Atlantic States Marine Fisheries Commission

Atlantic Striped Bass Management Board

November 4, 2015
8:00 – 10:00 a.m.
St. Augustine, Florida

Agenda

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

1. Welcome/Call to Order (*D. Grout)* 8:00 a.m.

2. Board Consent 8:00 a.m.
   - Approval of Agenda
   - Approval of Proceedings from August 2015

3. Public Comment 8:05 a.m.

4. 2015 Atlantic Striped Bass Stock Assessment Update **Action** 8:15 a.m.
   - Presentation of Stock Assessment Update (*C. Godwin*)
   - Consider Acceptance of Stock Assessment Update for Management Use

5. Technical Committee Report (*C. Godwin*) 9:15 a.m.
   - Comparing Atlantic Striped Bass Fishing Mortality Reference Points Using Two Different Time Periods for Selectivity

6. Other Business/Adjourn 10:00 a.m.

The meeting will be held at the World Golf Village Renaissance; 500 S. Legacy Trail; St. Augustine, FL; 904-940-8000

MEETING OVERVIEW

Atlantic Striped Bass Management Board Meeting
Wednesday, November 4, 2015
8:00 – 10:00 a.m.
Saint Augustine, Florida

Chair: Doug Grout (NH) Assumed Chairmanship: 02/14	Technical Committee Chair: Charlton Godwin (NC)	Law Enforcement Committee Rep: Kurt Blanchard (RI)
Vice Chair: Jim Gilmore (NY)	Advisory Panel Chair: Kelly Place (VA)	Previous Board Meeting: August 5, 2015
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 August 2015

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. 2015 Atlantic Striped Bass Stock Assessment Update (8:15 – 9:15 a.m.) ACTION

Background

- The 2015 Atlantic Striped Bass Stock Assessment Update was completed in October (**Briefing Materials**).

Presentations

- 2015 Atlantic Striped Bass Stock Assessment Update by C. Godwin

Board Actions for Consideration

- Accept the 2015 Atlantic Striped Bass Stock Assessment Update for management use

5. Technical Committee Report (9:15 – 10:00 a.m.)

Background

- In May 2015, the Board tasked the Technical Committee to develop fishing mortality (F) reference points for the ocean and discard fleet consistent with those developed for the Chesapeake Bay. At their August meeting, the Board reviewed a Technical Committee Report detailing F reference points for each of the three fleets.
- Upon review, the Board tasked the Technical Committee to redevelop the fleet-specific F reference points using an average selectivity over a longer time series (1996-2012, as opposed to 2008-2012 which is the time series used to develop the coastwide F reference points adopted through Addendum IV). The thought being that a longer time series would reflect the regulatory history of the fishery more adequately than the shorter time series.
- The Technical Committee compiled a report that compares the results of both methods and outlines the pros and cons associated with each method (**Briefing Materials)**.

Presentations

- Technical Committee Report by C. Godwin

6. Other Business/Adjourn

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

ATLANTIC STRIPED BASS MANAGEMENT BOARD

The Westin Alexandria
Alexandria, Virginia
August 5, 2015

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1. **Approval of agenda** by consent (Page 1).

2. **Approval of proceedings of August 2015** by consent (Page 1).

3. **Motion to accept the FMP Review for striped bass,** (Page 15). Motion made by Mr. Abbott and seconded by Mr. Emerson. Motion passes unanimously (Page 15).

4. **Move to adjourn** by consent (Page 16).

Draft Proceedings of the Atlantic Striped Bass Management Board Meeting May 2015

ATTENDANCE

Board Members

Terry Stockwell, ME, proxy for P. Keliher (AA)
Rep. Walter Kumiega, ME, proxy for Sen. B. Langley (LA)
Sen. Brian Langley, ME (LA)
G. Ritchie White, NH (GA)
Doug Grout, NH (AA)
Dennis Abbott, NH, proxy for Sen. David H. Watters (LA)
Jocelyn Cary, MA, proxy for Rep. Peake (LA)
Bill Adler, MA (GA)
Daniel McKiernan, MA, proxy for David Pierce (AA)
Mark Gibson, RI, proxy for Robert Ballou (AA)
Eric Reid, RI, proxy for Sen. Sosnowski (LA)
Rep. Craig Miner, CT (LA)
David Simpson, CT (AA)
Lance Stewart, CT (GA)
James Gilmore, NY (AA)
Emerson Hasbrouck, NY (GA)
Katherine Heinlein, NY, proxy for Sen. Boyle (LA)
Russ Allen, NJ, proxy for D. Chanda (AA)
Tom Fote, NJ (GA)
Adam Nowalsky, NJ, proxy for Assy. Andrzejczak (LA)
Leroy Young, PA, proxy for J. Arway (AA)
Tom Moore, PA, proxy for Rep. Mike Vereb (LA)
Loren Lustig, PA (GA)
Roy Miller, DE (GA)
John Clark, DE, proxy for David Saveikis (AA)
Craig Pugh, DE, proxy for Rep. Carson (LA)
David Sikorski, MD, proxy for Sel. Dana Stein (LA)
Mike Luisi, MD (AA)
Bill Goldsborough, MD (GA)
Kyle Schick, VA, proxy for Sen. Richard Stuart (LA)
Cathy Davenport, VA (GA)
Rob O'Reilly, VA, proxy for John Bull (AA)
Michelle Duval, NC, proxy for Dr. Daniel, Chair (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

Charlton Godwin, Technical Committee Chair
Kelly Place, Advisory Panel Chair

Staff

Robert Beal
Toni Kerns
Mike Waine
Katie Drew
Max Appelman

Guests

Robert T. Brown, MDWA
Rep. Bob Steinburg, NC
Pat Geer, GA
Wilson Laney, USFWS
George O'Donnell, MD DNR
Aaron Kornbluth, PEW
Kevin Chew, GARFO
Brandon Muffley, NJ DFW
Jack Travelstead, CCA
Ketih Auston, Jr., MCBA/SCCA
John Bello, VSSA
Doug Ochsenknecht, VSSA
Tom O'Connell, MD CBA
Phil Langley, MD CBA
Frank Abner, MD CBA
Bob Baker, MD CBA
Arnold Leo, NY
Curtis Johns, MD CBA
Meghan Lapp, Seafreeze LTD.
John Carmichael, SAFMC
Greg Drury, MD CBA
Tom Ireland, MD CBA
Harry Neld, MD CBA
Christopher Diehl, MD CBA

Russell Green, MD CBA
Eddie Green, MD CBA
Ken Hastings, Mason Springs Conserv.
John Bullard, NMFS
Mark Belton, MD DNR
Alexei Sharov, MD DNR
Marin Hawk, MS

The Atlantic Striped Bass Management Board of the Atlantic States Marine Fisheries Commission convened in the Edison Ballroom of The Westin Alexandria, Alexandria, Virginia, August 5, 2015, and was called to order at 1:15 o'clock p.m. by Chairman Douglas E. Grout.

CALL TO ORDER

CHAIRMAN DOUGLAS E. GROUT: Good afternoon, everybody. This is a meeting of the Striped Bass Board. My name is Doug Grout; I'm the Chair. We have an agenda today which involved getting a couple of technical committee reports; one on estimated harvest reductions in 2015 and then a report of fleet-specific fishing mortality reference points.

APPROVAL OF AGENDA

CHAIRMAN GROUT: Also we will be doing the FMP Review and state compliance reports. I just want to make one change to the agenda. I'm going to flip the order of the technical committee reports. We've decided that it would make for more of a smooth transition if we have the estimated harvest reduction report first. Are there any other changes to the agenda that anybody would like to have? Seeing none; any objections to approving the agenda? Seeing none; the agenda is approved.

APPROVAL OF PROCEEDINGS

CHAIRMAN GROUT: Also in your documents we our proceedings from our May meeting. Are there any comments or changes on the meeting minutes that were provided to us for that meeting? Seeing none; is there any objection to us approving the May 2015 proceedings? Seeing none; they'll stand approved. Before we go into the third item, I'd like to take a little liberty to recognize the former chair of the Striped Bass Board, my predecessor Tom O'Connell.

It is good to see you back here at the commission process. We really appreciate all the work that you've done here with the commission over the years and we're glad to see you back. (Applause)

PUBLIC COMMENT

Item 3 here is for public comment. I have two people signed up for the public comment period. I want to emphasize that this is for public comment on things that are not on the agenda. Obviously, we don't want to take any public comment on the technical reports or the FMP review. The first person I have is Robert T. Brown.

MR. ROBERT T. BROWN: Mr. Chairman, Robert T. Brown, President of the Maryland Watermen's Association. I have two graphs here. Hopefully each state got a copy of it. They are from the Atlantic States Marine Fisheries Commission. When I was going through it for my testimony today, I looked at it and looked where you were back in 1982 to where one goes to 20010 and another one goes to 2013. It looks like we've got a success here.

Just look where we were at then and where we are now. We didn't get there very easily. Back before 1985, before the moratorium, in Maryland we fished on rockfish minimum size of 12 inches and maximum size of 32; 24 hours a day; 365 days a year; no quotas; and fished on the spawning grounds. Today we've got a minimum size of an 18-inch fish, maximum of 36. We don't fish during the spawning seasons. We've got quotas that we meet and we keep.

Back in the early eighties and late seventies I caught more fish in one night than what I'm allowed in an entire season now. As you look at these graphs, I've heard the northern states say before we got this 25 percent reduction last fall and 20.5 on the Chesapeake Bay that they

weren't catching any – couldn't see the rockfish up and down the coast.

Well, according to these charts, which are produced by the Atlantic States Marine Fisheries Commission and the technical committee, they are out there somewhere. Well, about three or four weeks when Massachusetts opened its season, within three days our large rockfish, eight pounds and better, want from $5.50 a pound down to three dollars a pound in a matter of three or four days. That is the volume of fish that are out there.

They are out there; the market showed they're there; the charts show they're there. Fish change their patterns in where they stay at. Maybe during the summer when they're fishing, they go out past that three miles where you can't catch them. Who knows why fish go where they go? They have a head, they have a tail, they go where the feed is.

One of the things we have was when they raised this – on these charts, as you can see in both of the graphs, the level of the biomass is higher now than when the stock declared recovered back in 1995. Addendum IV came in the graph, a closer value, but still the biomass is greater than it was in 1995. We're fishing on a recovered fishery. The cut that we had last year, that 20.5 percent has really crippled the state of Maryland and the Chesapeake Bay.

I don't believe that it was correct that it was done but nevertheless that's what we have to live with. In the state of Maryland, according to the biologists in Maryland, anywhere from 70 to 90 percent of the fish that are caught are male fish. That has nothing to do with your female spawning stock. During the seasons, we have a maximum of 36 inches except for during the trophy season, which the charterboats have.

Well, this year they had to be sealed at a 36-inch maximum size or have a slot limit. A lot of them are – the people who had the party said they wouldn't be back if they had to deal with a slot limit again. Well, they've got a three-week season and they're allowed one fish per person within the slot limit or 36 or more.

However, they say, you know, to do that because those fish are getting ready to spawn, to save them. Well, on the ocean you've got a 36-inch minimum size on most of the coastal states. Well, if you catch them tomorrow or you caught him today or you catch him next week, that's before he spawns the next season. Our charterboats took a big hit last year on it and our sports fishermen.

Hopefully that won't happen again next year. Fishery management is a hard science. It is also a guesstimate. I just would like to say I think we've come a long way since 1982, and we are successful in what we did. We did bite the bullet and we have had to sacrifice. We need to get back on track and get our quotas back where we are.

If you look at the young-of-the-year index over the years, just because the young-of-the-year index or you have a bio-stock or spawning fish, it doesn't mean you're going to have a high index. If you look on some of your lower years, that's when you had your highest young-of-the-year class. I want to thank you for the opportunity of speaking to you today.

CHAIRMAN GROUT: Thank you, Mr. Brown. I also have Phil Langley here.

MR. PHIL LANGLEY: My name is Phil Langley. I'm actually President of the Maryland Charterboat Association. I also sit on Maryland's Sportfish Advisory; and I'm also one of the commissioners on the Potomac River Fisheries Commission. Clearly, everybody here today has a great concern and passion for our fishery; but before I start saying what I have to say, I would like to address everybody at this table and thank everybody sitting here for the extra time and commitment that you exhibit for our fishery.

Representing the Maryland Charterboat Association, our association is fully committed to conserving our resources. However, we are asking this commission to please give additional consideration to the economic impacts to our businesses as discussions are moving forward. In a downturned economy in recent years, combined with 2015 reductions absorbed in one year, many captains are struggling to stay in business.

The economic impacts to the charter industry this year will be felt in future years for either cost of advertising and marketing expenses to replace lost business from this year. In the bay we have a limited number of species to target, which makes striped bass critical to the livelihood of the charter fleet in the bay.

The latest statistics do indicate that the stock is not overfished and overfishing is not occurring. As stated earlier, we are fully committed to protecting the resource. However, we have a hard time understanding how the reductions we are taking in our summer/fall fishery is protecting the spawning stock biomass when it is heavily skewed towards the male fishery, approximately 80 percent.

In closing, I would like to recognize a group of charterboat captains from Maryland against the back wall, who have taken time out of their day today to come and show up at this meeting as far as to exhibit the importance of this meeting and what it has on their livelihoods. These guys are ambassadors of the Chesapeake Bay. They introduce thousands and thousands of kids to the bay and to first-time fishing, as well as responsible for introducing a lot of recreational anglers to buying their first boat and to continue into the fishery as a sport. That's all I have to say. Thank you and I do appreciate your time.

TECHNICAL COMMITTEE REPORT

2015 HARVEST REDUCTION ESTIMATE

CHAIRMAN GROUT: Thank you, Mr. Langley; and that's the last person I have on the list. We will be moving on to Agenda Item 4, which are technical committee reports. These are both responses to charges that we made to the technical committee. I will turn it over to Charlton.

MR. CHARLTON GODWIN: The first report we're going to have from the technical committee is the 2015 harvest reduction estimate. We will go over this one first and have some time for questions after this. As we know, the board approved Addendum IV in 2014, which established new coast-wide reference points and also required states to reduce removals in order to reduce F to a level at or below the new target.

This was a total of a 25 percent reduction for the coastal states and a 20.5 percent reduction for the Chesapeake Bay states. Of course, the commercial fisheries reduced their removals through the quota reductions. The recreational fisheries reduced their removals through bag limit and size limit restrictions.

Once again, Addendum IV required – you can see the percent reductions for the coastal states and for the Chesapeake Bay states' jurisdictions. We've just got this broken out by each region and each sector just to give you an idea of the reference harvest estimate and then the harvest estimate in 2015 after the reductions.

In each sector you see the percent reduction from the reference harvest; and then the total reduction at the bottom is 25.6 percent. Through the reductions from the various sectors, the states implementing their management measures for recreational fisheries, we were able to reduce to the target level.

The board members also wanted to look at the issue of non-compliance. The technical committee had originally looked at a hundred percent compliance rate for the 25 harvest reductions. This is due to different state-by-state regulations. The really unpredictable angler behavior and weather can have such a big impact on fisheries. The MRIP Survey is not really set up to estimate compliance.

For those reasons, the technical committee used the hundred percent compliance rate. At the board's request, we looked at the non-compliance harvest in years 2011, '12 and '13. This is looking at the MRFSS data, looking at the numbers of fish, some catch frequency of three fish or greater.

You can see that it varies from year to year, from 4 percent to 15 percent in 2013, for a total of 7 percent. These calculations are based on the historical MRFSS weighting and did not include the new MRIP Re-estimation Methodology. Really, for the first part, that's it for the first three slides. We can take any questions on the reductions on the non-compliance.

FLEET-SPECIFIC FISHING MORTALITY

REFERENCE POINTS

CHAIRMAN GROUT: Any questions from the board? Okay, seeing none, thank you very much, Charlton. You can on to the fleet-specific reference points.

MR. GODWIN: The next presentation will be about the fleet-specific reference points. Just to add some background, in the 2013 benchmark stock assessment we used three fleets in the model; the Chesapeake Bay fleet, the ocean fleet and the commercial discard fleet. Just as a reminder, we have this separate commercial discard fleet because the way the commercial discards are estimated based on return rate of tag returns from the various sectors, these commercial discards cannot be separated into bay and ocean removals; so all of those discards from those sectors are modeled as a single fleet.

The 2013 stock assessment recommended and developed new coast-wide reference points for fishing mortality and spawning stock biomass. These biological reference points were developed using a composite selectivity that represented the selectivity of all the three fleets weighted on how much they contributed to the total F over the last five years. Those are the new SSB and F reference points from that 2013 assessment.

Just to give an idea of once again how the total Fs are calculated; we have the discard fleet is the gray bars at the top of each bar. The ocean fleet is the orange in the middle and the Chesapeake Bay fleet is represented by the blue in the bottom. This is just an at-age – the bottom axis is age. This is how the total F at age by fleet is derived.

Once again from the 2013 assessment, the assessment found F was below the threshold so overfishing was not occurring; but it was indeed over the target in the terminal year of 2012. You can see that in the previous ten years it had actually been over the threshold for several of those years. The Striped Bass Board asked the technical committee to develop reference points for the Chesapeake Bay, Delaware Bay and Hudson River.

At our previous meeting we brought back to the board that it was a viable option and within the scope of an assessment update to look at developing a Chesapeake Bay fishing mortality reference point. It was a viable option but not within the scope of the assessment update to try to develop a Delaware Bay reference point.

At this time with the data we have, it is not possible to derive a fishing mortality reference point for the Hudson River using this modeling methodology. Since the last meeting, the technical committee did develop these fleet-

specific reference points intended to ensure the impact of each fleet on the total coast-wide population to remain sustainable.

When each fleet fishes at its target reference point, the total F at age on the population will be equal to the coast-wide F target. This is just how each fleet's target and threshold is set. It is the proportion of its full F at age over the last five years multiplied by the coast-wide target and the threshold F at that age. That is just for each one of the fleets, the bay, the ocean, and the commercial discards.

For the reference points that came out of that, looking at the ocean fleet you can see the F target of 0.141; the threshold of 01.72; and then the portion of the F in 2012 attributed to the ocean fleet's of 0.14. That was actually right at the target where that last column is just a percent difference from the target in 2012.

Once again for the Chesapeake Bay, a much smaller F target, 0.052; 0.64; and the fishing mortality attributed to the bay in 2012 is 0.059. That was actually a little bit over the target but still below the threshold. Then for the last fleet of commercial discards; the F target of 0.019, 0.024, 0.041; and that was over the target in 2012 by 50 percent.

I think it is important again to note, though, that the commercial discards, the way that these are calculated using the tag-return information, is one of the most imprecise estimates we have that go into the model of these three fleets of the harvest. Once again, looking at this graphically for the Chesapeake Bay fleet and the ocean fleet, F in the ocean has declined faster than the F in the bay over the last five years.

A lot of that has to do with the fact that the Chesapeake Bay has an annual quota and their harvest levels remain more constant and the harvest in the ocean can increase substantially based on the year class abundance and just availability of the fish and different economic pressures from year to year.

Some potential management issues and just some things to remind the board to be thinking about; once again, there is a lot of uncertainty in those discard estimates. Discards are primarily regulatory. It has to do with the size limits, closed seasons, quotas and gear restrictions. It is difficult to control that F that is attributed to the discard fleet as strong year classes move through. It is the same as with the discards in other sectors; strong year classes are going to lead to high discards. Looser regulations may shift F to the directed fleet; the restrictions implemented for biological reasons.

The target and threshold for the commercial discard fleet may not really be meaningful for management. It is not really biologically reference point based. The population could still experience overfishing even with the bay and ocean fleets fishing at the targets if the discard F is not controlled.

Just to go over some more management issues; remember the management triggers that we currently have in Amendment 6, board action is required when the fishing mortality reference points are exceeded. If the fishing mortality threshold is exceeded in any year, the board must reduce F to the target within a year.

If the fishing mortality target is exceeded two consecutive years and the female SSB is below the target in any of those years, the board must reduce the target within one year. This is basically what initiated Addendum IV that was approved last year. Just once again potential management issues to have to consider if we were to use these three F targets for the different fleets; consider changes to reflect the fleet-specific reference point management triggers; and now you have four sets of potential reference points and management triggers to consider if you were to move in that direction. I think with that we'll take any questions.

MR. JOHN CLARK: My first question, Charlton, would be about the discard reference points. Would you just give a little more detail as to how that was calculated and which fisheries you're seeing most of this discarding from?

MR. GODWIN: Once again, I guess maybe this may be the best slide to look at; but that reference point is still calculated as the proportion of its F at age over the last five years and its contribution to the coast-wide target and threshold at age. It is the same methodology for both the bay fleet and the coastal fleet.

MR. CLARK: I think I was just more concerned of which data from which fisheries; if you have any idea of where most of that is coming from. Just based on our experience in Delaware with discarding, it seems like a –

MR. GODWIN: The discards I guess, if I'm understanding your question, the way we calculate commercial discards themselves; that is a function of the number of tag returns from the recreational sector and the number of tag returns from each of the various commercial sectors and the gears.

That ratio of those tag returns to each other is how these commercial discards are estimated. To my knowledge there are no specific observer programs in any commercial fishery to where we're using empirical observer data or anything like that. Nothing from the independent surveys as a proxy for discards; it is just that tag-return-ration model; the same way those discards have been calculated through the years.

MR. MIKE LUISI: Charlton, thanks for the presentation. I read the description and I've seen your presentation about the methodologies used to calculate the fleet reference points. I understand that it was decided by the technical committee to present today to the board the methodologies that you used where you took the F at age from the Chesapeake Bay fleet compared to the total fleet over five years' time to calculate those points.

I also understand that there was an alternative approach that was brought up for discussion at the technical committee for calculating those fleet reference points, taking into consideration a much longer time period, starting back in 1996 to 2012 when management along the coast and in the bay were consistent and similar.

If this is accurate, can you provide some feedback to the board regarding the debate and explain a little bit about the technical committee's rationale only to bring to the attention of the board today the alternative option that used the five-year time period instead of consideration of multiple years outside of that five-year period?

MR. GODWIN: The time frame of years you're talking about were relative to the selectivity patterns that we assigned to these different fleets. It was just really a consistency issue. We went back and forth and did discuss the longer time frame. The reason we ended up going with the five-year time frame is because it is more consistent with the coastal and what was done in the benchmark stock assessment; more consistent with the coastal reference.

We did look at those and I don't remember off the top of my head the difference that it made. I don't know if we ever even calculated with both methodologies. I don't think the difference in this target reference for each particular fleet – I don't think it would have been much difference using the 12-year selectivity block versus the 5-year selectivity block.

CHAIRMAN GROUT: Do you have a follow-up, Mike?

MR. LUISI: Yes, I do, thank you. Well, I believe that the use – well, it is my opinion that the use of a longer time series would take into consideration a lot of the variable changes that

we have seen as stock has grown and has declined. The development of reference points using a five-year period of the F ratio, it is during a time when we've had a declining spawning stock; and it doesn't take into consideration these variable effects on fishing mortality, year class strengths, annual climate variations, effort variability, et cetera, et cetera, et cetera.

If it is a consistency thing that we're talking about, I'm not sure that there is much more – I don't that there is another fishery along the Atlantic coast right now that has as much consistency over the past 20 years leading up to changes we're made than with the striped bass fishery. I would think that this alternative analysis including a much larger, wide-ranging time period would be something that this board would like to see. We'll see how the discussion goes, but I think that's something that would be appropriate to present back to the board at another time.

MR. WILLIAM A. ADLER: Mr. Chairman, I'm referring here to Figure 3, Page 7, the charts. Excuse my ignorance here; but commercial discard fleet; what is it? I mean is this commercial catches that are thrown back over? Where does that come into play with what they – what is it?

MR. GODWIN: The commercial discards is exactly that; it is composed of fish that are maybe thrown back because they're undersize. It is composed of fish that are thrown back because it is out of the season or the harvest season. We have discards in the recreational sector as well. Most of those discards; they either come from fish that are under the size limit for the particular state or maybe if the angler is over their bag limit and they catch a few. We just don't model the recreational discards separately. They are modeled in with the catch.

Because of the way we have to estimate the commercial discards, we don't have a very way of estimating specifically commercial discards from the gillnet fishery in the Chesapeake Bay or commercial discards from the pound net fishery. Because of the way we have to estimate these discards, there is really no good, clean place to put them; so we just lump all that into one particular fleet and it is modeled that way. These commercial discards; it is really the same way that we've always estimated the discards from the various sectors in the stock assessments.

MR. ADLER: If I may, Mr. Chairman, then the other ones are commercial catches that are not discarded; am I correct?

MR. GODWIN: Correct.

MR. ROB O'REILLY: Mr. Chairman, I, too, have a couple of comments about the ratio of age five full F in the bay and the coast as it pertains to the biological reference points. I think the way I look at that is the last five years, through 2012, if you look at those graphs that were handed out earlier to us at the beginning of the meeting – and I think we already know this; that there is a non-equilibrium situation.

I'm not sure why you would want a biological reference point that was based on that type of information, non-equilibrium. The other part of this, I think Mike covered some of it, but the period from 1996 to 2012, the word "consistency" was mentioned in relation to the five years; but the consistency really is the regulations.

It is also the fact that you have three stocks primarily that are part of that full F on age five that is being looked at for the reference points. The variability of those stocks isn't linear; so there might be one stock more abundant or biomass might be better in one year than another. I think a longer time series at least gives you an idea of how you deal with that variability rather than taking a snapshot of the last five years. I appreciate the time.

MR. MARK GIBSON: Mr. Chairman, I want to follow up a little more on the length of the duration of the window for the computation. The question I have is in the SCA Model you have to set selectivity blocks to the separability assume; and what is the length of the window in the terminal year block?

DR. KATIE DREW: The longer time series that they're referencing, the '96 to 2012, is a single block within the model; so that is a single, constant selectivity block over that time. Obviously, that doesn't reflect the changes in effort that each fleet may or may not undergo.

DR. MICHELLE DUVAL: Mr. Chairman, my question was really about these differences on the slide in the commercial discard fleet. Those are such small numbers when we're talking about an F target and F threshold. Charlton, I was wondering if you might be able to put that into context in terms of something that I think the public could understand whether it is pounds of fish or numbers of fish or something like that. I think it is difficult for the public to grasp that just looking at F targets and thresholds that small in terms of what 52.8 percent difference means. Thank you.

MR. GODWIN: As far as numbers of fish, just to give you some sort of idea of what that kind of F target and referencing just really what the discards have been in that sector; if you look for the commercial discards, they average anywhere from a couple of hundred thousand fish to this most recent estimate was actually one of the highest in the time series to about 900,000 fish.

This is compared to total removals of three or four million fish in some years, to give you kind of an idea of the numbers of that commercial discard. Like I say, those estimates are really the least precise estimates that we have that go into the three different fleet models. That is something that we've kind of struggled with in estimating those numbers through the years.

MR. CLARK: Charlton, I just want to get back to something you said about the Delaware Bay reference points. You said it is a viable option to create reference points but not for an assessment update. Does this mean that you're planning to do those for the benchmark assessment; and prior to the benchmark would you be able to produce anything preliminary just so we could see what they might look like?

MR. GODWIN: I think that's up to the discretion of the board which way they want to go to continue developing those. The reason we kind of said that was a viable option is because, yes, that Delaware Bay – the harvest in that Delaware Bay fleet could be separated out fairly easily and put into a separate fleet in the model. Because it wasn't modeled that way in the benchmark, a stock assessment update, that would be considered a fairly substantial change. I think, yes, if the board wishes to continue looking at that a reference point in the future, I think we can certainly do that.

REPRESENTATIVE WALTER A. KUMIEGA, III: Are there any thoughts or discussion about how to improve the numbers on the commercial discards? I originally was going to ask if there was any way we could possibly reduce that number; but I don't think that number is good enough. I don't think we have enough information to really ask the commercial fleet or talk to the commercial fleet – and it is obviously more than one fleet. It is a lot of different fisheries. I mean, there is nothing worse than throwing dead fish overboard. If there is a way we can work on getting better information on that, maybe there is a way that can be reduced.

MR. GODWIN: I think really the ideal way to estimate discards from that sector would be to have some sort of observer in those fisheries to actually see what is getting discarded. I think your point to the way we currently estimate those discard estimates, it really would be very hard to actually put in some sort of management tool that then we could look at and say, okay,

we've done this and now the discards have been reduced and it is because we did this. I don't think that would work the way we currently estimate those discards based on the tag returns we get from the various sectors.

CHAIRMAN GROUT: Further questions of our Technical Committee Chair from the board? Seeing none; I appreciate the effort that you and the technical committee put in on this. I guess we look forward to the updated assessment at our fall meeting. Mike.

MR. LUISI: Mr. Chairman, this is not a question for the technical committee; but I had another comment that I'd like to make. This issue about Chesapeake reference points is something that is very important to us, especially in the bay states, specifically in Maryland. We've heard from the public today, both the commercial and for-hire fleet.

The recreational fishermen in our state and in the bay also feel that this is a very important issue. I want to remind the board that this objective was part of the original development of Addendum IV back two years ago. Getting to the point where we are today, we were able to see the development of these reference points, which I have to applaud the technical committee for the work as well as ASMFC staff over the last years. I know it has been a very tall order to fill.

Just the showing today of our charter fleet and also the Secretary of the Department of Natural Resources for Maryland, Mr. Mark Belton, is here in attendance with us today to show his support for our continued efforts to move this forward to develop this more fully. I think the board needs to see what I have suggested as another way of looking at reference points for the fleets, taking into consideration a longer period of time and the variation in time that would go into the development of those reference points.

Mr. Chairman, I do have a motion prepared. I did not have a chance to give it to staff prior to this discussion; but if you're okay with that, I can make a motion or suggest what it is we'd like to see the technical committee do in preparation for the annual meeting.

CHAIRMAN GROUT: If you'd like to bring that up as to what you're specifically suggesting, we can see if there is a consensus from the board about this. If there is discussion, then maybe it would be better put into a motion. Try it first as discussion about a specific charge to the technical committee.

MR. LUISI: Thank you for that, Mr. Chairman. The purpose of what we'd like to see would be to direct the Striped Bass Technical Committee to prepare for the board an evaluation of the various methodologies of calculating the F ratio and fleet reference points, which includes not only what they calculated with the five-year time period but inclusion of the 1996 to 2012 time series; present that back to the board with potentially pros and cons of each and an analysis or an assessment of whether or not each one of those options, I would guess we'd call them, are relevant and appropriate for management use to allow for it to maintain a stock at a sustainable level.

I feel that the decision to go with the five-year time series versus a twenty-year time series based on consistency with the previous assessment is not a technically driven decision. I think the decision to which time frame is being used should be a decision made by the board. I would like the board to have all of that information in front of them as well as the assessment update information that I'm aware is taking place as we speak at the annual meeting so that we can have a debate and discussion as to whether or not we move this forward in the form of an addendum for the adoption of these reference points.

Right now given what I've seen and the questions that we've had around the table, I'm not sure that we're at the point today that we

should be initiating an addendum without the full inclusion of the different methodologies and options that were used for calculating reference points. Thank you.

CHAIRMAN GROUT: Charlton, you had a comment about his request.

MR. GODWIN: I just wanted to make one comment just before the board discusses this. If we do look at the 12-year selectivity block; that would also require a recalculation of the current coast-wide F target and threshold that we currently have. In order to be consistent, we would have to recalculate that as well. I just wanted to let everybody know that is what would have to happen.

CHAIRMAN GROUT: I guess my question from a policy standpoint, usually we have updated reference points during a benchmark stock assessment. We have just been through that and the plan this year and as we've been moving forward, it is certainly a turn of the crank.

It is something to consider if we do look at trying to potentially consider modifications of the reference point; that is beyond the scope of the updated stock assessment right now. That's something to consider as we consider Maryland's request here of the technical committee. Do we have any discussion on this? You've heard Maryland's request to have an additional time period looked at in developing fleet reference points. Any discussion on that? Ritchie White.

MR. G. RITCHIE WHITE: I guess a question for the technical committee as to the amount of work involved in this and what workload they presently have and how this might impact that.

DR. DREW: The work of recalculating all the reference points, considering that we have a methodology that the technical committee has accepted and now it is merely a question of time periods involved for both the coastwide and for these fleet-specific reference points, it would not be an outrageous amount of work. I think it is something we could accomplish before the next meeting and be able to present that along with the update information if the board is so interested.

MR. O'REILLY: I'm glad to hear Katie say that because I think this is very important. It is a large step that we had hoped back in October of 2013 would have been done a lot earlier. There are no complaints about the timing; it is just that we keep waiting. I see the table up on the screen and that I would take as an illustration because that places ocean and bay and commercial discard reference points there.

I'm not certain that this isn't a better time, having done the benchmark stock assessment, to allow everyone to see what the changes are because, of course, there would be changes. If there is a difference from the 1996 to 2012 basis for the reference point, then it is going to have some changes in the ocean as well.

I think the points made earlier are at least not from the inter-workings of the model as such, but the fact we are looking at multiple stocks and we looking at not a very minor component of producing the Chesapeake Bay reference points when we look at that ratio of full F on age five in the bay and coast. I hope we can go forward to the annual meeting, have the type of information that Mike Luisi mentions, go through a discussion and vet then go forward at that level. I appreciate the time.

MR. GIBSON: I certainly don't object to the examination of the longer window of time, particularly in respect to the answer to my question on the model configuration and selectivity block. I would just hope that the technical committee – and they're probably already thinking about this – would pay close attention to the stability of the F ratios in the different time blocks, what the variation looks like under this five year versus twelve year,

whether there are time trends or obvious breaks to blocks in the F ratio series and think about that in terms of the pros and cons.

CHAIRMAN GROUT: Anymore questions? Bill.

MR. WILLIAM J. GOLDSBOROUGH: Mr. Chairman, two quick things; one, a clarification. I don't believe it is a 12-year time frame we're looking at but 12 years beyond the 5, so it is actually a total of 17 versus the 5 that was used. I guess I would just make – sort of stepping back from it a second – a broad observation.

It seems to me all things being equal that our technical datasets tend to be more powerful for us the long they are. It seems to me especially over this time period we're talking about where we've seen quite a variation in the stock and fishery that it would be a richer dataset as well taking this whole 17 years. It seems it would yield more robust estimates.

DR. DUVAL: Mr. Chairman, I agree with Mark Gibson's comments in regards that I have no objection to looking at a longer time frame. I'm certainly sympathetic to the bay states' jurisdictions regarding having some reference against which to measure the impact or success of their management measures.

I think some of my only concerns, as we continue to discuss this, is really – and this was brought up at the last meeting as well – is some consistency in management given that we have just had a benchmark stock assessment, that given sort of the pain that we just went through to implement some decreases in available quota.

I guess maybe just sort of philosophically, it seems like we're sort of tied up between fleets that we have in our existing model based on selectivities along with a desire to actually have an assessment that's really based more on stocks. We have this bay fleet that is not necessarily the Chesapeake Bay stock that presents a little bit of a conundrum, but I think everyone would like to work towards perhaps a future term of reference and a future benchmark assessment that would allow us to get to those types of stock-specific approaches.

I understand that we don't have the information there. It is a bit of a long ramble. I just have some concerns about consistency in management given what we've just gone through, but I certainly don't object to Maryland's request.

CHAIRMAN GROUT: Seeing no other hands; is there any objection to tasking the technical committee with the task that was requested by Maryland? Seeing none; you have been tasked, Charlton; more work. Again, thank you very much for the efforts the technical committee has put in on this issue.

2015 FISHERY MANAGEMENT PLAN REVIEW

CHAIRMAN GROUT: Our next item on the agenda is the FMP review that we need to approve and also state compliance. I will turn it over to our new plan coordinator, Max Appelman.

