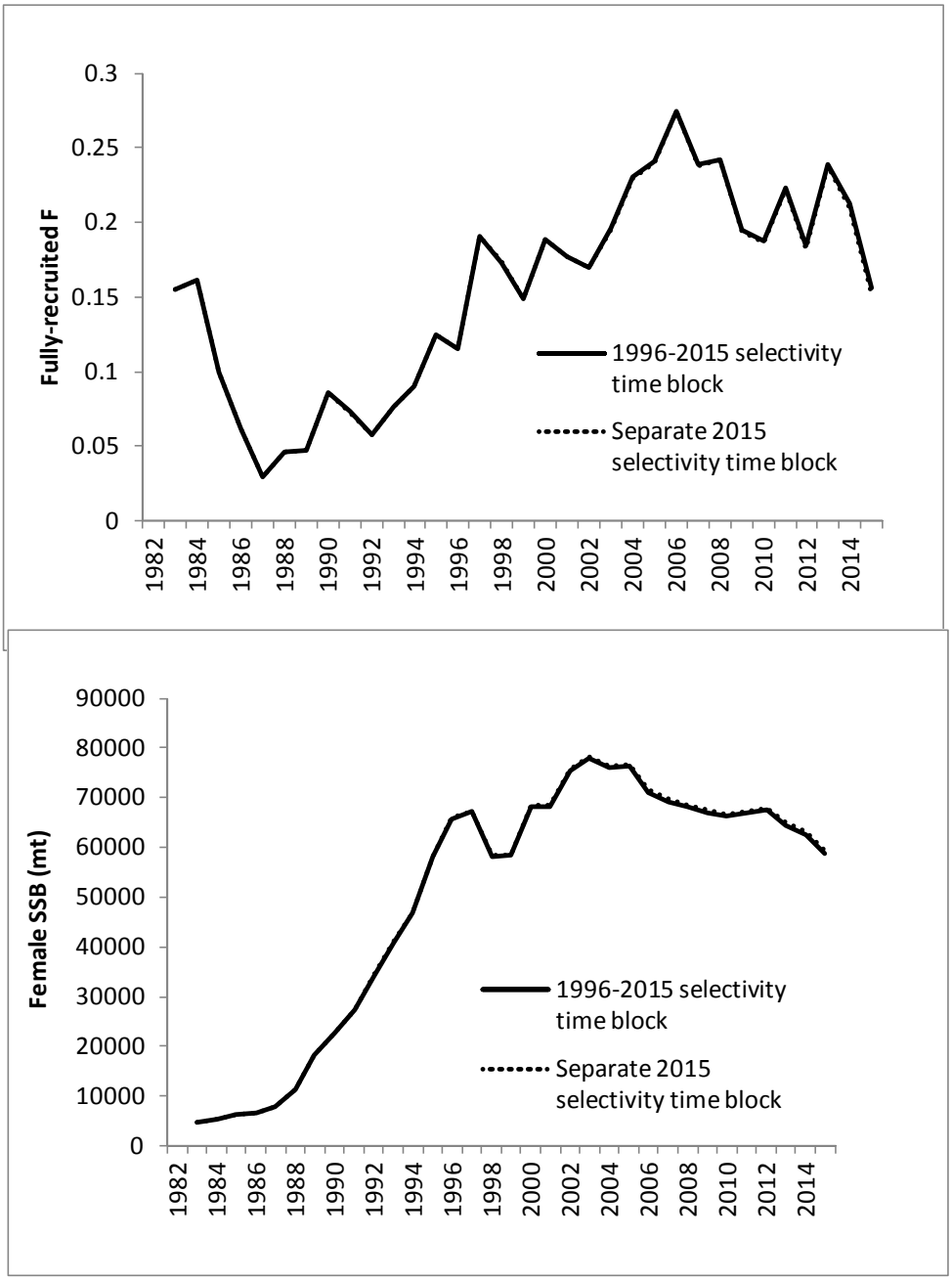


Figure 16. Projections of female spawning stock biomass and estimated fishing mortality assuming constant catch during 2016-2018 compared to the reference threshold values. The projections using the 2015 estimates of abundance and F are shown in black and the projections using the 2015 estimates adjusted for average retrospective biases are shown in red. The graph on the left contains the projected estimates (median is the solid symbols; 95% confidence intervals are dotted lines) compared to the reference threshold values (solid horizontal lines), and the graph on the right is the probability of the estimate comparison.

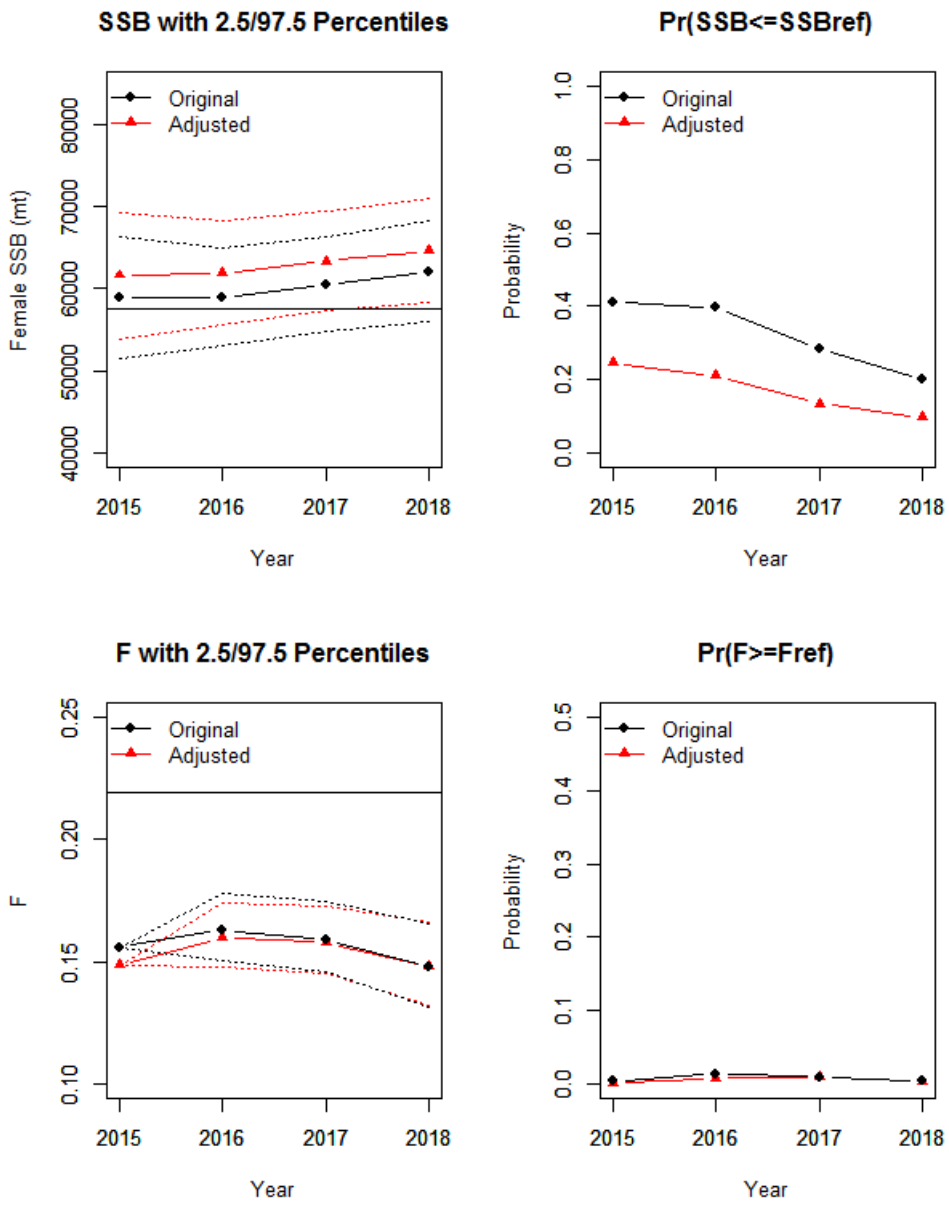


Figure 17. Projections of female spawning stock biomass and estimated fishing mortality assuming constant catch during 2016-2018 compared to target reference points. The projections using the 2015 estimates of abundance and F are shown in black and the projections using the 2015 estimates adjusted for average retrospective bias are shown in red. The graph on the left contains the projected estimates (median is the solid symbols; 95% confidence intervals are dotted lines) compared to the target values (solid horizontal lines), and the graph on the right is the probability of the estimate comparison.

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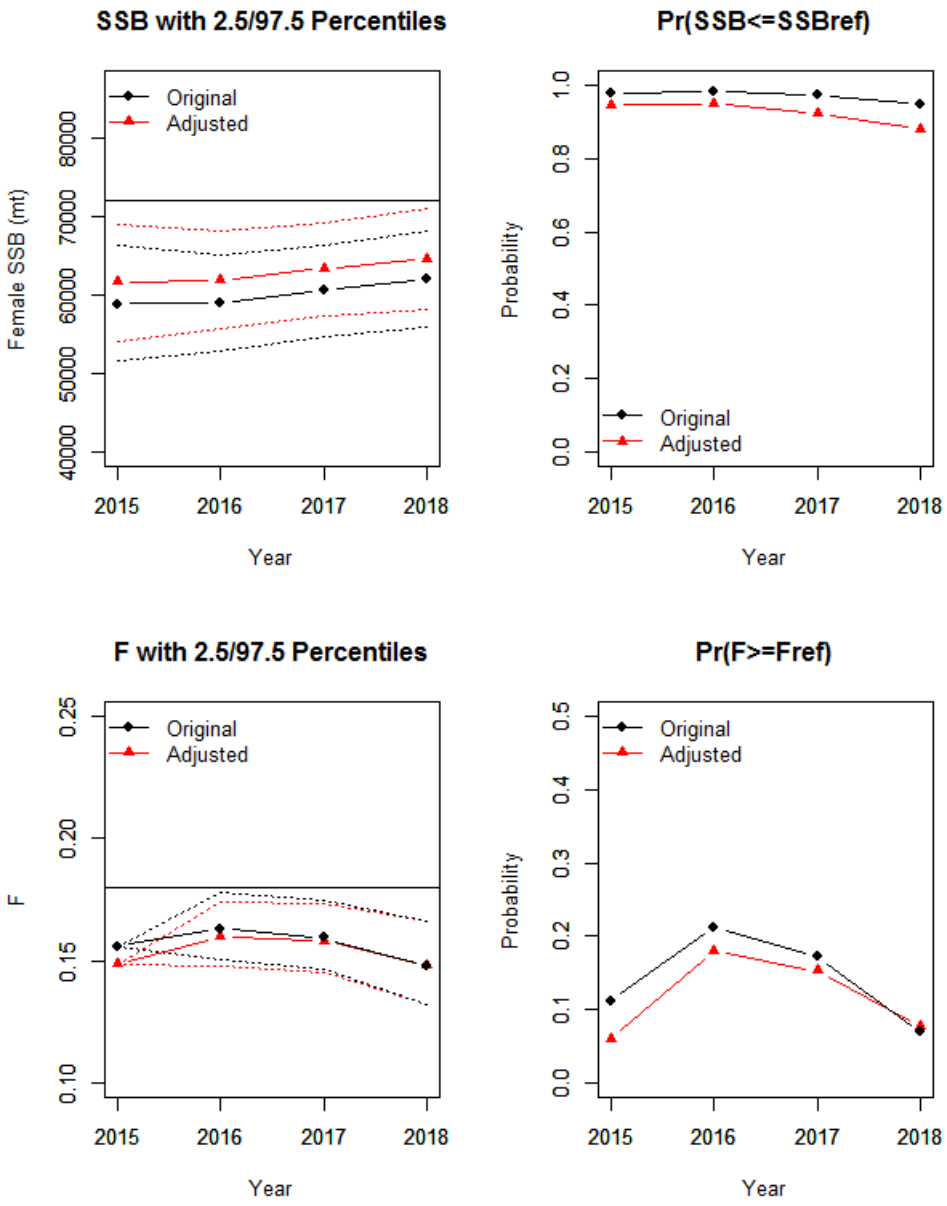
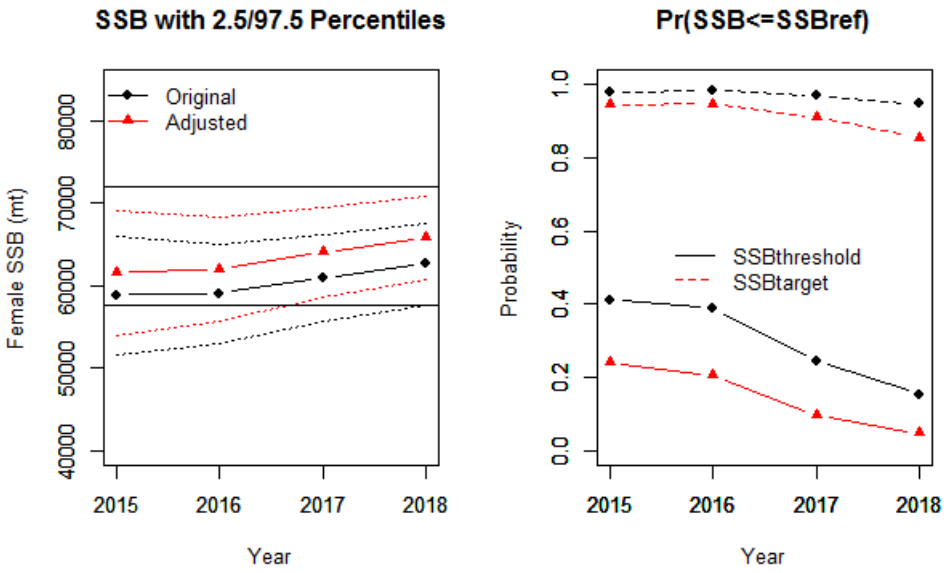


Figure 18. Projections of female spawning stock biomass and estimated catch assuming constant fully-recruited fishing mortality equal to the 2015 value (0.157) during 2016-2018 compared to threshold and target reference points. The projections using the 2015 estimates of age-specific abundances are shown in black with the solid circle and the projections using the 2015 estimates adjusted for average retrospective bias are shown in red with a triangle. The graph on the left contains the projected estimates (median is the solid symbols; 95% confidence intervals are dotted lines) and, for spawning stock biomass, is compared to the threshold (lower solid horizontal line) and target (upper solid horizontal line) reference points. The graph on the right is the probability of SSB being less than or equal to the reference points.