MR. MAX APPELMAN: Again, for those of you I have not formally met, I am Max Appelman. I am the FMP coordinator for striped bass. I will be walking through the 2015 Striped Bass Fishery Management Plan Review. A brief little overview; we will cover the status of the stock; also the status of the fishery; status of management measures; and then wrap up with compliance and plan review team recommendations.

A brief reminder to the board that this is a review of the 2013 and 2014 fishing seasons. Basically Amendment 6 and Addenda 1 through 3 set the management, regulations and monitoring requirements for those fishing seasons. Addendum IV wasn't implemented until and so that will be covered in next year's FMP review of the 2015 fishing season.

Based on results of the 2013 benchmark stock assessment and the recommended biological reference points that are listed here in this table, the Atlantic striped bass stock is not overfished and overfishing is not occurring. If you take a look at this figure here, this is of spawning stock biomass from 1982 to 2012, which is the terminal year from the last stock assessment.

Basically the take-home here is that spawning stock biomass has declined over the last decade or so and was estimated at just over 58,000 metric tons in 2012, which is below the target and just above the threshold. This figure is showing the fishing mortality for the same time series. Again, the take-home here is that over the last decade or so fishing mortality has been fluctuating across that F threshold and in 2012 was estimated at 0.20, which is below the threshold but above the target.

This table here is summarizing Tables 3 and 4 from the FMP Review, which went out in board materials. Instead of reciting all these numbers here, I'm just going to highlight a few of them. It has also been brought to my attention that these numbers in red might be sending the wrong message. I'm not trying to insinuate anything negative here. I'm just trying to help out with my presentation; so please ignore the red.

Essentially total harvest in 2014 was roughly 30 million pounds and 2.5 million fish, which is a 7 and 12 percent decrease from 2013; also pointing out that commercial landings in 2013 and 2014 were relatively similar with 5.9 million pounds landed in 2014, which represents 20 percent of total harvest and sort of indicates that striped bass harvest is predominantly from the recreational sector.

Another point I wanted to make was that in 2014 60 percent of commercial landings came from the Chesapeake Bay fisheries. This next table is showing coastal commercial quotas for 2014. Essentially one state had a reduced coastal commercial quota due to overages in 2013; and all states harvested under their coastal commercial quotas in 2014 and therefore no deductions had been applied to the 2015 quota.

This next table is a summary of Tables 5 and 6 from the FMP Review for the recreational fisheries. Just a couple of highlights here; the recreational fishery harvested approximately 1.8 million fish in 2014, weighing 24.1 million pounds, which is roughly 80 percent of the total striped bass harvest by weight; and again pointing out that much of the total harvest is from the recreational sector.

This next figure is showing total recreational catch; so both fish harvested and fish released, while the dotted line at the top of the figure is showing the percentage of that released catch towards the total. Basically over the past decade total recreational catch has decreased and so has the percent of catch released. That was estimated at 80 percent in 2014; and this could indicate that anglers are keeping more fish or are catching fewer sub-legal fish.

Moving on to the Chesapeake Baywide quota in 2014; in summary here each fishery harvested under their respective quotas. Total removals were estimated at 7.3 million pounds and were split relatively equal between the commercial and recreational sectors, with 3.6 million pounds landed in the commercial fishery and 3.7 million pounds in the recreational fishery.

Continuing on now with the Albemarle Sound and Roanoke River striped bass stock, based on results of the 2013 North Carolina specific benchmark assessment, the Albemarle Sound and Roanoke River striped bass fishery is not overfished and overfishing is not occurring; very similarly to the stock status of the Atlantic coast-wide stock. In 2012 the fishing mortality was estimated at 0.34, which is just above the target and below the threshold, while spawning stock biomass was estimated at 835,000 pounds, which is also between target and threshold.

Also, the 2014 harvest was roughly 122,000 pounds; 28 percent of that came from the Roanoke River Management Area and 72 percent from the Albemarle Sound Management Area. Moving on to the status of management measures, under Addendum II the technical committee annually reviews juvenile abundance indices or JAIs from six different surveys to monitor recruitment failure.

Here it is defined as a value that is lower than 75 percent of all values in the dataset for three consecutive years. During this 2015 review, the technical committee evaluated 2012, 2013 and 2014 JAI values; and no states met the criteria for recruitment failure in 2015. Under Addendum II all states with commercial fisheries are required to implement a commercial tagging program and submit a monitoring report no less than 60 days prior to the start of their first commercial fishing season.

Some of the pieces of information that are included in this report are the number of tags that are going to be issued for the upcoming season and account for tags from the last season; changes to tag appearance; orientation of the date or the color of the tag, for example. Also, any changes to how the program is implemented or any other issues that merit being brought up that should be addressed.

It is important to note that not all states submitted these monitoring reports as described in Addendum III; and so the plan review team sort of had to track down the necessary information for this review. However, the PRT did find that all states had implemented commercial tagging programs consistent with the requirements of Addendum III. Please refer to Table 10 in the FMP Review for a description of each state's commercial tagging program.

Moving on to compliance and recommendations; the plan review team did find that all states had implemented regulations consistent with Amendment 6 and Addendums 1 through 3. Since not all states submitted their commercial tagging reports, the plan review team does recommend that all states submit those reports as described in Addendum III to Amendment 6. Lastly, the plan review team recommends the board accept this 2015 Striped Bass Fishery Management Plan Review. Thank you, Mr. Chair; I'll take any questions.

MR. ADLER: On Page 29, Table 4, help me understand. It says commercial harvest and the total is 766,298 for 2014; and they had dead discards and they have that at 931,000. Does that mean they harvested 766,000 and threw over dead 931,000? That was one question. Now, over on Table 7, recreational, I sort of see this one where it says recreational releases, 7 million; dead discards estimated at 655,000. I don't understand how Table 4 can have more dead discards from the commercial than they caught. Am I misreading this?

MR. APPELMAN: You're correct; those are fish that were thrown over dead. This might be a better question directed to the technical committee, but it goes back to those tag returns from the commercial and recreational fisheries and coming up with an estimate of commercial discards. Also with the recreational dead discards, that is a percentage which is applied to the MRIP data that we get. We apply a 9 percent post-release mortality estimate to the total recreational harvest to get that number in Table 7.

MR. ADLER: If I may, Mr. Chairman, okay, I understand you do a percentage for dead discards in the recreational fishery. I understand that and those figures sort of – they say, okay, you know, they discarded a lot and some of them died, okay; but Table 4 on the commercial one, it seems out of whack that they would estimate that the catch was 766,000 and they threw over dead more than that. That sort of like doesn't fit.

DR. DREW: Those are two separate numbers. To get the total commercial removals in this case, you would actually add them together. We're saying 780,000 of them were reported harvested and we estimated that in addition 900,000 were discarded dead. If you look back, you can see that's actually the highest number we've had in a long time; so I think there are two issues.

One is that this number is fairly uncertain so it is difficult to estimate so that probably there is a lot of uncertainty around that actual number. The other thing to keep in mind is that the 2011 year class is now moving into the fishery; and so you probably have a large number of fish that are available to the gear but not legal harvest size.

We would expect dead discards to increase during this time period as the 2011 fishery recruits to the gear but is not legal to be harvested yet. As you have more and more of those small fish around, people are going to have to throw more of them back. I think there are two things that are going into that really high number that we're seeing for the most recent year.

MR. ADLER: Okay, so in other words we're not talking about discards by the commercial fleet that swim away. We're talking about some of them apparently swam away but more of them died than swam away according to these figures.

DR. DREW: They're two separate numbers. The total harvest is the total amount that is reported harvested. The dead discards includes – it does include a mortality correction; so we don't assume that everything thrown overboard dies. We assume there is a proportion – depending on the gear, a certain number of them will survive and a certain number of them will die; but that discard number is based completely separate from the number that is reported harvested. You would have to add those two together to get the total number of fish that the commercial fishery killed in 2014.

MR. ROY MILLER: Mr. Chairman, I just have a quick correction to Table 8 that is on Page 33 where it has Delaware harvest in 2014. I believe the number that is shown there of 14,894 was in fact the number of fish and not the pounds. That should be corrected. Thank you.

MR. O'REILLY: Mr. Chairman, just a friendly edit; and I guess these will get posted. From Table 3 on – and maybe this has been the convention, I'm not sure – everything is entitled "Migratory Striped Bass"; so we have harvest of migratory striped bass when in fact although it says the bay, Maryland and Virginia are included, clearly, we have fish that are non-migratory.

You heard a lot about the male fish. In addition, a lot of our harvest is before any migration happens; so if there would be some confusion down the line, I'd recommend maybe not using the word "migratory" for each of these tables.

CHAIRMAN GROUT: Rob, I think this comes back to the convention that was used back when you and I were on the technical committee that it is a migratory stock of striped bass. Even though you're right, there are fish in the Chesapeake Bay that have yet to migrate and some that don't, that's fine. I think that's the reference here. Michelle.

DR. DUVAL: Just a quick question regarding the tagging report; we were one of the states that submitted a tagging report last year and we're getting ready to prepare one for this past year. My question is really more about the information contained in there. When we got the data request I guess a couple weeks ago, one of the pieces of information that was requested was number of participants.

I think in Addendum III it was your tags, what do they look like, different colors you're using for gear types or area, et cetera, the total number of tags that each states orders versus the total number of tags that were used. Is the total number of participants something that you want

us to include in that tagging report? It doesn't really matter for us at this point, but just for future references the total number of participants is a piece of information that is requested.

MR. APPELMAN: For next year we're probably going to send out a very specific report of what we want to see in that report or specific guidelines as to what to include in that report. You can expect to see that for next year.

DR. DUVAL: So for this year, because North Carolina's fishery has a December 1 start date, we would be submitting our report no later than October 1st. Our intent was to update the numbers that we submitted last year with a table; so we should go ahead and just do what we did for last year for this year and then expect a format to be sent out for the following fishing year?

MR. APPELMAN: The short answer is, yes, we'll probably send out a brief memo immediately following this meeting.

DR. DUVAL: This is just a question probably for some of the bay jurisdictions. It was in 2013 that you all implemented that 14 percent reduction in the baywide quota; is that correct? Did that stay the same for the 2014 fishing year or did that go up or did it go down? It went back up?

MR. LUISI: I can answer the question, Mr. Chairman. The years kind of jumble themselves together after a while, but we did reduce, based on the exploitable stock biomass in the bay in 2013, by 14 percent. We then turned the following year, based on the exploitable stock biomass at the time as a result of new recruits coming into part of the fishery, we did go back to – again, we went up 14 percent the following year.

The reductions that we took last year were based in part I believe on 2012 quota or harvest; so it didn't factor into the decision of the reductions that we took last year in the bay because it went back prior to the time period where we had the 14 percent, it came back up 14 percent again. I hope that answers your question.

DR. DUVAL: It was just out of curiosity because I noticed that some of the harvest numbers went up for 2014 both on the commercial and recreational side in the bay jurisdictions; and I just didn't see the number in there for what the actual baywide quota was.

CHAIRMAN GROUT: Further questions? Go ahead, Mike.

MR. LUISI: Just a simple observation. This might be a little picky, but it is a sensitive issue for us in Maryland. Between Page 10 and 11 there is a discussion referring to the Chesapeake Bay trophy fishery. It gives the history of the fishery, some of the changes that have been made, and it establishes the limits for what Maryland has had in place in the Potomac River since 2008.

It then goes into explaining after that how Virginia's fishery has a higher size limit and a shorter season, which kind of implies that they're functioning under that fishery as more conservative. I'm not sure that's necessarily the case. I think we have measures in place that would correspond with one another as far as their conservation effort. Again, it is a little picky and just in future reports, it might be best not to – you know, just state the facts and not have an implication implying that there is a difference between states. Thanks.

CHAIRMAN GROUT: Any further questions or comments? I need a motion to approve the FMP Review. Dennis Abbott.

MR. DENNIS ABBOTT: **I make a motion to accept the FMP Review for striped bass.**

CHAIRMAN GROUT: Is there a second; okay, Emerson. **Any discussion? Any objections? It stands approved.** We're now down to other

business; is there any other business before this board today? Bill Goldsborough.

MR. GOLDSBOROUGH: Mr. Chairman, I was just wondering – I see Captain Ed O'Brien is here for the advisory panel – was there going to be a report from the panel?

ADJOURNMENT

CHAIRMAN GROUT: He was just here as are most APs in case the board had specific questions of the AP about certain things. Anything further? I'll take a motion to adjourn. Thank you very much.

(Whereupon, the meeting was adjourned at 2:30 o'clock p.m., August 5, 2015.)

— — —

From: Nicholas Zullo [mailto:nszullo@gmail.com]
Sent: Wednesday, August 19, 2015 10:12 PM
To: Mike Waine <mwaine@asmfc.org>
Subject: Striped Bass Fishery

Mike Waine
Fishery Management Plan Coordinator
Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200 A-N
Arlington, VA 22201
Dear ASMFC Commissioners,

I believe the ASMFC should act as quickly as possible to halt the current decline in Striped Bass Fishery. The proposals in Draft Addendum IV are all aimed at bringing fishing mortality down to the new target level and that means reducing the total recreational(controlled through bag and size limits) and commercial(regulated by quotas) catch of striped bass by 25% or more, coast-wide and in the Chesapeake Bay(striped bass chief spawning grounds). The 25% reduction in catch for recreational and commercial should occur within a one year time frame starting with 2015 season. The immediate reductions will restore striped bass to the target abundance level sooner but even then not likely before the end of the decade.

My preferences on the specific options are as follows.

2.5.1 Coast wide Population Reference Point Options – I support Option B.

2.5.2 Chesapeake Bay Stock Reference Point Options – I support Option B.

2.5.3 Albemarle Sound/Roanoke River Stock Reference Point Options – I support Option B.

2.6 Timeline to Reduce F (Fishing Mortality) to the Target – I support Option A

3.0 Proposed Management Program – I support Option B. I see no reason to delay reducing fishing mortality. The sooner fishing mortality can be reduced the sooner abundance may begin to rebound.

Proposed Recreational Fishery Management Options – I support Option B2 for the Coastal fishery and B10 for the Chesapeake Bay.

Proposed Commercial Fishery Management Options - I support Option B16 for the Commercial Coastal Fishery and B18 for the Chesapeake Bay.

Thank you for your consideration,

Sincerely,

Nicholas Zullo
9 N. Harvie St, 1
Richmond, VA 23220

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Nicholas S. Zullo
(703)835-5451

From: David Bouder [mailto:Dave@pdipowerdata.com]
Sent: Sunday, September 27, 2015 7:19 AM
To: info <info@asmfc.org>
Subject: Rock fish breeding stock decline

To Whom it May Concern,

After doing much reading and my own observations fishing mostly the middle Chesapeake bay . It has become apparent that the available breeding size Rockfish(Striped Bass) has shown signs of a steep decline. It is my opinion that an upper harvest limit of somewhere between 40 and 44 inches should be imposed. This would allow the average size and population of the breeding stock to increase. As a side benfit it would increase angling opportunity for trophy sized catch and release fish which are of a higher economic value.

All of this will be for nothing if we do not increase the biomass of the Atlantic menhaden. The commercial industry is keying in on the part of the study that shows that the actual number of individual fish is the same as in the 70'S but with the aveage age of those fish being lower the biomass is nearly half of what was available.

Thank you,

David Bouder

MERLE E. MARBLE
1793 BRIAR HILL LANE
COOPERSBURG, PA. 18036

10/11/15

TO FOLKS AT ASMFC,

I HAVE READ SEVERAL ARTICLES IN THE FISHERMAN MAGAZINE, N.J EDITION, REGARDING STRIPED BASS MANAGEMENT, STOCK ASSESSMENT, STOCK BIOMASS & A PROPOSAL TO MAKE THE STRIPED BASS THE OFFICIAL SALTWATER NEW JERSEY STATE FISH.

I HAVE BEEN FISHING THE "SALT" SINCE 1975, WITH MOST OF MY EXPERIENCE BEING SURF FISHING. I HAVE EXPERIENCED THE LOW OF LOWS, DURING THE LATE '70's & '80's, WHEN THE "TALK OF THE TOWN" WAS IF A BASS WAS CAUGHT. THEN CAME THE '90's AND AS YOU ALL KNOW THE STRIPED BASS FISHING WAS A WHOLE DIFFERENT STORY.

WITH THIS SAID, AND MY EXPERIENCING THE HIGHEST OF HIGHS & THE LOWEST OF LOWS FISHING FOR STRIPED BASS, MY QUESTION WOULD BE THIS. IN ORDER TO SAVE THE LARGER FEMALES, HAS THERE EVER BEEN MUCH THOUGHT TO ALLOWING A "SLOT" SIZED FISH TO BE RETAINED AND THEN SAY THE LARGER FISH MUST BE RELEASED. THIS WOULD BE SIMILAR TO THE RED DRUM REGULATIONS IN PLACE IN MOST STATES.

EXAMPLE: 1 FISH BETWEEN 24"-30" / ALL FISH OUT OF THAT RANGE
(OR MAYBE 2 DURING CERTAIN DATES) / MUST BE RELEASED.

THIS TYPE OF REGULATION HAS WORKED WITH THE RED DRUM FISHERY. THIS WOULD ELIMINATE A LOSS OF THE EGG LADEN FEMALES IN THE SPRING, THUS THOUSANDS OF FUTURE FISH.

THANK YOU FOR HARD WORK ON FISHERIES ISSUES.

Merle E. Marble (267) 446-3609

Atlantic States Marine Fisheries Commission

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

MEMORANDUM

October 8, 2015

To: **Atlantic Striped Bass Management Board**

From: **Atlantic Striped Bass Technical Committee**

RE: **2015 Atlantic Striped Bass Stock Assessment Update**

The 2015 Atlantic Striped Bass Stock Assessment Update utilizes catch and index data from 1982-2014.

In 2014, 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 this assessment. SSB was estimated at 63,918 metric tons (140 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 0.205 which is below the F threshold of 0.22 but above the F target of 0.18.

Commercial removals, i.e., landings plus dead discards, in 2013 and 2014 were estimated at 1,290,682 and 1,697,689 fish, respectively. Recreational removals, i.e., angler harvest plus dead releases, in 2013 and 2014 were estimated at 2,921,317 and 2,444,551, respectively.

Total abundance 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. In 2014, total abundance was estimated at 134 million fish. Abundance of age 8+ fish has declined since 2012 and is expected to drop slightly in 2015.

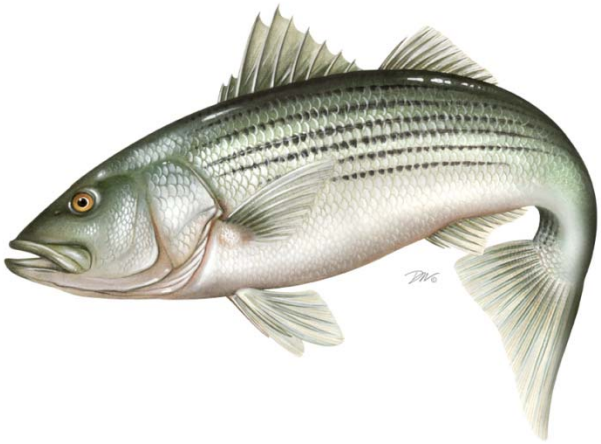
According to the projections model, if a constant catch of 3,402,641 fish, i.e., 2015 harvest estimate plus the average commercial discards during 2010-2014, was maintained during 2015-2017, the probability of SSB falling below the threshold is 0.49 by 2015 and declines slightly thereafter. The fully-recruited F is expected to decrease to an average of 0.18 during 2015-2017 and there is little chance (less than 12%) that F would exceed the F threshold.

Enclosed: 2015 Atlantic Striped Bass Stock Assessment Update

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

M15-081

Atlantic States Marine Fisheries Commission
Atlantic Striped Bass Stock Assessment Update
2015



Prepared by:
Atlantic Striped Bass Technical Committee

Sustainably Managing Atlantic Coastal Fisheries

Update of the Striped Bass Stock Assessment using Data through 2014

This document summarizes the striped bass assessment that uses catch and index data from 1982-2014.

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, but through management actions, it declined by 99 percent to 63 mt (140,000 pounds) in 1986. Commercial landings have increased from 313 mt (800,000 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) (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 2014, only 766,298 fish were harvested and the Chesapeake Bay jurisdictions (Maryland, Virginia, and the Potomac River Fisheries Commission) accounted for 81% 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 2013 and 2014, the commercial harvest was comprised primarily of ages 4-10 striped bass (Table 3). Harvest in Chesapeake Bay fisheries (Maryland, Virginia, and the PRFC) was comprised mostly of ages 3-7 (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 discards in 2013 and 2014 were estimated to be 3.1 million and 4.6 million fish, respectively.

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 525,581 and 931,391 fish for 2013 and 2014, respectively (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 expanded estimates 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 1.29 million and 1.69 million fish in 2013 and 2014, respectively. Except for 2014, harvest has generally exceeded dead discards since the mid 1990s (Figure 2). Commercial losses in 2013 and 2014 were dominated by the 2008 and 2009 year classes (ages 4 and 5 in 2013, and ages 5 and 6 in 2014).

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 obtains numbers of fish harvested and released per angler trip, and a telephone survey that derives 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. The timeline of MRIP changes can be found at http://www.st.nmfs.noaa.gov/recreational-fisheries/in-depth/making-improvements-mrip-initiative/history-timeline/index. 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 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 2013 and 2014, the 2005-2012 regression was used to estimate Virginia wave-1 harvest Dead releases for the winter recreational fishery in North Carolina or 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 total number dead releases-at-length. For those programs that do not collect data on released fishes, 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. We converted the Virginia lengths to age with a Virginia age-length key in 2013, and used the MD coast age distribution to apportion wave-1 harvest to age classes in 2014 (there were 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 2014. 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) and increased in 2013 and 2014 (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 and increased to an average of 1.97 million fish in 2013-2014 (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 2003 (age 10) and 2007 (age 6) year-classes in 2013, and by the 2004 (age 10) and 2009 (age 5) year-classes in 2014 (Table 7). Ages 5-10 comprised about 62% in 2013 and 72% in 2014 of the coast-wide harvest, and ages 8+ comprised >49% in both years (Table 6). Recreational harvest from the ocean states (includes Delaware Bay) was comprised mostly of ages 6-10, while harvest in Chesapeake Bay (MD and VA) was dominated by ages 4-8 (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 and declined slightly to 655,429 fish in 2014 The numbers of fish released dead 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 2-6 (Table 10). The dead releases were dominated by ages 2-5 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 2013 and 2014 were 2.92 million and 2.44 million fish, respectively (Figure 2). In 2013 and 2014, the harvest and dead releases combined were dominated by ages 2-6 in Maryland and Virginia and ages 6-10 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

Combined losses (commercial, recreational and incidental removals) indicated that the recreational fishery removed the largest number of striped bass in 2013 and 2014 (Figure 3). Historically, 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 Chesapeake Bay and the Ocean regions declined from 2006 through 2012 (Table 12; Figure 4). The total removals of striped bass in Chesapeake Bay in 2013 increased by 14% compared to 2012 and in 2014 increased by 9% compared to 2013 (Table

12; Figure 4). The total removals of striped bass in the Ocean region in 2013 increased by 40% compared to 2012 and in 2014 declined by 26% compared to 2013 (Table 12; Figure 4). Ages 3-6 in 2013 and 2014 sustained the highest losses in Chesapeake Bay and ages 6-10 in 2013 and 2014 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 72º 03') to Greenwich, Connecticut (longitude 73º 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). LISTS 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 bottom 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 km2 (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 total 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 between 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 electroshock 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. We 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. We 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. Begun 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 indicate 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 and increases in 2012 and 2013, respectively (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 decline in 2012 (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 and declined slightly in 2014 (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 has remained at about the same level during 2012-2014.

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 not observed since 1990 (Figure 6). In Delaware Bay, recruitment of YOY increased from 2007 through 2009, declined slightly during 2010-2011, and increased in 2013 and 2014. Recruitment in the Hudson River declined from 2007-2013 (Figure 6). Strong year-classes were evident in 1993, 1996, 2001, 2003 and 2011 in Chesapeake Bay (Maryland and Virginia), and in 1993, 1995, 1999, 2003, 2009 and 2014 in Delaware Bay, in 1997, 1999, 2001, 2003, 2010 and 2014 in Hudson River (Figure 6). The lowest YOY index value in the Chesapeake Bay time series was observed in 2012.

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, 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. Used as starting values, the average effective sample size for each survey with age composition data was calculated in the 2007 benchmark (http://www.nefsc.noaa.gov/publications/crd/crd0803/) by using methods in Pennington and Volstad (1994) and Pennington and others (2002). In essence, effective sample size was estimated by first calculating the length sample variance using the simple random sampling equation and dividing into it the cluster sampling variance of mean length derived through bootstrapping, assuming each seine/trawl haul, gillnet set, or electrofishing run was the sampling unit. The average of the annual effective sample sizes was used as starting values in each survey multinomial error distribution (NJ Trawl = 23; NYOHS = 56; DESSN = 68; MDSSN=68; VAPNET = 68).

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

Phases

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. 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 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 10,383.3. 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 2014 for the Bay, Ocean and Commercial Discard fleets was 0.065, 0.145, and 0.042, respectively (total fully-recruited F_{2014} =0.205) (Table 23; Figure 9). The maximum total F-at-age in 2014 was 0.205 for age 11 (Table 24). Fishing mortality-at-age in 2013 and 2014 for the three fleets is shown in Figure 10. Fishing mortality-at-age peaked at age 5 in the Chesapeake Bay and Commercial Discards fleets and age 13+ in the Ocean fleet. The highest fishing mortality was attributed to the Ocean fleet at ages $\geq$6 (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 133 million fish. Total abundance increased to 195 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 134 million fish. Abundance of striped bass age 8+ increased steadily through 2004 to 11.4 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 2015.

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 78 thousand metric tons (Table 26, Figure 12A). Female SSB has declined since then and was estimated at 63,918 metric tons (95% CI: 51,183-76,653) in 2014 (Table 26; Figure 12A). The SSB point estimate in 2014 remained above the threshold level of 57,626 thousand metric tons and indicates that the striped bass are not overfished. However, given the error associated with the 2014 values, there is a probability of 0.16 that the female spawning stock biomass in 2014 is below the threshold. The spawning stock numbers (Figure 12B) declined more rapidly than the spawning stock biomass.

Exploitable biomass (January 1) increased from 9,901 metric tons in 1982 to its peak at 109 thousand metric tons in 1997(Figure 12C). It declined through 1999 but increased slightly in 2000. Exploitable biomass was relatively stable at an average of 103 thousand metric tons through 2005, but it has since declined to about 89 thousand metric tons in 2014 (Figure 12C).

Retrospective Analysis

Retrospective analysis plots and percent difference plots between the 2014 and peels of the retrospective analysis are shown in Figure 13. Moderate retrospective bias was evident in the more recent estimates of fully-recruited total F, SSB, and age 8+ abundance of SCA (Figure 13). The 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 supporting ASAP model presented in the 2013 benchmark assessment document.

Comparison of Results from the 2015 Updated Assessment with 2013 Benchmark Assessment

Fully-recruited fishing mortality and female spawning stock biomass estimates from the update and benchmarks assessments are shown in Figure 14. The updated assessment produced slightly lower fully-recruited fishing mortality and higher female spawning stock biomass estimates from 2005-2012 than the 2013 benchmark assessment (Figure 14).

Status of the Stock

In 2014, the Atlantic striped bass stock was not overfished or experiencing overfishing based on the point estimates of fully-recruited fishing mortality and female spawning stock biomass relative to the reference points defined in this assessment. Female spawning stock biomass was estimated at 63,918 metric tons (140 million pounds) which is 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 0.205 which is below the F threshold of 0.219 but above the F target of 0.180 (Figure 14). However, because of error associated with these estimates, there is a probability of 0.16 that the 2014 female SSB estimates is below or equal to the SSB threshold, or conversely, a probability of 0.84 that the 2014 female SSB is above the threshold. There is a probability of 0.29 that the 2014 fully-recruited fishing mortality is

above or equal the fishing mortality threshold, or conversely, a 0.71 chance that the 2014 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 (since there was not a consistent pattern in the retrospective bias and the number of years chosen for the correction will affect the level of bias, the committee chose the last five years for recent trends), the probability of the 2014 female SSB estimates being below or equal to the SSB threshold declines to 0.03, while the probability of the 2014 fully-recruited fishing mortality being above or equal the fishing mortality threshold declines to 0.19.

Projections

Three-year projections of female spawning stock biomass were made by using a population simulation model written in R. The model begins in year 2014 with known January-1 values of abundance-at-age from the SCA and projects SSB and fishing mortality in 2015-2017 assuming a constant catch of 3,402,641 fish (estimated 2015 harvest plus average commercial discards during 2010-2014). For 2014, the January-1 abundance-at-age data with associated standard errors from the SCA model, the fully-recruited fishing mortality estimate in 2014 (F=0.205), selectivity-at-age in 2014, Rivard weights in 2014, 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 2015, the January-1 abundance-at-age is calculated from the known values of 2014 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. The fully-recruited fishing mortality in 2015-2017 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 average selectivity-at-age from 2010-2014. The sum of age-specific catches are then compared to the assumed constant catch for 2015-2017. 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 each iteration of the simulation, the abundance-at-age in 2014 is randomly drawn from a normal distribution parameterized with the 2014 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 1990-2014 recruitment estimates. An age 13 plus-group is assumed. For years 2015-2017, selectivity-at-age was derived from the geometric mean of the 2010-2014 F-at-ages and dividing the resulting vector by the maximum F-at-age. Female spawning stock biomass was calculated by using average Rivard weight estimates from 2010-2014, 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=0.22) was calculated from 10,000 simulations as well. The CV of the F reference point was assumed equal to the value for the 2014 fully-recruited F estimate.

If the constant catch of 3,402,641 fish was maintained during 2015-2017, the probability of being below the SSB threshold increases to 0.49 by 2015 (Figure 15). After 2015, the probability is expected to decline slightly (2017: Pr=0.40). The fully-recruited F is expected to decrease to an average of 0.18 during 2015-2017 and there is little chance that the fully-recruited F would exceed the F threshold in any year ($Pr \leq 0.12$).

If the numbers-at-age and fully-recruited F in 2014 were adjusted for average (2009-2013) retrospective bias, the probabilities of being below the SSB threshold are sharply reduced (Figure 16). The probability increases from 0.03 in 2014 to 0.12 by 2015 (Figure 16). After 2015, the probability is expected to decline (2017: Pr=0.06). The fully-recruited F is expected to decrease to an average of 0.17 during 2015-2017 and there is little chance that the fully-recruited F would exceed the F threshold in any year ($Pr \leq 0.06$). However, these results should be treated with caution because the magnitude of the retrospective bias in numbers-at-age and fully-recruited F appears relatively unpredictable (i.e., it is expected that numbers-at-age are underestimated and fully-recruited F is overestimated in the terminal year, but the magnitude cannot be predicted).

In addition, projections were 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 point. If the constant catch of 3,402,641 fish was maintained during 2015-2017, the probability of being below the SSB target reference point increases to 0.98 by 2015 (Figure 17). After 2015, the probability is expected to decline slightly (2017: Pr=0.978). The fully-recruited F is expected to decrease to an average of 0.18 during 2015-2017 and the probability of being above the F target is expected to increase slightly from 0.46 in 2015 to 0.60 in 2017.

If the numbers-at-age and fully-recruited F in 2014 were adjusted for average (2009-2013) retrospective bias, the probabilities of being below the SSB target are reduced (Figure 18). The probability increases from 0.62 in 2014 to 0.88 in 2015 (Figure 18). After 2015, the probability is expected to decline (2017: Pr=0.81). The fully-recruited F is expected to decrease to an average of 0.17 during 2015-2017. The probability of F being below the F target drops to 0.25 in 2015 but increases to 0.42 by 2017. The same caution made in the reference point comparisons above for the retrospective adjustment applies here as well.

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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

* Includes fish taken for personal consumption

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

Table 3. Age composition of commercial harvest in 2013 and 2014 by state.

2013

State	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
MA	0	0	3	10	167	685	1,676	8,951	18,711	14,960	5,864	3,056	8,486	62,569
RI	0	0	0	0	304	1,148	2,064	2,906	3,889	1,859	345	529	780	13,825
NY	0	0	276	2,209	4,970	16,843	10,492	14,082	10,216	14,358	1,104	1,381	276	76,206
DE	0	0	0	170	1,576	5,048	5,028	3,860	1,352	126	422	73	24	17,679
MD Bay	0	0	52,339	105,400	102,753	85,465	24,523	11,055	5,105	4,122	615	134	0	391,510
MD Cst	0	0	0	0	34	432	412	565	1,072	2,753	628	908	803	7,608
PRFC	0	0	431	6,177	18,819	24,278	18,532	8,188	862	287	0	287	144	78,006
VA Bay	0	465	3,828	16,756	21,036	14,816	7,567	7,487	8,317	12,922	5,059	4,860	6,607	109,719
VA Cst	0	0	0	0	0	25	25	151	497	1,791	761	1,313	3,415	7,978
NC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
														765,100

2014

Age

State	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
MA	0	0	0	0	142	440	1,670	2,909	9,631	16,262	13,407	5,281	10,877	60,619
RI	0	0	7	15	56	110	349	851	2,349	2,644	1,963	822	1,304	10,468
NY	0	0	126	5,935	9,413	10,571	11,492	7,322	4,348	2,539	896	260	0	52,903
DE	0	0	0	162	1,131	2,601	2,345	3,154	1,365	921	1,305	748	1,162	14,894
MD Bay	0	0	35,270	69,988	114,454	64,571	35,685	20,383	13,796	6,290	1,500	81	163	362,180
MD Cst	0	0	0	0	345	1,073	1,547	1,931	995	651	1,316	116	508	8,481
PRFC	0	0	0	7,834	28,861	27,418	12,369	3,711	825	0	412	0	0	81,430
VA Bay	0	469	22,669	24,080	39,680	26,442	22,046	9,189	6,655	7,024	4,288	870	2,965	166,377
VA Cst	0	0	0	0	0	95	352	171	1,215	2,275	1,629	1,041	2,169	8,946
NC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
														766,299

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

	Age													
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
1982	0	31,645	3,644	11,456	5,623	1,291	2,397	1,014	369	92	85	0	7	57,624
1983	0	24,067	1,453	2,878	7,761	2,311	610	610	262	174	0	0	0	40,127
1984	0	33,575	1,611	5,812	9,734	11,272	2,815	117	586	66	0	52	0	65,639
1985	0	7,728	30,472	5,939	10,891	3,395	2,742	1,045	261	131	131	0	0	62,734
1986	0	5,841	20,758	100,067	27,989	13,315	4,295	1,415	346	0	0	0	0	174,024
1987	0	4,206	14,382	28,597	51,389	16,940	6,520	1,319	1,011	395	111	86	111	125,066
1988	0	6,142	22,593	36,616	70,959	71,694	23,232	9,116	3,110	1,653	218	195	24	245,552
1989	0	13,854	50,240	49,029	83,396	82,757	33,479	15,502	6,342	705	1,409	1,409	705	338,827
1990	0	14,526	68,713	80,935	111,888	115,702	71,600	36,256	5,948	1,539	1,401	1,503	0	510,011
1991	79	12,632	37,009	64,210	77,335	56,894	36,912	24,857	6,610	4,071	6,542	16	0	327,167
1992	117	3,698	34,218	36,746	44,412	34,688	14,798	11,179	3,398	2,356	991	0	0	186,601
1993	0	7,449	50,160	79,011	95,116	63,487	20,941	15,351	9,270	4,606	1,651	536	260	347,839
1994	0	31,770	47,169	45,081	88,122	84,570	39,229	12,524	6,223	3,674	712	415	30	359,518
1995	0	72,822	75,520	53,551	94,158	121,592	61,447	19,083	7,569	4,269	2,290	2,346	807	515,454
1996	0	27,133	114,085	76,336	61,884	58,787	30,835	14,916	6,148	3,989	159	502	50	394,824
1997	476	7,108	64,352	61,871	30,602	20,951	14,002	6,592	1,963	4,309	2,658	801	1,060	216,745
1998	0	13,233	53,899	98,510	83,288	29,197	12,970	12,591	7,860	4,372	3,891	2,419	3,802	326,032
1999	984	58,076	49,894	43,744	55,740	14,477	5,213	3,704	1,980	1,304	648	612	243	236,619
2000	196	178,457	189,933	157,291	62,699	33,918	26,938	7,831	4,111	3,876	801	863	83	666,997
2001	0	2,638	58,079	77,958	88,808	29,410	18,877	11,613	9,664	6,371	4,778	1,957	747	310,900
2002	1,700	20,888	42,641	21,409	28,791	23,720	12,381	6,854	5,645	2,255	1,522	149	248	168,201
2003	1,512	6,227	28,061	54,464	56,728	19,866	30,850	18,633	16,410	13,572	8,164	3,207	4,281	261,974
2004	2,943	52,811	80,744	76,790	62,580	48,683	52,231	41,378	23,549	9,829	10,381	2,365	1,359	465,642
2005	432	11,513	103,930	245,644	169,860	68,808	54,397	43,911	43,609	23,102	16,147	8,477	8,713	798,544
2006	0	555	25,769	28,836	36,995	27,669	15,055	16,698	12,693	13,187	7,392	4,430	5,245	194,524
2007	284	6,302	18,190	89,608	97,557	139,873	78,655	48,521	42,665	30,644	22,419	19,979	11,902	606,599 *
2008	0	109	2,928	45,076	71,474	58,005	44,675	21,699	13,857	13,043	12,619	14,253	10,978	308,715
2009	0	1,661	80,748	166,818	123,878	91,220	30,653	38,426	20,517	16,384	15,706	7,675	18,258	611,944
2010	0	1,379	16,212	76,208	64,148	46,221	19,637	9,510	6,534	4,079	3,116	1,792	6,007	254,841
2011	0	3,880	61,564	109,748	131,320	80,575	54,479	49,187	37,502	30,917	15,468	11,281	31,535	617,457 *
2012	0	9,118	50,673	116,560	205,853	136,385	109,776	38,433	41,328	17,081	22,239	17,148	28,267	792,861 *
2013	0	4,502	70,746	116,465	100,230	73,842	44,949	32,774	22,008	20,188	7,357	10,847	21,673	525,581
2014	0	21	37,916	108,024	233,435	180,063	148,881	62,830	47,609	50,812	33,159	6,274	22,367	931,391

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		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

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

Table 7. Age composition of recreational harvest in 2013 and 2104 by state.