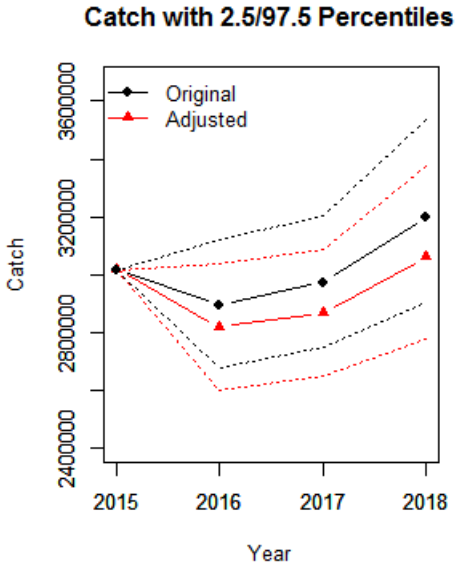
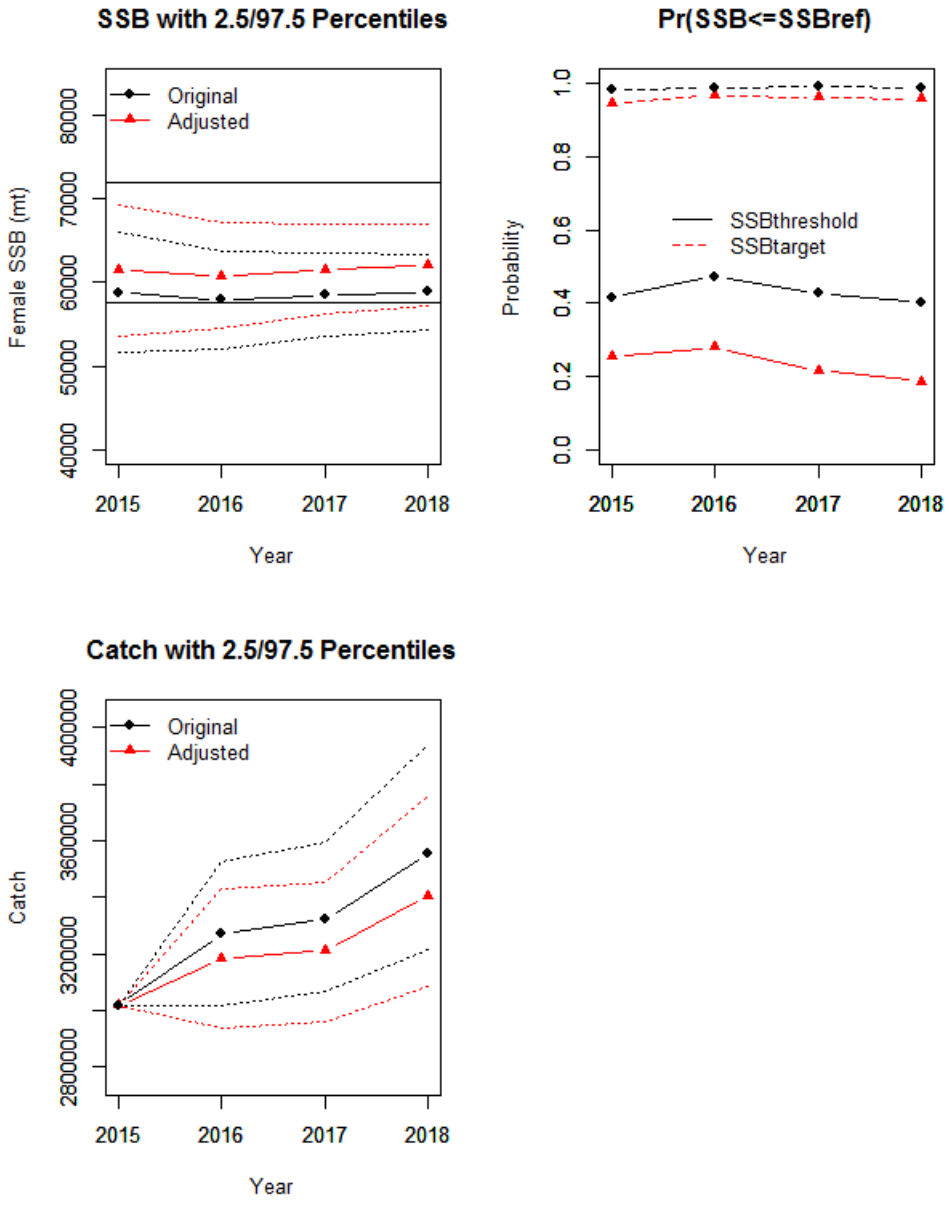


Figure 19. Projections of female spawning stock biomass and estimated catch assuming constant fully-recruited fishing mortality equal to the F_{target} (0.18) during 2016-2018 compared to threshold and target reference points. The projections using the 2015 estimates of age-specific abundances are shown in black with a solid circle and the projections using the 2015 estimates adjusted for average retrospective bias are shown in red with a triangle. The graph on the left contains the projected estimates (median is the solid symbols; 95% confidence intervals are dotted lines) and, for spawning stock biomass, is compared to the threshold (lower solid horizontal line) and target (upper solid horizontal line) reference points. The graph on the right is the probability of SSB being less than or equal to the reference points.



Appendix A. Plots of SCA model output.

Figure 1. Plots of observed and predicted catch proportions-at-age by year for each fleet.

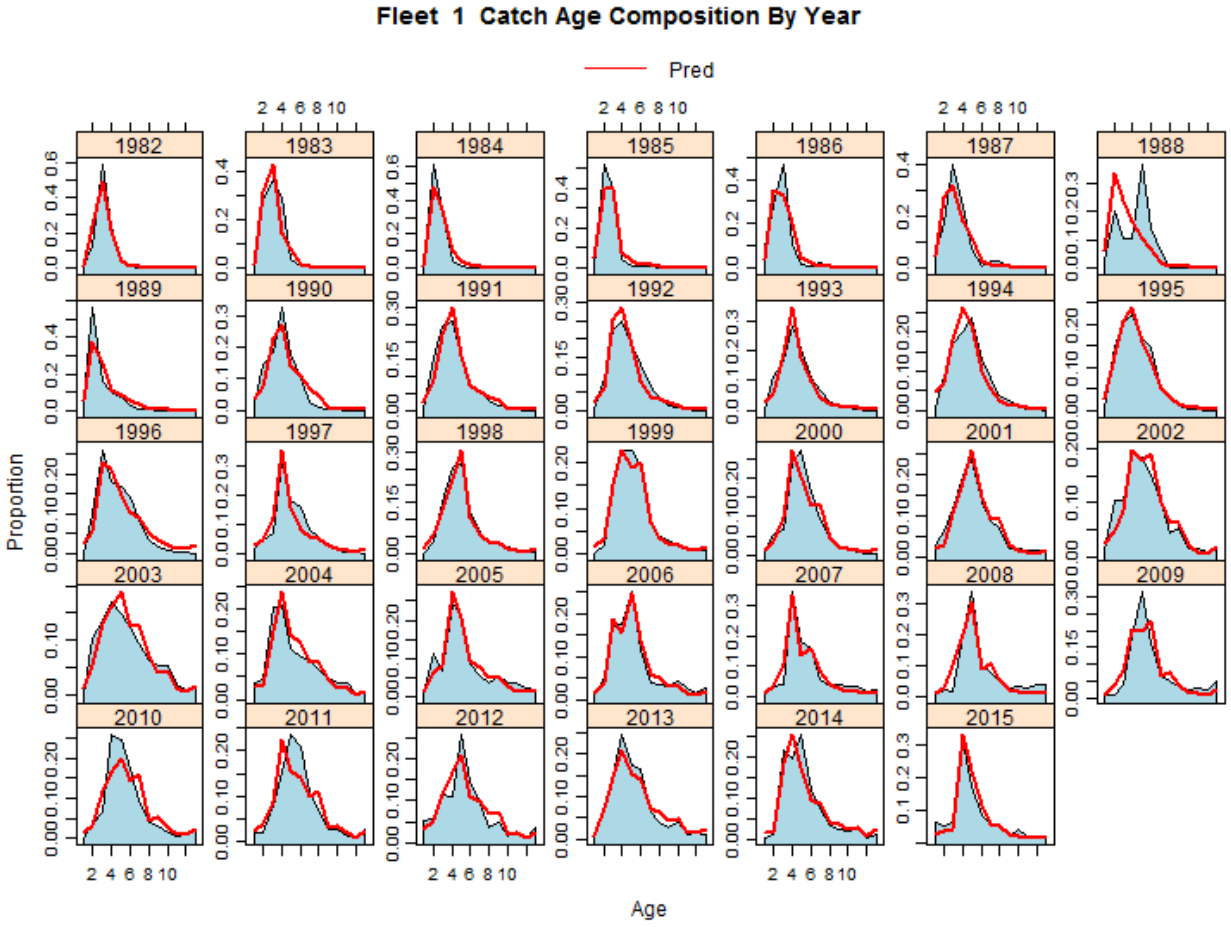


Figure 1 cont.

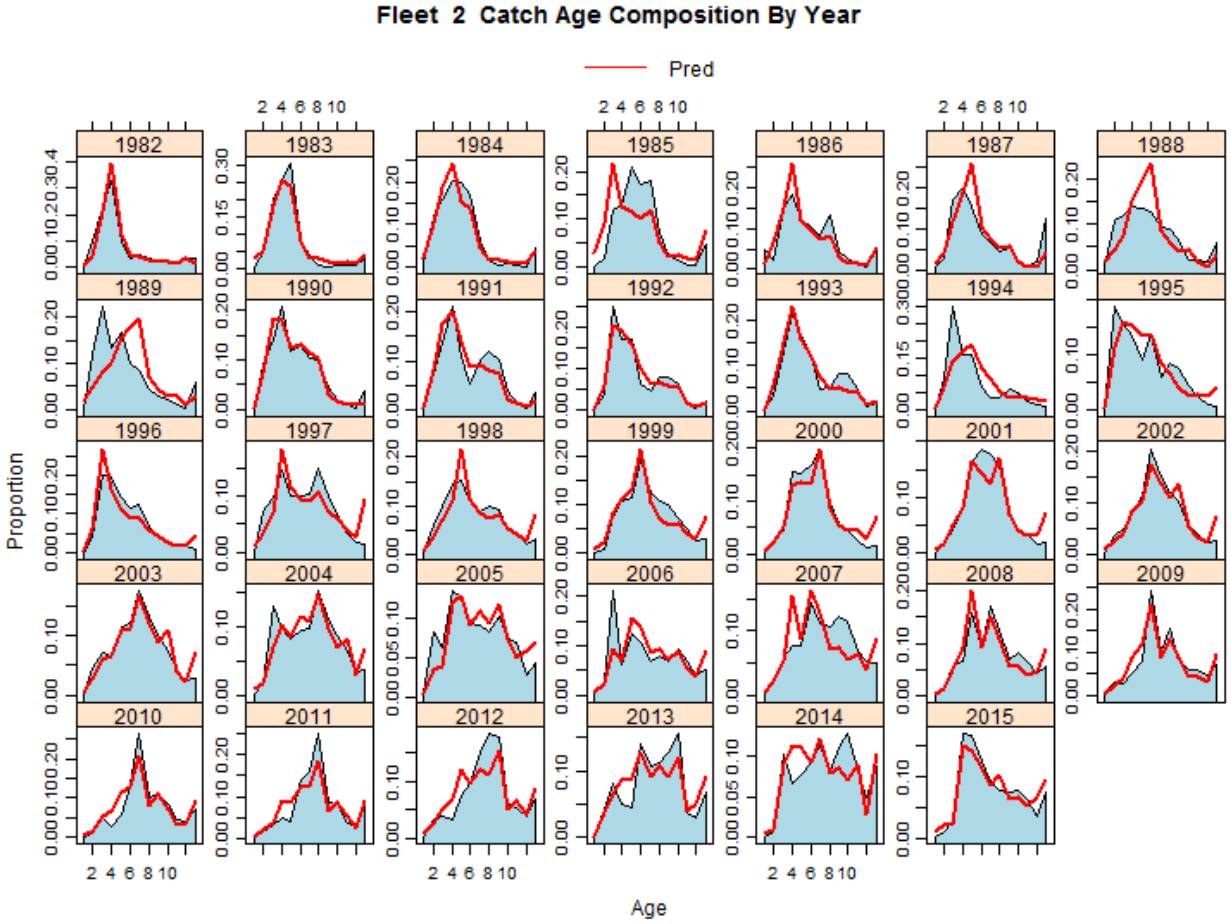


Figure 1 cont.

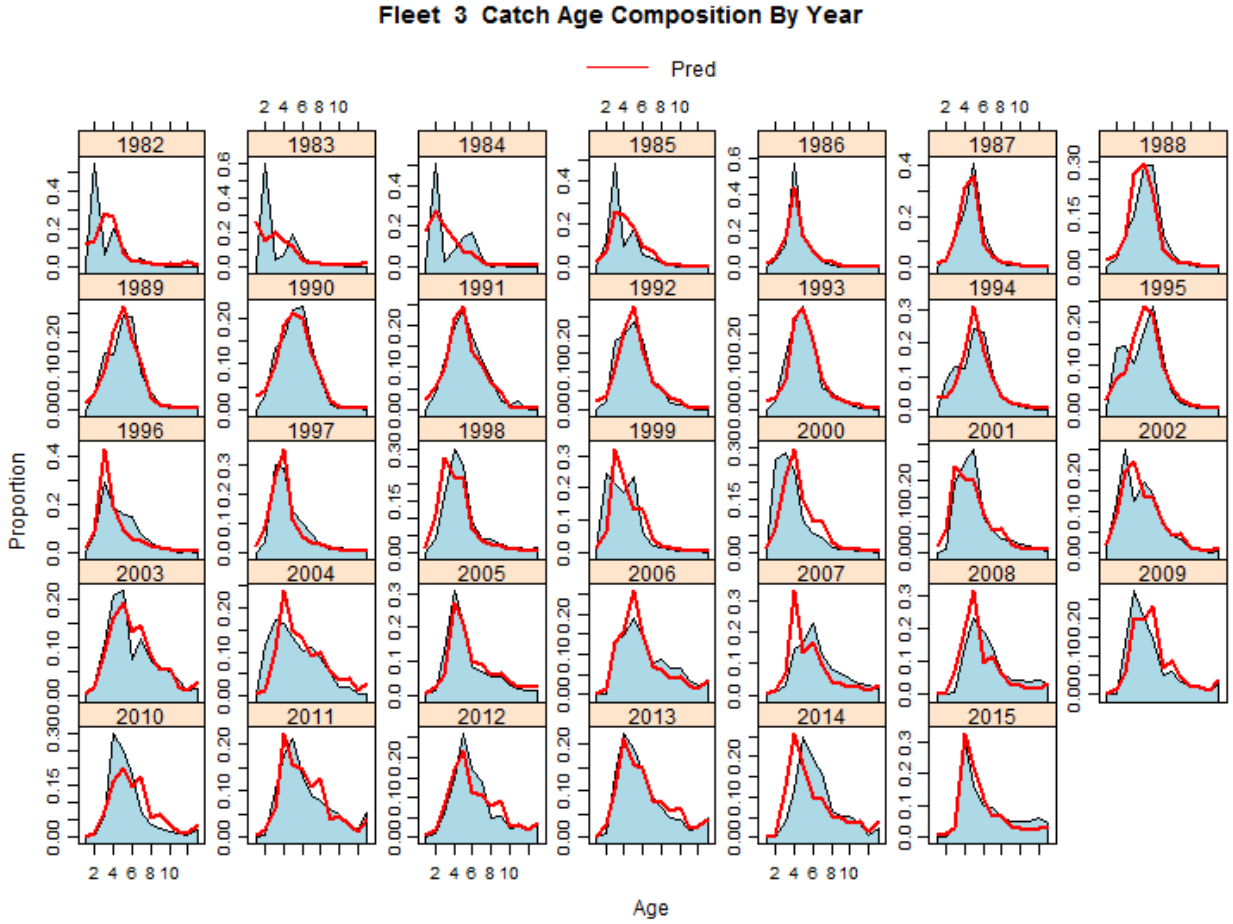


Figure 2. Standardized residuals of catch proportions-at-age by year for each fleet.