2013 **Age**

State	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
ME	0	1,489	5,213	3,704	2,368	3,311	1,818	1,647	1,733	1,123	349	163	226	23,143
NH	0	0	83	158	1,963	5,145	2,858	2,800	2,446	1,525	290	190	199	17,657
MA	0	0	642	6,053	28,774	57,188	38,366	42,629	48,936	37,782	12,445	8,143	17,987	298,945
RI	0	0	0	0	5,699	41,989	79,481	46,533	26,334	9,588	2,859	2,999	2,755	218,236
CT	0	0	17	567	2,802	32,938	10,156	17,329	25,961	41,477	5,568	1,525	5,034	143,373
NY	0	2,442	3,358	2,061	17,382	71,288	20,040	32,098	88,446	109,726	32,095	29,910	82,008	490,855
NJ	0	0	0	0	325	41,819	47,915	59,316	39,678	94,696	18,593	12,862	29,805	345,008
DE	0	0	0	3	229	2,598	3,639	3,007	2,520	2,328	1,598	1,564	2,034	19,520
MD Bay	0	10,924	71,035	133,802	70,036	79,800	25,592	17,160	16,767	26,688	4,180	8,211	4,448	468,642
MD Cst	0	0	0	0	51	699	1,273	1,335	1,765	2,304	196	291	739	8,654
VA Bay	0	9,586	10,703	22,621	10,441	9,189	4,192	4,974	3,557	5,126	2,339	2,334	1,330	86,391
VA Cst	0	0	0	0	190	2,610	4,749	4,982	6,588	8,599	733	1,085	2,759	32,295
NC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	24,441	91,051	168,967	140,260	348,575	240,079	233,810	264,731	340,962	81,245	69,275	149,324	2,152,719

2014 **Age**

State	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
ME	0	295	8,306	6,422	2,393	916	1,001	353	388	355	220	49	53	20,750
NH	0	0	0	0	709	1,558	1,915	509	562	541	370	94	158	6,415
MA	0	0	0	1,476	10,319	29,805	57,596	29,644	41,356	44,669	29,955	10,113	22,204	277,138
RI	0	0	40	0	4,379	8,372	13,321	7,731	14,182	18,140	15,006	6,652	15,693	103,516
CT	0	0	692	2,413	6,221	11,718	12,885	11,940	15,667	12,148	7,045	2,835	3,199	86,763
NY	0	0	384	298	16,297	51,836	44,715	41,316	62,254	67,718	52,686	20,248	51,590	409,342
NJ	0	0	0	2,850	6,436	16,468	28,927	22,913	26,725	41,518	11,410	32,638	36,024	225,910
DE	0	0	30	45	155	752	872	1,428	1,423	1,010	633	463	1,963	8,774
MD Bay	0	0	86,682	156,785	170,625	49,576	35,536	10,571	15,585	15,610	27,939	2,575	9,725	581,208
MD Cst	0	0	0	0	0	72	166	178	288	270	499	61	285	1,819
VA Bay	0	130	17,718	9,605	9,169	7,842	6,356	2,634	1,311	720	236	369	5,275	61,366
VA Cst	0	0	0	0	0	244	558	599	968	908	1,678	205	960	6,120
NC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	425	113,852	179,894	226,704	179,159	203,847	129,816	180,710	203,607	147,676	76,302	147,129	1,789,121

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

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

Table 10. Recreational dead releases (numbers) by age and year.

2013 **Age**

State	0	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
ME	0	0	2,779	8,998	4,407	3,194	5,653	3,261	3,074	3,196	2,095	651	304	422	38,034
NH	0	0	1,160	2,261	1,321	670	865	430	319	294	167	32	21	22	7,561
MA	0	0	37,188	39,760	19,343	9,912	11,147	6,963	7,574	9,754	6,397	1,785	749	1,620	152,192
RI	0	0	20,460	21,504	19,035	5,618	3,621	1,623	792	858	437	139	89	186	74,365
CT	0	326	11,533	27,733	14,979	5,227	6,962	605	603	997	824	167	23	64	70,043
NY	0	907	16,199	38,694	13,559	4,475	5,823	980	1,466	2,745	3,483	344	61	344	89,080
NJ	0	0	6,103	38,483	30,899	8,752	7,353	2,065	1,426	921	2,385	275	305	684	99,650
DE	0	0	2,219	2,716	686	125	560	789	344	32	13	8	10	11	7,514
MD Bay	0	723	68,367	57,664	45,124	13,753	11,104	5,039	3,684	2,687	3,633	574	981	1,034	214,367
MD Cst	0	0	50	91	99	50	87	32	32	16	22	3	1	5	488
VA Bay	0	536	2,851	4,104	4,557	1,153	776	324	203	107	163	26	28	70	14,898
VA Cst	0	0	32	58	63	32	56	20	20	10	14	2	1	3	311
NC	0	0	4	10	13	10	14	8	8	8	10	2	2	4	95
Total	0	2,491	168,947	242,077	154,085	52,972	54,019	22,140	19,545	21,627	19,643	4,009	2,575	4,469	768,599

2014 **Age**

State	0	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
ME	0	0	428	11,248	6,411	2,168	1,257	1,444	508	551	495	302	64	72	24,949
NH	0	0	195	3,858	1,774	684	210	164	47	47	45	31	8	13	7,075
MA	0	0	4,040	78,151	37,692	17,257	7,237	7,256	2,771	3,038	3,159	2,124	685	968	164,377
RI	0	0	374	7,614	4,787	832	150	139	82	145	186	154	68	161	14,692
CT	0	148	995	10,740	7,017	3,217	651	440	634	561	730	647	467	1,099	27,345
NY	0	320	3,482	33,544	17,410	5,204	1,062	758	773	600	496	375	409	919	65,352
NJ	0	0	756	17,402	17,156	42,293	9,316	2,394	1,472	1,074	1,021	218	781	736	94,619
DE	0	0	1,943	4,377	2,479	1,695	2,756	2,058	675	328	208	76	24	45	16,665
MD Bay	0	4,809	10,595	153,153	23,820	15,985	2,948	2,015	611	907	693	1,299	118	320	217,275
MD Cst	0	0	0	26	22	23	11	5	5	1	0	0	0	0	93
VA Bay	0	40	7,502	9,267	2,711	1,426	724	304	319	120	139	162	14	36	22,765
VA Cst	0	0	0	46	39	42	20	8	8	1	0	0	0	0	167
NC	0	0	0	7	7	10	7	6	3	4	4	3	1	3	56

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

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

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, 1982-2014. 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

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

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

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

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	0.29	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	0.31	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	0.89	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	1.06	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	2.04	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	2.01	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	1.77	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	1.43	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	1.24	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	0.20	2.64	0.25	1.94	0.19	17.48	0.25
2013	1.73	0.15			0.67	0.09			2.51	0.54	4.41	0.25	2.10	0.07	10.60	0.25
2014	1.16	0.15			0.41	0.08			0.31	1.00	5.57	0.25			13.01	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

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

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

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

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		-	-	-	-	-	-	-	-	-	-	-	-

Table 17 cont.

VA PNET

	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

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 = {1,..,13+}	a	
Fleet Index: f = {1: Chesapeake Bay, 2: Coast, 3: Commercial Dead Discards}	f	
Indices Index: t = {1,..,16}	t	
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 Starting Values	$\hat{n}$	Fleets: 50 Indices: NYOHS – 22, NJ Trawl – 23, MDSSN – 68, DESSN – 68, VAPNET – 68, VAGNET – 68 (calculated from method of Pennington and Volstad, 1995)

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, 1996-2014 Fleet 2 (Coast): 1982-1984 Fleet 3 (Commercial Dead Discards): 1985-1989,1990-1996,1997-2002, 2003-2014 $\hat{s}_a = \frac{1}{1-\hat{\gamma}} \cdot \left(\frac{1-\hat{\gamma}}{\hat{\gamma}}\right)^{\hat{\gamma}} \frac{\exp^{\hat{\alpha}\hat{\gamma}(\hat{\beta}-a)}}{1+\exp^{\hat{\alpha}(\hat{\beta}-a)}}$ Fleet 2 (Coast): 1985-1989, 1990-1996, 1997-2014 $\hat{s}_a = \exp^{(-\exp^{-\hat{\beta}(a-\hat{\alpha})})}$ 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	$\hat{C}_{y,a}$	$\hat{C}_{f,y} = \sum_a \hat{C}_{f,y,a}$
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	$\hat{I}_{t,y,\sum a}$	$\hat{I}_{t,y,\Sigma a} = \hat{q}_t \cdot \sum_a \hat{N}_{y,a} \cdot \exp^{-p_t \cdot Z_{y,a}}$
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_{fy} 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.
Effective sample size	$\hat{\bar{n}}$	The multiplier from equation 1.8 method of Francis (2011) was used to adjust the starting values.
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	35	2.65	1.000	0.768	1.239
NJYOY	32	1.45	0.998	0.757	1.248
MDYOY	45	1.85	1.002	0.797	1.213
VAYOY	32	1.40	0.986	0.757	1.248
NYAge1	29	1.40	0.990	0.743	1.259
MDAge1	45	1.30	0.987	0.797	1.213
MRFSS	27	1.83	0.994	0.733	1.268
CTTRL	31	3.30	1.007	0.752	1.252
NEFSC	18	1.30	0.997	0.669	1.318
NYOHS	20	2.85	1.019	0.687	1.304
NJTRAWL	26	2.60	1.017	0.728	1.272
MDSSN	30	2.82	0.995	0.748	1.256
DESSN	18	2.60	1.000	0.669	1.318
VAPNET	24	1.90	1.010	0.716	1.281

Age Composition	
Fleet/Index	n_{eff}
Bay Fleet	31.7
Ocean Fleet	46.8
Commercial Discards	23.0
NYOHS	18.7
NJTRAWL	5.0
MDSSN	17.5
DESSN	24.5
VAPNET	8.4

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

Likelihood Components

Concentrated Log-Likelihood	Weight	RSS
Bay Total Catch	2	19.92
Ocean Total Catch	2	0.56
Commercial Discards Total Catch	2	0.11
Aggregate Abundance Indices		
NY YOY	1	24.39
NJ YOY	1	25.46
MD YOY	1	39.53
VA YOY	1	28.24
NY Age 1	1	24.31
MD Age 1	1	31.43
MRFSS/MRIP	1	25.18
CTTRL	1	21.42
NEFSC	1	15.78
Age Comp Abundance Indices		
NYOHS	1	19.52
NJ Trawl	1	18.61
MD SSN	1	24.12
DE SSN	1	16.93
VA PNET	1	22.08
Total RSS		357.60
No. of Obs		511.00
Conc. Likel.		-91.20
Age Composition Data	Likelihood	
Bay Age Comp	1	2014.65
Ocean Age Comp	1	3570.94
Commercial Discards Age Comp	1	1549.42
NYOHS	1	622.88
NJ Trawl	1	254.87
MD SSN	1	1060.51
DE SSN	1	1001.44
VA PNET	1	433.53
log_R constraint	1	0.28
Recr Devs	1	14.09
Total Likelihood		10383.30
AIC		21178.60

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
1982	0.811	0.120	0.15	0.158	0.004	0.02	0.010	0.005	0.47	0.866	0.119	0.14
1983	0.067	0.045	0.67	0.119	0.003	0.03	0.006	0.019	2.91	0.155	0.049	0.31
1984	0.135	0.003	0.02	0.060	0.006	0.11	0.008	0.004	0.42	0.160	0.044	0.27
1985	0.009	0.013	1.56	0.096	0.005	0.05	0.017	0.005	0.31	0.099	0.045	0.46
1986	0.004	0.048	13.61	0.056	0.003	0.06	0.031	0.019	0.62	0.062	0.017	0.28
1987	0.001	0.002	1.30	0.026	0.006	0.22	0.017	0.006	0.35	0.030	0.007	0.23
1988	0.002	0.043	18.09	0.036	0.006	0.16	0.029	0.006	0.20	0.046	0.008	0.18
1989	0.001	0.019	23.46	0.024	0.006	0.25	0.038	0.024	0.64	0.047	0.010	0.21
1990	0.015	0.002	0.16	0.017	0.008	0.45	0.056	0.002	0.03	0.085	0.014	0.17
1991	0.022	0.002	0.11	0.022	0.006	0.27	0.032	0.006	0.19	0.073	0.009	0.13
1992	0.021	0.045	2.13	0.025	0.006	0.23	0.016	0.021	1.32	0.057	0.006	0.10
1993	0.029	0.005	0.16	0.027	0.003	0.09	0.025	0.005	0.18	0.077	0.008	0.10
1994	0.039	0.001	0.03	0.034	0.006	0.18	0.023	0.004	0.19	0.090	0.008	0.09
1995	0.047	0.018	0.39	0.056	0.016	0.28	0.031	0.023	0.75	0.124	0.011	0.09
1996	0.057	0.009	0.16	0.055	0.001	0.02	0.010	0.002	0.24	0.114	0.008	0.07
1997	0.066	0.000	0.01	0.159	0.005	0.03	0.005	0.005	1.03	0.190	0.018	0.09
1998	0.060	0.008	0.13	0.144	0.015	0.10	0.008	0.017	2.19	0.173	0.017	0.10
1999	0.051	0.004	0.08	0.124	0.002	0.01	0.005	0.005	0.97	0.149	0.014	0.10
2000	0.059	0.001	0.02	0.156	0.004	0.03	0.015	0.006	0.38	0.188	0.018	0.10
2001	0.052	0.011	0.21	0.152	0.013	0.08	0.008	0.017	2.21	0.177	0.017	0.10
2002	0.042	0.007	0.17	0.150	0.001	0.01	0.004	0.002	0.53	0.170	0.016	0.09
2003	0.068	0.000	0.00	0.159	0.005	0.03	0.009	0.006	0.63	0.195	0.017	0.09
2004	0.060	0.007	0.11	0.193	0.016	0.08	0.016	0.020	1.27	0.230	0.022	0.10
2005	0.064	0.010	0.15	0.193	0.004	0.02	0.027	0.006	0.22	0.240	0.023	0.10
2006	0.078	0.003	0.04	0.235	0.004	0.02	0.007	0.006	0.82	0.275	0.028	0.10
2007	0.071	0.002	0.03	0.193	0.015	0.08	0.021	0.016	0.76	0.238	0.024	0.10
2008	0.054	0.014	0.27	0.211	0.002	0.01	0.011	0.008	0.74	0.242	0.026	0.11
2009	0.065	0.003	0.05	0.149	0.003	0.02	0.023	0.006	0.27	0.194	0.020	0.10
2010	0.061	0.003	0.05	0.153	0.014	0.09	0.011	0.024	2.29	0.187	0.020	0.11
2011	0.060	0.008	0.14	0.176	0.001	0.01	0.027	0.006	0.21	0.221	0.024	0.11
2012	0.054	0.003	0.05	0.131	0.005	0.04	0.036	0.007	0.20	0.181	0.020	0.11
2013	0.062	0.003	0.05	0.190	0.015	0.08	0.025	0.019	0.77	0.234	0.028	0.12
2014	0.065	0.004	0.06	0.145	0.002	0.01	0.042	0.010	0.24	0.205	0.025	0.12

Recruitment	SD	CV
19,164,800	2,235,250	0.116633
46,186,300	4,254,990	0.092127
40,908,500	3,910,340	0.095587
39,887,500	3,724,700	0.09338
32,095,100	3,254,630	0.101406
42,690,600	3,910,190	0.091594
55,831,600	4,678,200	0.083791
62,126,900	5,061,920	0.081477
83,533,700	6,215,900	0.074412
68,563,500	5,560,030	0.081093
70,015,800	5,787,600	0.082661
90,969,700	6,935,760	0.076243
180,963,000	10,579,600	0.058463
114,886,000	8,133,810	0.070799
124,648,000	8,585,730	0.06888
153,941,000	9,578,590	0.062222
98,336,800	7,269,810	0.073928
100,575,000	7,242,380	0.07201
79,720,800	6,332,940	0.079439
118,508,000	8,066,220	0.068065
138,314,000	8,939,080	0.064629
76,283,800	6,366,090	0.083453
166,587,000	10,416,000	0.062526
93,274,000	7,404,280	0.079382
86,785,300	7,141,460	0.082289
65,913,200	6,258,270	0.094947
87,451,600	7,765,440	0.088797
61,360,500	6,460,080	0.105281
78,064,700	8,026,970	0.102825
97,968,500	9,669,200	0.098697
125,129,000	15,264,900	0.121993
31,872,000	5,741,350	0.180138
76,119,600	9,983,850	0.13116

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	-5.628	0.429	0.08	α	-2.483	0.338	0.14	α	0.017	0.008	0.49
β	2.259	0.064	0.03	β	3.363	0.253	0.08	β	1.242	0.194	0.16
ϒ	0.923	0.021	0.02	ϒ	0.991	0.023	0.02				
1985-1989				1985-1989				1985-1989			
α	-3.821	0.480	0.13	α	5.133	0.614	0.12	α	-2.134	0.244	0.11
β	2.010	0.125	0.06	β	0.433	0.065	0.15	β	4.093	0.389	0.10
ϒ	0.951	0.023	0.02					ϒ	0.879	0.066	0.08
1990-1995				1990-1995				1990-1995			
α	-2.290	0.229	0.10	α	3.100	0.175	0.06	α	-1.908	0.157	0.08
β	3.467	0.247	0.07	β	0.918	0.111	0.12	β	4.674	0.366	0.08
ϒ	0.889	0.038	0.04					ϒ	0.815	0.063	0.08
1996-2014				1997-2014				1996-2002			
α	-1.918	0.118	0.06	α	5.427	0.263	0.05	α	-2.745	0.506	0.18
β	3.772	0.144	0.04	β	0.421	0.029	0.07	β	2.815	0.280	0.10
ϒ	0.941	0.017	0.02					ϒ	0.957	0.028	0.03
								2003-2014			
								α	-2.371	0.287	0.12
								β	3.748	0.193	0.05
								ϒ	0.976	0.017	0.02

Survey Selectivity Parameters			
NYOHS	Estimate	SD	CV
α	-5.691	0.088	0.02
β	2.288	0.034	0.02
ϒ	0.962	0.006	0.01
NJ Trawl			
α	3.107	0.611	0.20
β	0.525	0.133	0.25
DE SSN			
α	3.355	0.194	0.06
β	0.776	0.110	0.14
MDSSN			
s_2	0.138	0.022	0.16
VAPNET			
α	-3.221	0.438	0.14
β	3.108	0.106	0.03
ϒ	0.999	0.000	0.00

Catchability Coefficients			
Survey	Estimate	SD	CV
NY YOY	2.96E-07	4.17E-08	0.14
NJ YOY	1.23E-08	8.28E-10	0.07
MD YOY	4.35E-08	3.36E-09	0.08
VA YOY	1.08E-07	7.88E-09	0.07
NY Age 1	4.49E-08	3.99E-09	0.09
MD Age 1	9.54E-09	8.54E-10	0.09
MRFSS	3.14E-08	1.89E-09	0.06
NEFSC	3.48E-08	2.62E-09	0.08
CTTRL	1.00E-08	1.02E-09	0.10
NYOHS	1.59E-07	1.42E-08	0.09
NJTRL	9.65E-08	1.19E-08	0.12
MDSSN	1.24E-07	1.44E-08	0.12
DESSN	8.26E-08	9.64E-09	0.12
VAPNET	5.07E-07	5.16E-08	0.10

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	0.003	0.248	0.866	0.680	0.514	0.391	0.309	0.254	0.218	0.193	0.176	0.164	0.157
1983	0.001	0.025	0.108	0.154	0.155	0.144	0.135	0.128	0.122	0.118	0.115	0.111	0.109
1984	0.001	0.044	0.160	0.149	0.126	0.105	0.091	0.081	0.074	0.069	0.066	0.063	0.061
1985	0.001	0.008	0.019	0.038	0.057	0.069	0.079	0.086	0.092	0.095	0.097	0.099	0.099
1986	0.000	0.004	0.013	0.035	0.054	0.058	0.060	0.061	0.062	0.062	0.062	0.062	0.061
1987	0.000	0.002	0.006	0.018	0.027	0.029	0.029	0.029	0.030	0.029	0.029	0.029	0.029
1988	0.000	0.003	0.010	0.029	0.044	0.046	0.045	0.044	0.044	0.043	0.042	0.041	0.041
1989	0.000	0.002	0.009	0.031	0.047	0.046	0.042	0.039	0.037	0.035	0.033	0.031	0.030
1990	0.000	0.004	0.019	0.053	0.085	0.084	0.068	0.054	0.043	0.036	0.031	0.027	0.024
1991	0.000	0.004	0.021	0.052	0.073	0.070	0.059	0.050	0.042	0.037	0.033	0.030	0.028
1992	0.000	0.004	0.019	0.045	0.057	0.056	0.049	0.043	0.039	0.035	0.033	0.031	0.030
1993	0.000	0.005	0.025	0.059	0.077	0.073	0.063	0.054	0.047	0.042	0.038	0.035	0.033
1994	0.001	0.006	0.031	0.072	0.090	0.085	0.074	0.064	0.057	0.051	0.047	0.044	0.041
1995	0.001	0.008	0.043	0.098	0.124	0.120	0.107	0.094	0.085	0.078	0.072	0.068	0.065
1996	0.001	0.008	0.040	0.088	0.112	0.114	0.111	0.105	0.100	0.096	0.091	0.088	0.084
1997	0.001	0.006	0.031	0.081	0.121	0.143	0.160	0.173	0.182	0.187	0.190	0.190	0.190
1998	0.001	0.006	0.030	0.076	0.112	0.132	0.147	0.158	0.166	0.170	0.173	0.173	0.173
1999	0.001	0.005	0.025	0.064	0.095	0.112	0.126	0.135	0.142	0.146	0.148	0.149	0.149
2000	0.001	0.007	0.036	0.086	0.122	0.144	0.160	0.172	0.180	0.185	0.188	0.188	0.188
2001	0.001	0.006	0.029	0.072	0.106	0.128	0.145	0.158	0.167	0.173	0.176	0.177	0.177
2002	0.001	0.005	0.024	0.061	0.093	0.115	0.133	0.147	0.157	0.163	0.167	0.169	0.170
2003	0.001	0.006	0.029	0.084	0.127	0.150	0.166	0.179	0.187	0.192	0.195	0.195	0.195
2004	0.001	0.006	0.030	0.088	0.136	0.165	0.187	0.204	0.216	0.223	0.227	0.229	0.230
2005	0.001	0.007	0.033	0.100	0.152	0.180	0.201	0.217	0.228	0.235	0.239	0.240	0.239
2006	0.001	0.008	0.036	0.103	0.159	0.194	0.221	0.242	0.256	0.266	0.271	0.274	0.275
2007	0.001	0.007	0.034	0.100	0.152	0.180	0.201	0.217	0.227	0.234	0.237	0.238	0.238
2008	0.001	0.006	0.029	0.084	0.131	0.163	0.189	0.208	0.223	0.232	0.238	0.241	0.242
2009	0.001	0.006	0.030	0.090	0.135	0.156	0.171	0.181	0.189	0.193	0.194	0.194	0.193
2010	0.001	0.006	0.027	0.078	0.119	0.141	0.158	0.170	0.179	0.184	0.186	0.187	0.187
2011	0.001	0.006	0.031	0.093	0.142	0.167	0.187	0.201	0.211	0.217	0.220	0.221	0.220
2012	0.001	0.005	0.028	0.088	0.131	0.150	0.162	0.171	0.177	0.180	0.181	0.180	0.179
2013	0.001	0.006	0.032	0.096	0.146	0.174	0.195	0.211	0.222	0.229	0.233	0.234	0.234
2014	0.001	0.006	0.033	0.103	0.153	0.173	0.186	0.196	0.201	0.204	0.205	0.204	0.202

Chesapeake Bay

Age

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.0016	0.2399	0.8105	0.5333	0.3456	0.2240	0.1451	0.0941	0.0610	0.0395	0.0256	0.0166	0.0129
1983	0.0001	0.0199	0.0672	0.0442	0.0287	0.0186	0.0120	0.0078	0.0051	0.0033	0.0021	0.0014	0.0011
1984	0.0003	0.0401	0.1353	0.0890	0.0577	0.0374	0.0242	0.0157	0.0102	0.0066	0.0043	0.0028	0.0022
1985	0.0003	0.0052	0.0085	0.0072	0.0060	0.0050	0.0041	0.0034	0.0028	0.0024	0.0020	0.0016	0.0013
1986	0.0001	0.0021	0.0035	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	0.0014	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	0.0065	0.0153	0.0149	0.0119	0.0093	0.0072	0.0056	0.0043	0.0034	0.0026	0.0020
1991	0.0002	0.0016	0.0096	0.0225	0.0219	0.0175	0.0136	0.0106	0.0082	0.0064	0.0050	0.0038	0.0030
1992	0.0002	0.0015	0.0089	0.0210	0.0205	0.0163	0.0127	0.0099	0.0077	0.0060	0.0046	0.0036	0.0028
1993	0.0003	0.0021	0.0125	0.0293	0.0286	0.0228	0.0178	0.0138	0.0107	0.0083	0.0065	0.0050	0.0039
1994	0.0004	0.0028	0.0168	0.0394	0.0385	0.0307	0.0239	0.0186	0.0144	0.0112	0.0087	0.0067	0.0052
1995	0.0005	0.0034	0.0201	0.0472	0.0461	0.0368	0.0286	0.0222	0.0173	0.0134	0.0104	0.0081	0.0063
1996	0.0005	0.0028	0.0144	0.0421	0.0565	0.0545	0.0493	0.0441	0.0394	0.0352	0.0315	0.0281	0.0251
1997	0.0006	0.0033	0.0168	0.0491	0.0659	0.0635	0.0574	0.0514	0.0459	0.0410	0.0367	0.0327	0.0293
1998	0.0005	0.0030	0.0152	0.0446	0.0599	0.0578	0.0522	0.0467	0.0417	0.0373	0.0333	0.0298	0.0266
1999	0.0004	0.0025	0.0130	0.0381	0.0511	0.0493	0.0446	0.0399	0.0356	0.0318	0.0284	0.0254	0.0227
2000	0.0005	0.0029	0.0149	0.0437	0.0587	0.0567	0.0512	0.0458	0.0409	0.0366	0.0327	0.0292	0.0261
2001	0.0004	0.0026	0.0131	0.0384	0.0515	0.0497	0.0449	0.0402	0.0359	0.0321	0.0287	0.0256	0.0229
2002	0.0004	0.0021	0.0106	0.0311	0.0417	0.0402	0.0364	0.0325	0.0291	0.0260	0.0232	0.0207	0.0185
2003	0.0006	0.0034	0.0173	0.0507	0.0680	0.0656	0.0593	0.0531	0.0474	0.0424	0.0379	0.0338	0.0302
2004	0.0005	0.0030	0.0152	0.0446	0.0599	0.0577	0.0522	0.0467	0.0417	0.0373	0.0333	0.0298	0.0266
2005	0.0005	0.0032	0.0163	0.0478	0.0641	0.0619	0.0559	0.0501	0.0447	0.0400	0.0357	0.0319	0.0285
2006	0.0007	0.0039	0.0198	0.0581	0.0779	0.0752	0.0680	0.0608	0.0543	0.0485	0.0434	0.0387	0.0346
2007	0.0006	0.0035	0.0180	0.0528	0.0709	0.0684	0.0618	0.0553	0.0494	0.0442	0.0395	0.0353	0.0315
2008	0.0005	0.0027	0.0137	0.0402	0.0539	0.0520	0.0470	0.0421	0.0376	0.0336	0.0300	0.0268	0.0240
2009	0.0005	0.0032	0.0164	0.0481	0.0645	0.0623	0.0563	0.0504	0.0450	0.0402	0.0359	0.0321	0.0287
2010	0.0005	0.0030	0.0154	0.0451	0.0605	0.0584	0.0528	0.0472	0.0422	0.0377	0.0337	0.0301	0.0269
2011	0.0005	0.0030	0.0152	0.0444	0.0596	0.0575	0.0520	0.0465	0.0416	0.0371	0.0332	0.0296	0.0265
2012	0.0005	0.0027	0.0137	0.0401	0.0538	0.0519	0.0469	0.0420	0.0375	0.0335	0.0300	0.0268	0.0239
2013	0.0005	0.0031	0.0157	0.0460	0.0617	0.0596	0.0538	0.0482	0.0430	0.0385	0.0344	0.0307	0.0274
2014	0.0006	0.0032	0.0165	0.0483	0.0649	0.0626	0.0566	0.0506	0.0453	0.0404	0.0361	0.0323	0.0288

Table 24 cont.

Ocean

Year	Age 1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.0005	0.0057	0.0486	0.1365	0.1582	0.1570	0.1537	0.1502	0.1468	0.1435	0.1403	0.1371	0.1340
1983	0.0004	0.0043	0.0367	0.1031	0.1194	0.1186	0.1161	0.1134	0.1109	0.1084	0.1059	0.1035	0.1012
1984	0.0002	0.0022	0.0185	0.0520	0.0602	0.0598	0.0585	0.0572	0.0559	0.0546	0.0534	0.0522	0.0510
1985	0.0003	0.0020	0.0080	0.0193	0.0342	0.0497	0.0633	0.0740	0.0819	0.0875	0.0913	0.0938	0.0955
1986	0.0001	0.0012	0.0047	0.0113	0.0201	0.0292	0.0371	0.0434	0.0481	0.0514	0.0536	0.0551	0.0561
1987	0.0001	0.0006	0.0022	0.0052	0.0093	0.0135	0.0172	0.0201	0.0222	0.0238	0.0248	0.0255	0.0259
1988	0.0001	0.0008	0.0030	0.0073	0.0130	0.0188	0.0240	0.0280	0.0310	0.0331	0.0346	0.0355	0.0362
1989	0.0001	0.0005	0.0020	0.0049	0.0087	0.0127	0.0162	0.0189	0.0209	0.0223	0.0233	0.0240	0.0244
1990	0.0000	0.0011	0.0056	0.0109	0.0141	0.0157	0.0164	0.0166	0.0167	0.0168	0.0168	0.0168	0.0168
1991	0.0000	0.0014	0.0074	0.0143	0.0186	0.0207	0.0216	0.0220	0.0221	0.0222	0.0222	0.0222	0.0222
1992	0.0000	0.0016	0.0085	0.0164	0.0213	0.0236	0.0246	0.0251	0.0252	0.0253	0.0253	0.0253	0.0253
1993	0.0000	0.0017	0.0091	0.0175	0.0228	0.0253	0.0264	0.0268	0.0270	0.0271	0.0271	0.0271	0.0271
1994	0.0000	0.0022	0.0113	0.0218	0.0284	0.0316	0.0329	0.0335	0.0337	0.0338	0.0338	0.0338	0.0338
1995	0.0001	0.0036	0.0188	0.0363	0.0472	0.0525	0.0547	0.0556	0.0560	0.0561	0.0562	0.0562	0.0562
1996	0.0001	0.0036	0.0185	0.0358	0.0465	0.0517	0.0539	0.0548	0.0552	0.0553	0.0554	0.0554	0.0554
1997	0.0003	0.0024	0.0103	0.0268	0.0501	0.0755	0.0989	0.1181	0.1327	0.1432	0.1506	0.1556	0.1590
1998	0.0002	0.0022	0.0093	0.0242	0.0452	0.0682	0.0893	0.1066	0.1198	0.1293	0.1360	0.1405	0.1436
1999	0.0002	0.0019	0.0081	0.0209	0.0391	0.0589	0.0772	0.0921	0.1035	0.1117	0.1174	0.1214	0.1240
2000	0.0003	0.0024	0.0102	0.0263	0.0492	0.0742	0.0972	0.1161	0.1304	0.1408	0.1480	0.1530	0.1563
2001	0.0003	0.0023	0.0099	0.0256	0.0478	0.0721	0.0944	0.1127	0.1266	0.1366	0.1436	0.1484	0.1517
2002	0.0003	0.0023	0.0097	0.0253	0.0472	0.0712	0.0933	0.1114	0.1251	0.1350	0.1420	0.1467	0.1499
2003	0.0003	0.0024	0.0103	0.0267	0.0500	0.0754	0.0987	0.1178	0.1324	0.1429	0.1502	0.1552	0.1586
2004	0.0003	0.0029	0.0125	0.0324	0.0607	0.0915	0.1198	0.1430	0.1607	0.1734	0.1824	0.1885	0.1926
2005	0.0003	0.0029	0.0126	0.0325	0.0609	0.0918	0.1202	0.1435	0.1612	0.1740	0.1829	0.1891	0.1932
2006	0.0004	0.0036	0.0153	0.0397	0.0741	0.1118	0.1465	0.1748	0.1964	0.2120	0.2229	0.2304	0.2354
2007	0.0003	0.0029	0.0125	0.0325	0.0607	0.0915	0.1199	0.1431	0.1608	0.1735	0.1824	0.1885	0.1927
2008	0.0004	0.0032	0.0137	0.0355	0.0664	0.1002	0.1312	0.1567	0.1760	0.1900	0.1997	0.2064	0.2109
2009	0.0003	0.0023	0.0097	0.0251	0.0469	0.0708	0.0927	0.1106	0.1243	0.1342	0.1411	0.1458	0.1490
2010	0.0003	0.0023	0.0099	0.0258	0.0482	0.0727	0.0952	0.1136	0.1276	0.1378	0.1448	0.1497	0.1530
2011	0.0003	0.0027	0.0115	0.0297	0.0555	0.0838	0.1097	0.1310	0.1471	0.1588	0.1670	0.1726	0.1763
2012	0.0002	0.0020	0.0085	0.0221	0.0412	0.0622	0.0814	0.0972	0.1092	0.1179	0.1239	0.1281	0.1309
2013	0.0003	0.0029	0.0123	0.0320	0.0598	0.0902	0.1182	0.1411	0.1585	0.1711	0.1799	0.1859	0.1900
2014	0.0002	0.0022	0.0094	0.0244	0.0457	0.0689	0.0902	0.1077	0.1210	0.1306	0.1373	0.1419	0.1450

Commercial Discards

Year	Age 1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.0006	0.0020	0.0070	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
1983	0.0004	0.0013	0.0045	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	0.0111	0.0167	0.0145	0.0114	0.0088	0.0068	0.0053	0.0041	0.0032	0.0024
1986	0.0001	0.0009	0.0052	0.0206	0.0309	0.0269	0.0211	0.0164	0.0127	0.0098	0.0076	0.0059	0.0045
1987	0.0001	0.0005	0.0028	0.0111	0.0167	0.0145	0.0114	0.0088	0.0068	0.0053	0.0041	0.0032	0.0024
1988	0.0001	0.0008	0.0050	0.0195	0.0292	0.0254	0.0199	0.0154	0.0119	0.0092	0.0071	0.0055	0.0043
1989	0.0002	0.0011	0.0064	0.0252	0.0378	0.0329	0.0258	0.0200	0.0155	0.0120	0.0093	0.0072	0.0055
1990	0.0003	0.0015	0.0069	0.0267	0.0563	0.0563	0.0422	0.0300	0.0211	0.0148	0.0104	0.0073	0.0051
1991	0.0002	0.0009	0.0039	0.0152	0.0321	0.0321	0.0240	0.0171	0.0120	0.0084	0.0059	0.0042	0.0029
1992	0.0001	0.0004	0.0019	0.0074	0.0156	0.0156	0.0117	0.0083	0.0058	0.0041	0.0029	0.0020	0.0014
1993	0.0001	0.0007	0.0031	0.0119	0.0252	0.0252	0.0189	0.0134	0.0094	0.0066	0.0047	0.0033	0.0023
1994	0.0001	0.0006	0.0028	0.0109	0.0230	0.0230	0.0172	0.0122	0.0086	0.0061	0.0043	0.0030	0.0021
1995	0.0002	0.0008	0.0038	0.0147	0.0309	0.0309	0.0232	0.0165	0.0116	0.0081	0.0057	0.0040	0.0028
1996	0.0001	0.0013	0.0073	0.0100	0.0092	0.0082	0.0073	0.0065	0.0058	0.0052	0.0046	0.0041	0.0036
1997	0.0001	0.0007	0.0038	0.0052	0.0048	0.0043	0.0038	0.0034	0.0030	0.0027	0.0024	0.0021	0.0019
1998	0.0001	0.0010	0.0055	0.0076	0.0070	0.0062	0.0055	0.0049	0.0044	0.0039	0.0035	0.0031	0.0027
1999	0.0001	0.0007	0.0038	0.0052	0.0048	0.0043	0.0038	0.0034	0.0030	0.0027	0.0024	0.0021	0.0019
2000	0.0002	0.0020	0.0113	0.0155	0.0143	0.0127	0.0113	0.0101	0.0090	0.0080	0.0071	0.0063	0.0056
2001	0.0001	0.0010	0.0057	0.0078	0.0072	0.0064	0.0057	0.0051	0.0045	0.0040	0.0036	0.0032	0.0028
2002	0.0000	0.0006	0.0032	0.0044	0.0041	0.0036	0.0032	0.0029	0.0026	0.0023	0.0020	0.0018	0.0016
2003	0.0000	0.0002	0.0015	0.0064	0.0089	0.0088	0.0084	0.0079	0.0075	0.0071	0.0067	0.0063	0.0060
2004	0.0000	0.0003	0.0027	0.0114	0.0158	0.0156	0.0148	0.0140	0.0132	0.0125	0.0118	0.0112	0.0105
2005	0.0001	0.0005	0.0046	0.0192	0.0268	0.0264	0.0251	0.0237	0.0224	0.0212	0.0200	0.0189	0.0178
2006	0.0000	0.0001	0.0012	0.0049	0.0068	0.0068	0.0064	0.0061	0.0057	0.0054	0.0051	0.0048	0.0046
2007	0.0000	0.0004	0.0035	0.0148	0.0207	0.0204	0.0194	0.0183	0.0173	0.0163	0.0154	0.0146	0.0138
2008	0.0000	0.0002	0.0019	0.0079	0.0109	0.0108	0.0103	0.0097	0.0092	0.0087	0.0082	0.0077	0.0073
2009	0.0001	0.0005	0.0040	0.0166	0.0231	0.0228	0.0217	0.0205	0.0193	0.0183	0.0173	0.0163	0.0154
2010	0.0000	0.0002	0.0018	0.0076	0.0105	0.0104	0.0099	0.0093	0.0088	0.0083	0.0079	0.0074	0.0070
2011	0.0001	0.0005	0.0045	0.0191	0.0265	0.0262	0.0249	0.0235	0.0222	0.0210	0.0198	0.0187	0.0177
2012	0.0001	0.0007	0.0061	0.0257	0.0358	0.0354	0.0336	0.0317	0.0300	0.0283	0.0267	0.0253	0.0239
2013	0.0001	0.0005	0.0042	0.0177	0.0246	0.0243	0.0231	0.0218	0.0206	0.0194	0.0184	0.0173	0.0164
2014	0.0001	0.0008	0.0072	0.0302	0.0421	0.0416	0.0395	0.0373	0.0352	0.0333	0.0314	0.0297	0.0280

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	19,164,800	5,877,320	4,201,390	2,456,710	598,881	198,913	170,662	115,002	87,552	97,978	77,167	152,037	78,761	33,277,173	608,497
1983	46,186,300	6,174,050	2,324,490	1,126,690	894,979	279,032	111,266	107,869	76,763	60,612	69,531	55,710	169,053	57,636,345	539,538
1984	40,908,500	14,906,400	3,049,230	1,329,850	694,562	597,196	199,880	83,711	81,713	58,459	46,357	53,370	173,409	62,182,638	497,020
1985	39,887,500	13,202,300	7,227,720	1,657,500	823,521	476,819	444,450	157,078	66,436	65,294	46,939	37,355	183,486	64,276,397	556,587
1986	32,095,100	12,877,500	6,637,540	4,520,550	1,147,620	605,881	367,958	353,566	124,029	52,180	51,101	36,655	172,129	59,041,809	789,660
1987	42,690,600	10,363,800	6,496,720	4,175,870	3,138,390	847,204	472,742	298,273	286,249	100,346	42,207	41,341	169,027	69,122,769	937,443
1988	55,831,600	13,788,000	5,240,620	4,116,060	2,949,860	2,379,100	680,684	395,158	249,266	239,206	83,864	35,283	175,948	86,164,649	1,178,725
1989	62,126,900	18,030,200	6,964,100	3,307,220	2,875,160	2,198,820	1,879,720	560,071	325,344	205,365	197,222	69,198	174,519	98,913,839	1,531,719
1990	83,533,700	20,064,000	9,115,580	4,399,700	2,305,460	2,136,080	1,736,470	1,550,770	463,521	269,952	170,764	164,284	203,491	126,113,772	2,822,782
1991	68,563,500	26,971,100	10,127,300	5,702,720	3,000,320	1,648,580	1,624,280	1,396,570	1,264,880	382,011	224,150	142,552	308,667	121,356,630	3,718,830
1992	70,015,800	22,138,900	13,610,700	6,323,750	3,892,150	2,172,940	1,270,810	1,317,620	1,143,900	1,043,600	316,870	186,656	377,359	123,811,055	4,386,005
1993	90,969,700	22,610,200	11,176,100	8,512,510	4,347,430	2,862,240	1,699,820	1,041,450	1,086,110	947,163	867,040	263,927	471,104	146,854,794	4,676,794
1994	180,963,000	29,372,900	11,403,000	6,952,870	5,770,920	3,136,330	2,199,770	1,373,750	849,285	891,814	781,718	718,313	611,482	245,025,152	5,226,362
1995	114,886,000	58,425,100	14,797,100	7,049,390	4,650,520	4,107,880	2,381,650	1,758,220	1,108,810	690,687	729,414	642,099	1,096,980	212,323,850	6,026,210
1996	124,648,000	37,086,200	29,367,700	9,040,640	4,594,080	3,198,610	3,012,480	1,842,820	1,377,140	876,750	550,056	584,016	1,400,650	217,579,142	6,631,432
1997	153,941,000	40,239,800	18,645,400	17,987,700	5,952,620	3,197,810	2,359,060	2,321,580	1,427,410	1,072,100	685,762	432,073	1,568,770	249,831,085	7,507,695
1998	98,336,800	49,684,900	20,257,200	11,527,600	11,925,300	4,108,660	2,291,330	1,729,980	1,680,970	1,024,550	765,456	488,301	1,423,840	205,244,887	7,113,097
1999	100,575,000	31,740,100	25,017,700	12,534,000	7,678,380	8,302,880	2,977,050	1,702,470	1,271,050	1,225,650	743,623	554,324	1,384,330	195,706,557	6,881,447
2000	79,720,800	32,466,700	15,998,500	15,560,400	8,450,930	5,438,160	6,135,650	2,260,110	1,279,810	949,071	911,443	551,856	1,438,090	171,161,520	7,390,380
2001	118,508,000	25,729,000	16,329,300	9,836,740	10,269,600	5,824,460	3,895,570	4,501,300	1,637,960	919,813	678,710	650,200	1,419,080	200,199,733	9,807,063
2002	138,314,000	38,252,800	12,958,700	10,118,100	6,582,530	7,190,240	4,237,290	2,900,430	3,308,340	1,193,000	666,122	489,965	1,491,640	227,703,157	10,049,497
2003	76,283,800	44,651,200	19,284,500	8,070,300	6,845,430	4,671,170	5,299,620	3,193,260	2,155,620	2,434,420	872,133	485,057	1,439,140	175,685,650	10,579,630
2004	166,587,000	24,621,200	22,486,500	11,943,300	5,335,520	4,695,710	3,325,440	3,862,260	2,298,430	1,538,520	1,728,790	617,832	1,362,860	250,403,362	11,408,692
2005	93,274,000	53,767,100	12,396,300	13,908,300	7,860,150	3,625,770	3,293,040	2,374,480	2,711,520	1,594,540	1,059,300	1,185,250	1,355,080	198,404,830	10,280,170
2006	86,785,300	30,103,100	27,058,900	7,644,320	9,051,770	5,259,620	2,504,230	2,317,770	1,644,670	1,857,460	1,084,920	718,214	1,720,570	177,750,844	9,343,604
2007	65,913,200	28,004,800	15,135,500	16,638,800	4,959,790	6,013,790	3,583,410	1,728,370	1,566,600	1,095,360	1,225,410	711,873	1,595,420	148,172,323	7,923,033
2008	87,451,600	21,271,800	14,090,800	9,327,480	10,822,700	3,317,190	4,152,550	2,522,520	1,197,760	1,074,050	746,086	831,910	1,565,230	158,371,676	7,937,556
2009	61,360,500	28,226,400	10,711,100	8,725,370	6,168,220	7,391,540	2,330,500	2,960,060	1,762,650	825,065	732,890	506,201	1,620,180	133,320,676	8,407,046
2010	78,064,700	19,804,900	14,215,500	6,627,580	5,734,390	4,198,970	5,230,340	1,691,250	2,124,930	1,256,330	585,721	519,455	1,508,540	141,562,606	7,686,226
2011	97,968,500	25,197,700	9,978,090	8,821,670	4,405,470	3,964,030	3,014,410	3,844,650	1,227,910	1,529,770	899,816	418,418	1,447,910	162,718,344	9,368,474
2012	125,129,000	31,620,300	12,687,200	6,167,190	5,778,040	2,977,750	2,772,590	2,152,980	2,706,630	855,936	1,059,960	621,575	1,288,420	195,817,571	8,685,501
2013	31,872,000	40,390,900	15,933,700	7,863,880	4,060,850	3,947,940	2,120,540	2,029,600	1,561,910	1,952,290	615,532	761,554	1,374,360	114,485,056	8,295,246
2014	76,119,600	10,286,600	20,331,500	9,837,430	5,137,910	2,732,540	2,743,120	1,501,690	1,414,500	1,076,570	1,336,450	419,845	1,455,080	134,392,835	7,204,135

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	197	481	466	416	713	748	1,532	1,037	5,736	1327.34
1983	0	0	0	27	128	230	256	403	378	397	580	534	1,768	4,701	1122.1
1984	0	0	0	35	106	503	557	307	433	370	347	578	2,031	5,267	1195.72
1985	0	0	0	51	113	434	1,220	605	357	412	364	344	2,405	6,305	1308.56
1986	0	0	0	165	173	473	872	1,277	562	284	352	307	2,081	6,545	1225.7
1987	0	0	0	145	528	646	1,014	976	1,290	544	278	351	2,109	7,883	1302.09
1988	0	0	0	139	567	2,323	1,657	1,254	1,062	1,167	604	314	2,213	11,300	1484.3
1989	0	0	0	115	536	2,481	5,781	2,306	1,540	1,371	1,415	601	2,212	18,359	1984.4
1990	0	0	0	147	362	2,107	5,132	6,490	2,253	1,410	1,190	1,368	2,434	22,893	2216.61
1991	0	0	0	196	501	1,323	4,536	5,486	6,679	2,033	1,703	1,060	4,166	27,681	2570.37
1992	0	0	0	205	696	2,003	3,436	5,255	6,302	7,002	2,494	1,996	5,002	34,390	3022.65
1993	0	0	0	283	745	2,630	4,688	4,340	6,063	6,387	7,157	2,550	6,502	41,345	3408.36
1994	0	0	0	250	1,017	2,820	6,154	5,752	4,682	5,750	6,520	6,858	7,378	47,181	3634.86
1995	0	0	0	266	820	3,826	7,040	7,357	6,433	4,976	4,950	5,728	17,280	58,677	4395.3
1996	0	0	0	339	907	3,474	10,234	8,762	8,404	6,595	4,531	5,022	18,109	66,379	4693.68
1997	0	0	0	720	1,075	3,060	6,478	8,882	8,010	8,116	5,931	3,913	21,651	67,836	4866.78
1998	0	0	0	319	1,851	3,246	6,146	6,598	8,769	6,133	5,503	4,380	15,809	58,755	4267.34
1999	0	0	0	320	951	5,509	5,912	6,016	6,635	8,015	5,459	4,646	15,551	59,014	4371.87
2000	0	0	0	390	1,034	3,737	13,017	7,386	6,864	5,839	7,440	5,078	18,200	68,987	5034.94
2001	0	0	0	284	1,379	4,524	8,873	15,122	8,115	6,027	5,011	5,084	14,422	68,842	4850.9
2002	0	0	0	263	918	5,656	10,166	10,569	15,711	7,440	5,180	4,208	16,078	76,190	5374.99
2003	0	0	0	195	924	3,675	12,390	11,198	10,523	14,402	6,383	4,093	14,775	78,558	5513.22
2004	0	0	0	284	760	3,619	7,834	13,379	11,001	9,024	12,106	4,958	13,576	76,541	5569.8
2005	0	0	0	356	1,045	2,943	7,747	8,789	13,436	9,418	7,611	10,159	15,349	76,854	6037.35
2006	0	0	0	183	1,140	3,744	5,570	8,246	8,616	11,304	7,842	5,915	19,197	71,757	6074.51
2007	0	0	0	355	627	4,453	8,403	6,010	8,295	7,062	9,575	6,231	18,934	69,945	6336.47
2008	0	0	0	222	1,377	2,744	11,236	9,276	6,198	7,253	5,818	7,280	17,448	68,852	6317.69
2009	0	0	0	211	741	5,907	5,964	11,710	9,418	5,283	5,634	4,308	18,513	67,687	6438.82
2010	0	0	0	160	706	3,308	12,735	6,048	10,721	8,043	4,492	4,266	16,332	66,811	6392.72
2011	0	0	0	232	543	2,957	7,126	13,380	6,128	9,437	6,414	3,671	17,631	67,520	6842.52
2012	0	0	0	169	811	2,320	6,835	8,241	13,755	5,732	8,138	5,527	16,670	68,197	7362.52
2013	0	0	0	186	574	3,272	5,011	7,301	8,287	12,183	4,900	6,918	16,790	65,423	7418.14
2014	0	0	0	215	666	2,100	6,717	5,317	7,573	7,348	10,341	4,247	19,394	63,918	7959.33

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

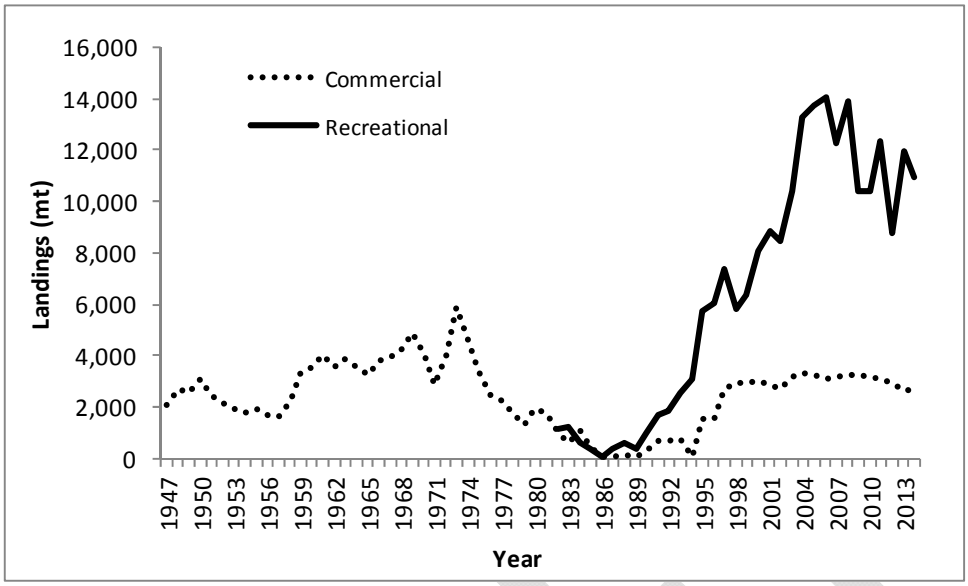


Figure 2. Time series of harvest and dead release/discard numbers from the coast-wide commercial and recreational fisheries during 1982-2014.

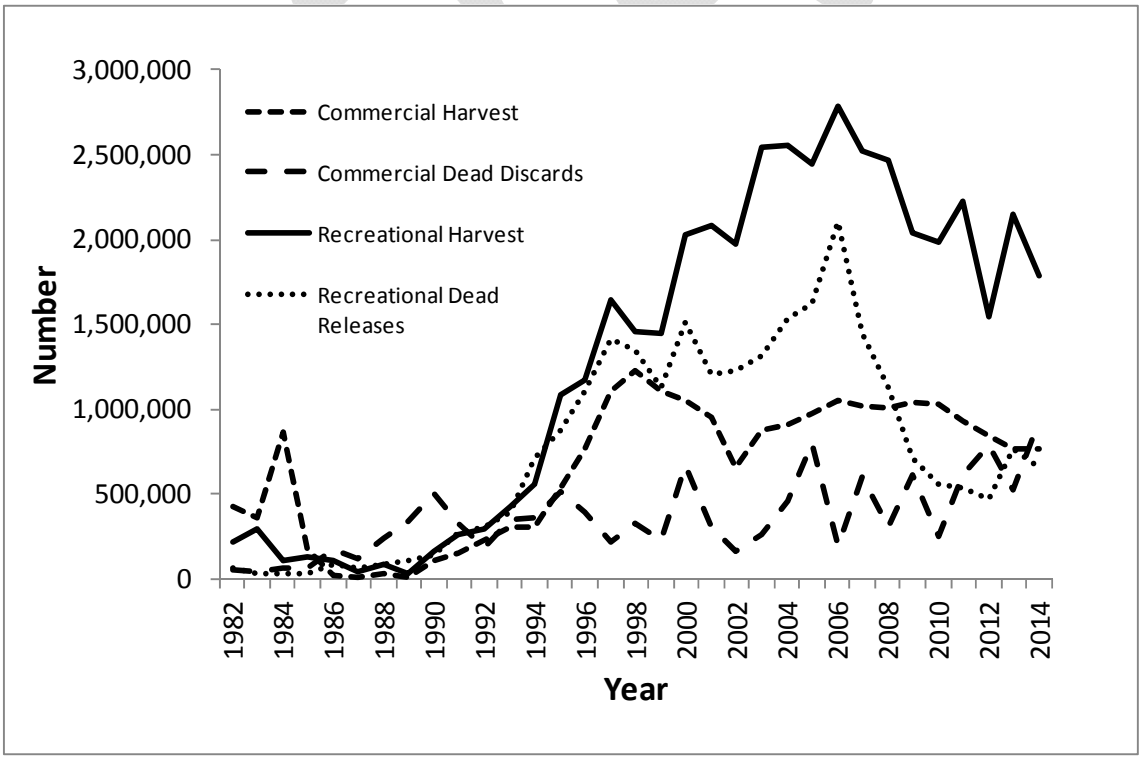


Figure 3. Percentage of total removals by fishery component in 2013 and 2014.

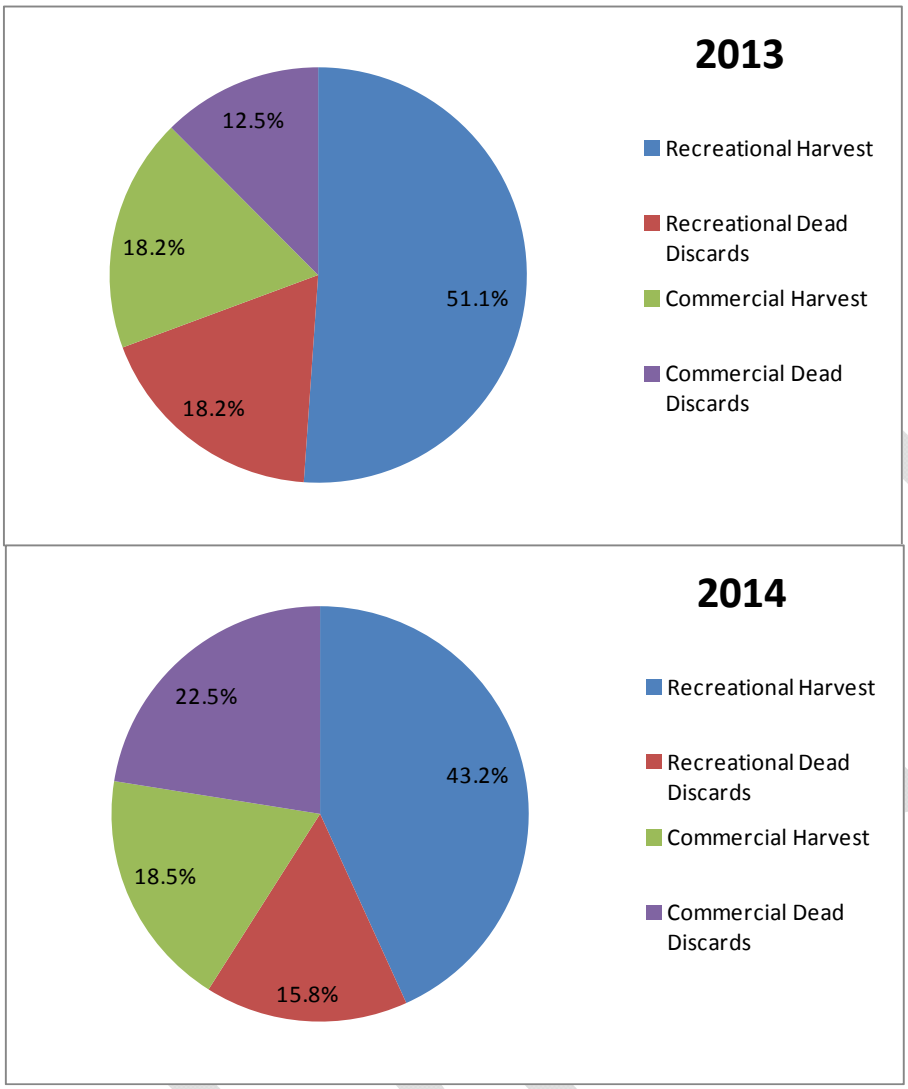


Figure 4. Total removals (numbers) of striped bass by regional fleets.

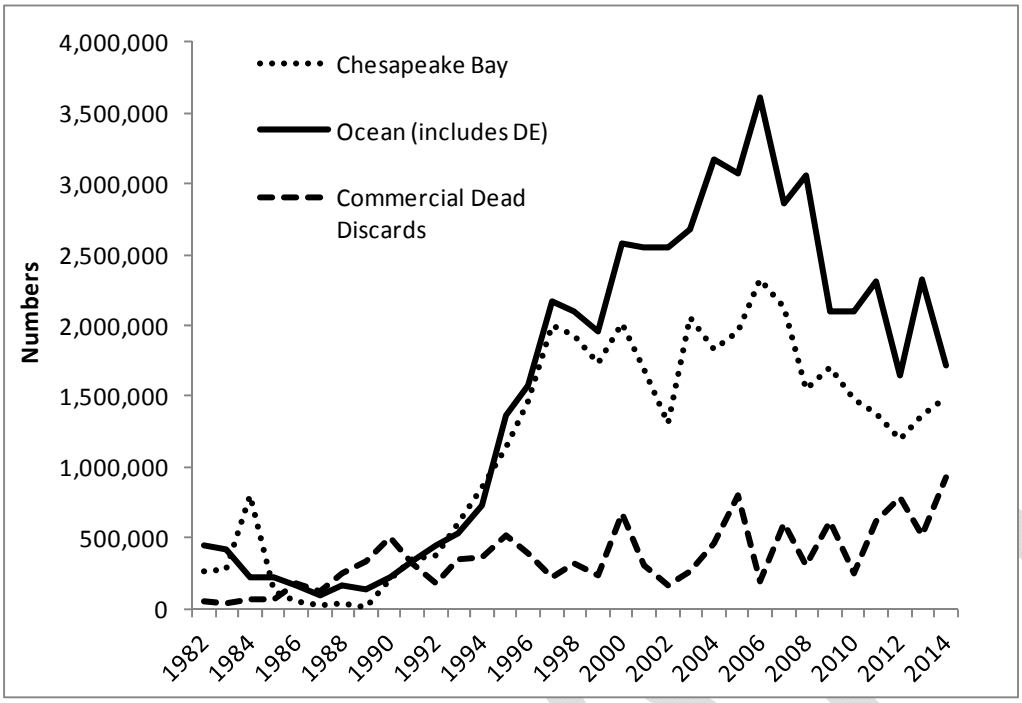


Figure 5. Fishery-independent and –dependent indices of relative abundance.

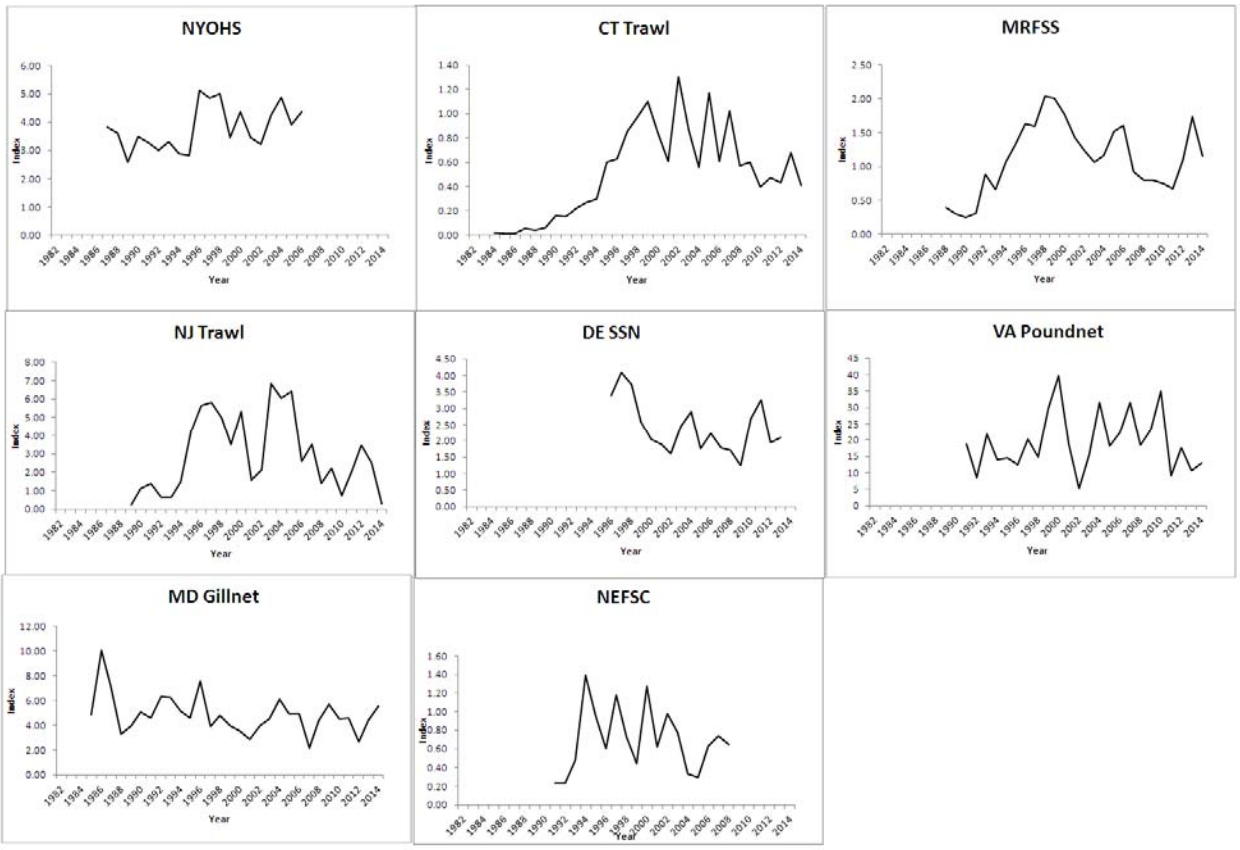


Figure 6. Young-of-the-year and age-1 indices of relative abundance.

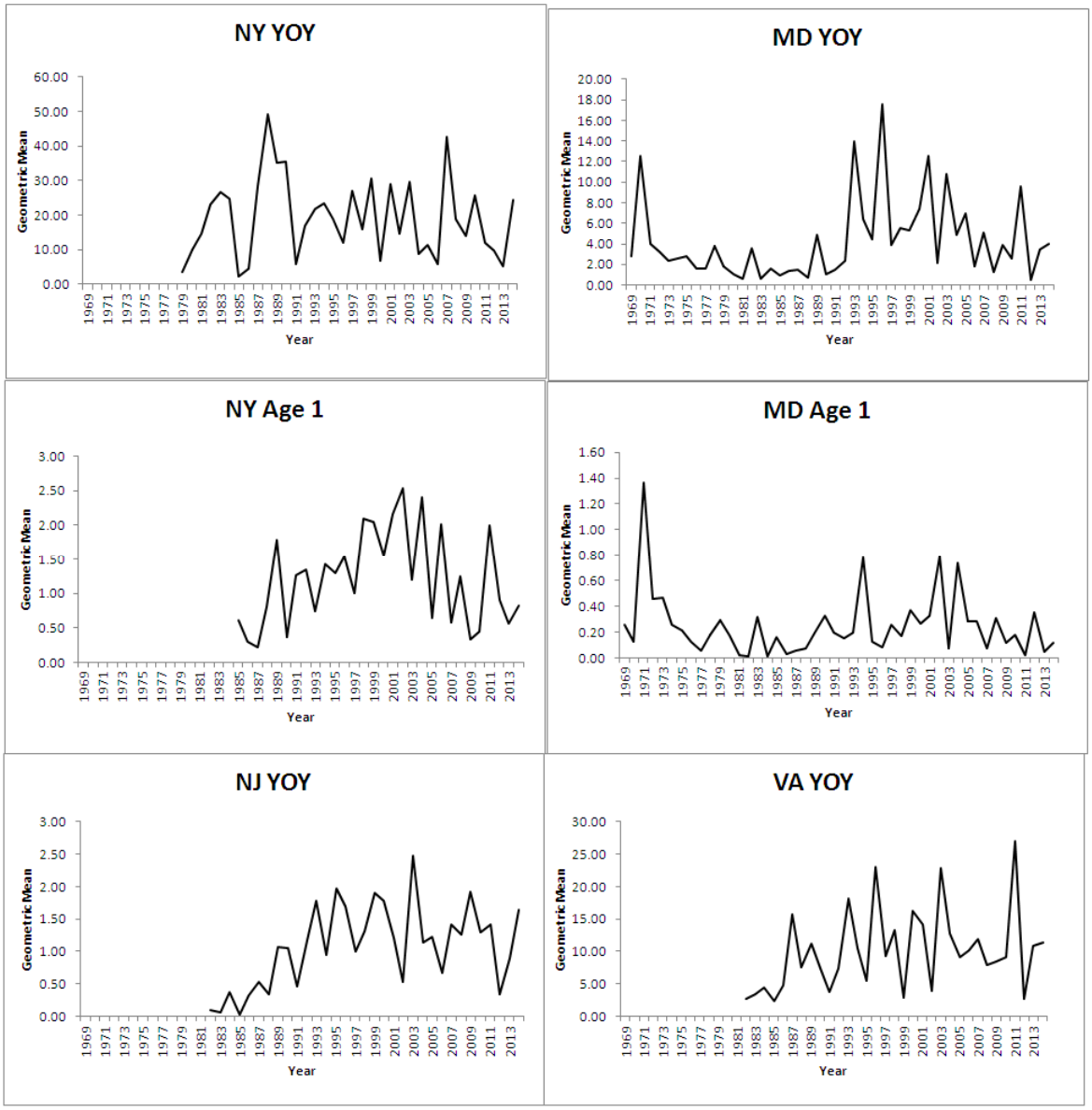


Figure 7. Observed and predicted total catch and standardized residuals by fleet (Fleet 1 = Bay, Fleet 2 = Ocean, Fleet 3 = Commercial Discards).