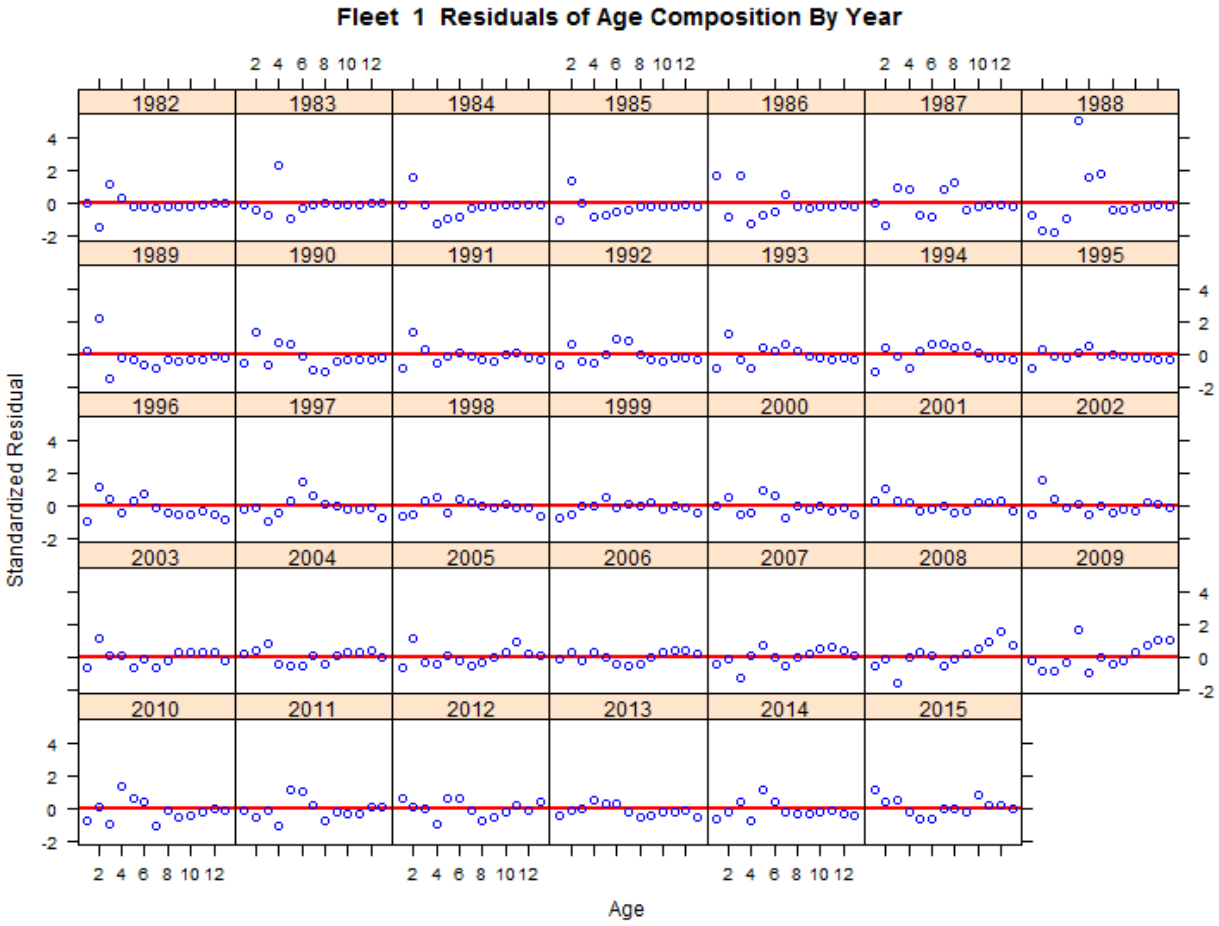


Figure 2 cont.

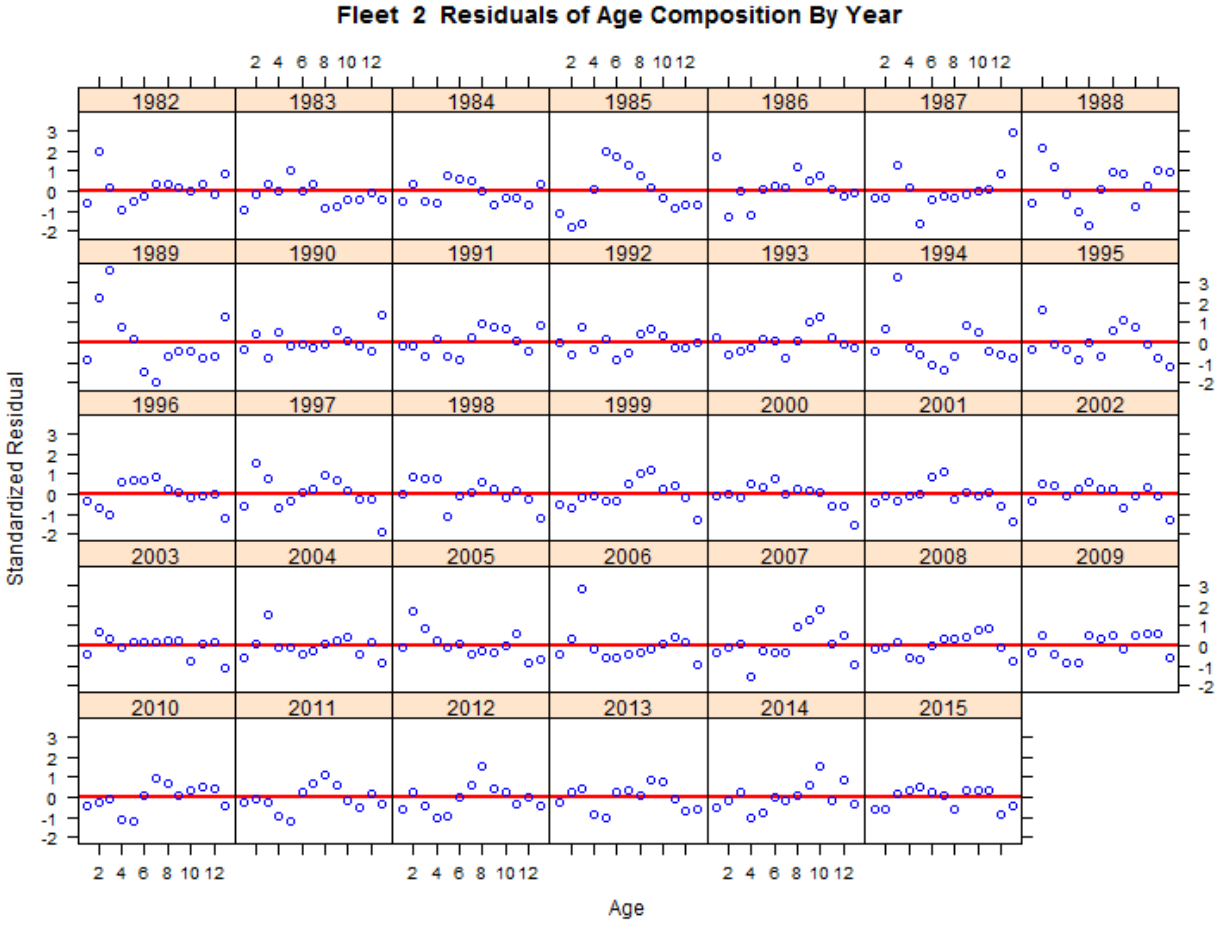


Figure 2 cont.

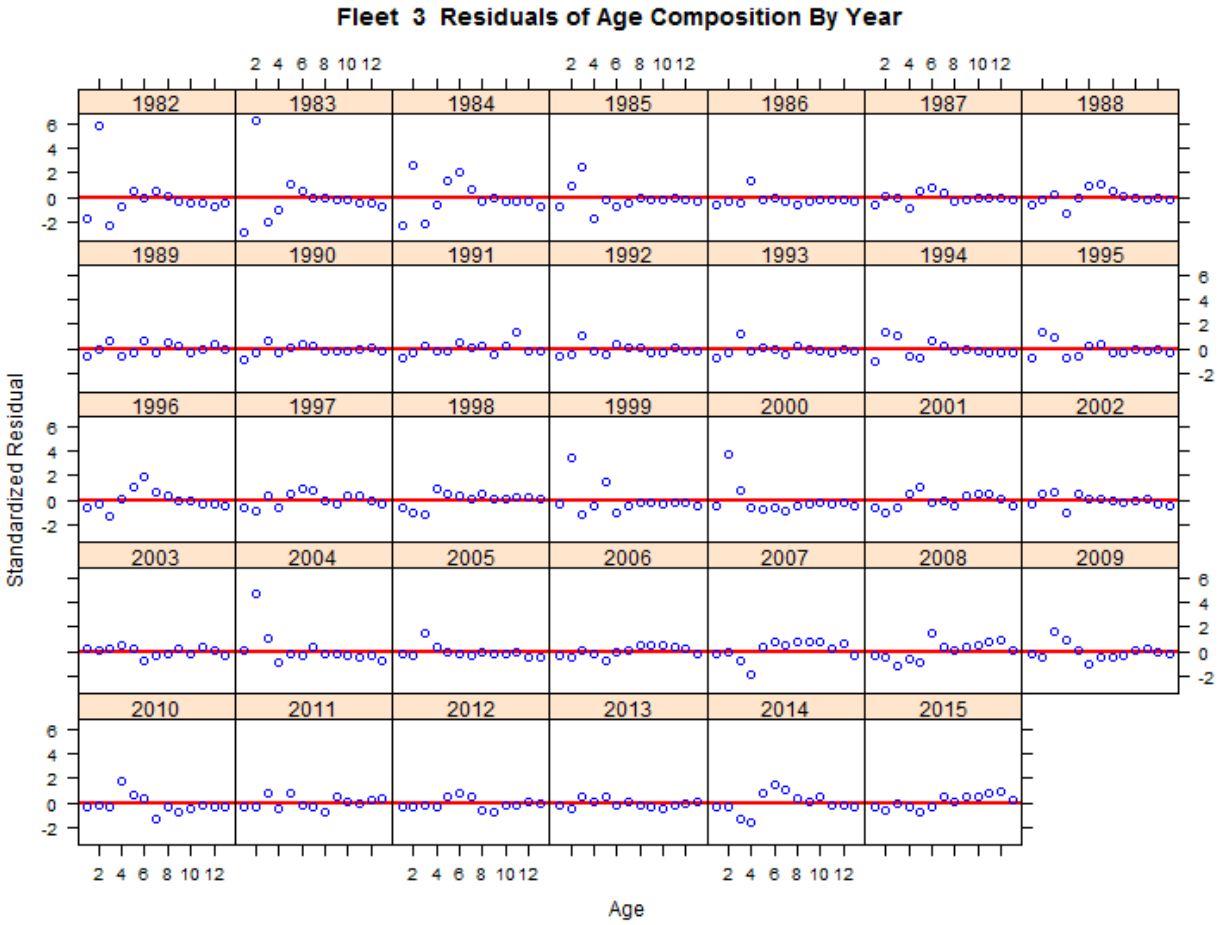


Figure 3 .Observed and predicted catch proportions-at-age by age for each fleet

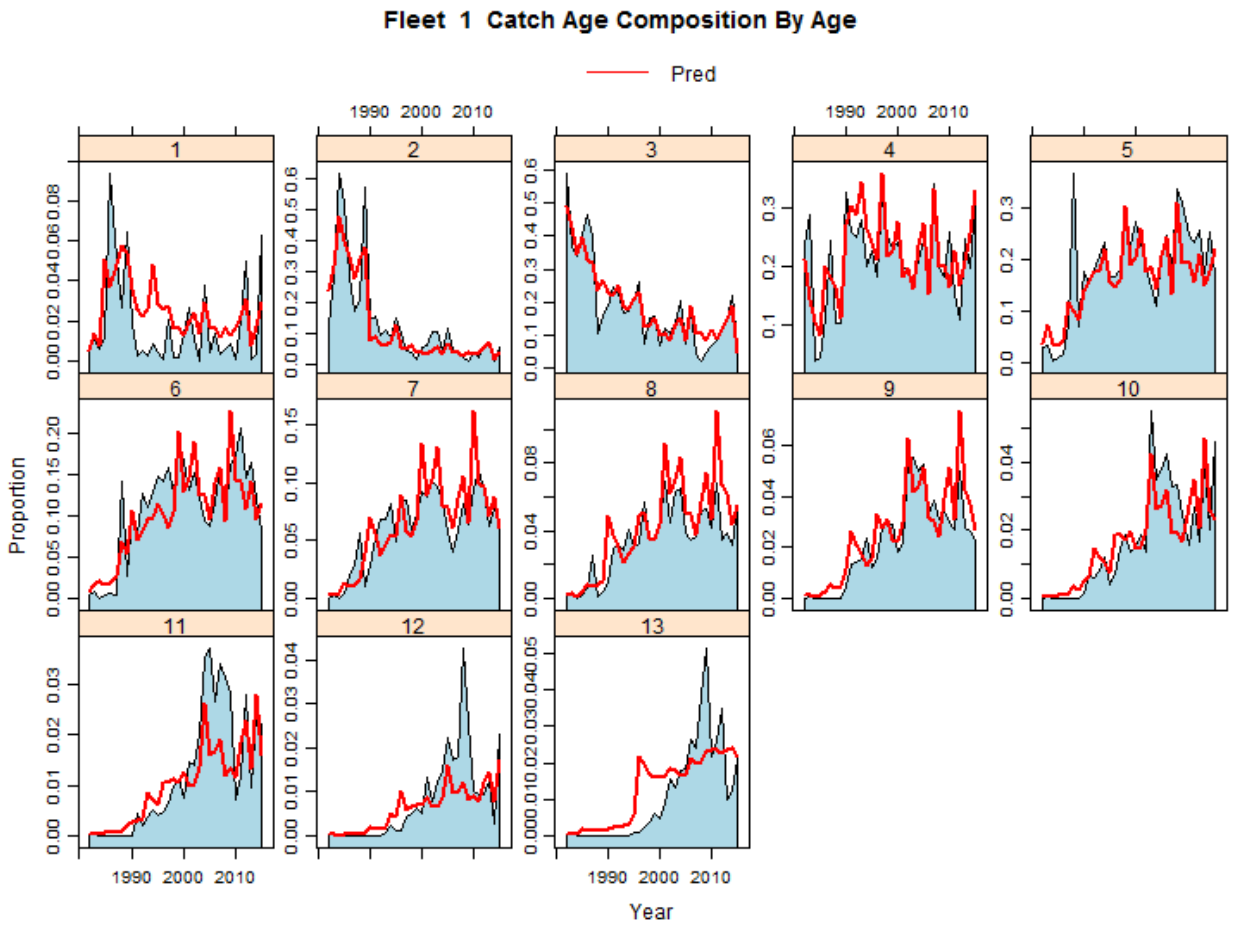


Figure 3 cont.