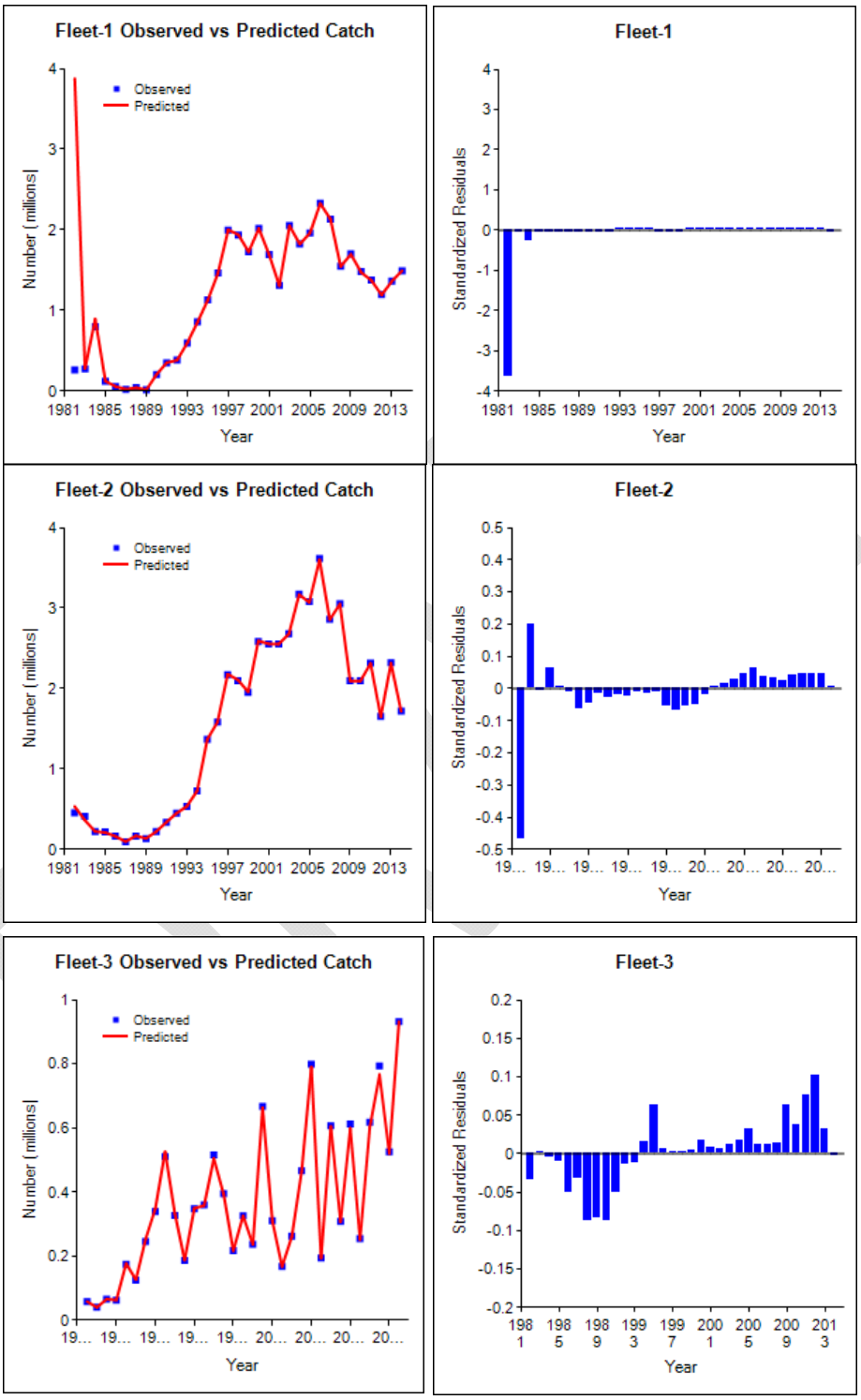


Figure 8. Catch selectivity patterns by fleet (Fleet 1 = Bay, Fleet 2 = Ocean, Fleet 3 = Commercial Discards).

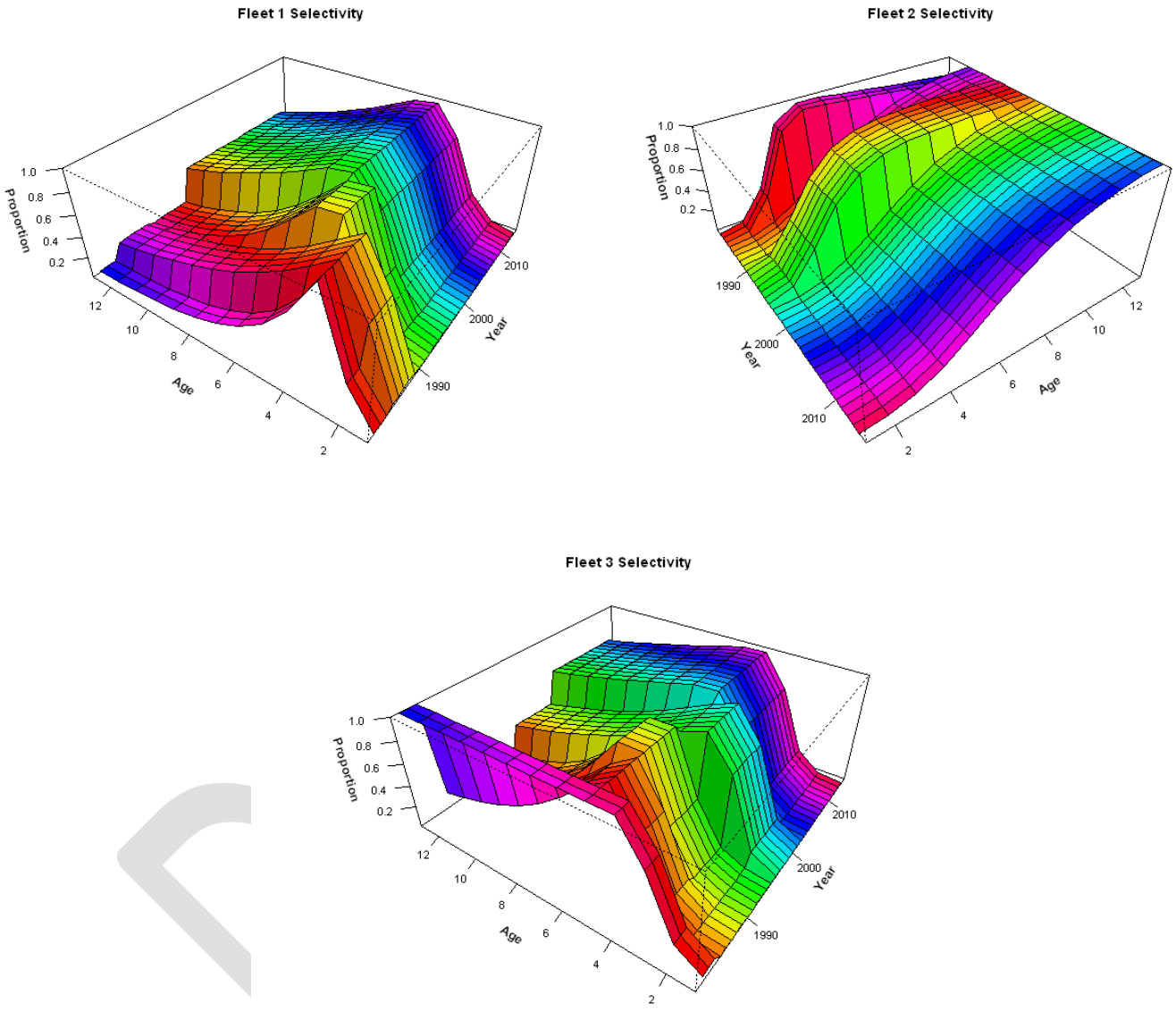


Figure 9. Estimates of total and fleet-specific fully-recruited fishing mortality (±1 SD) and recruitment (±1 SD) from the SCA base model run.

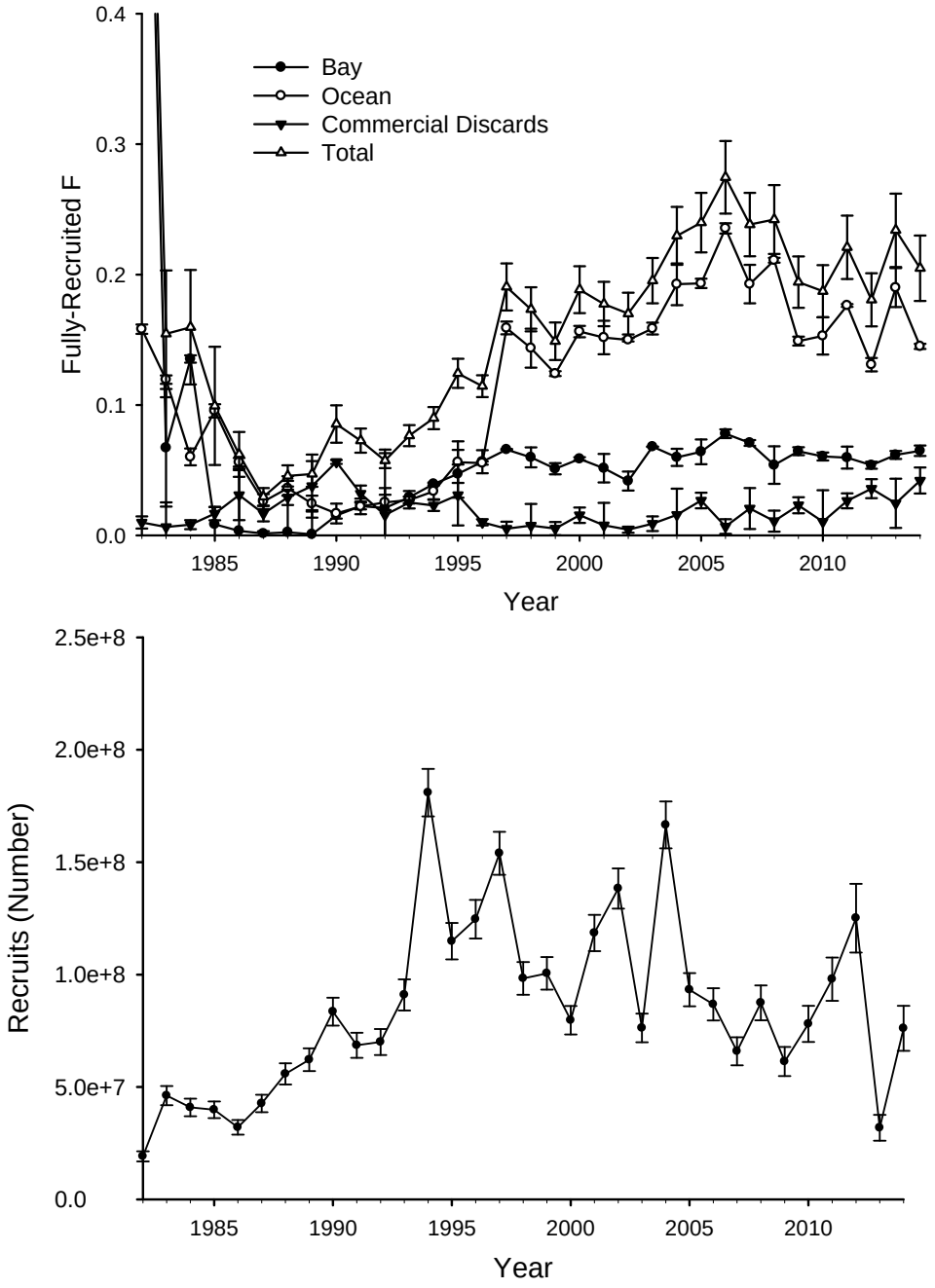


Figure 10. Comparison of fishing mortality-at-age in 2013 and 2014 from the SCA model partitioned into fleets.

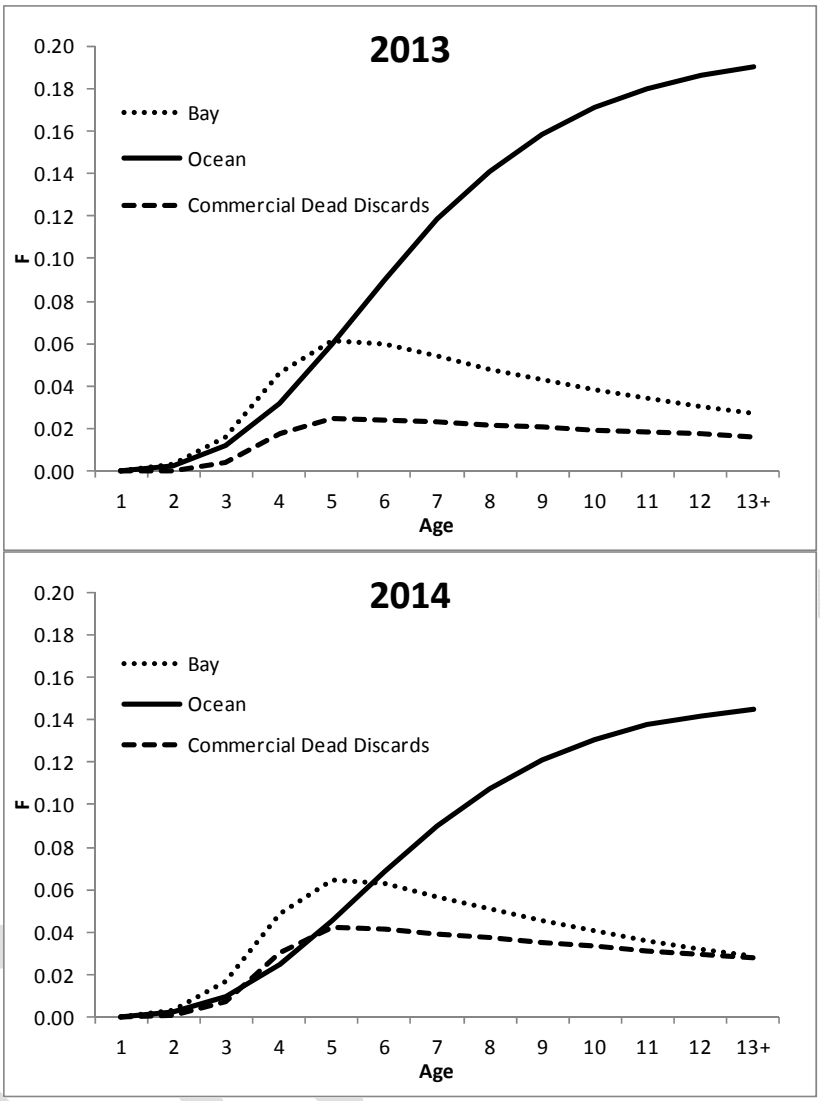


Figure 11. Estimates of January-1 total (age 1+) and 8+ abundance for 1982-2015. January-1 abundance for age 1 in 2015 was estimated from the 2014 observed values of the YOY indices and SCA model catchability coefficients, while older ages were projected from January-1 abundances and fishing and natural mortalities-at-age for 2014.

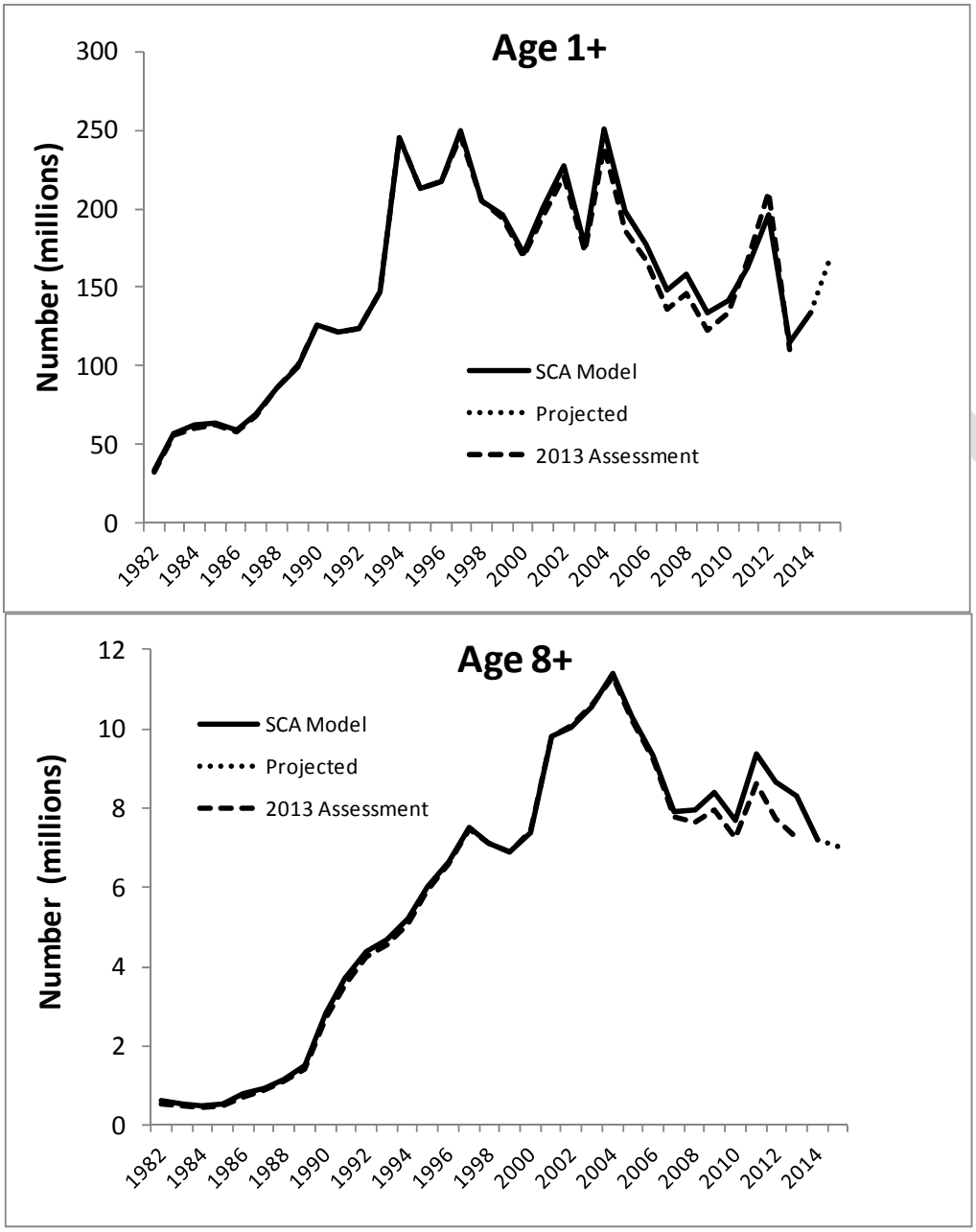


Figure 12. Estimates of A) female spawning stock biomass by year (solid line), B) female spawning stock numbers, and C) 1+ and 2+ January-1 biomass . Dotted lines equal 95% confidence intervals. Dashed line is the female spawning stock reference point (1995 value).

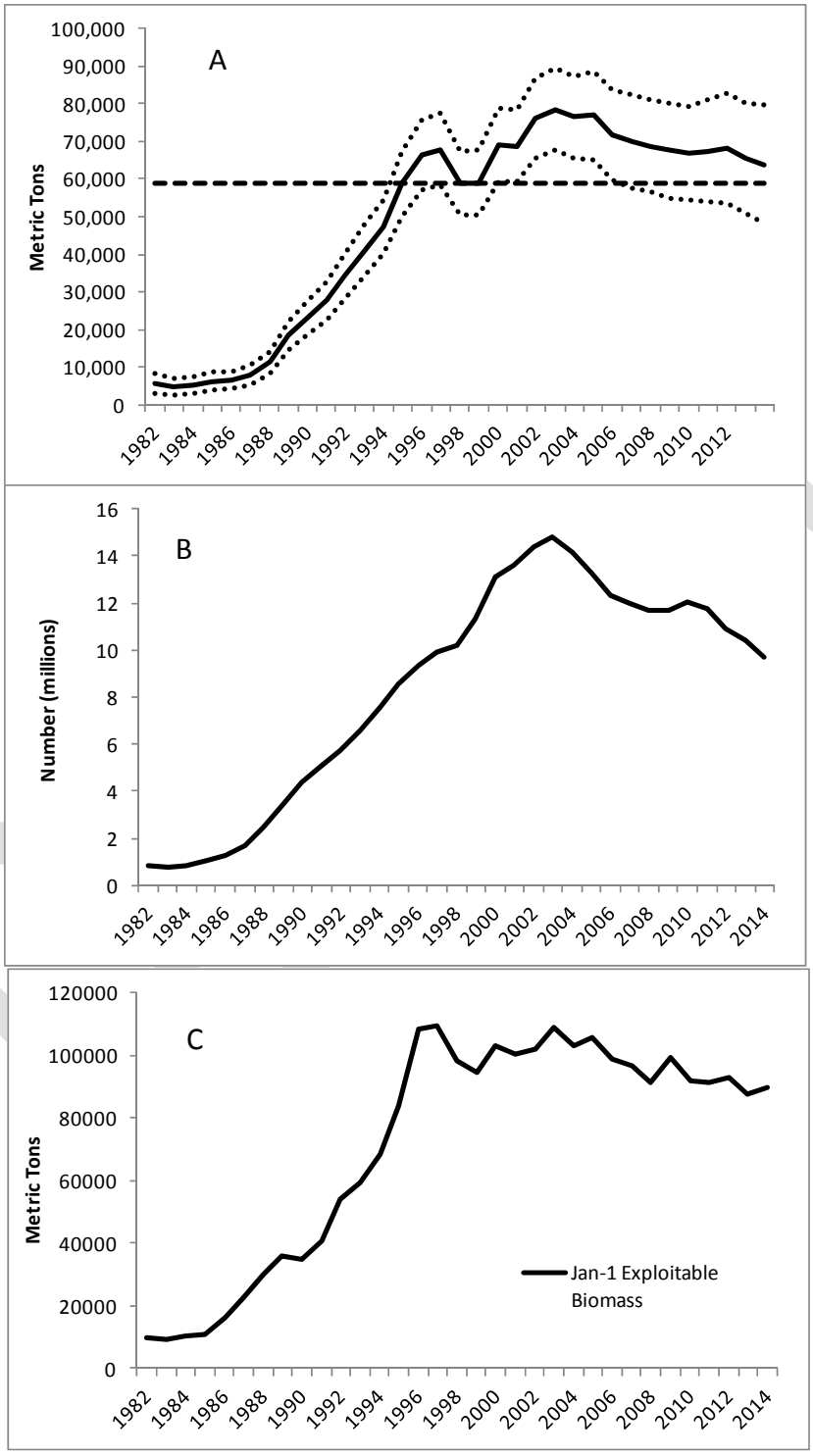


Figure 13. Retrospective analysis of fully-recruited F, female spawning stock biomass, 8+ abundance and Age 1 recruits.

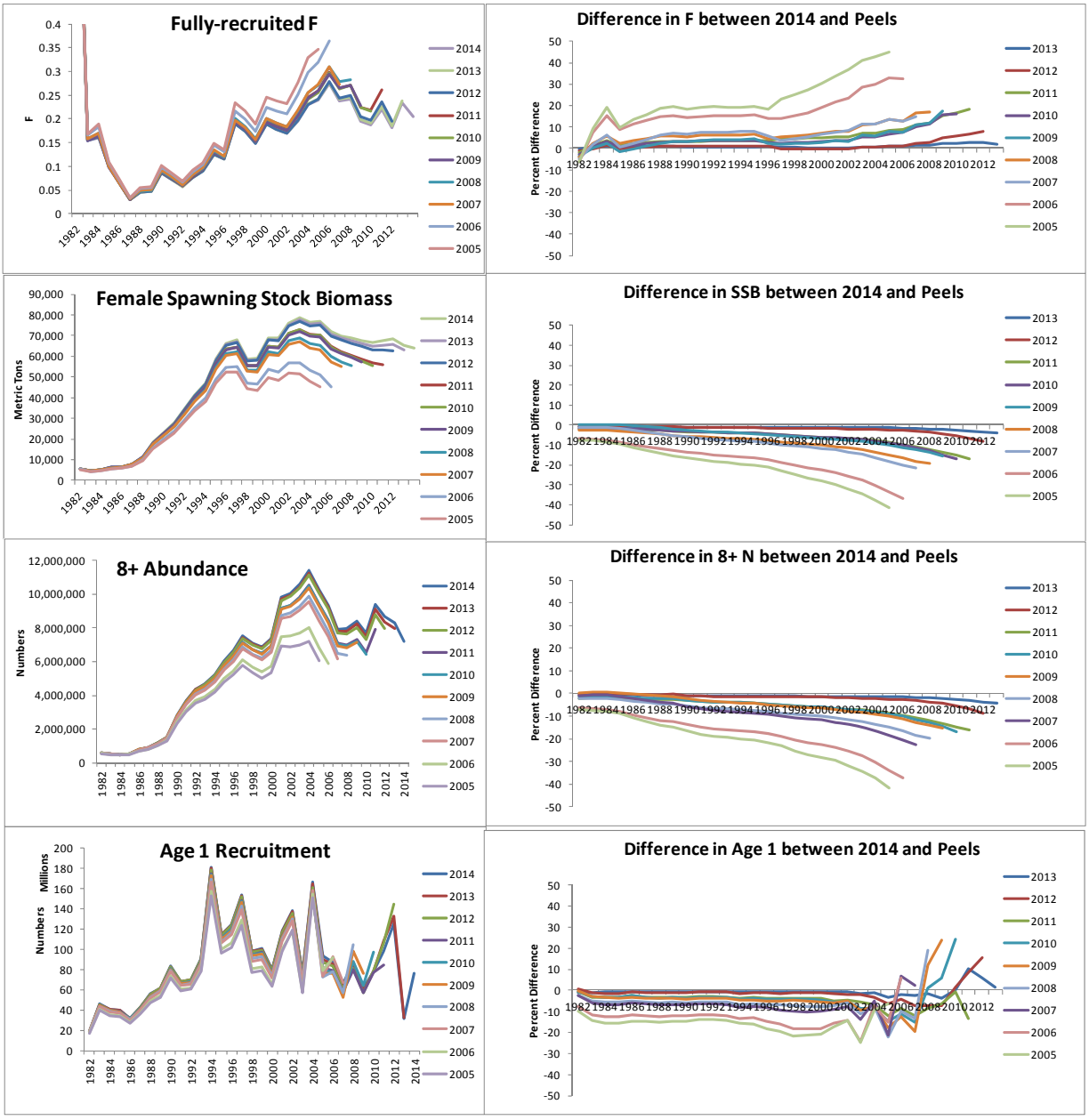
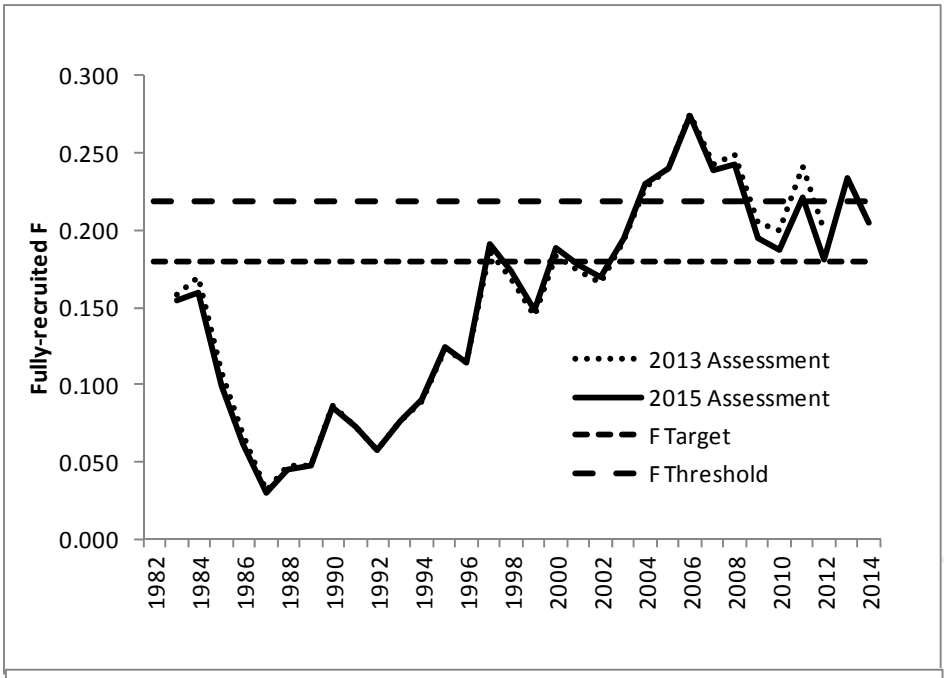


Figure 14. Comparison of coast-wide fully-recruited (age-11) fishing mortality and female spawning stock biomass estimates between the 2015 and 2013 assessments.



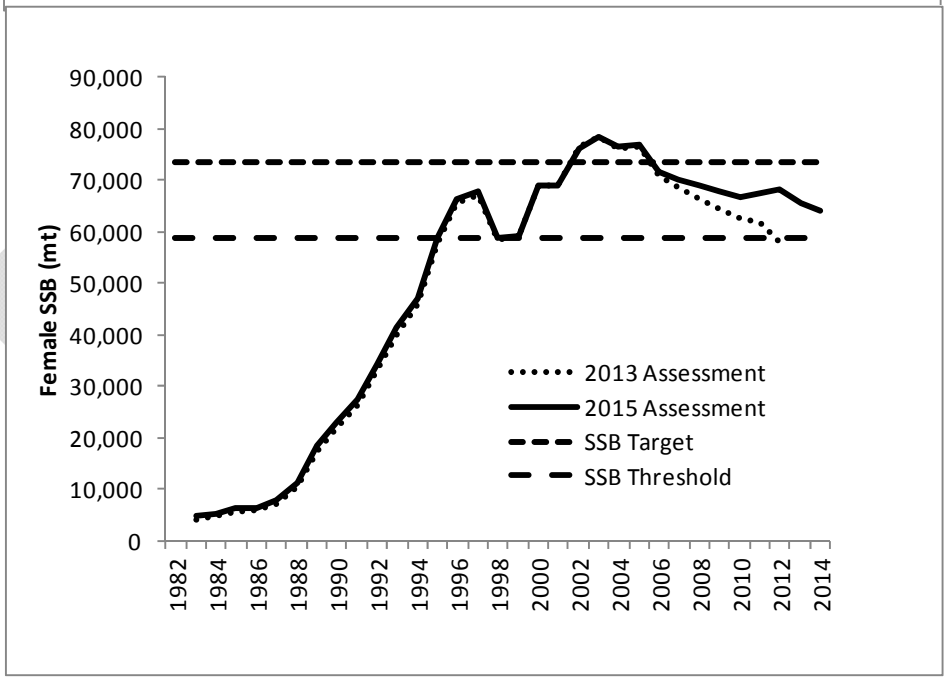


Figure 15. Projections of female spawning stock biomass and estimated fishing mortality assuming constant catch during 2015-2017. The graph on the left contains the projected estimates (median is the solid line with circle; 95% confidence intervals are dashed lines) compared to the reference point (dotted lines), and the graph on the right is the probability of the estimate comparison.

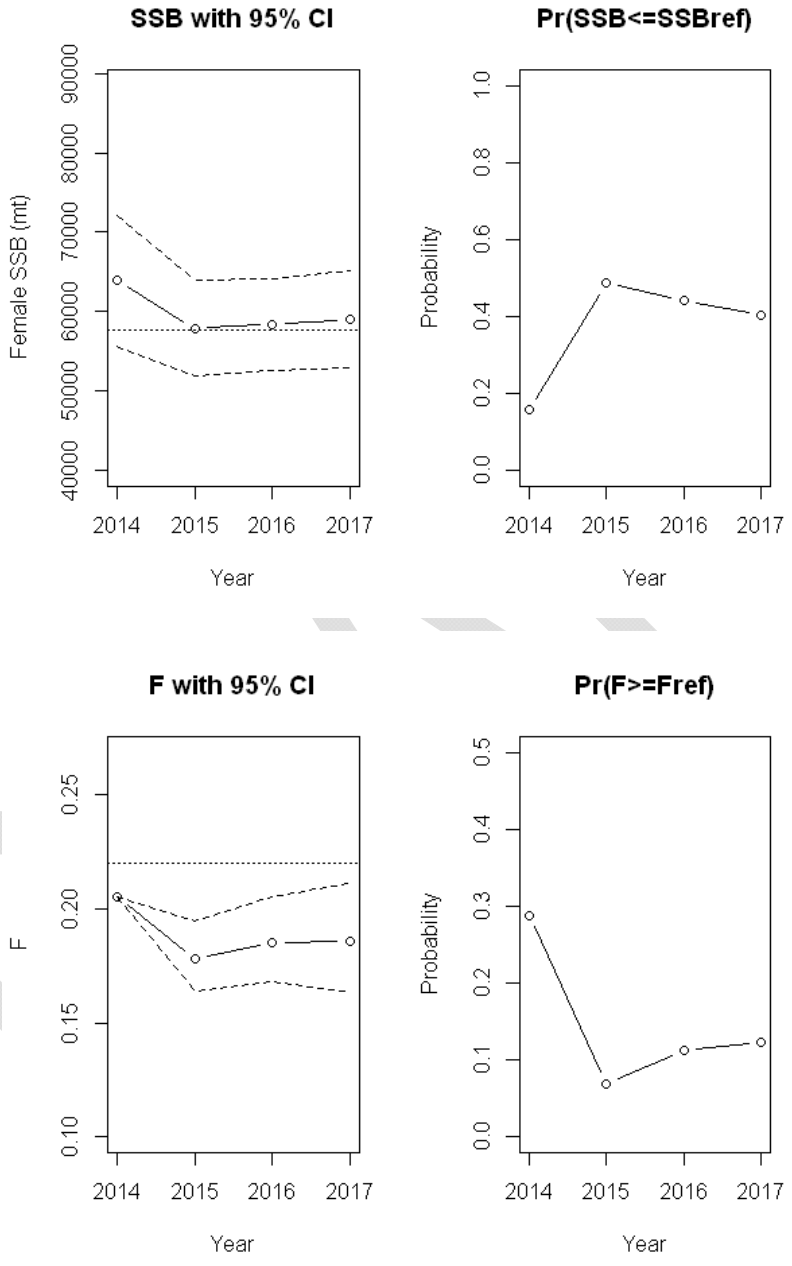


Figure 16. Projections of female spawning stock biomass and estimated fishing mortality assuming constant catch during 2015-2017 and adjusting the numbers-at-age in 2014 for the average age-specific retrospective bias in 2009-2013. The graph on the left contains the projected estimates (median is the solid line with circle; 95% confidence intervals are dashed lines) compared to the reference point (dotted lines), and the graph on the right is the probability of the estimate comparison.

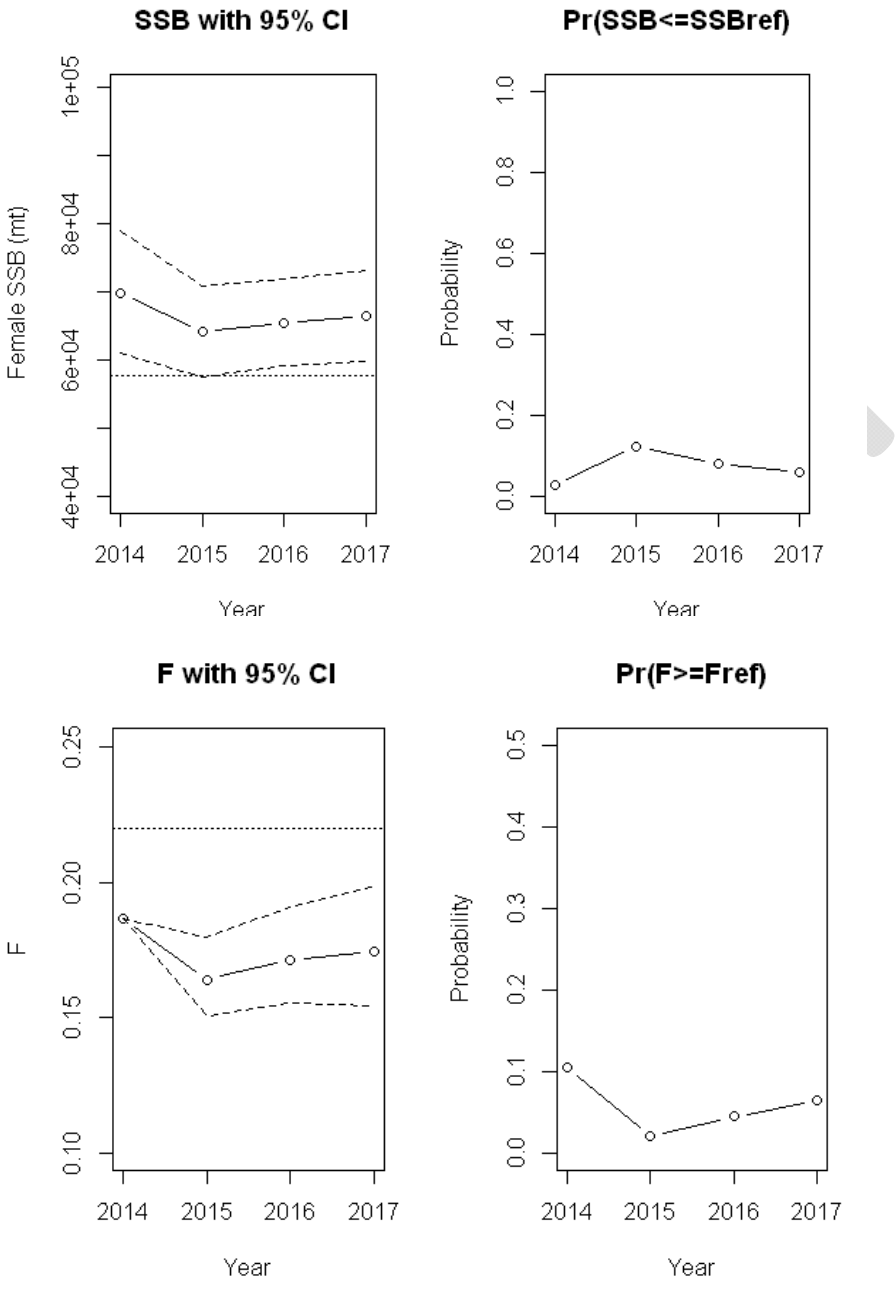


Figure 17. Projections of female spawning stock biomass and estimated fishing mortality assuming constant catch during 2015-2017. The graph on the left contains the projected estimates (median is the solid line with circle; 95% confidence intervals are dashed lines) compared to the targets (dotted lines), and the graph on the right is the probability of the estimate comparison.

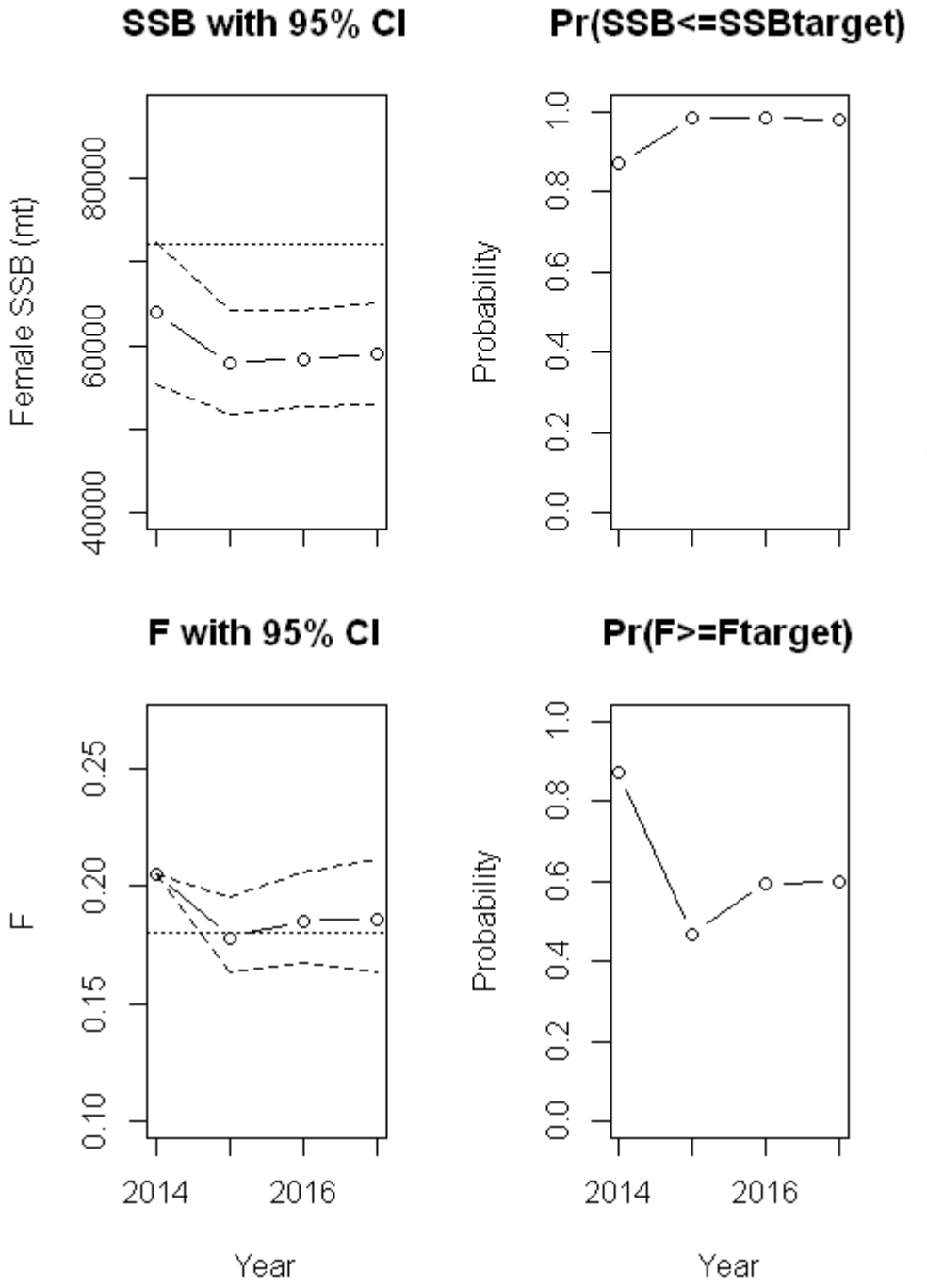
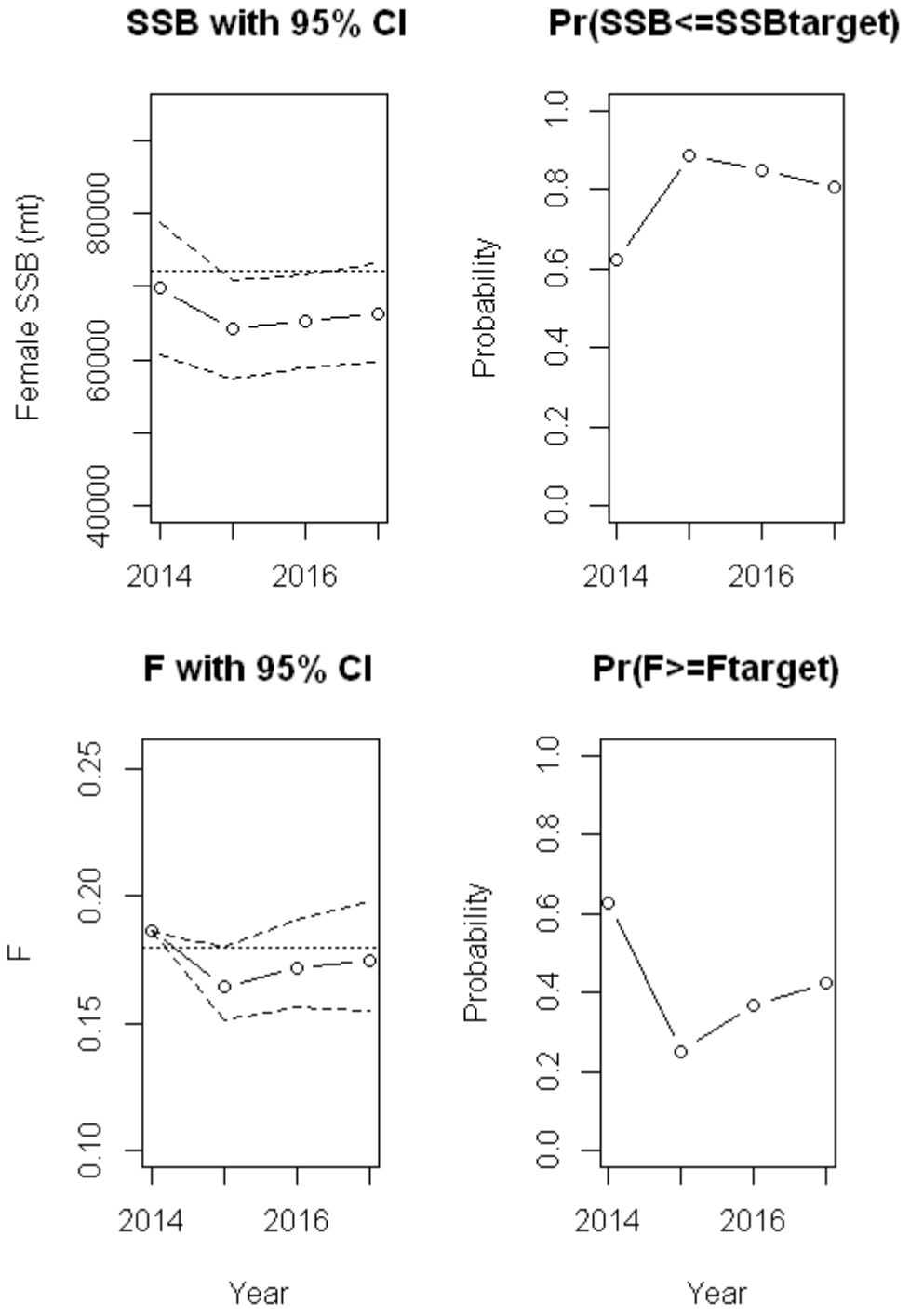


Figure 18. Projections of female spawning stock biomass and estimated fishing mortality assuming constant catch during 2015-2017 and adjusting the numbers-at-age in 2014 for the average age-specific retrospective bias in 2009-2013. The graph on the left contains the projected estimates (median is the solid line with circle; 95% confidence intervals are dashed lines) compared to the targets (dotted lines), and the graph on the right is the probability of the estimate comparison.



Appendix A. Plots of SCA model output.

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

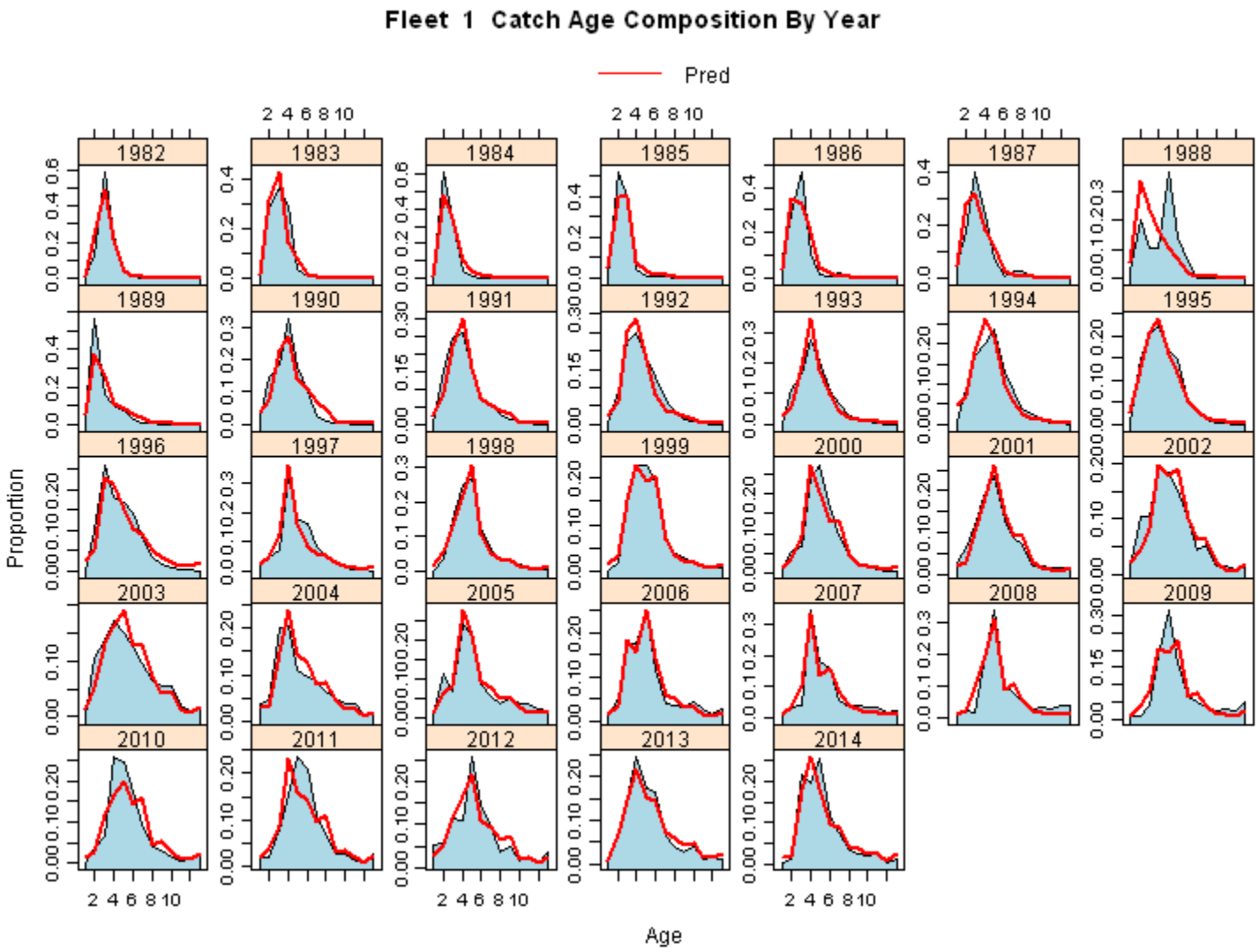


Figure 1 cont.

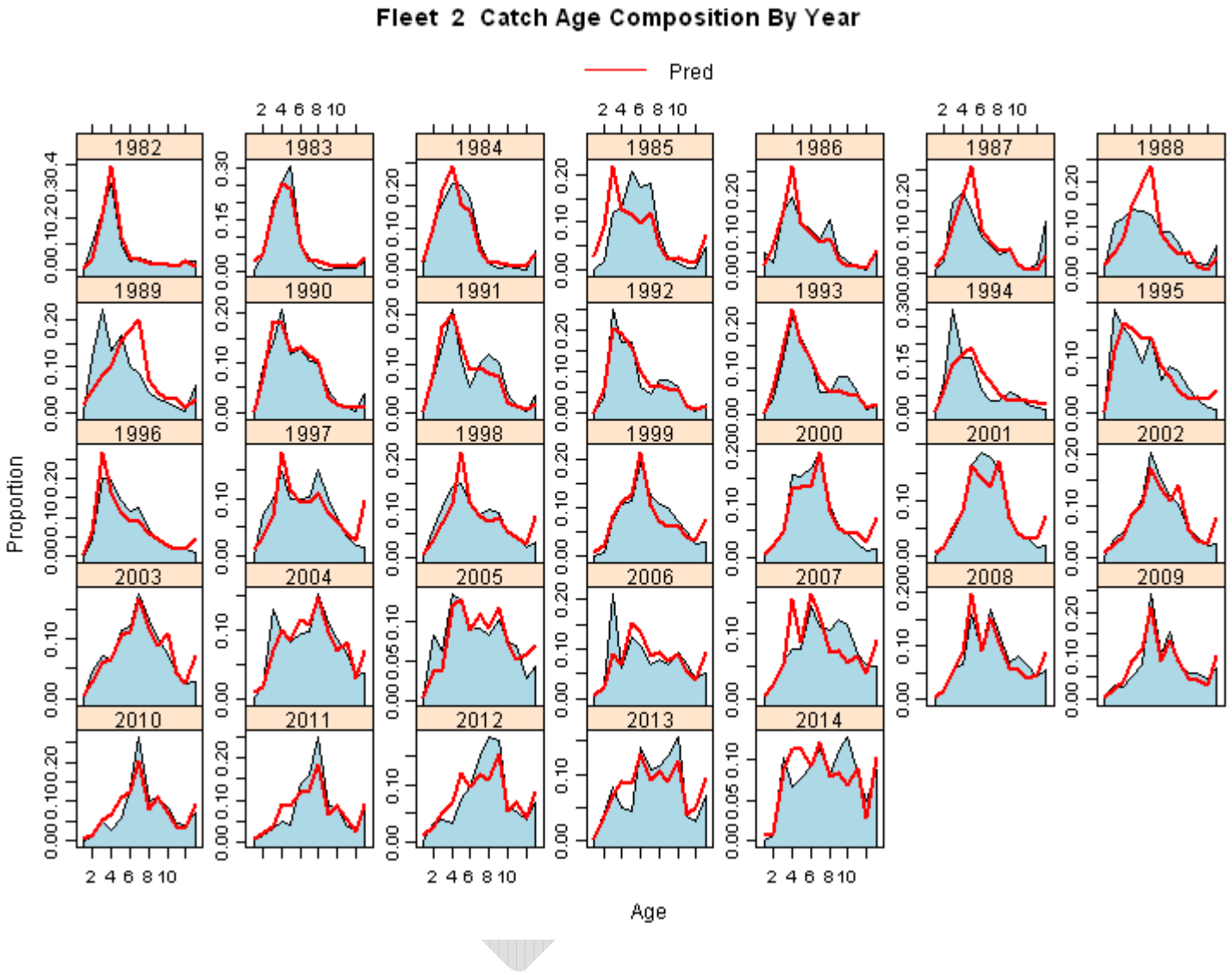


Figure 1 cont.

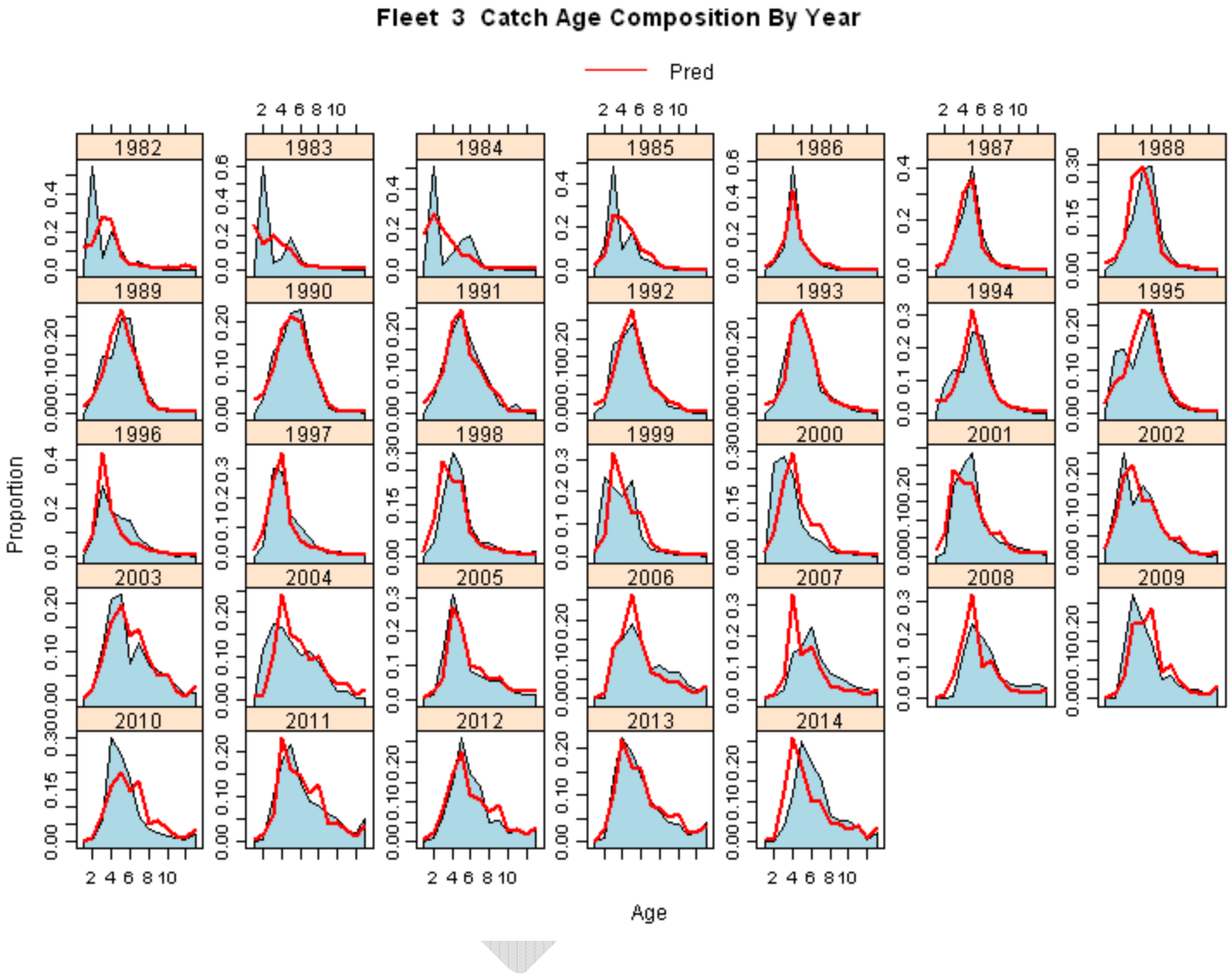


Figure 2. Standardized residuals of catch proportions-at-age by year for each fleet.

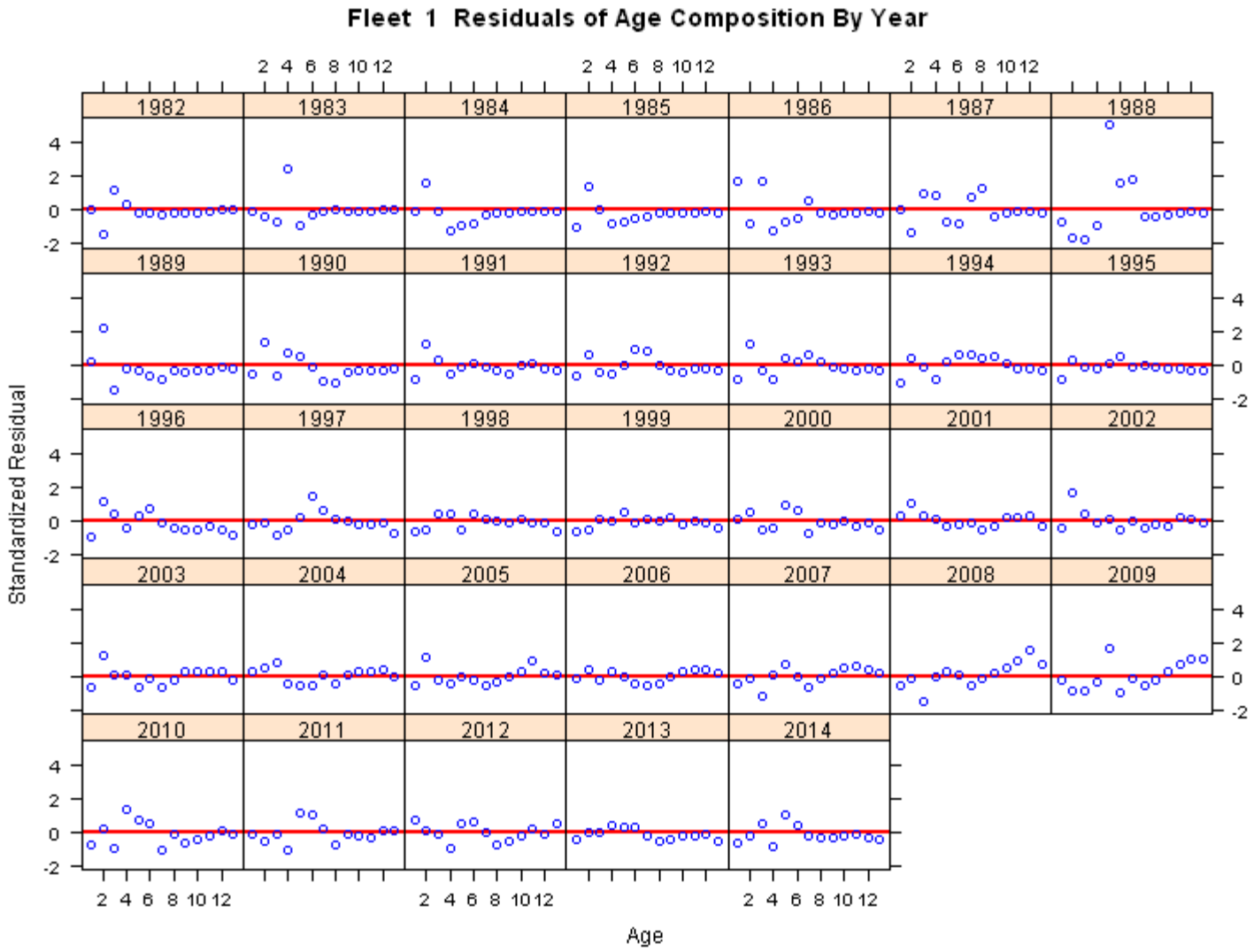


Figure 2 cont.

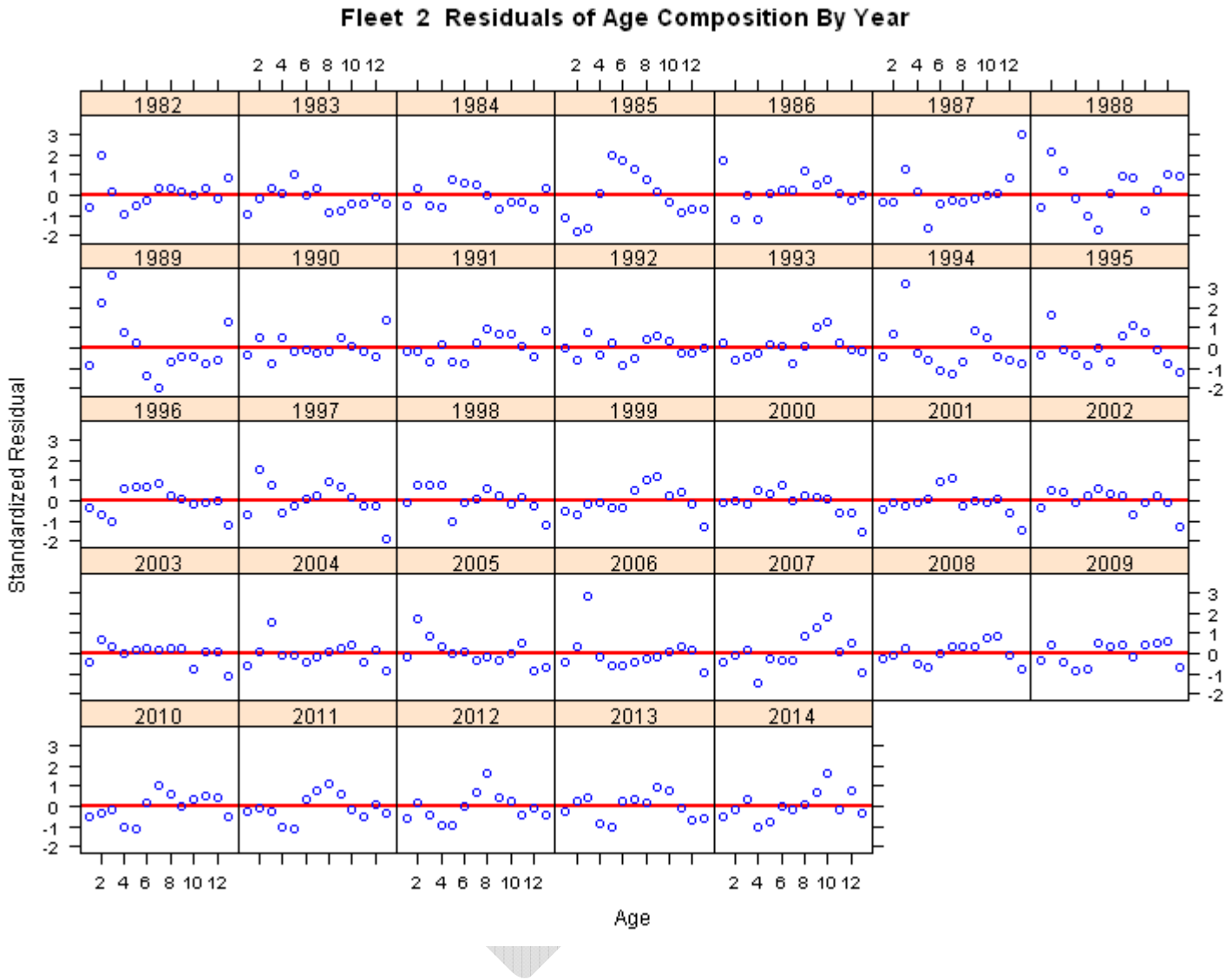


Figure 2 cont.

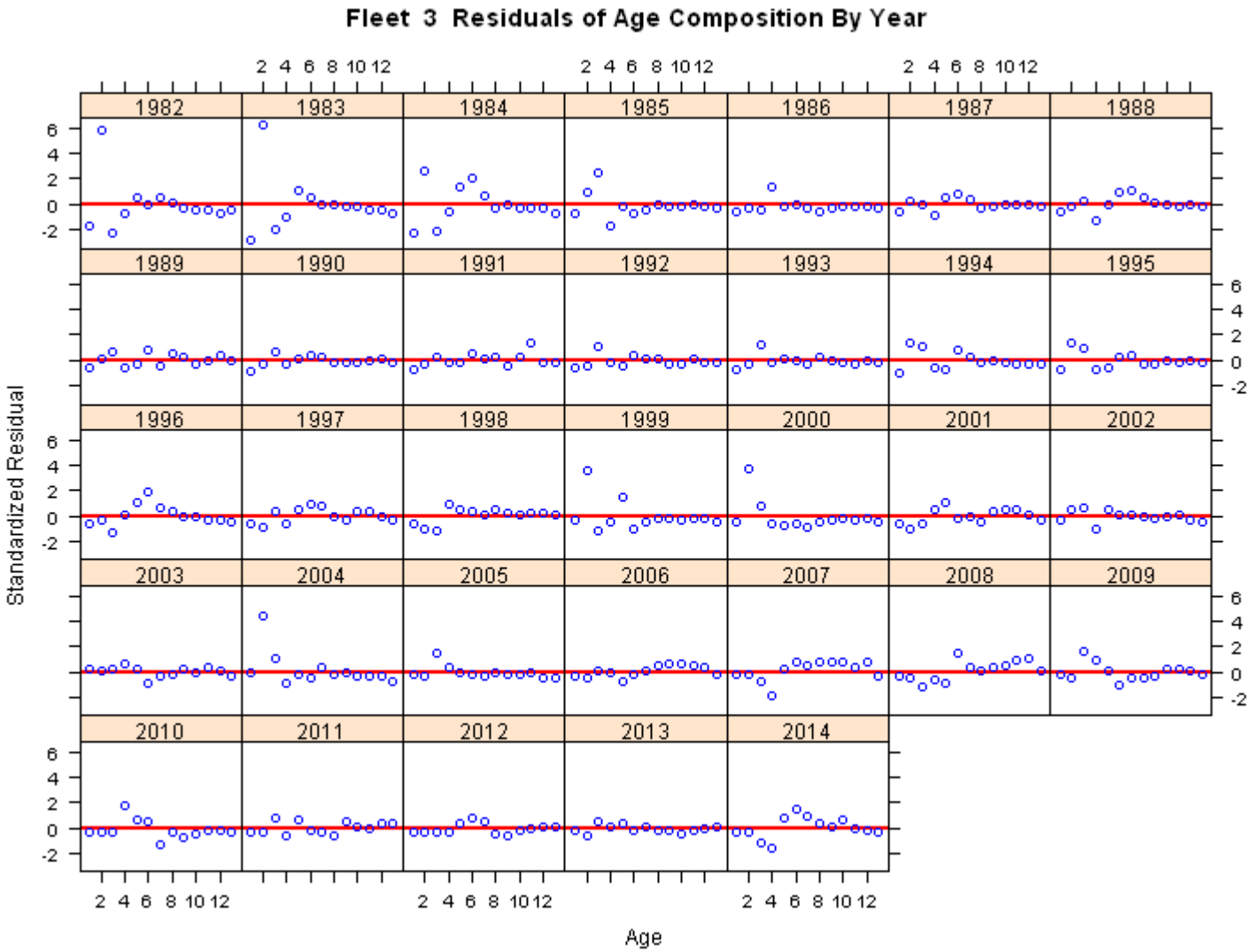


Figure 3 .Observed and predicted catch proportions-at-age by age for each fleet

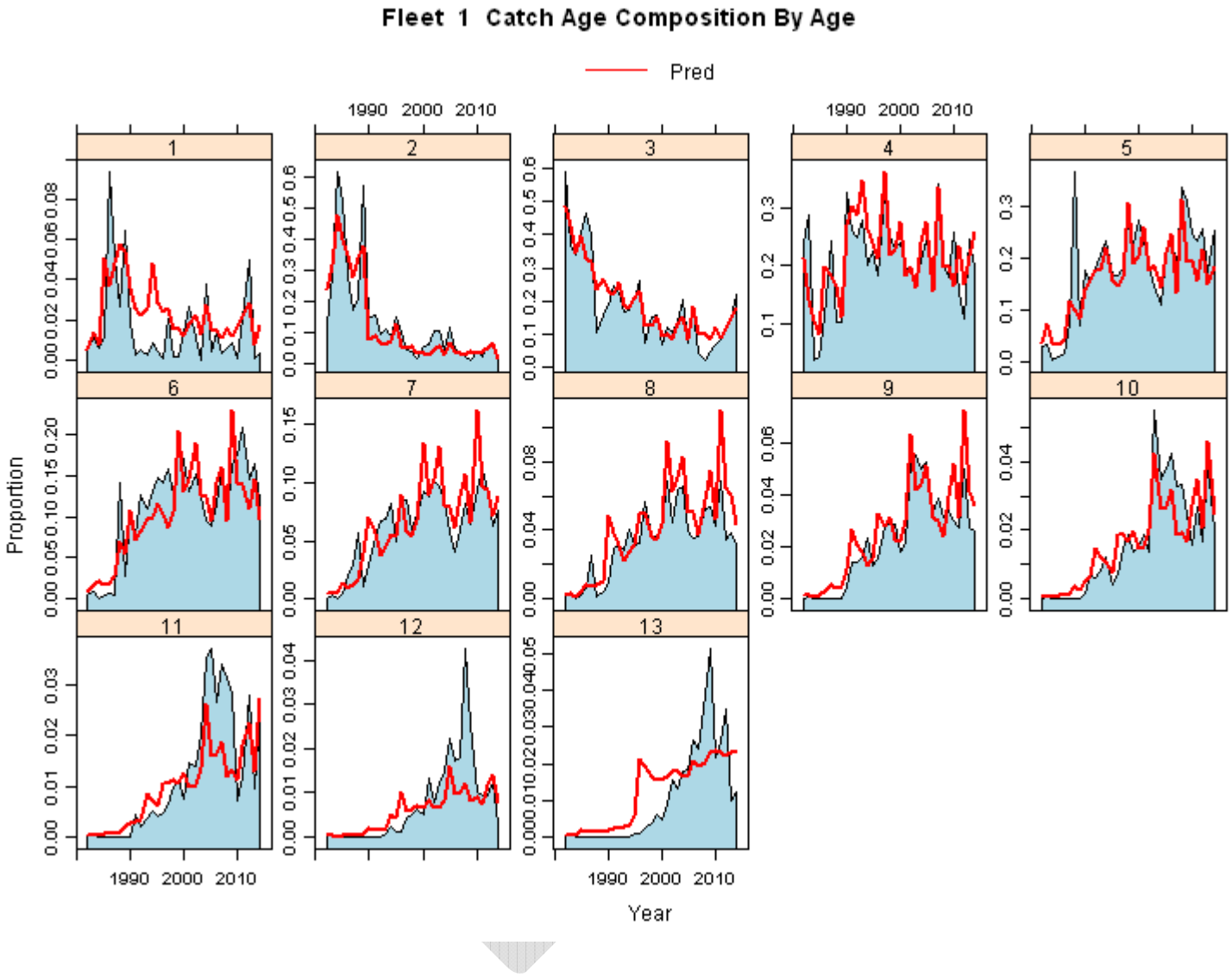


Figure 3 cont.