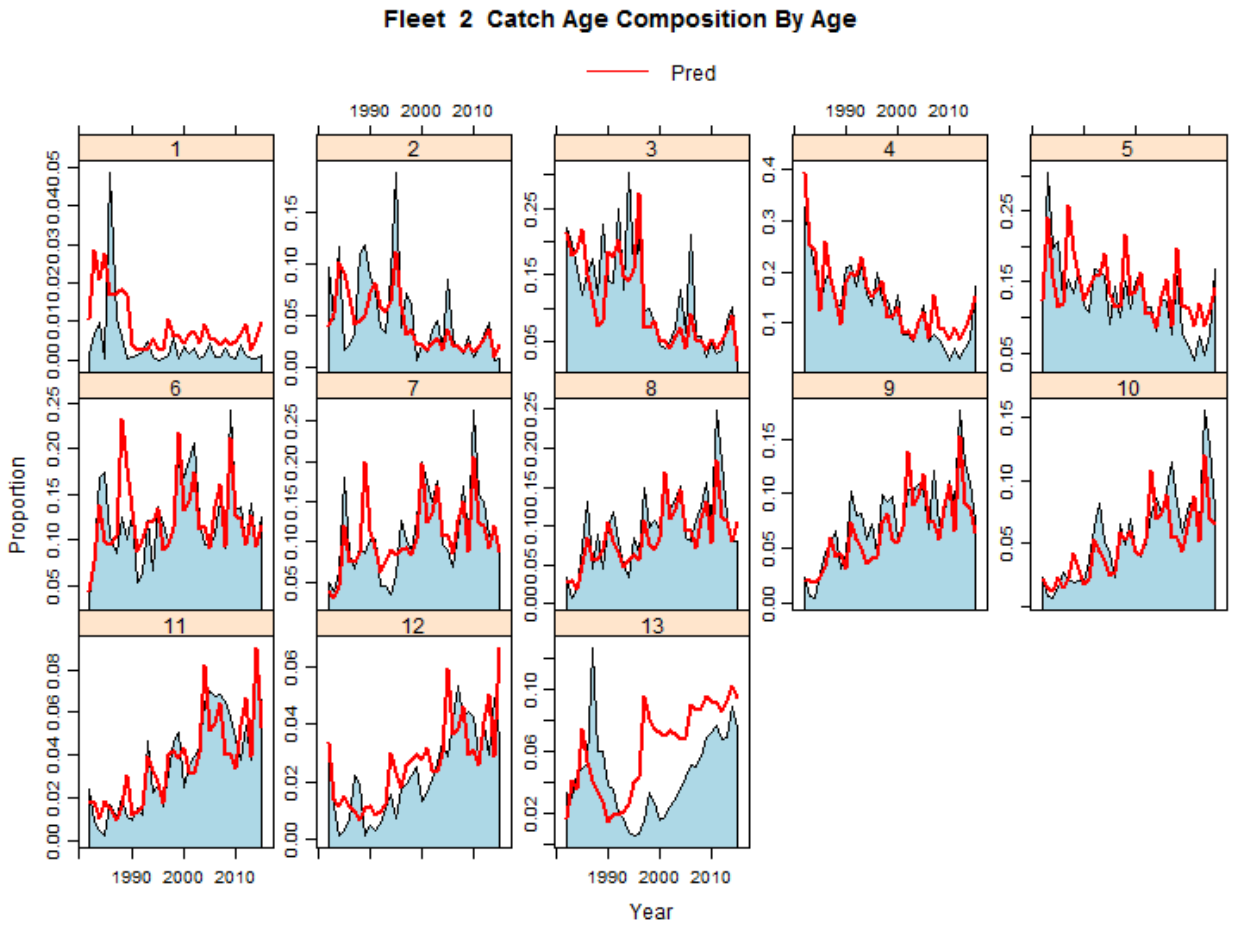


Figure 3 cont.

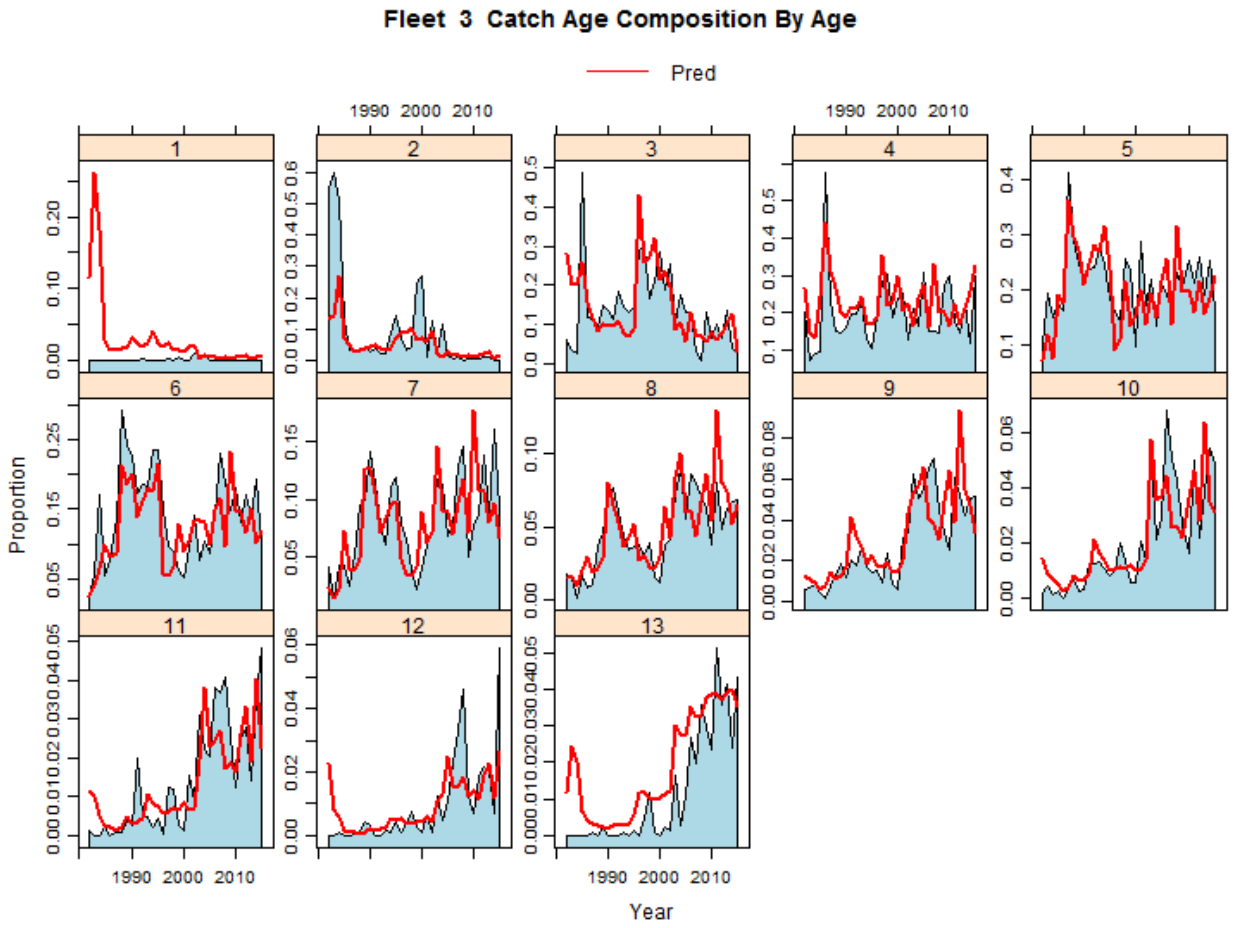


Figure 4. Standardized residuals of catch proportions-at-age by age.

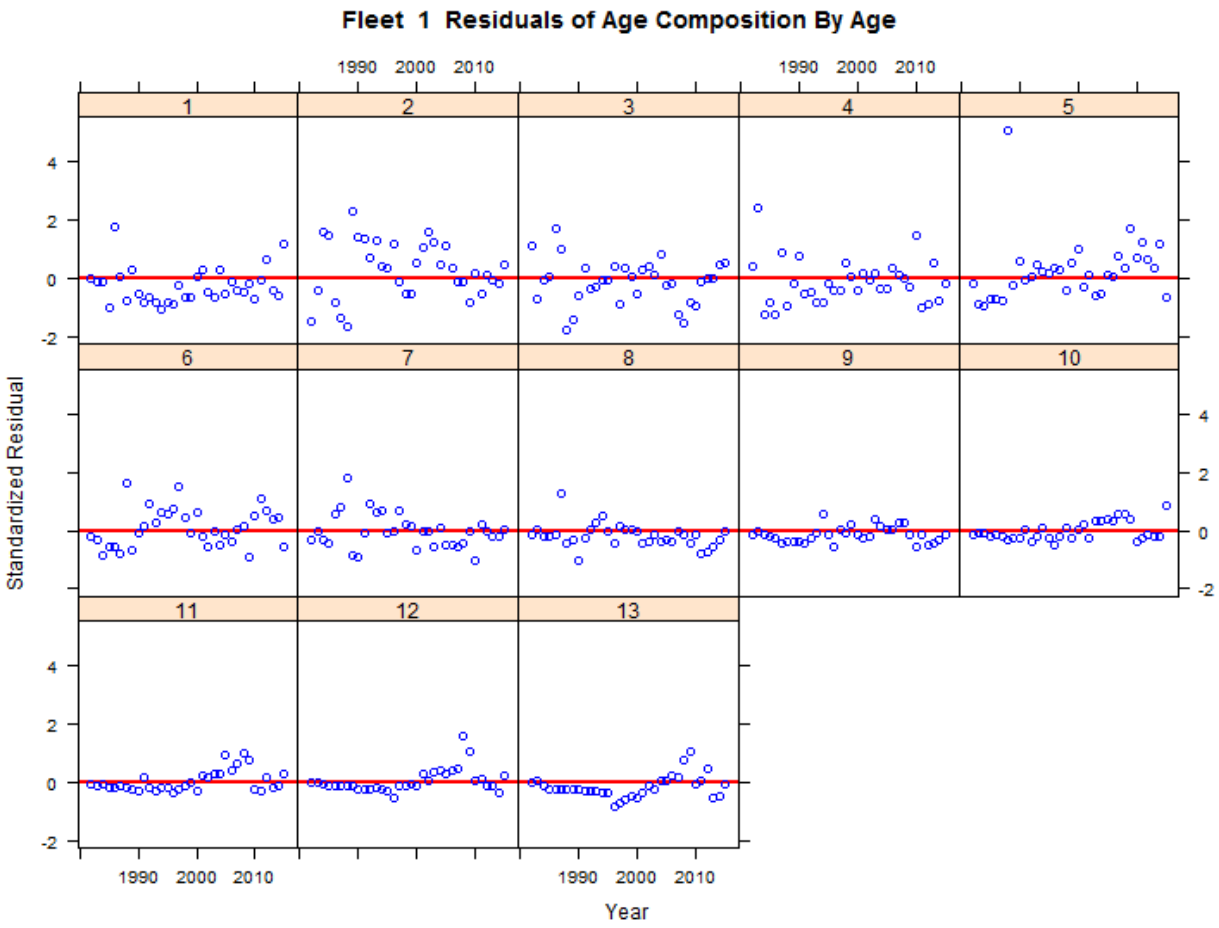


Figure 4 cont.

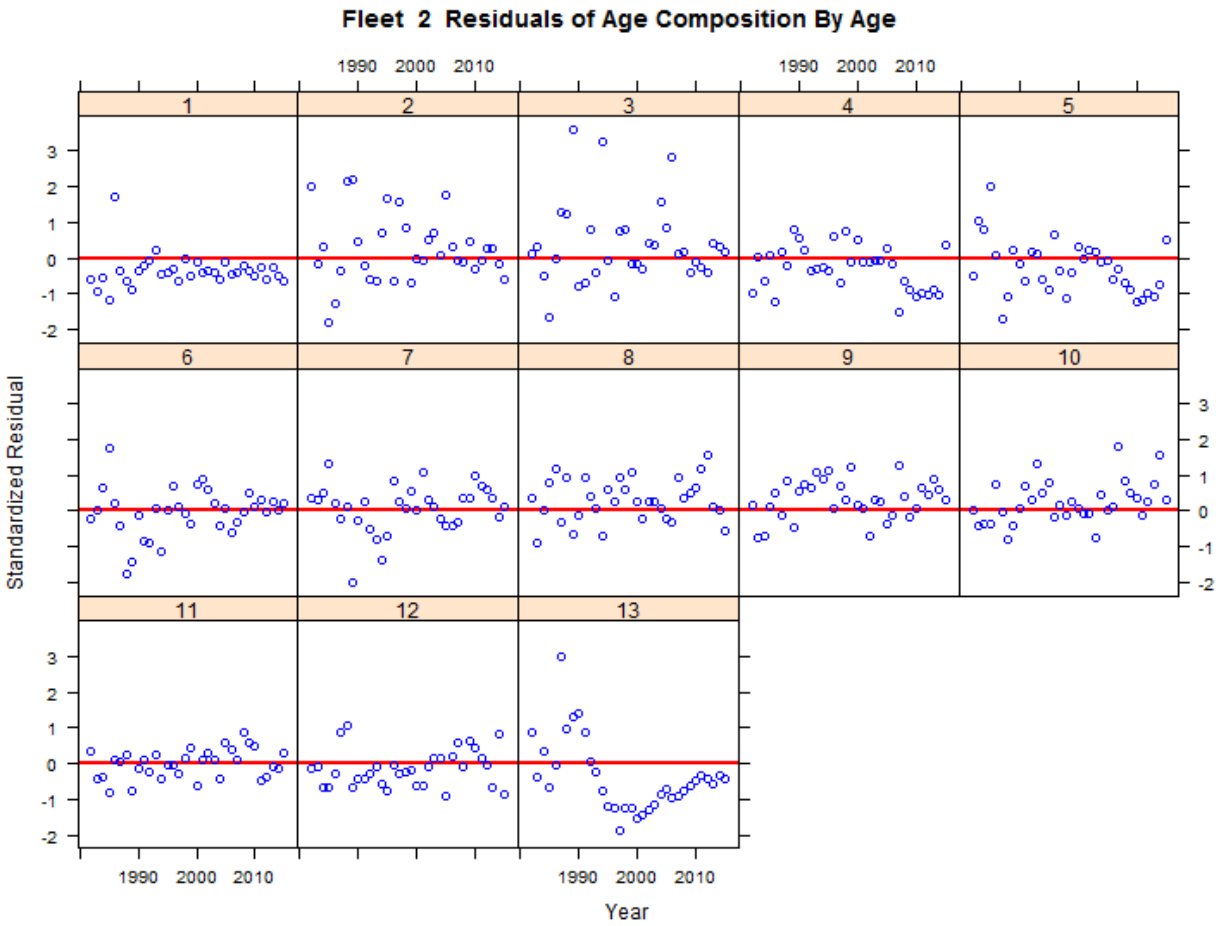


Figure 4 cont.

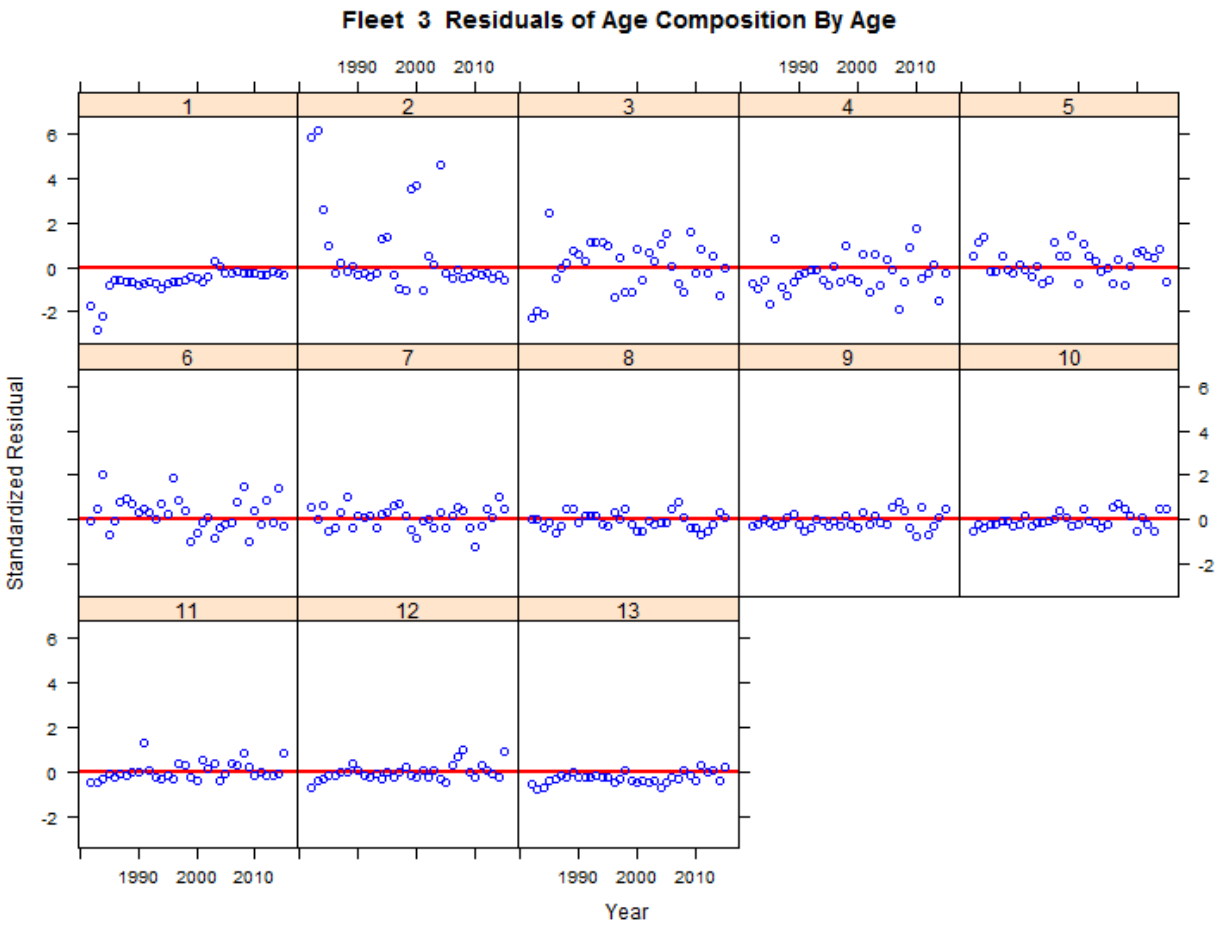


Figure 5. Observed and predicted values and standardized residuals for young-of-the-year and yearling surveys tuned to Age 1 and 2, respectively.