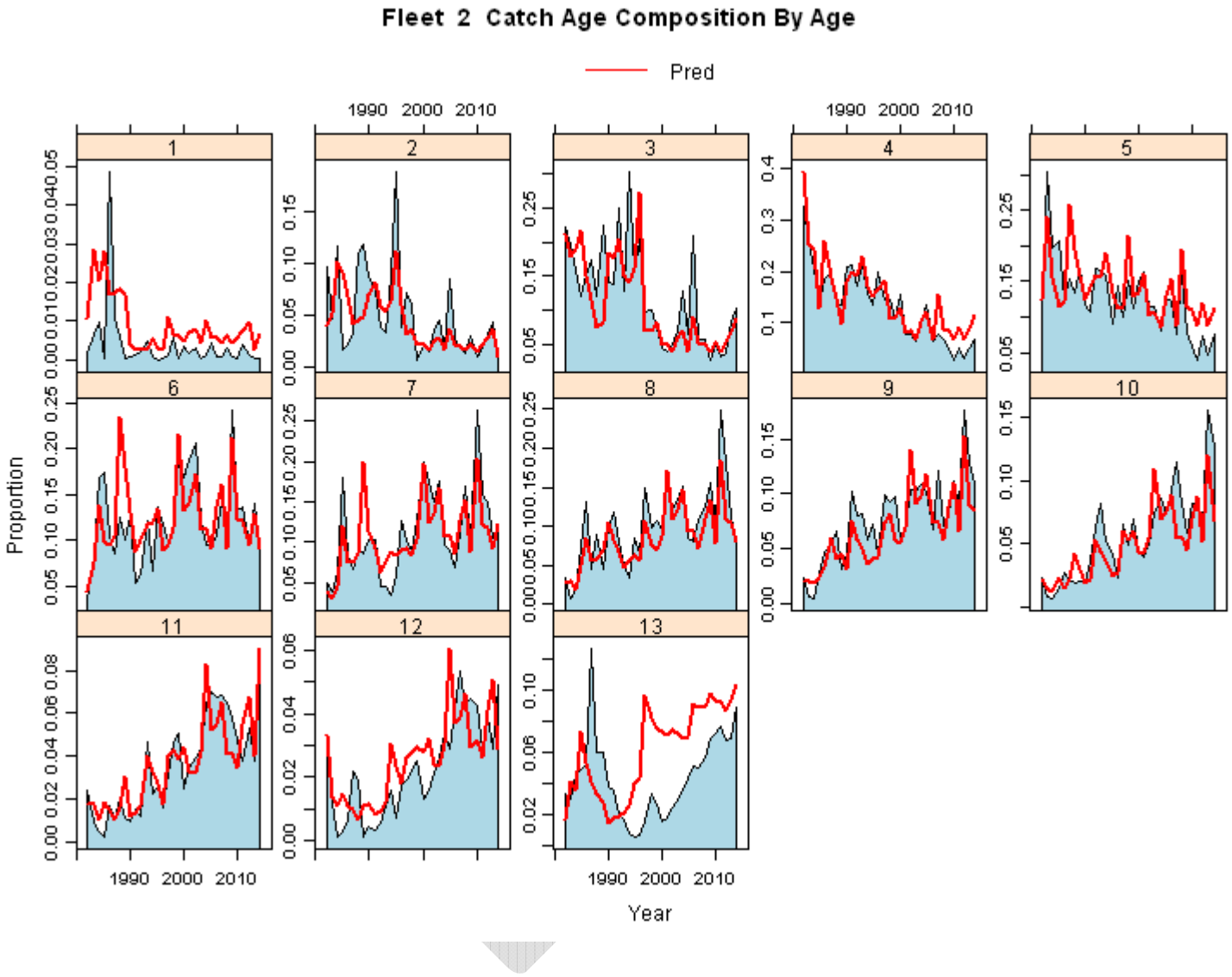


Figure 3 cont.

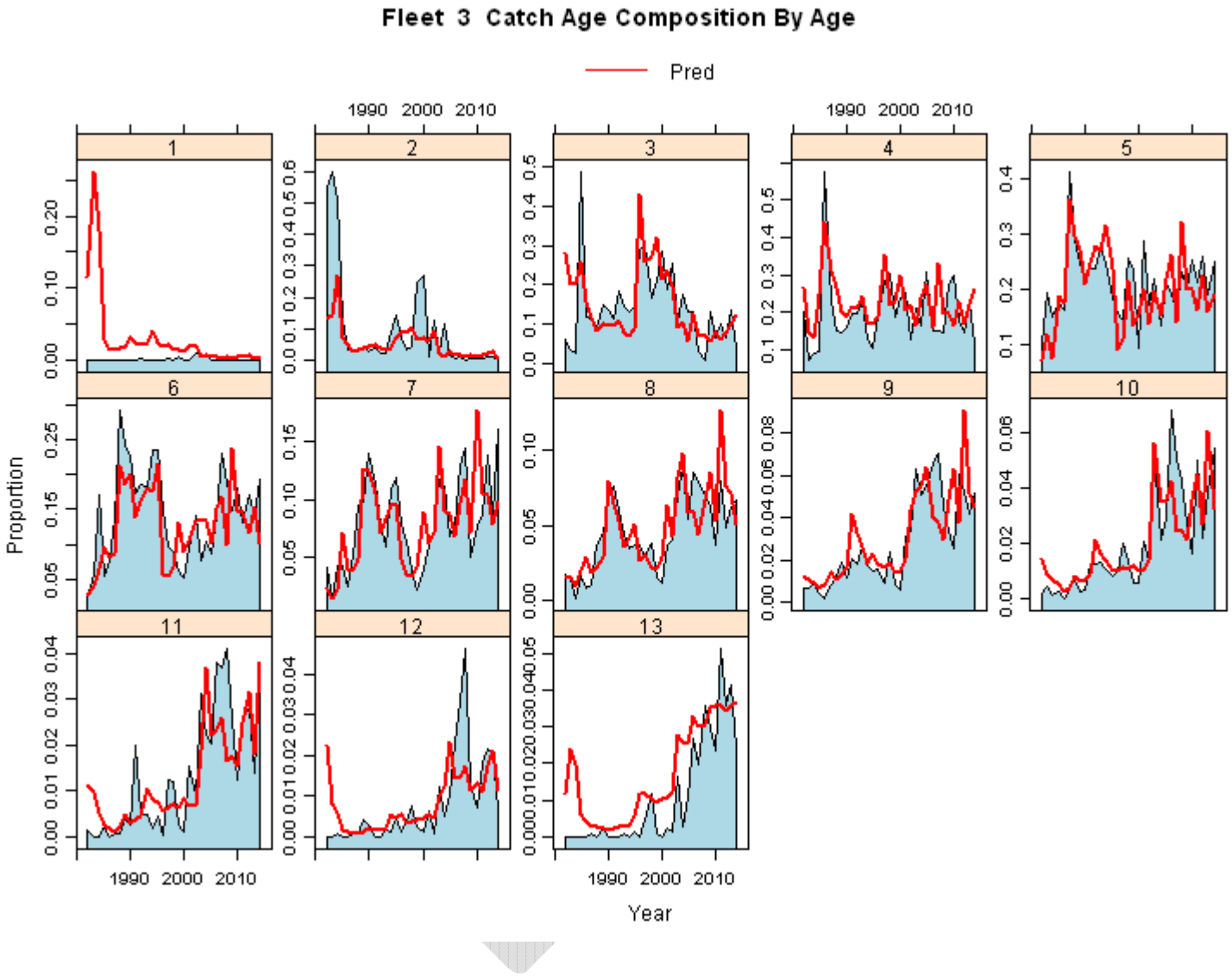


Figure 4. Standardized residuals of catch proportions-at-age by age.

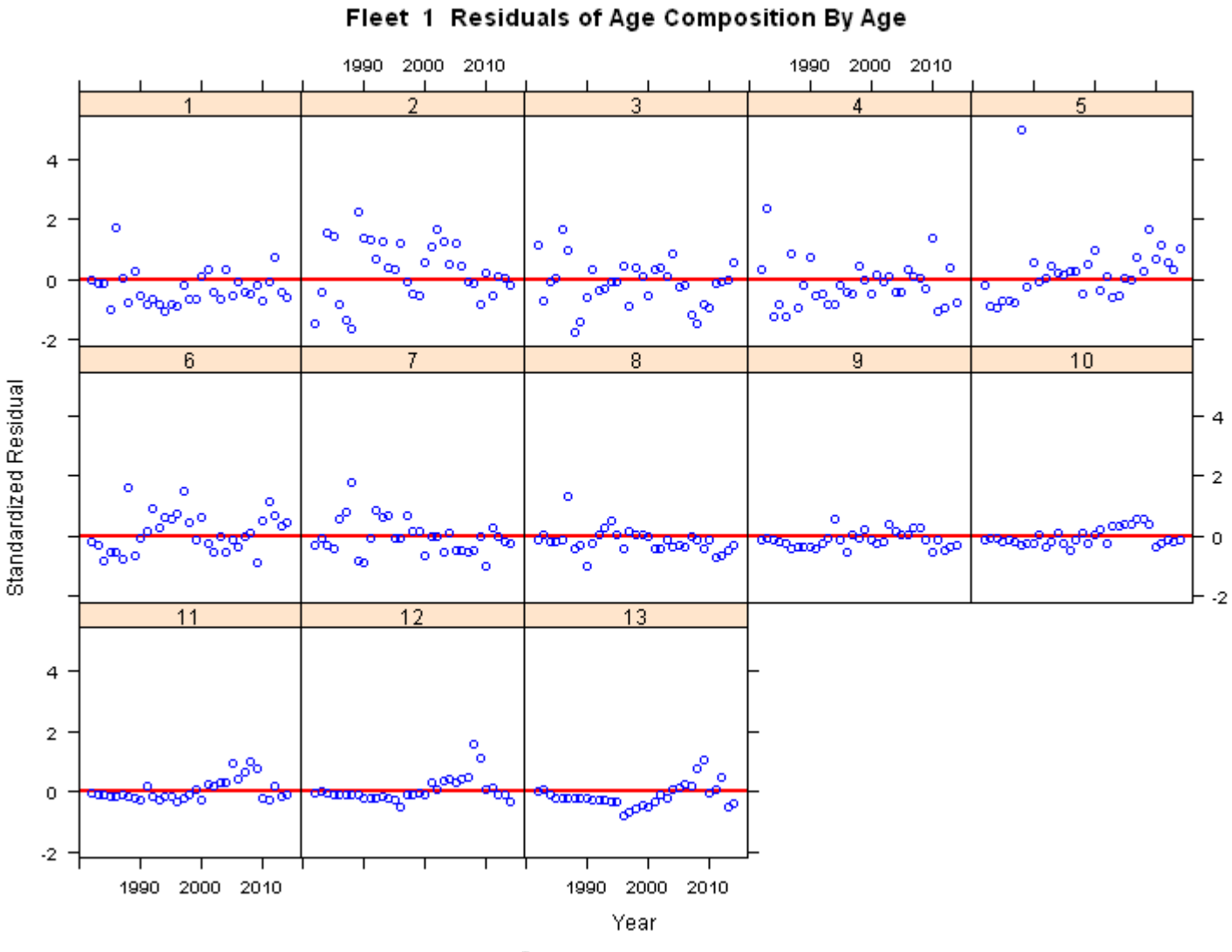


Figure 4 cont.

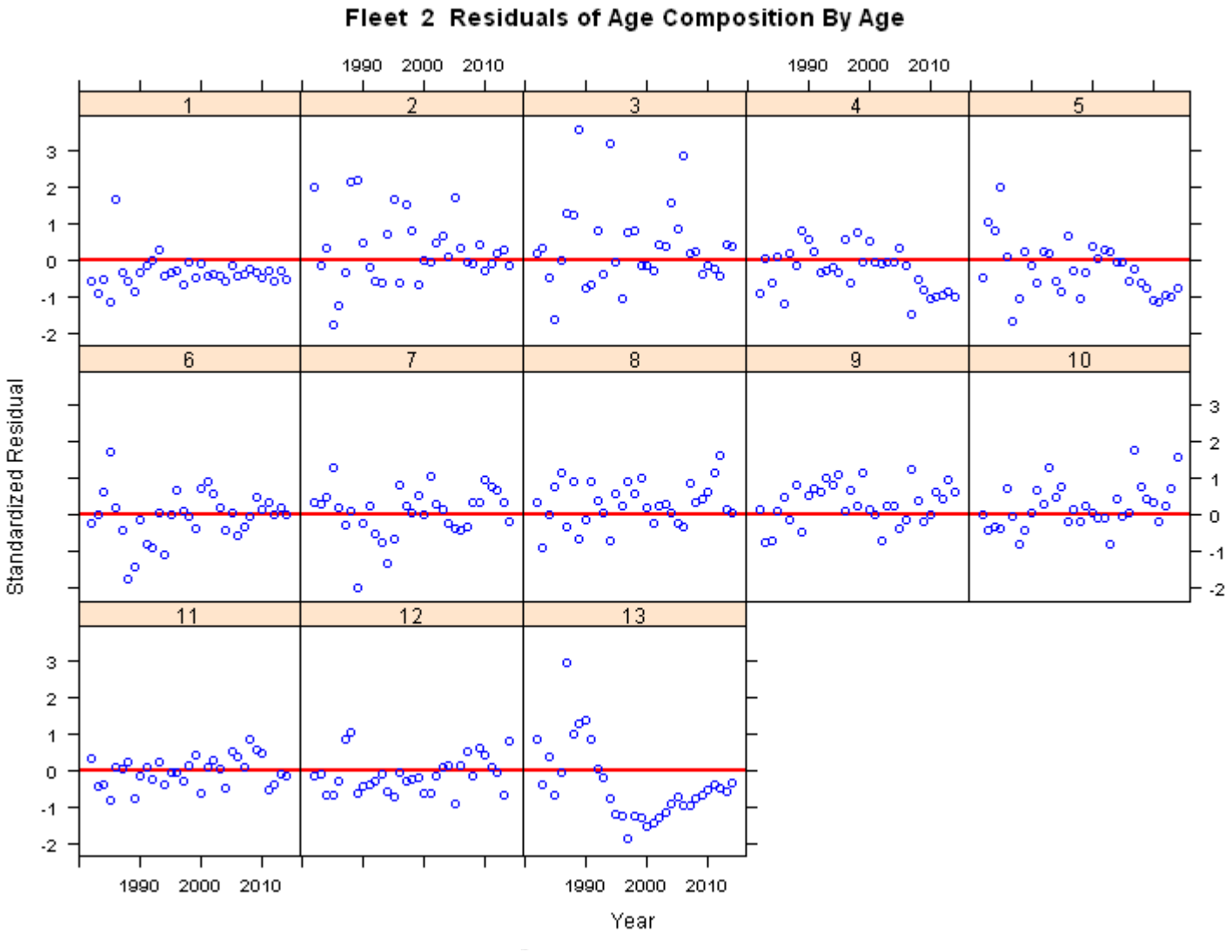


Figure 4 cont.

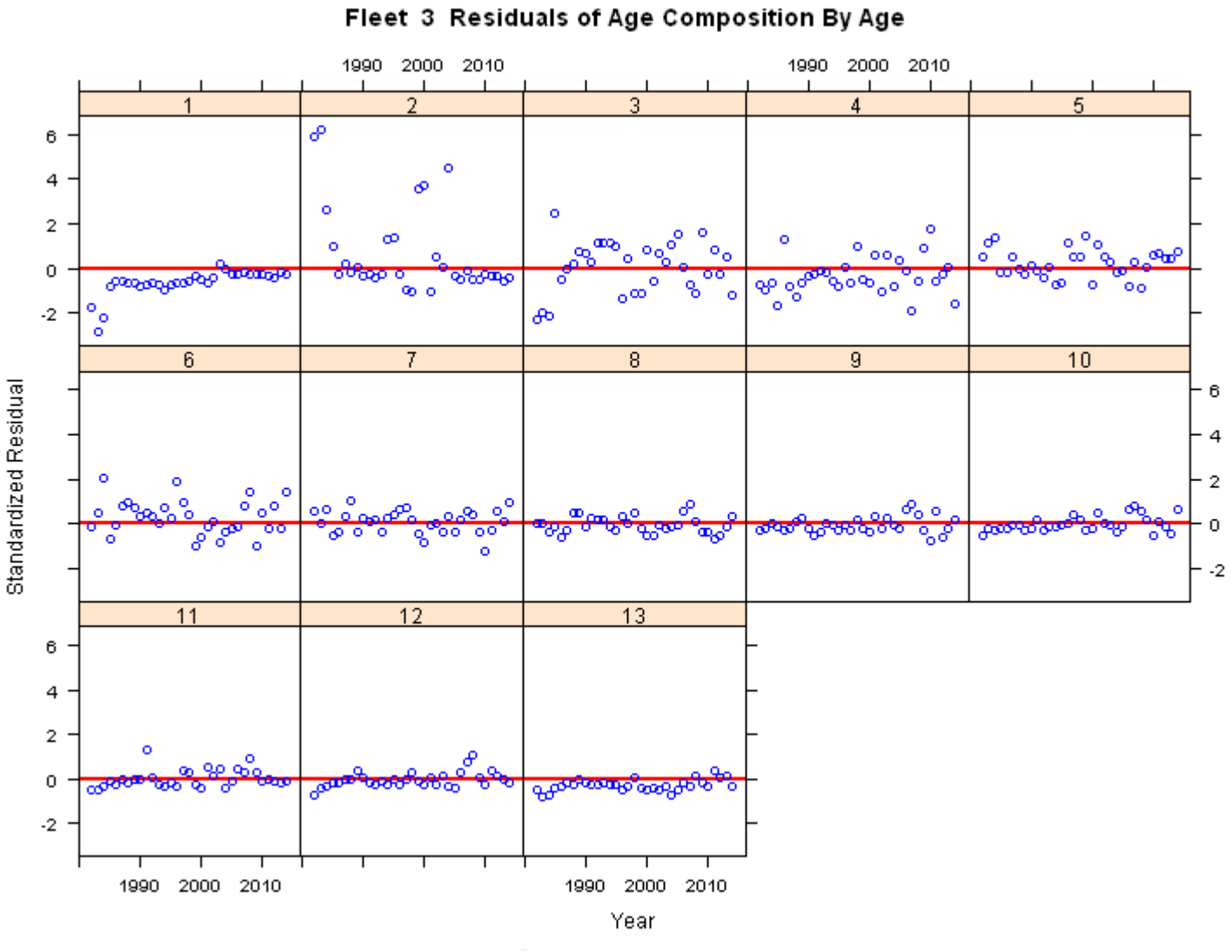


Figure 5. Observed and predicted values and standardized residuals for young-of-the-year and yearling surveys tuned to Age 1 and 2, respectively.

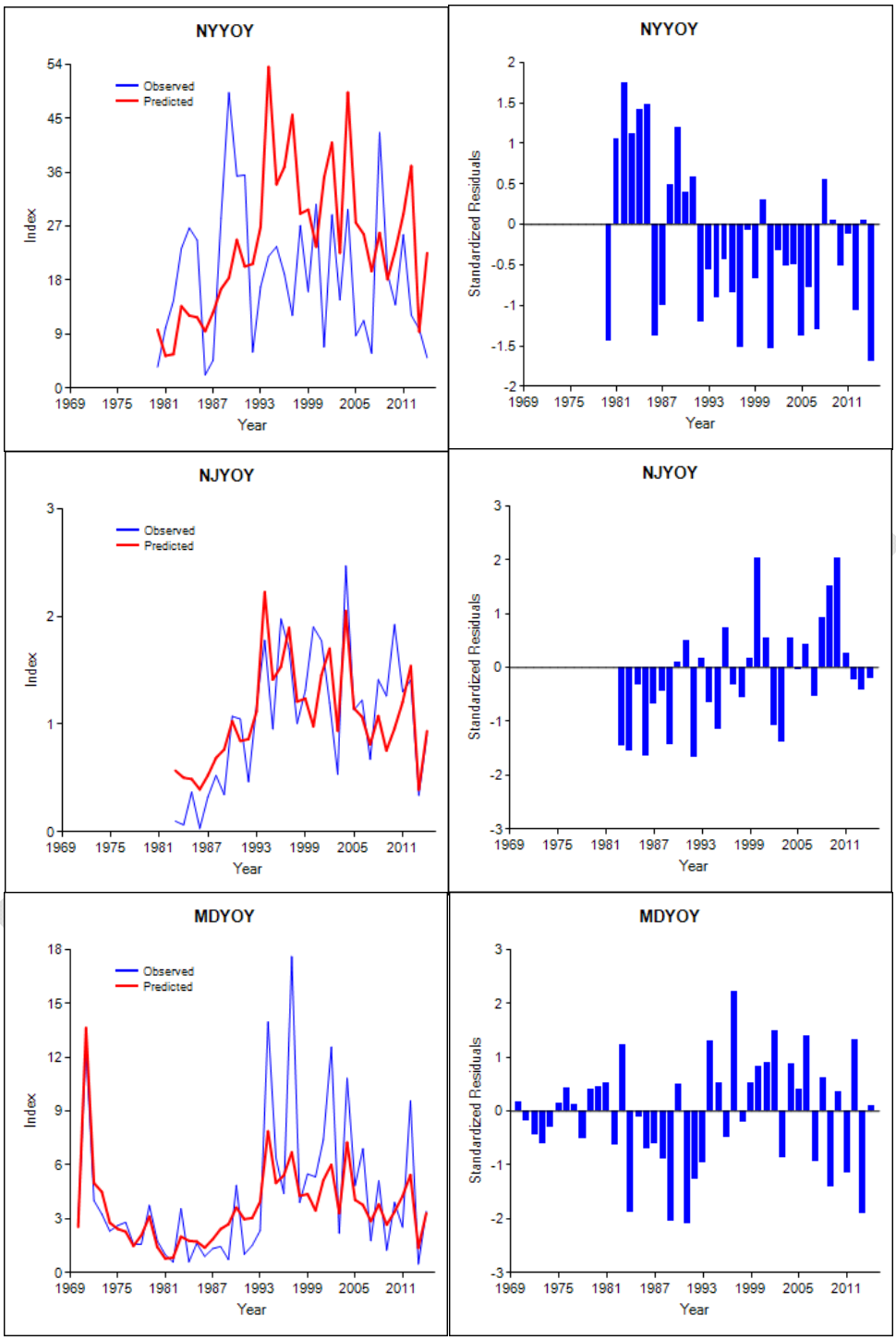


Figure 5 cont.

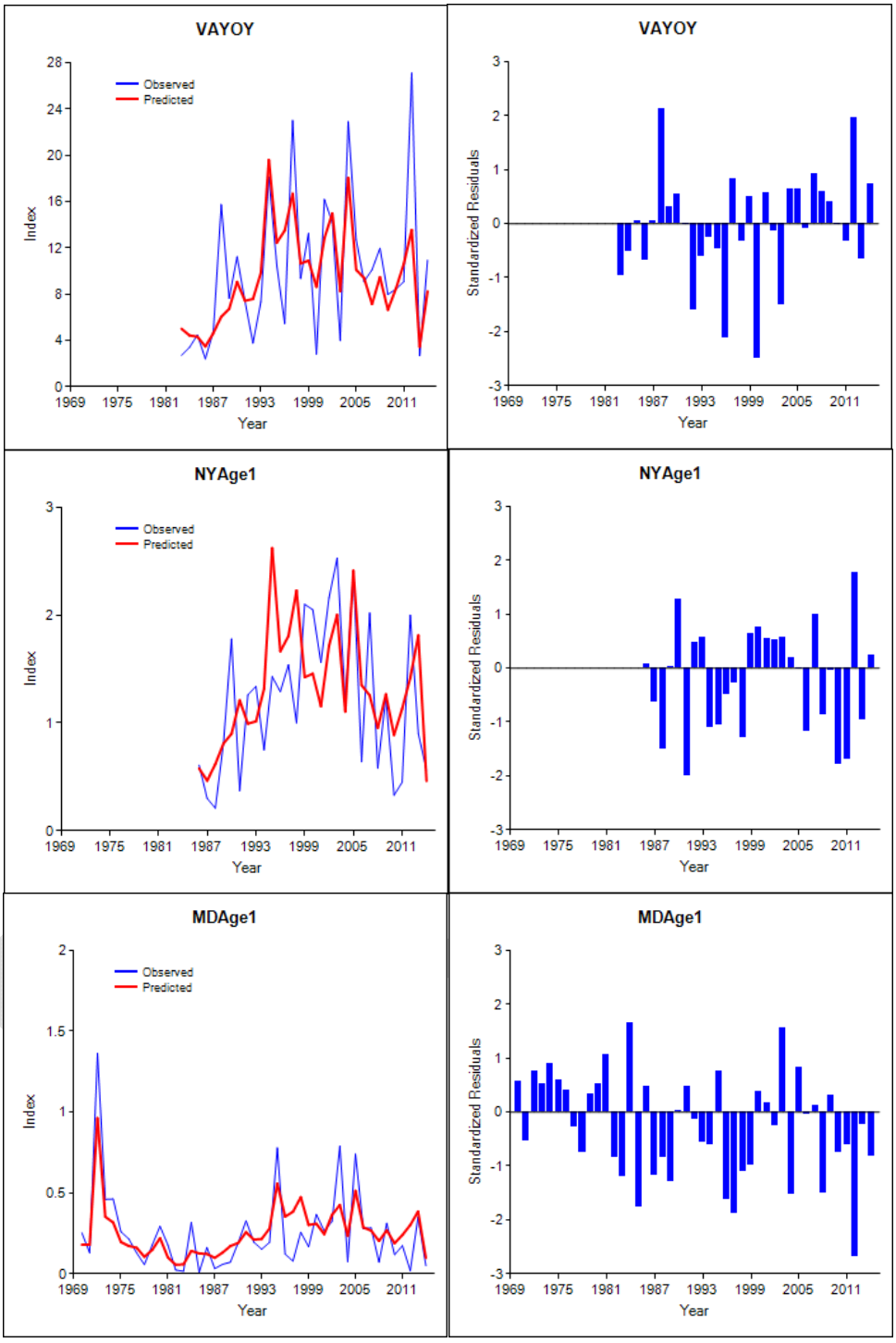


Figure 6. Observed and predicted values and standardized residuals for age-aggregated surveys.

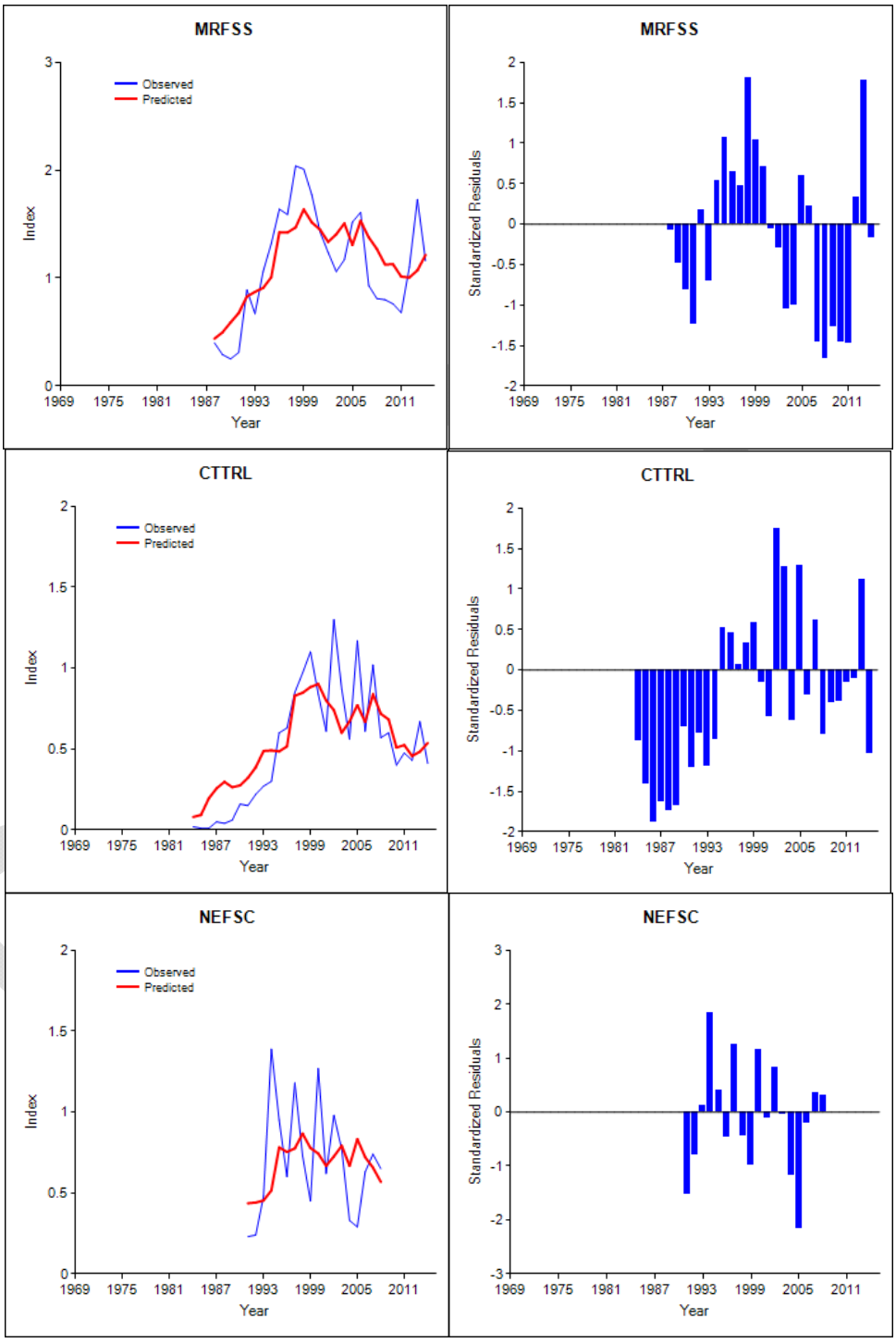


Figure 7. Observed and predicted values of the total index and standardized residuals for surveys with age composition data.

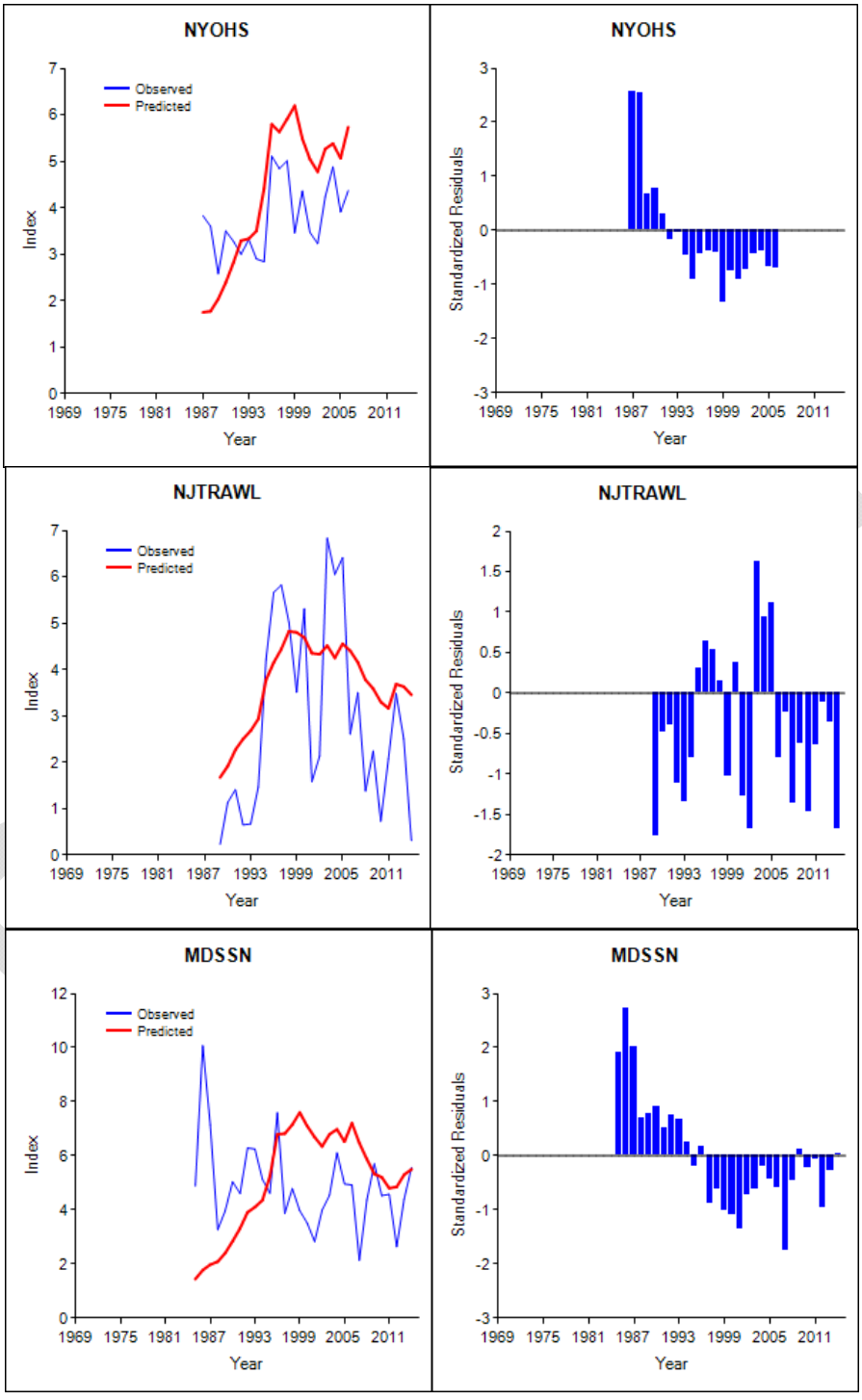


Figure 7 cont.