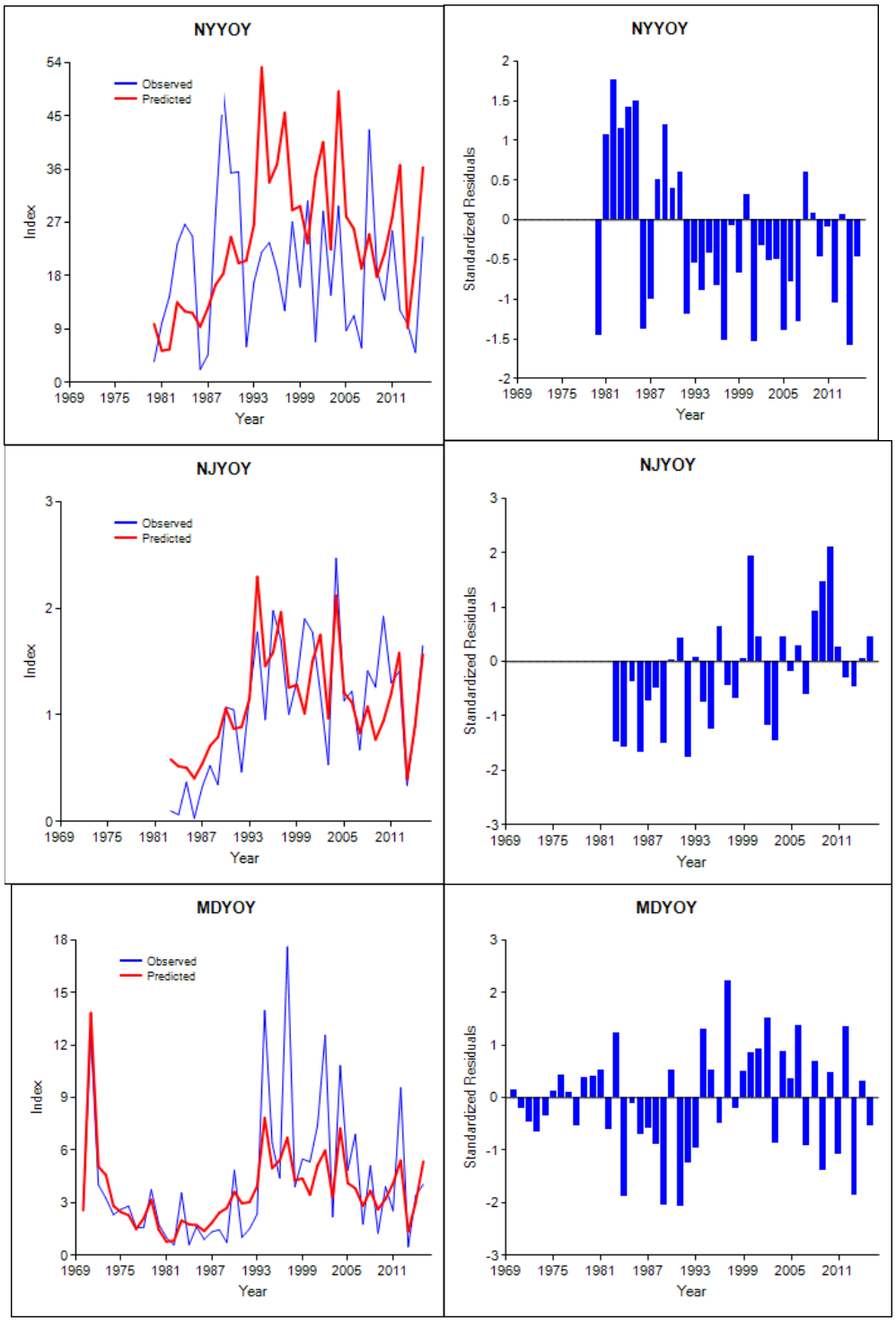


Figure 5 cont.

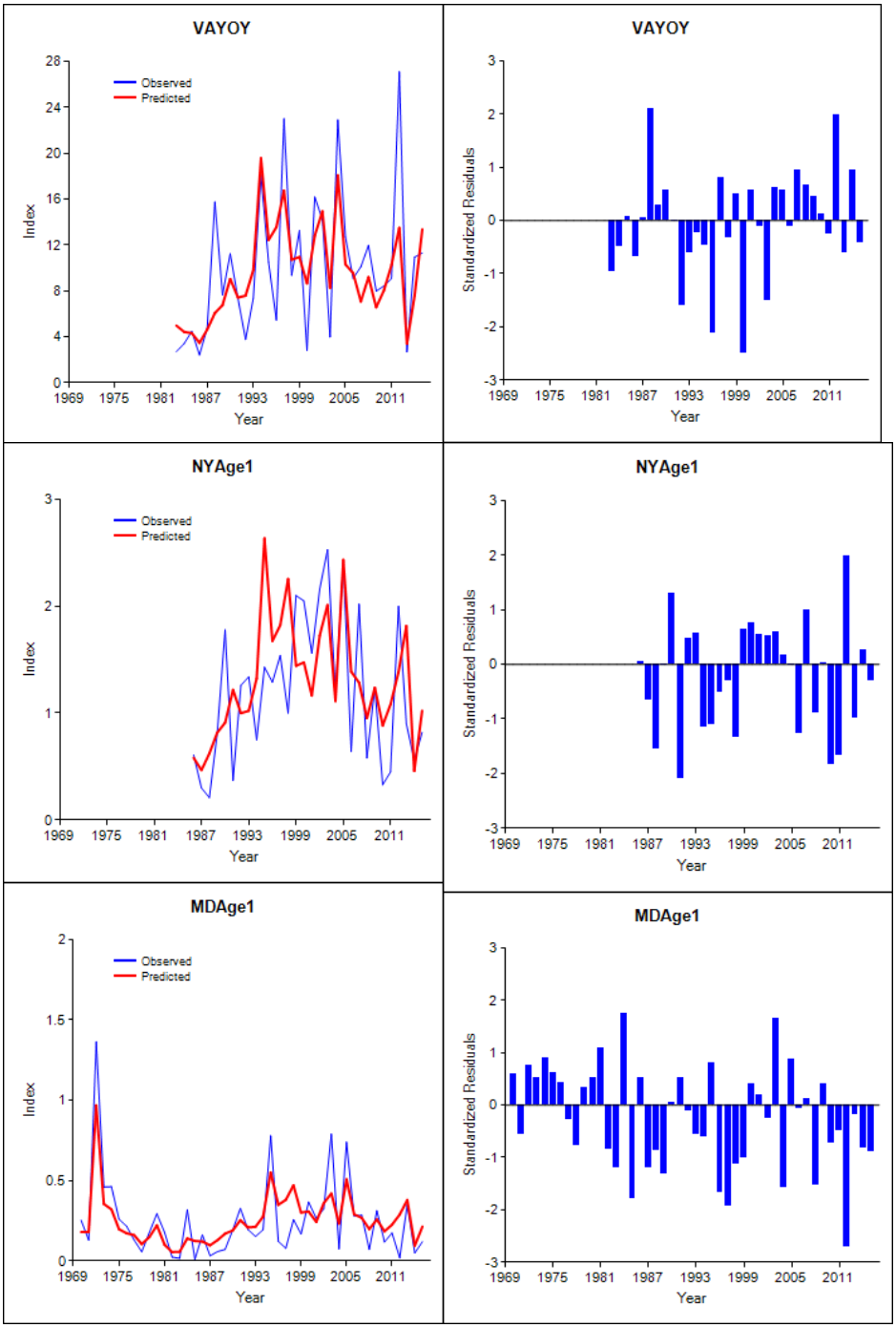


Figure 6. Observed and predicted values and standardized residuals for age-aggregated surveys.

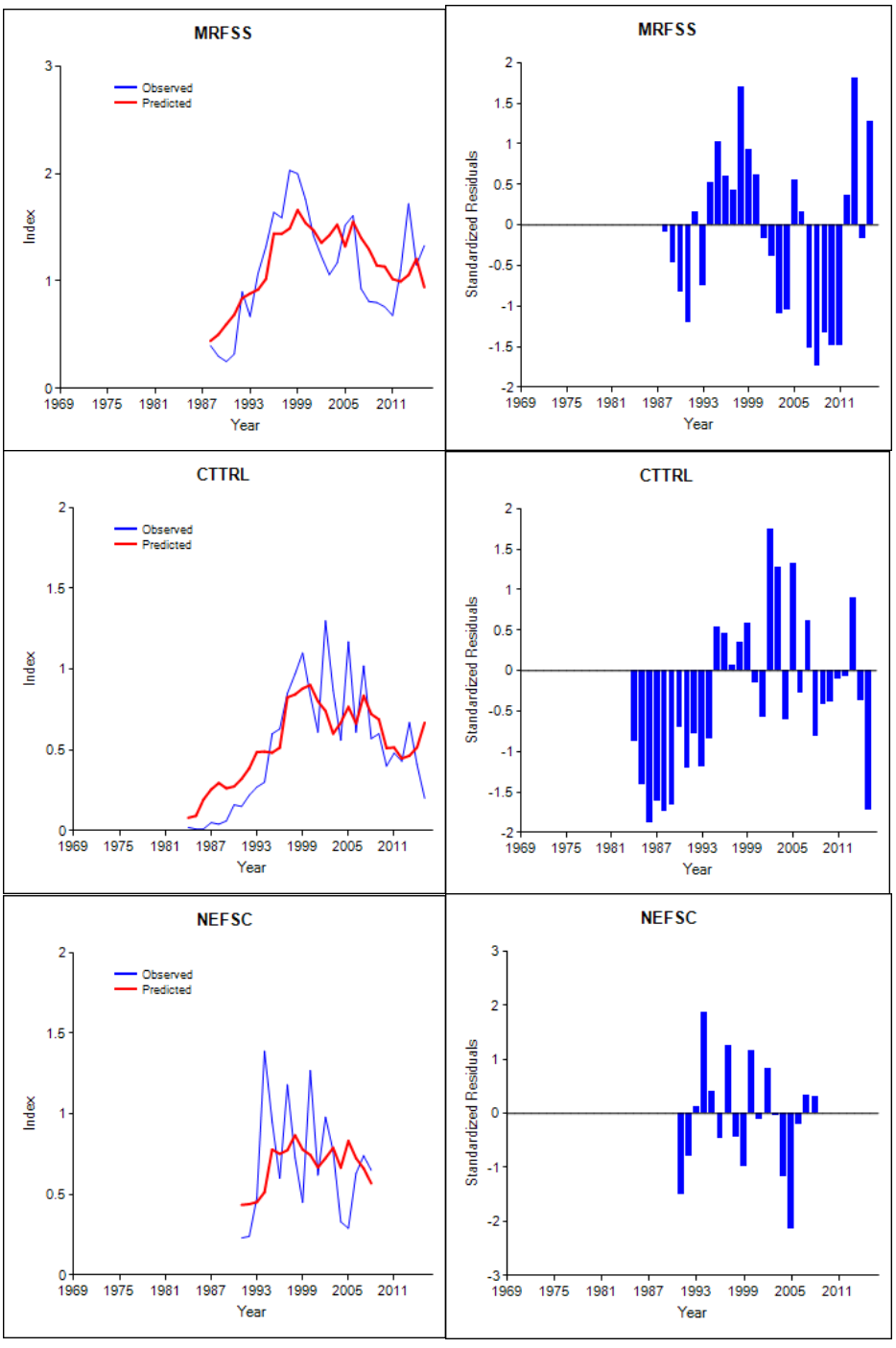


Figure 7. Observed and predicted values of the total index and standardized residuals for surveys with age composition data.

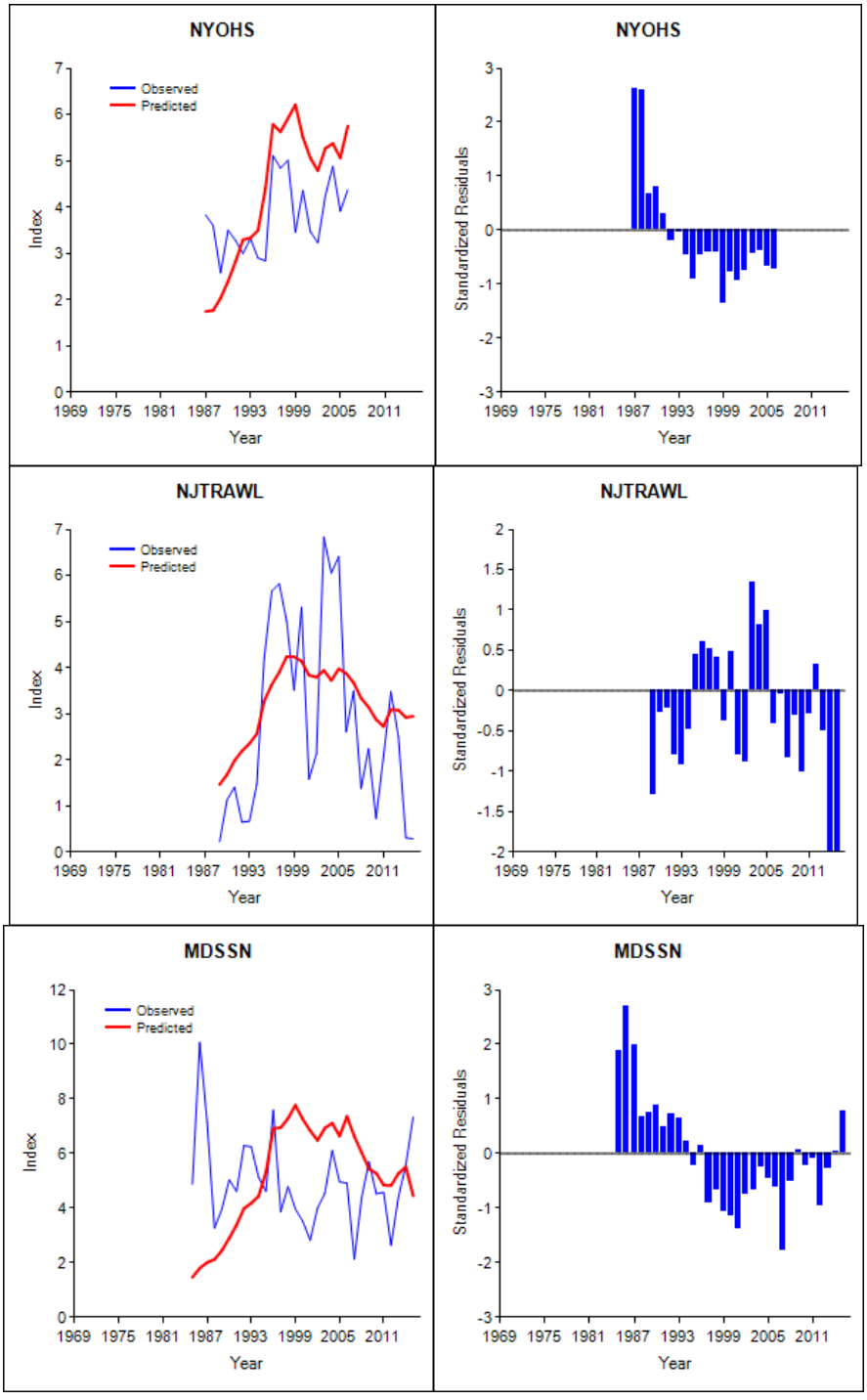


Figure 7 cont.

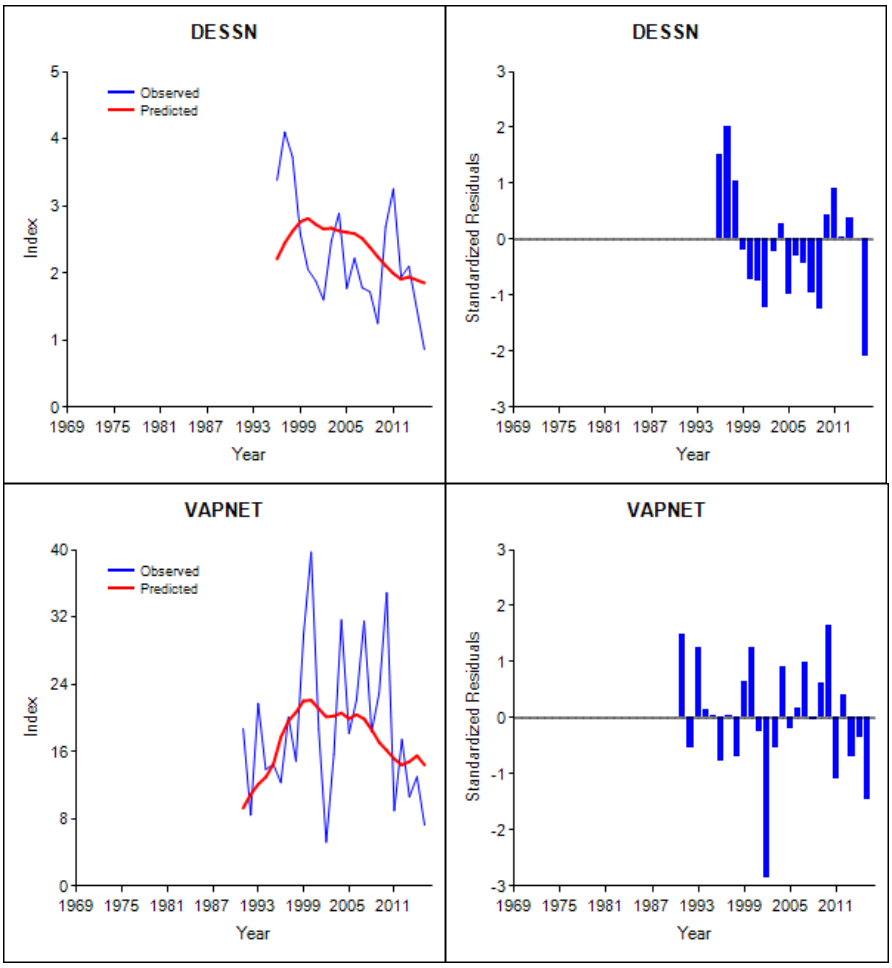


Figure 8. Selectivity patterns estimated for the NYOHS, NJ Trawl, MD SSN, DE SSN surveys and VAPNET.

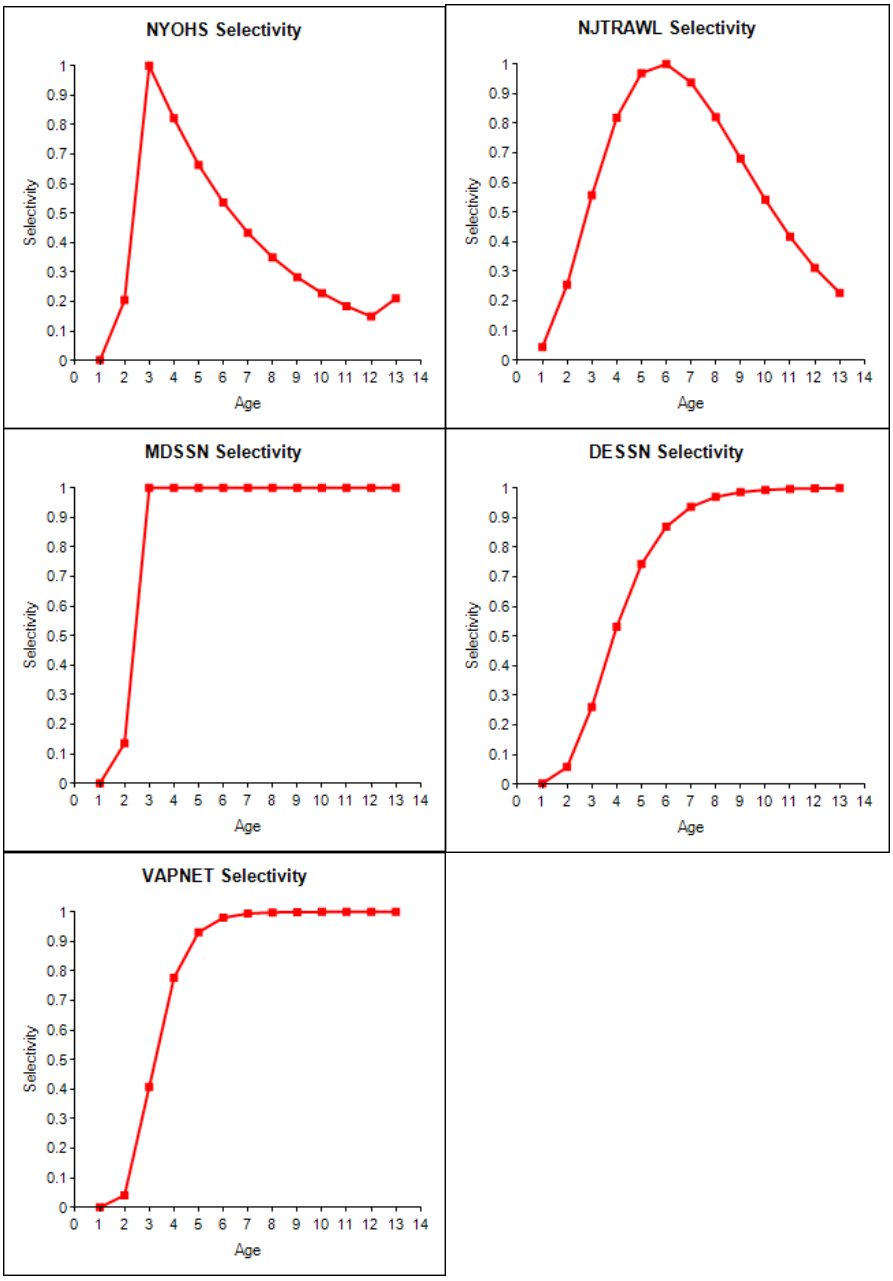


Figure 9. Observed and predicted proportions-at-age and standardized residual for each age by year for the NYOHS survey.

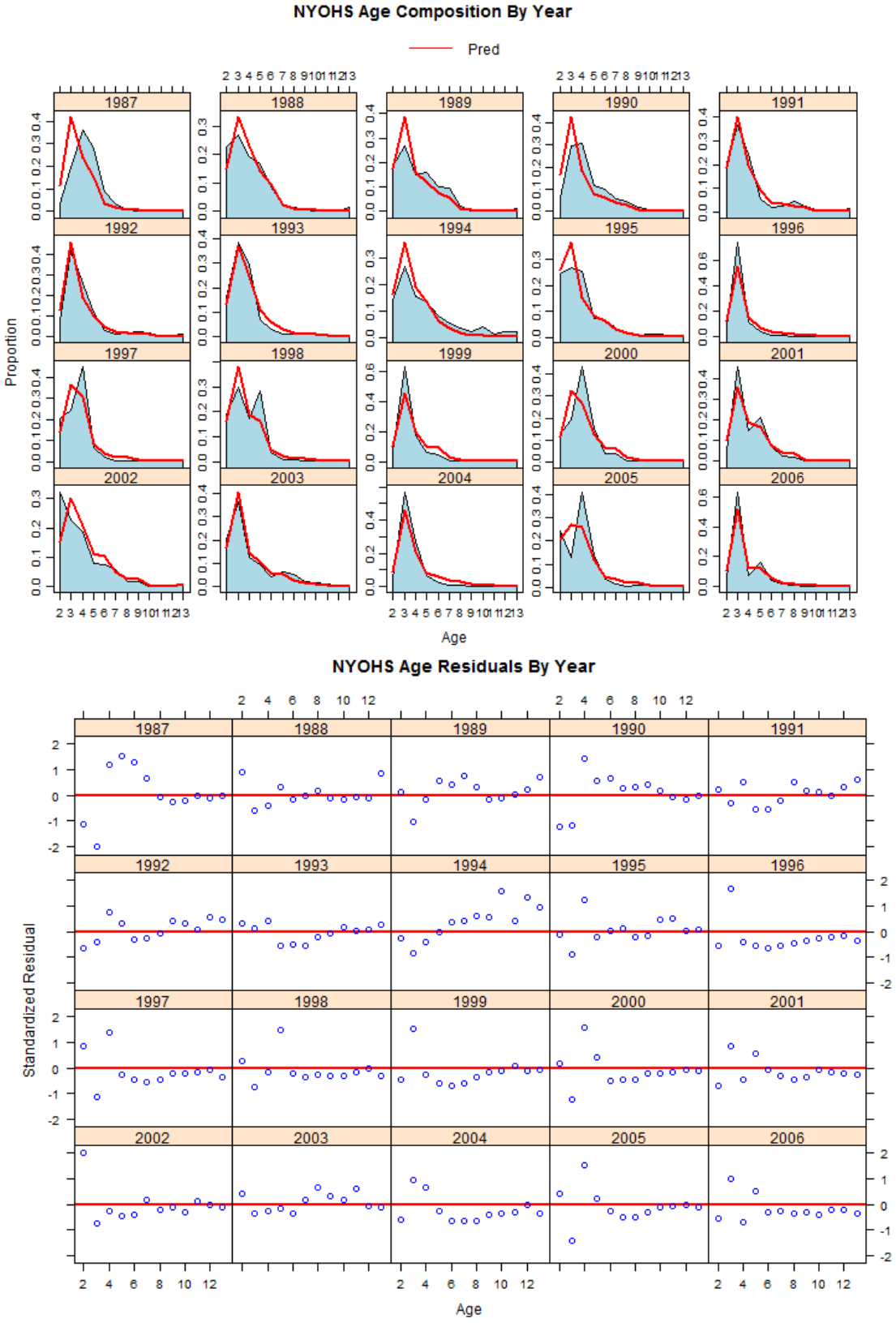
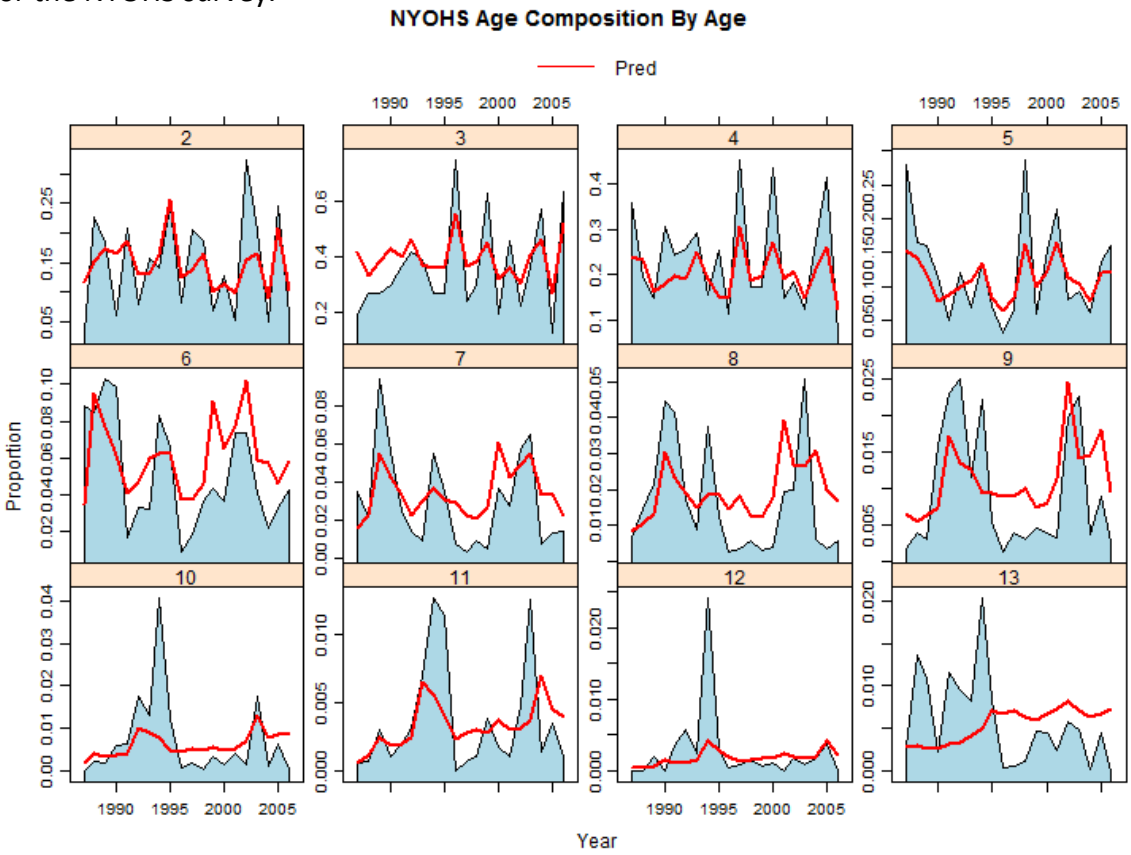


Figure 10. Observed and predicted proportions-at-age and standardized residual for each year by age for the NYOHS survey.



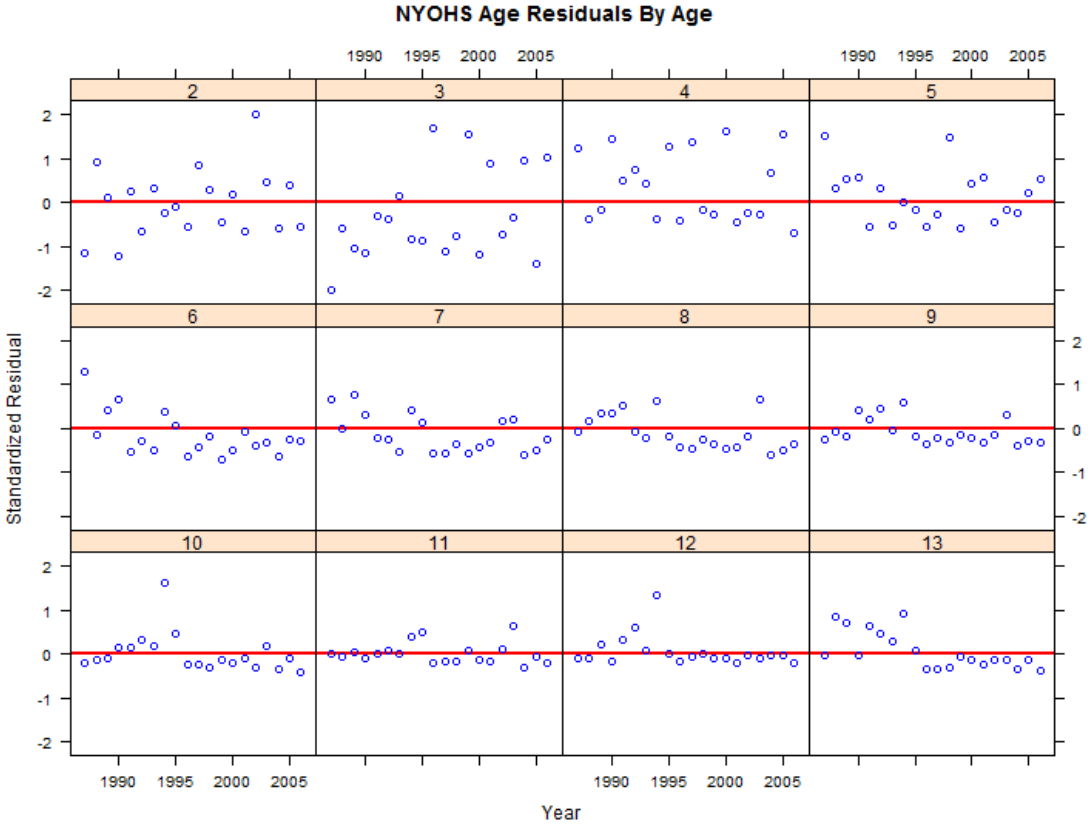


Figure 11. Observed and predicted proportions-at-age and standardized residuals for each age by year for the NJ Trawl survey.

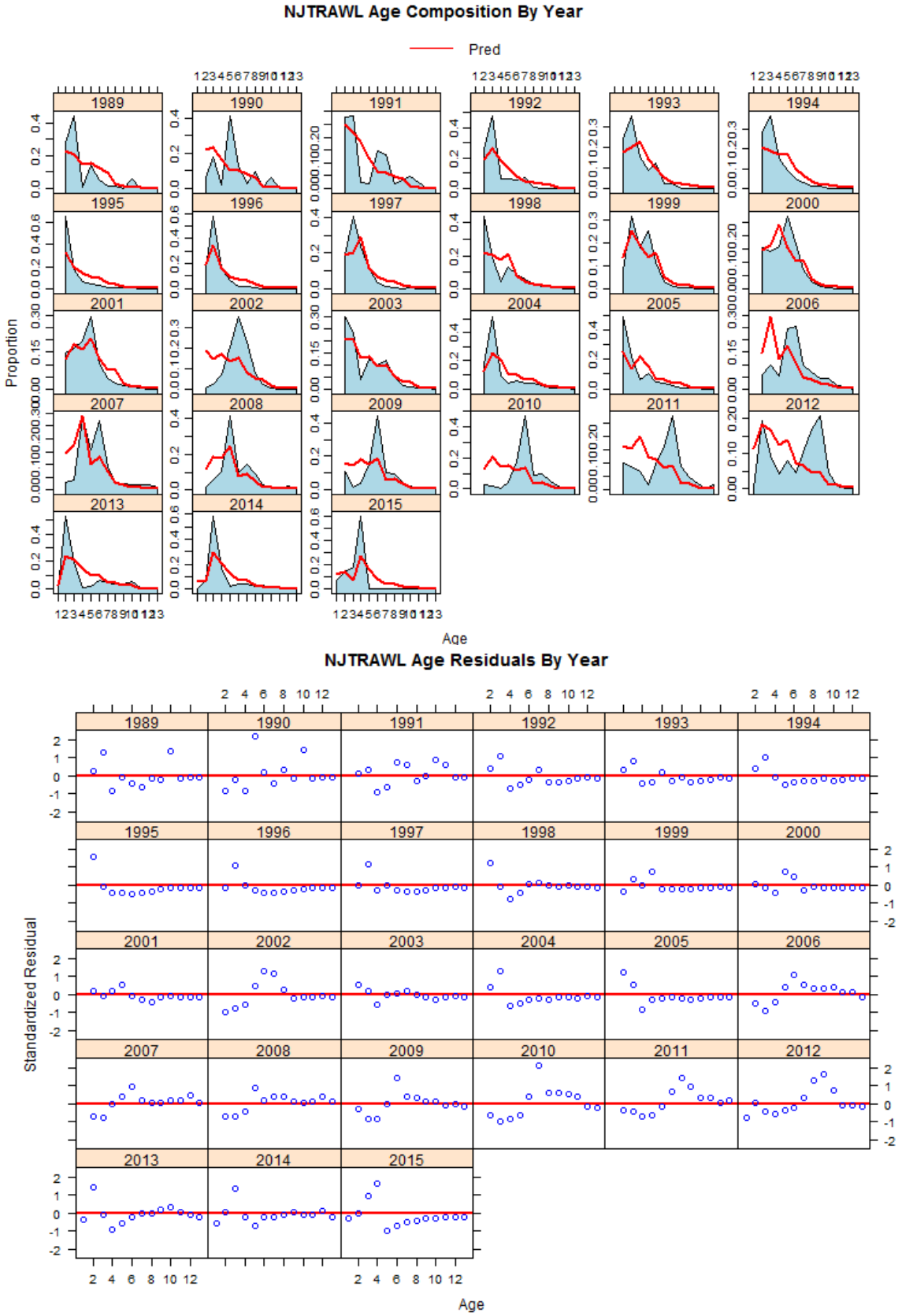
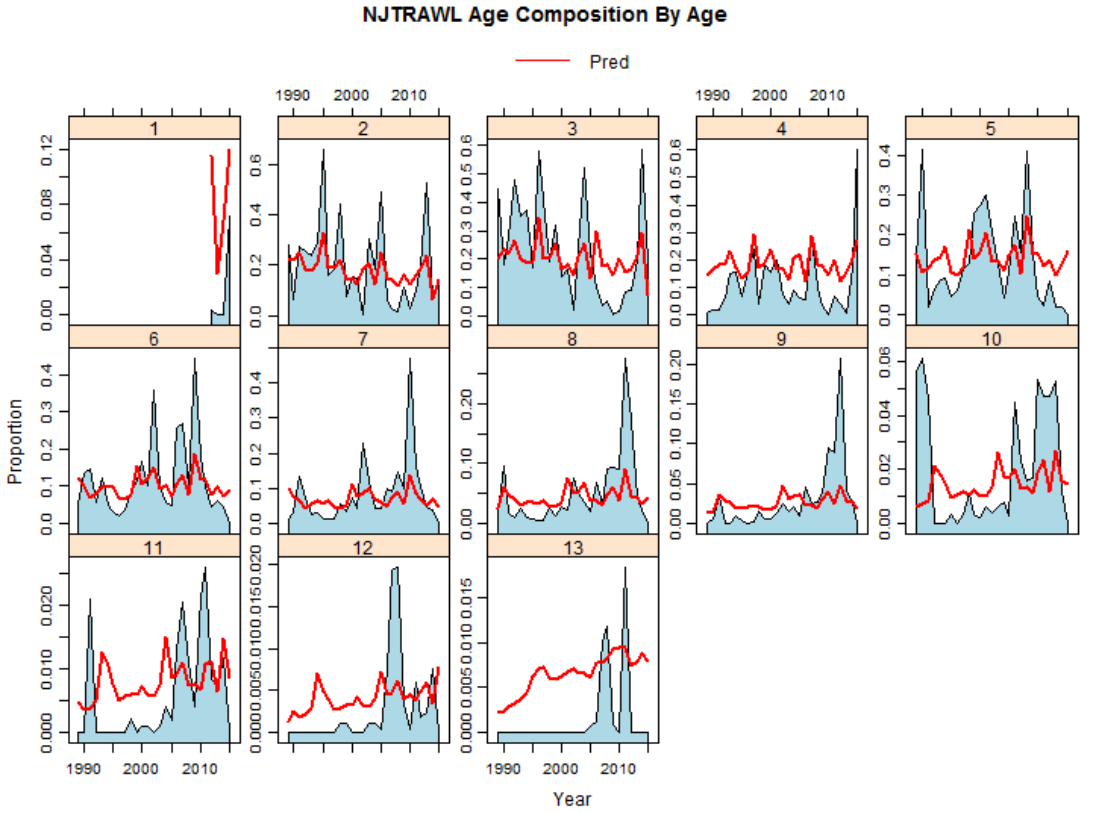


Figure 12. Observed and predicted proportions-at-age and residuals for each year by age for the NJ Trawl survey.



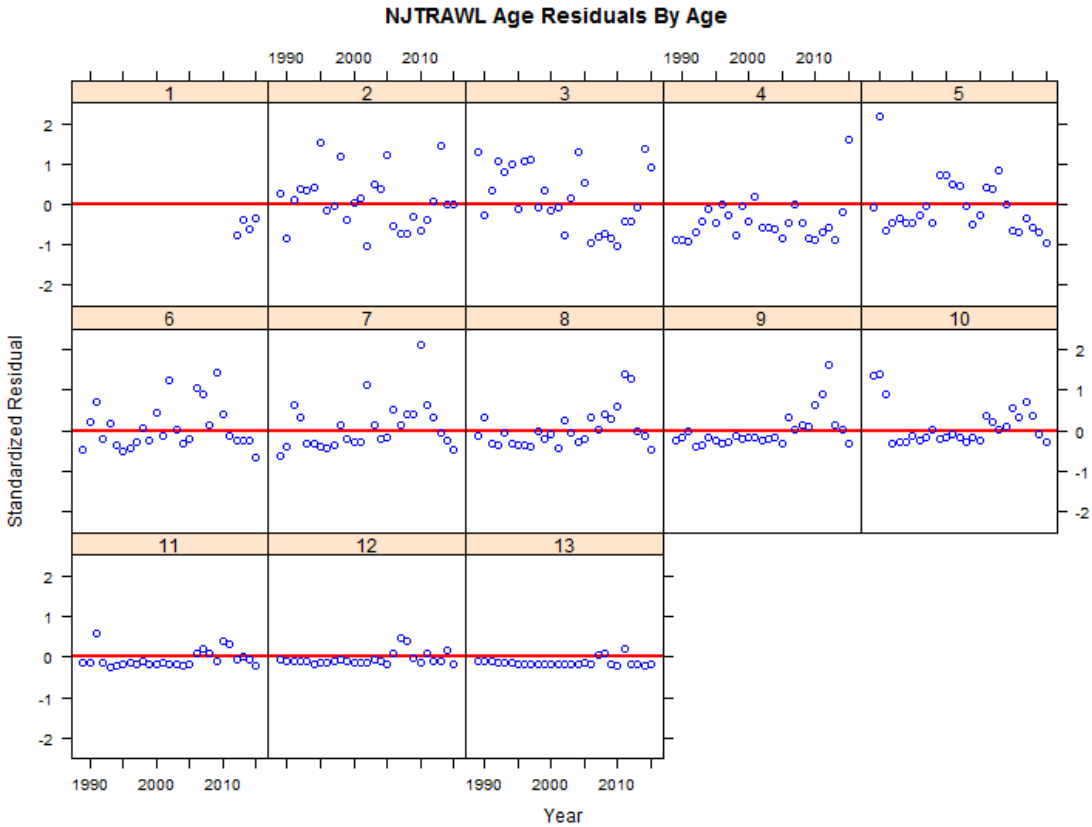


Figure 13. Observed and predicted proportions-at-age for each age by year for the MD SSN gillnet survey.

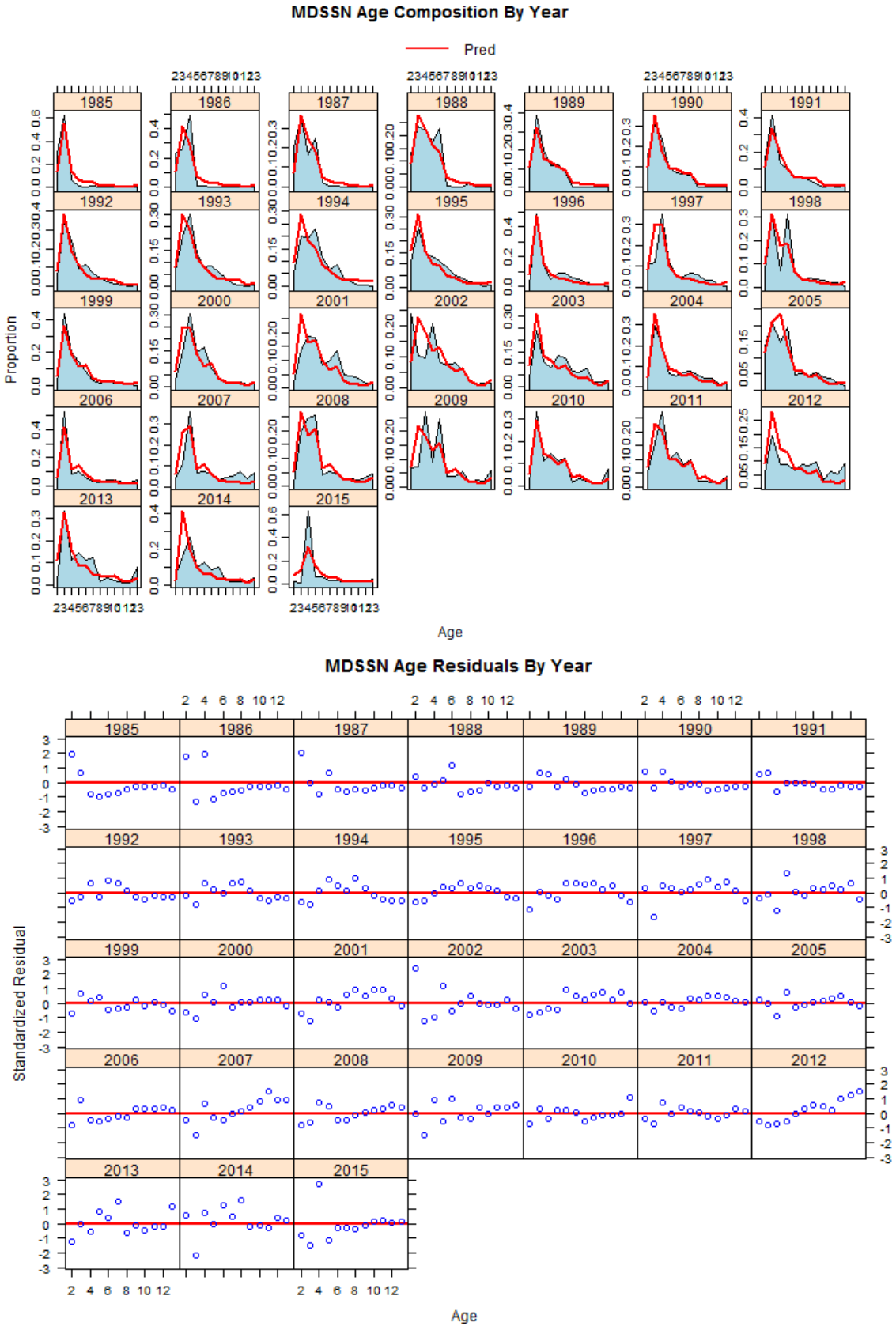


Figure 14. Observed and predicted proportions-at-age and standardized residuals for each year by age for the MD SSN gillnet survey.

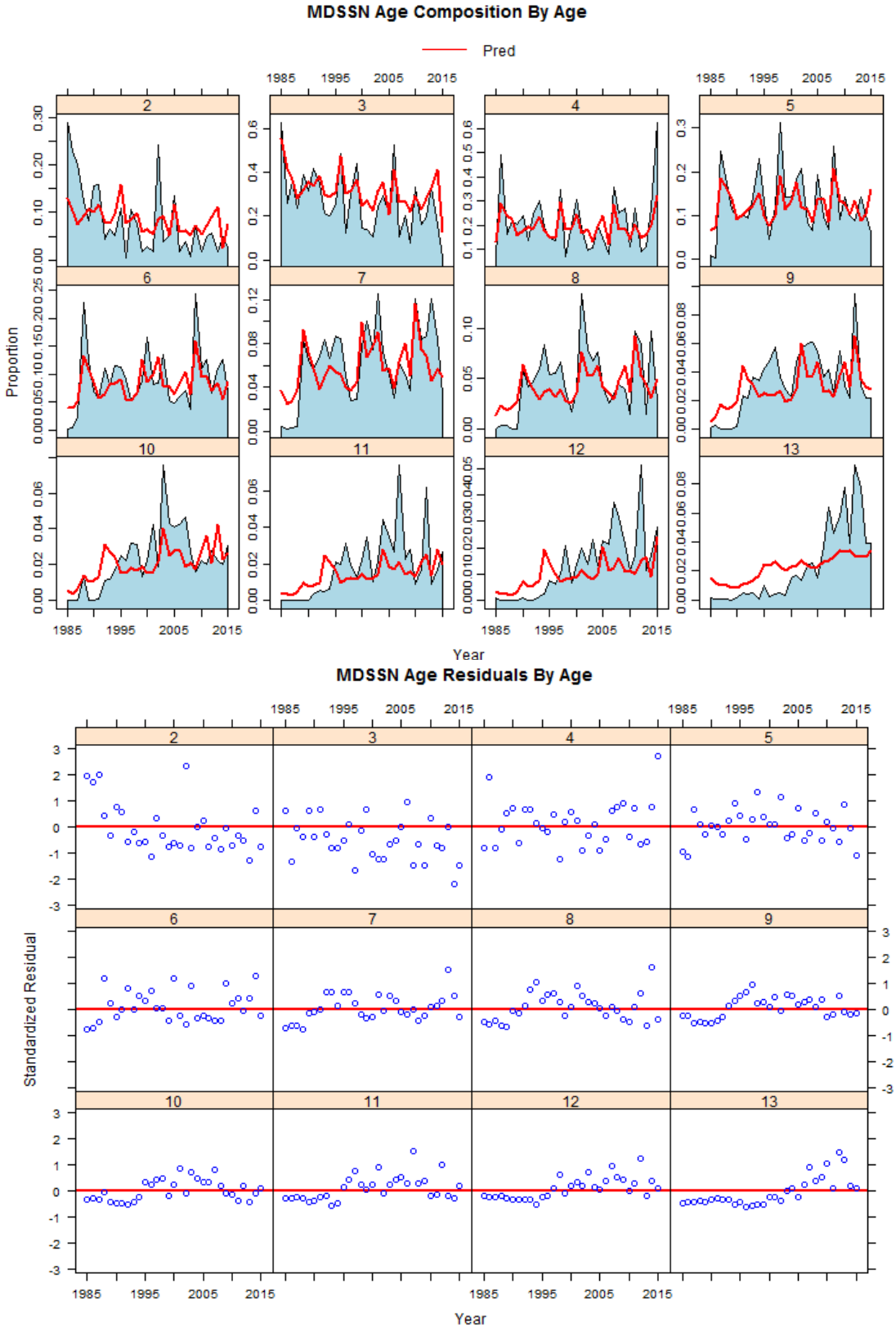


Figure 15. Observed and predicted proportions-at-age and standardized residuals for each age by year for the DE SSN electrofishing survey.

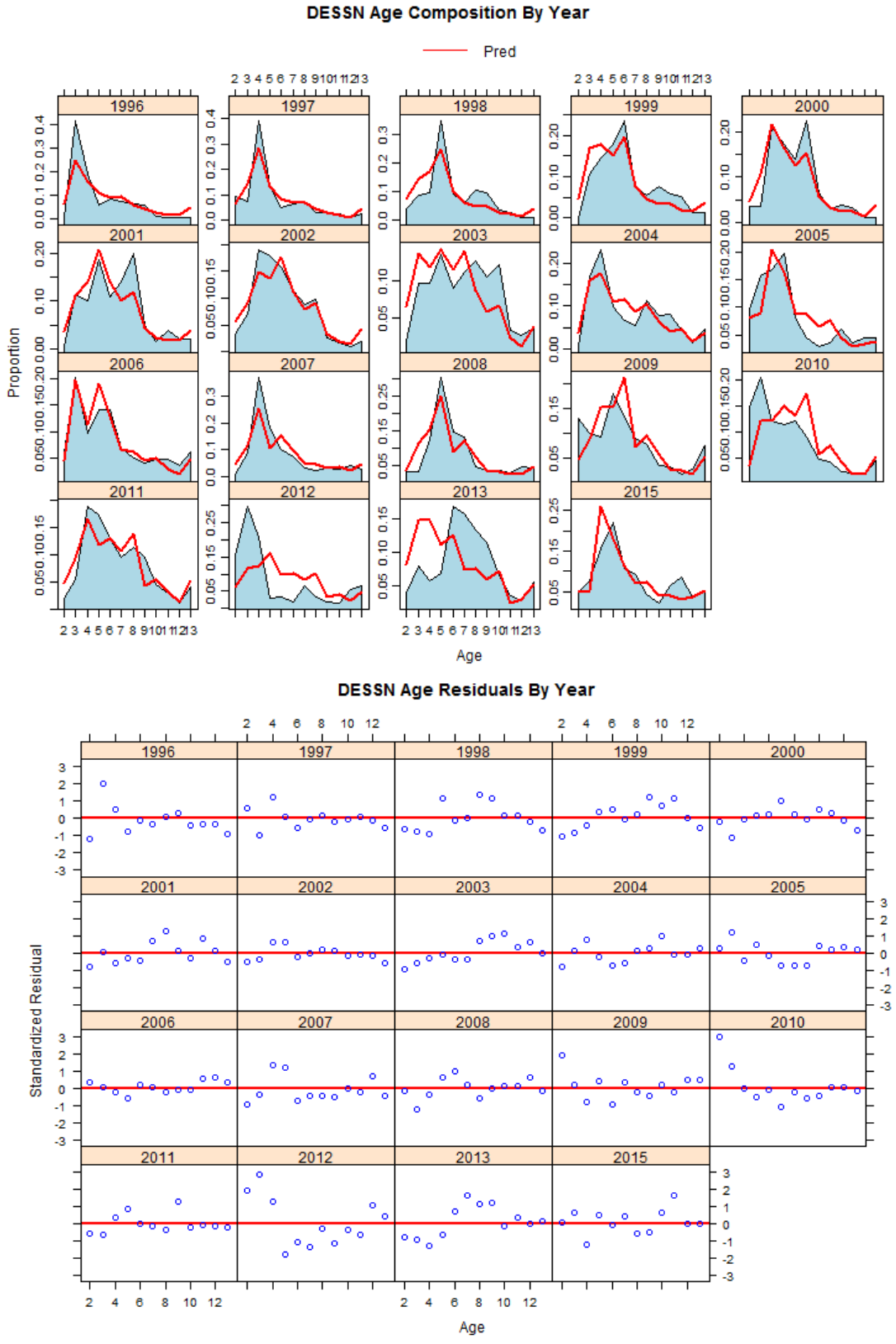


Figure 16. Observed and predicted proportions-at-age and standardized residuals for each year by age for the DE SSN electrofishing survey.

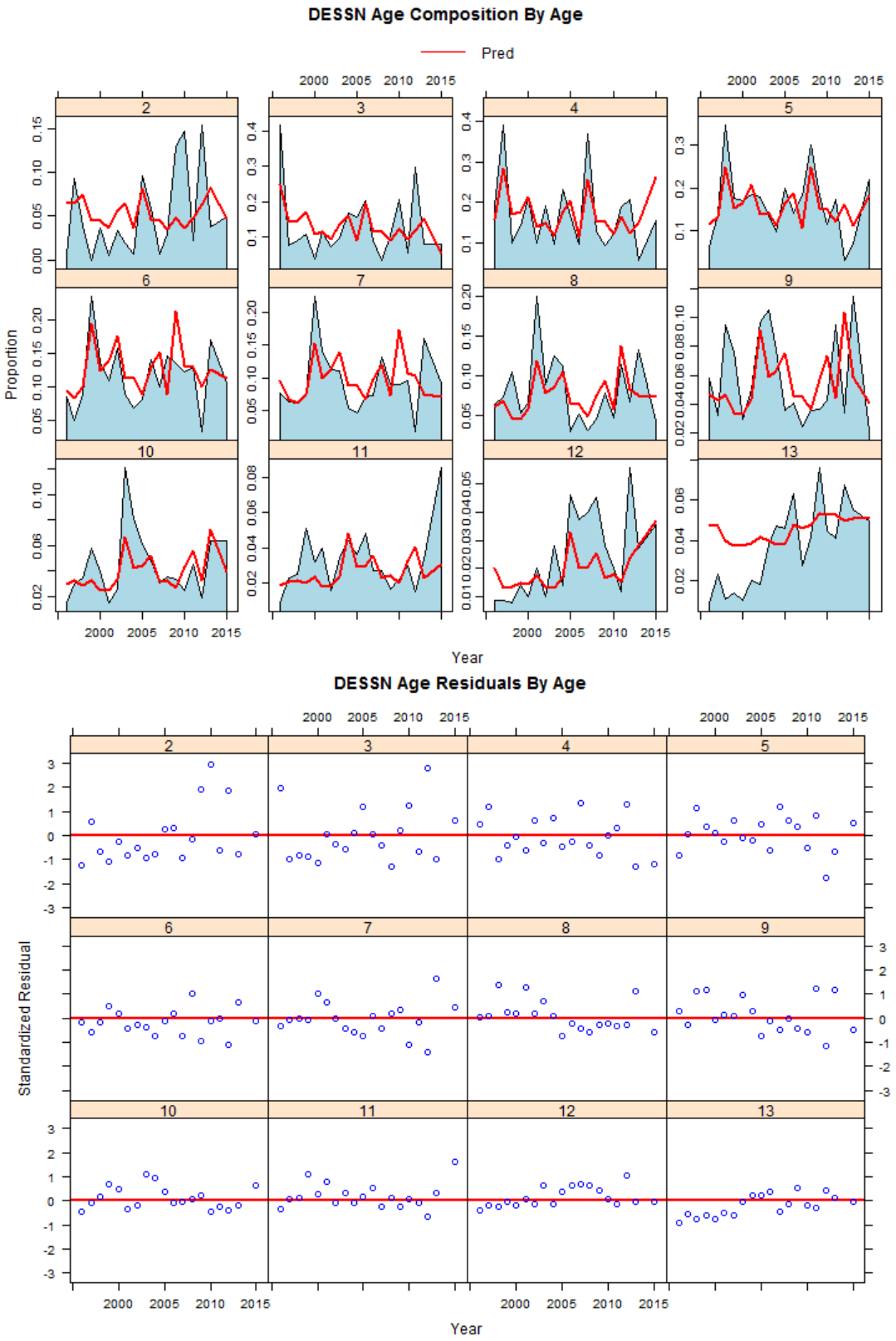


Figure 17. Observed and predicted proportions-at-age and standardized residuals for each age by year for the VAPNET survey.

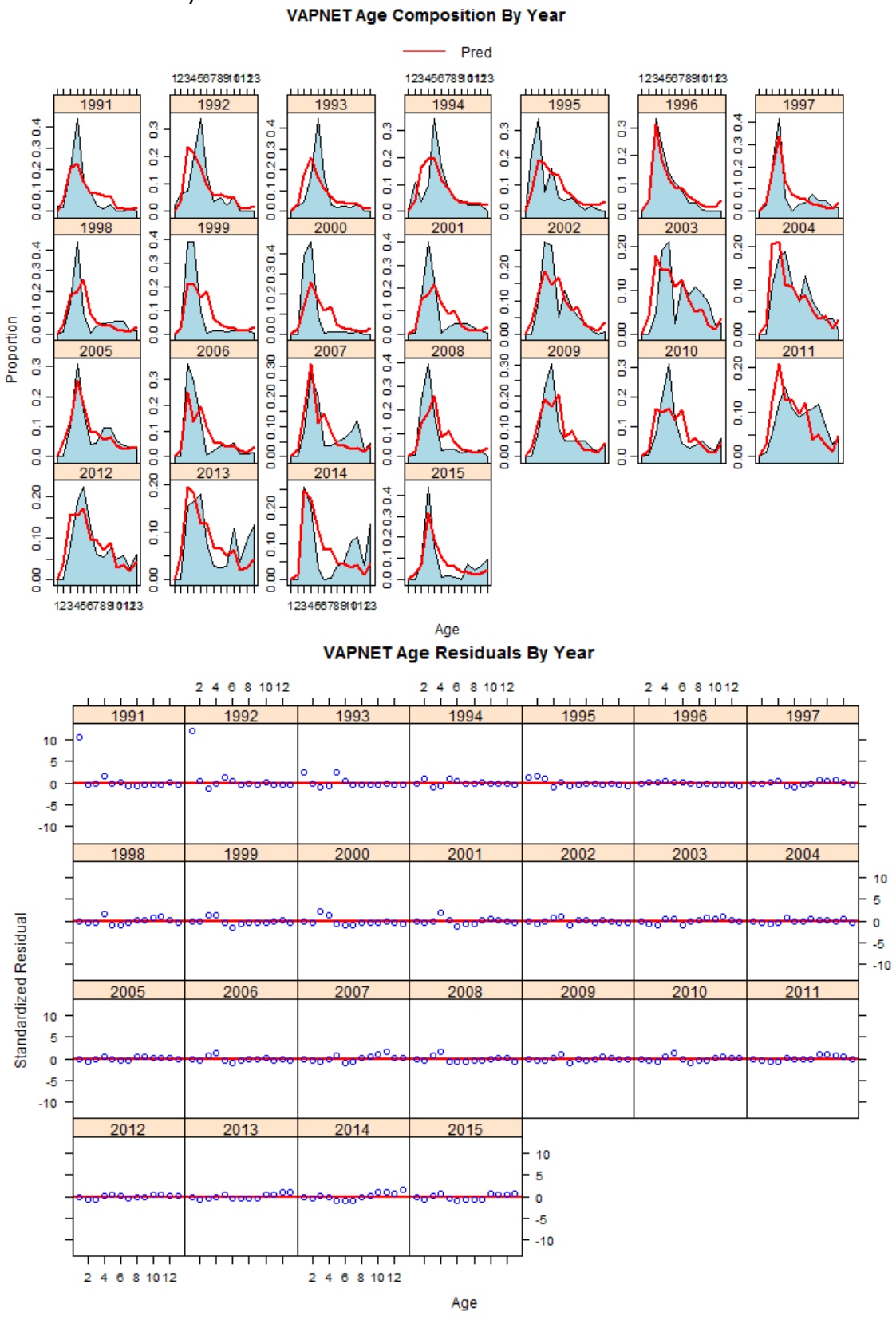


Figure 18. Observed and predicted proportions-at-age and standardized residuals for each year by age for the VAPNET survey.