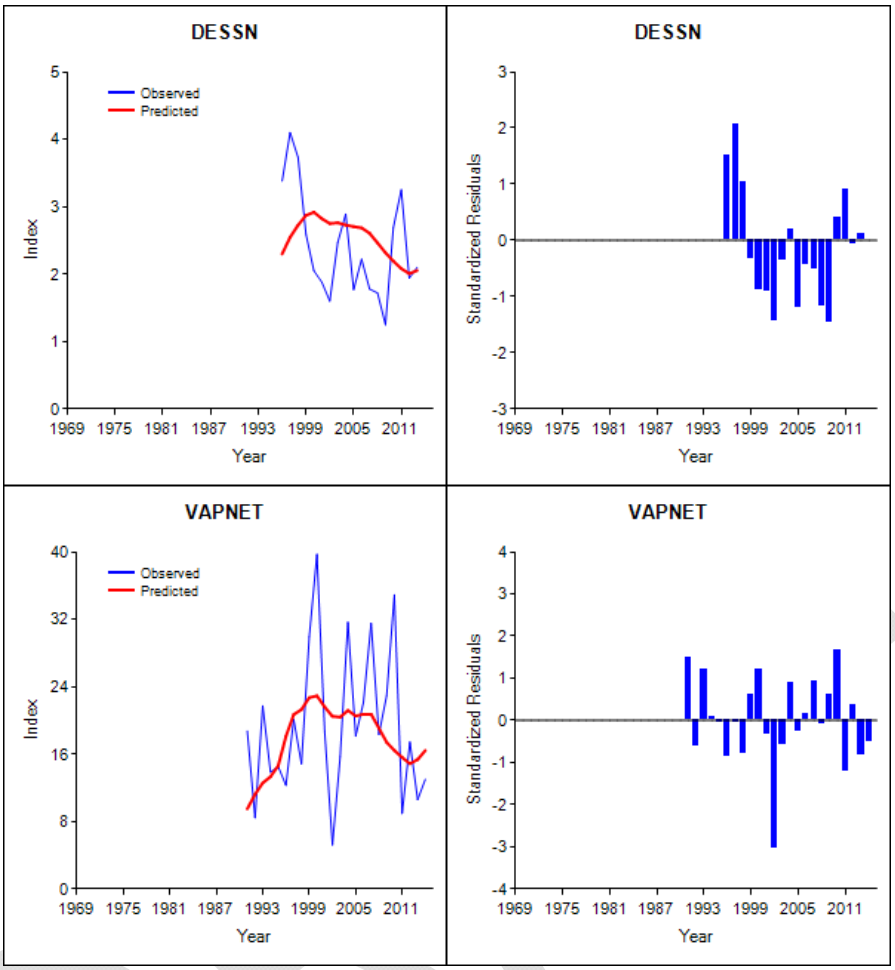


Figure 8. Selectivity patterns estimated for the NYOHS, NJ Trawl, MD SSN, DE SSN surveys and VAPNET.

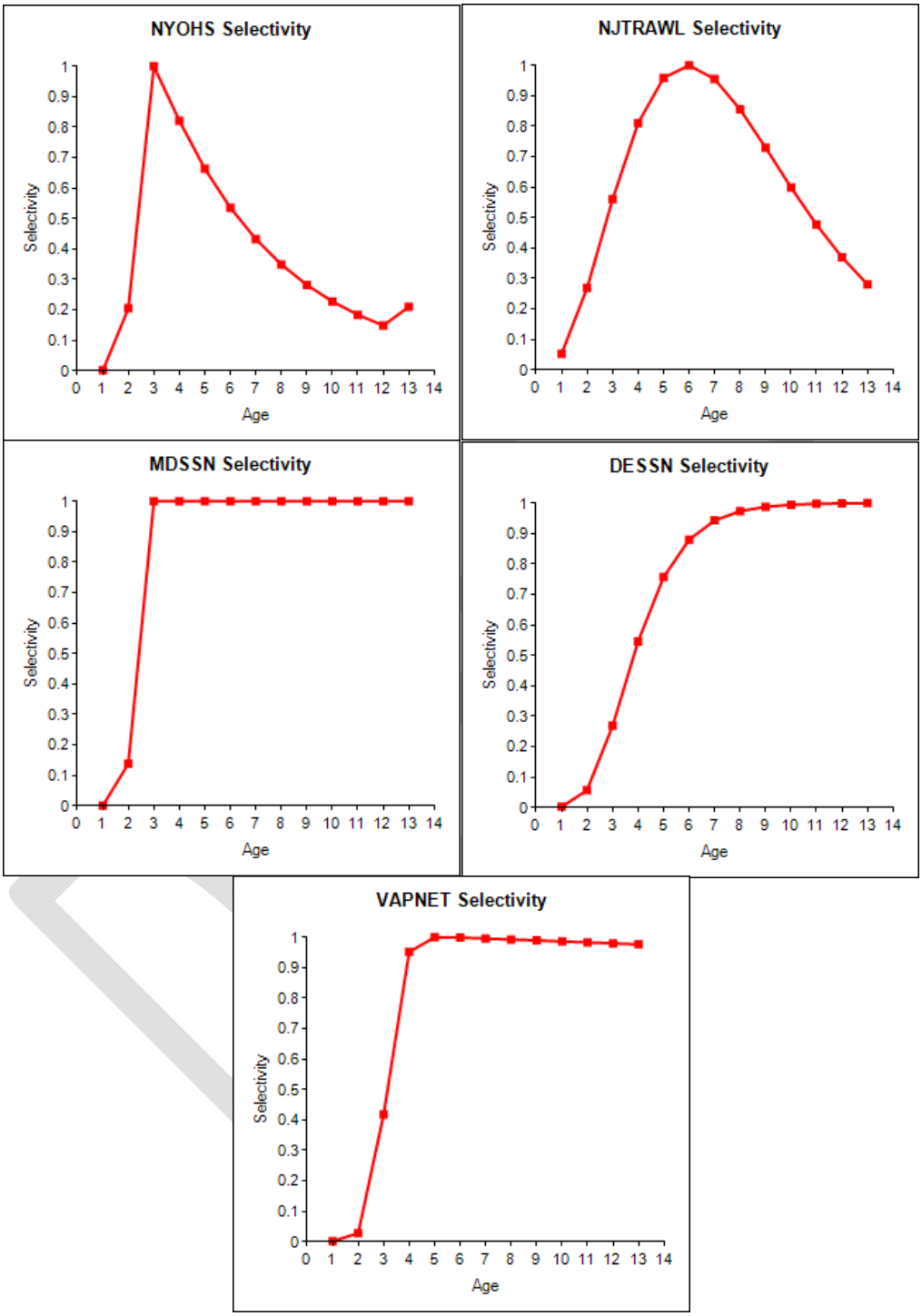


Figure 9. Observed and predicted proportions-at-age and standardized residual for each age by year for the NYOHS survey.

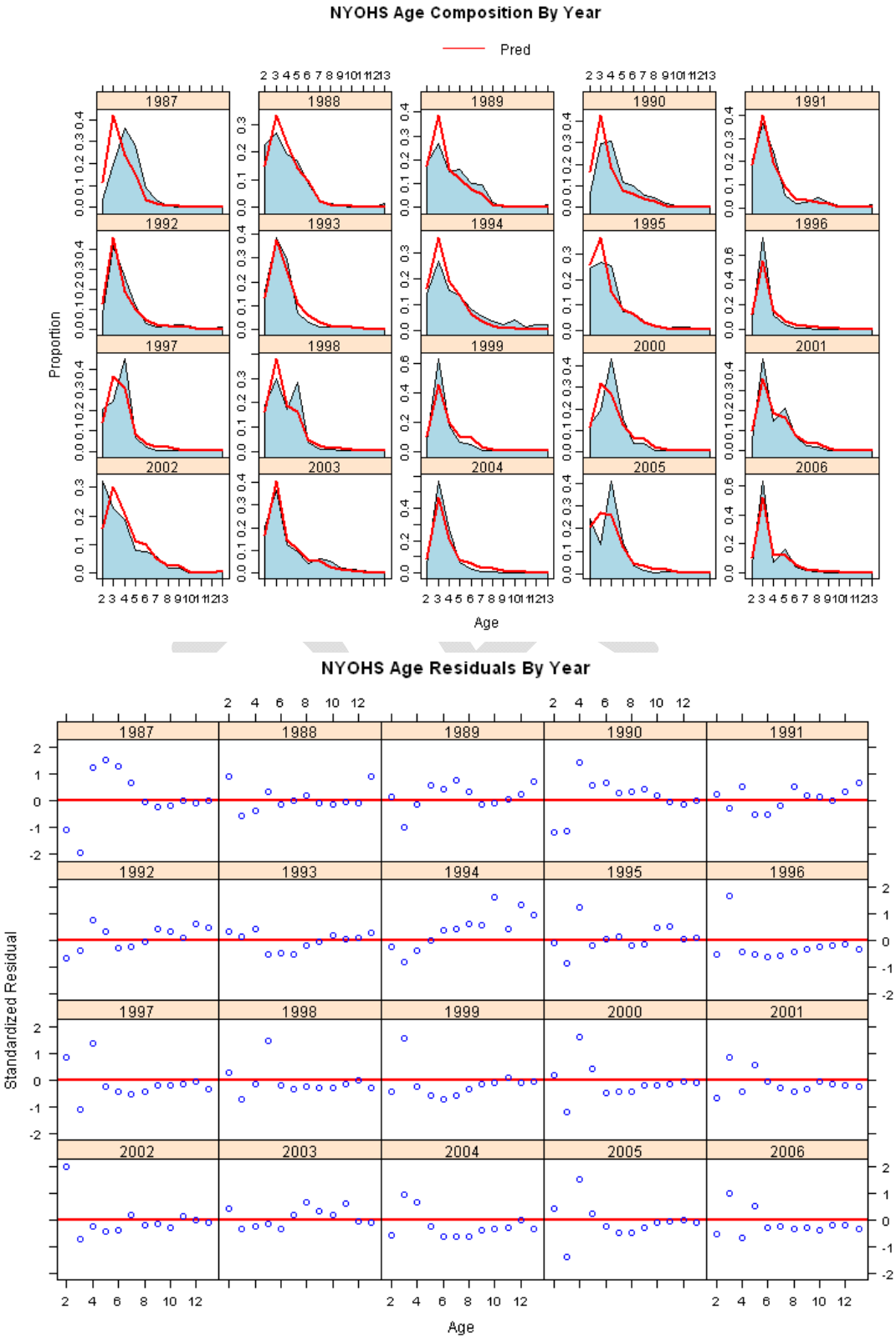


Figure 10. Observed and predicted proportions-at-age and standardized residual for each year by age for the NYOHS survey.

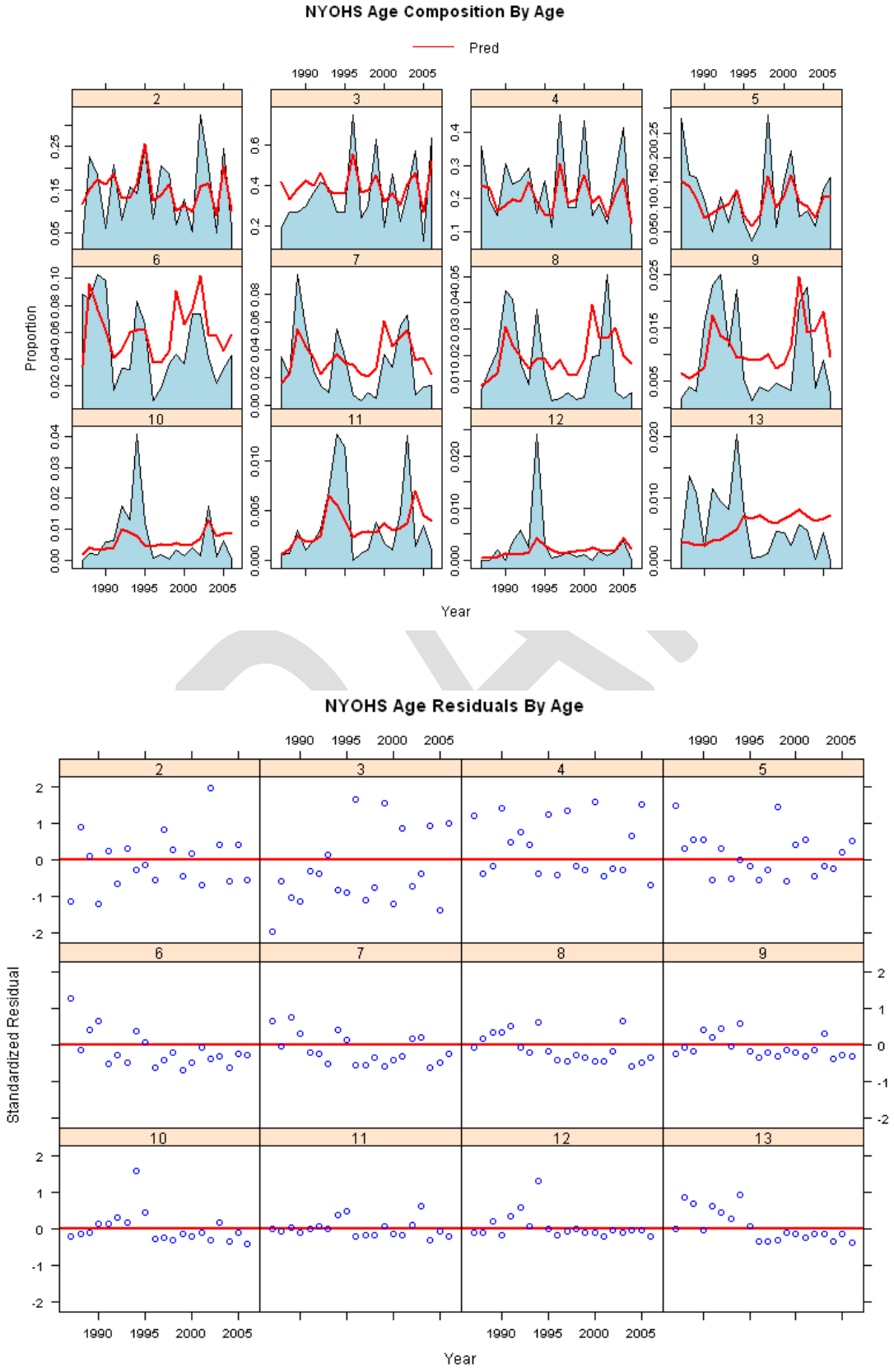
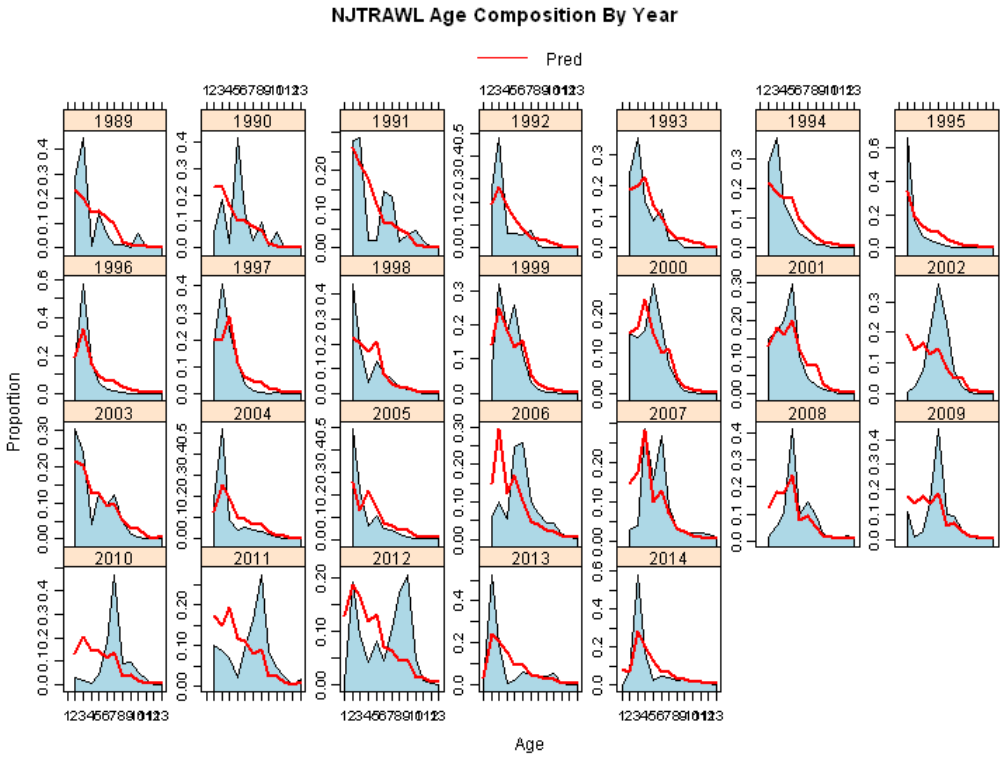


Figure 11. Observed and predicted proportions-at-age and standardized residuals for each age by year for the NJ Trawl survey.



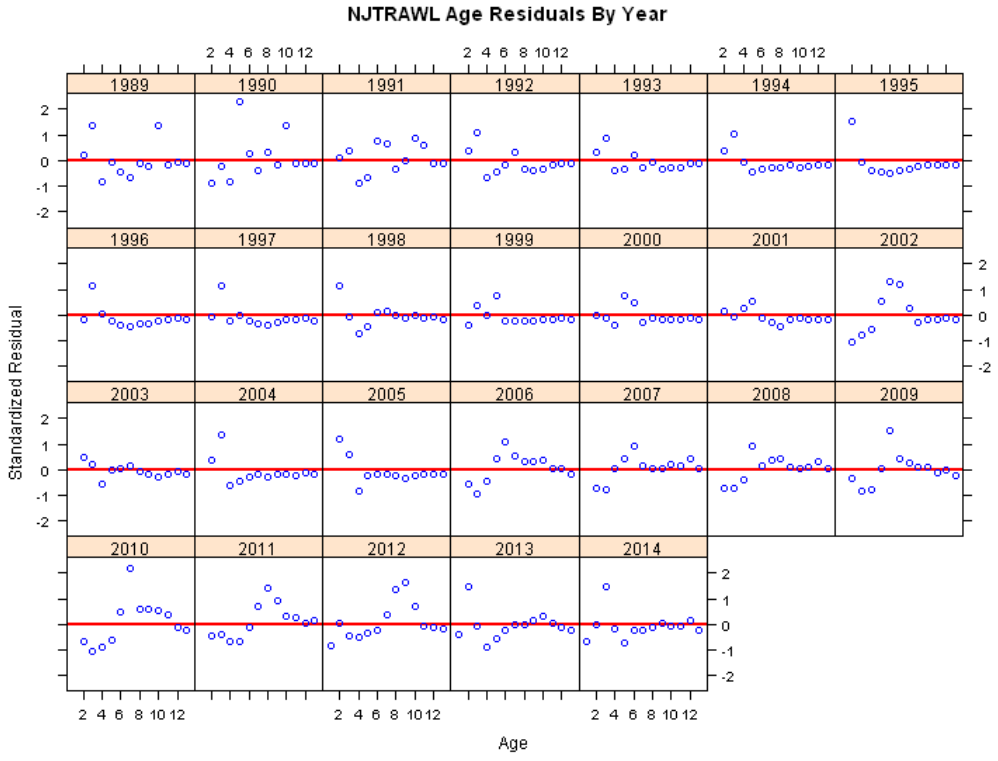


Figure 12. Observed and predicted proportions-at-age and residuals for each year by age for the NJ Trawl survey.

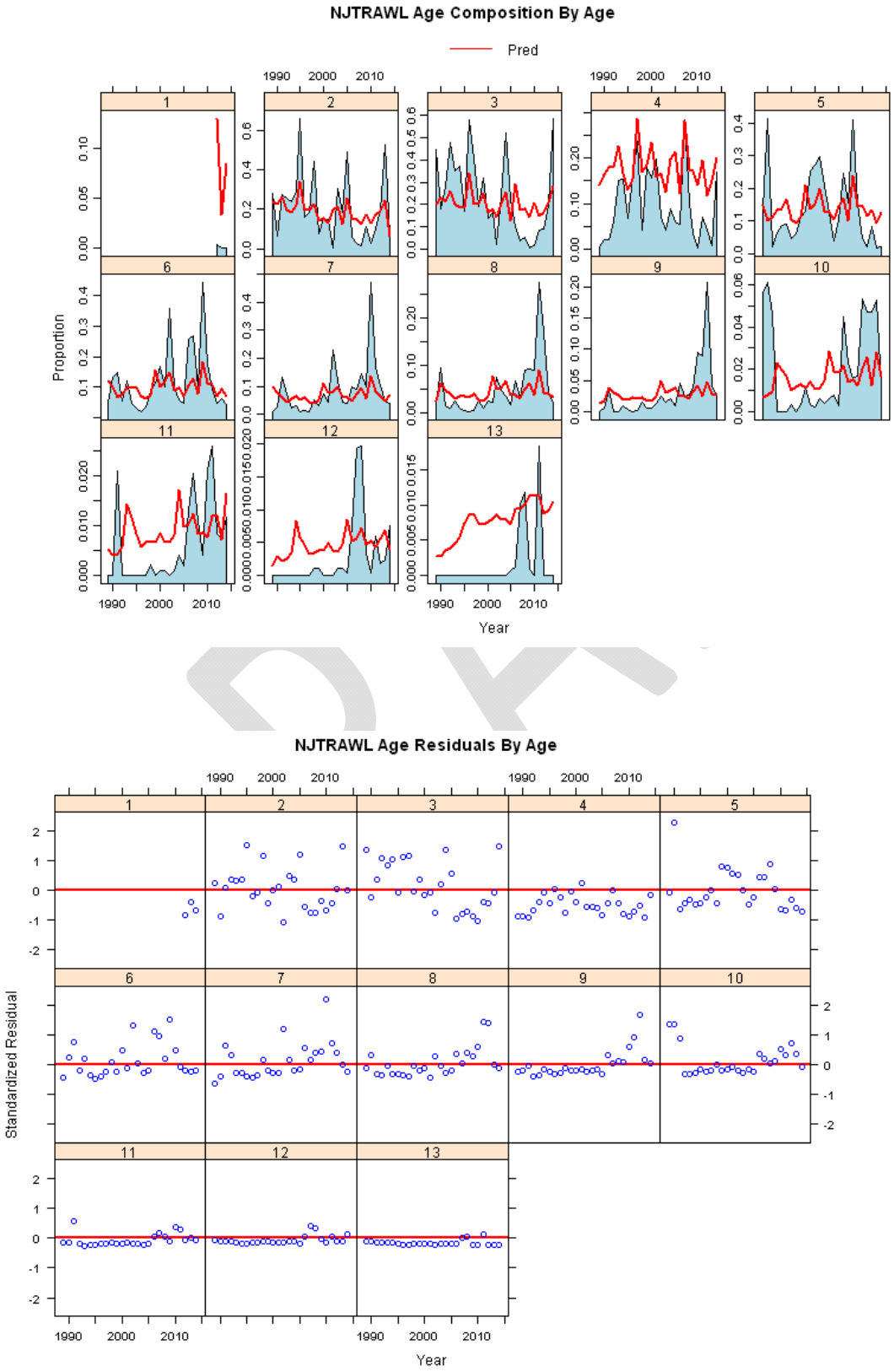


Figure 13. Observed and predicted proportions-at-age for each age by year for the MD SSN gillnet survey.

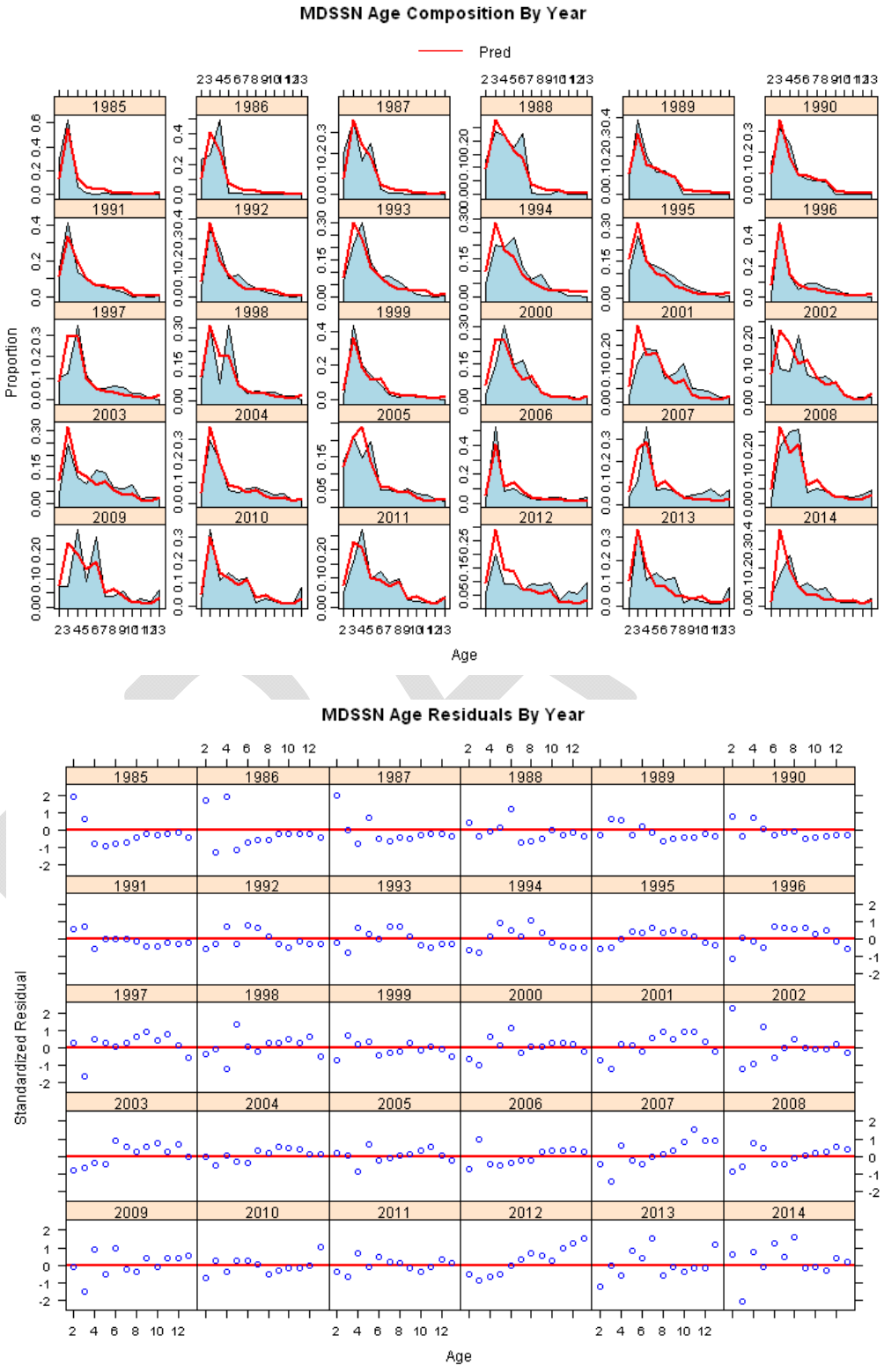
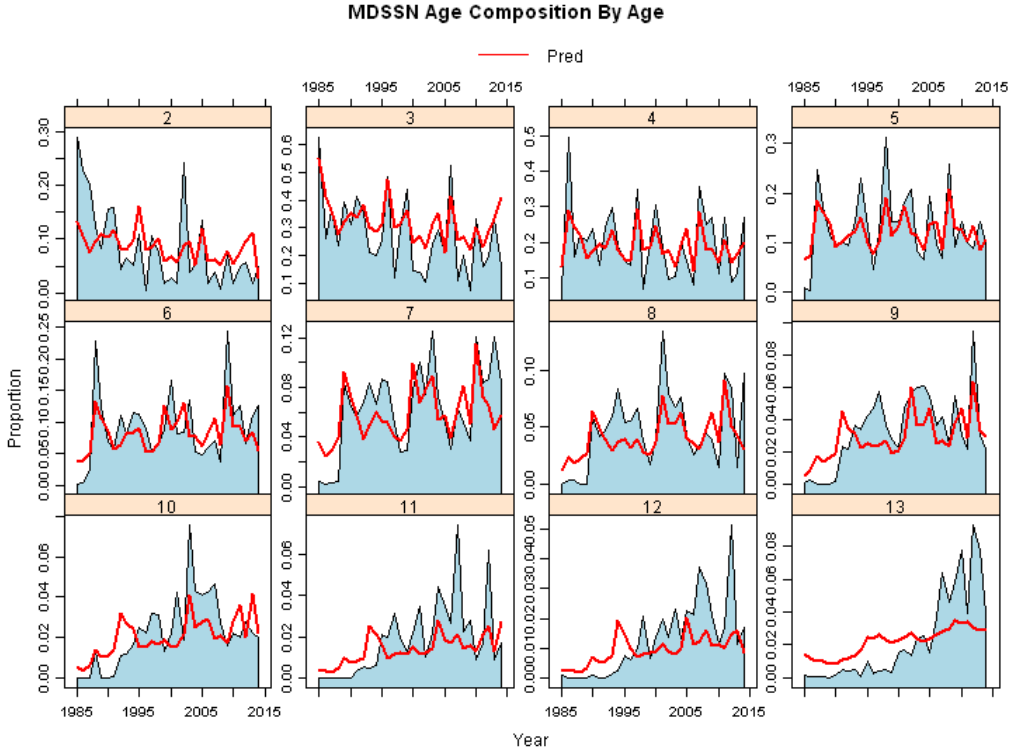


Figure 14. Observed and predicted proportions-at-age and standardized residuals for each year by age for the MD SSN gillnet survey.



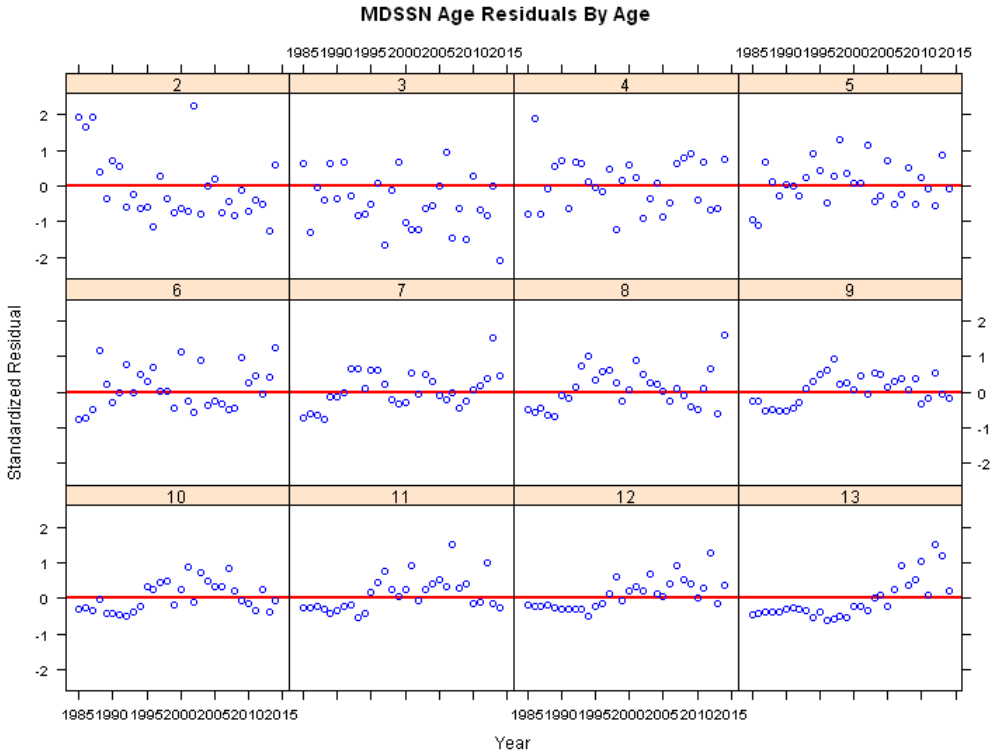
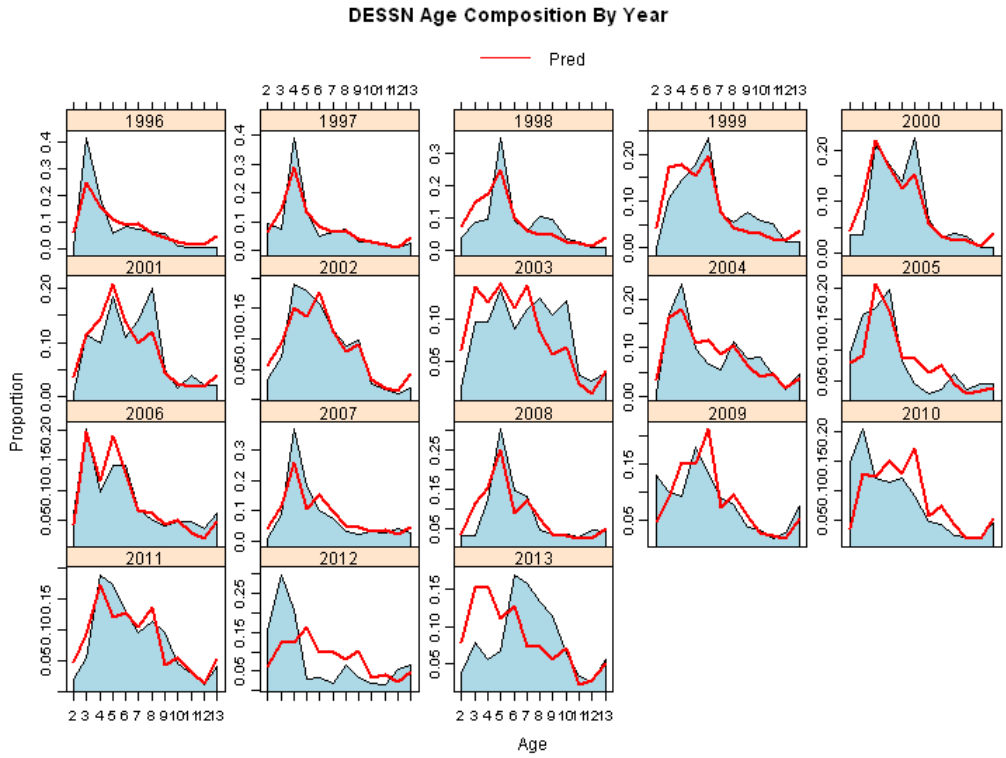


Figure 15. Observed and predicted proportions-at-age and standardized residuals for each age by year for the DE SSN electrofishing survey.



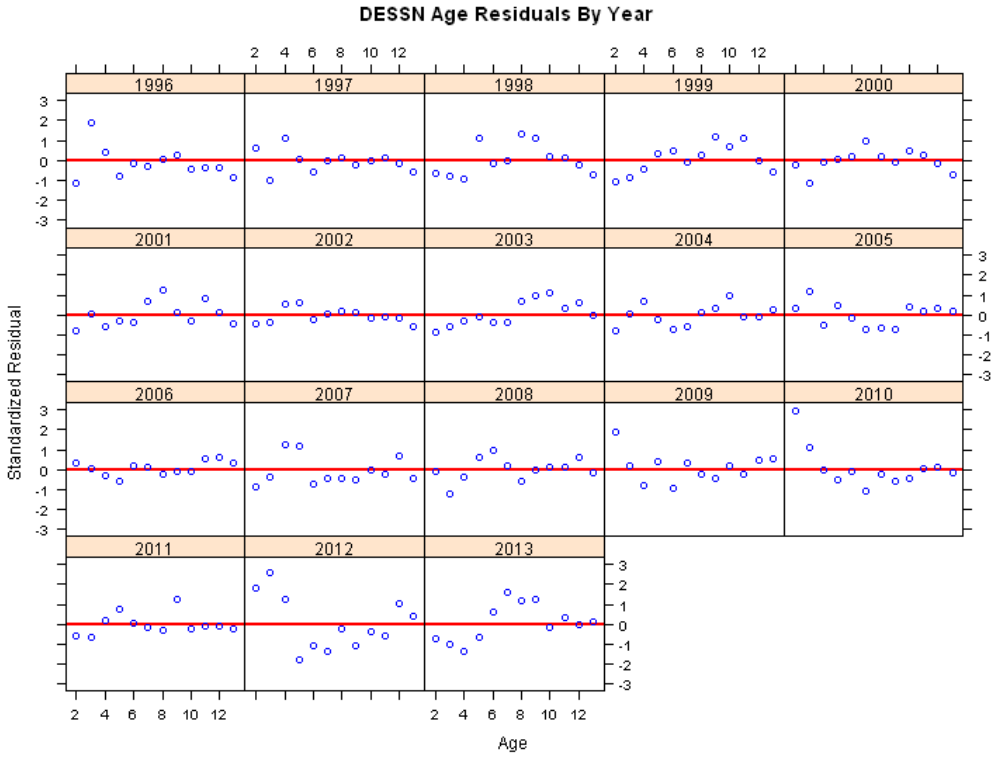
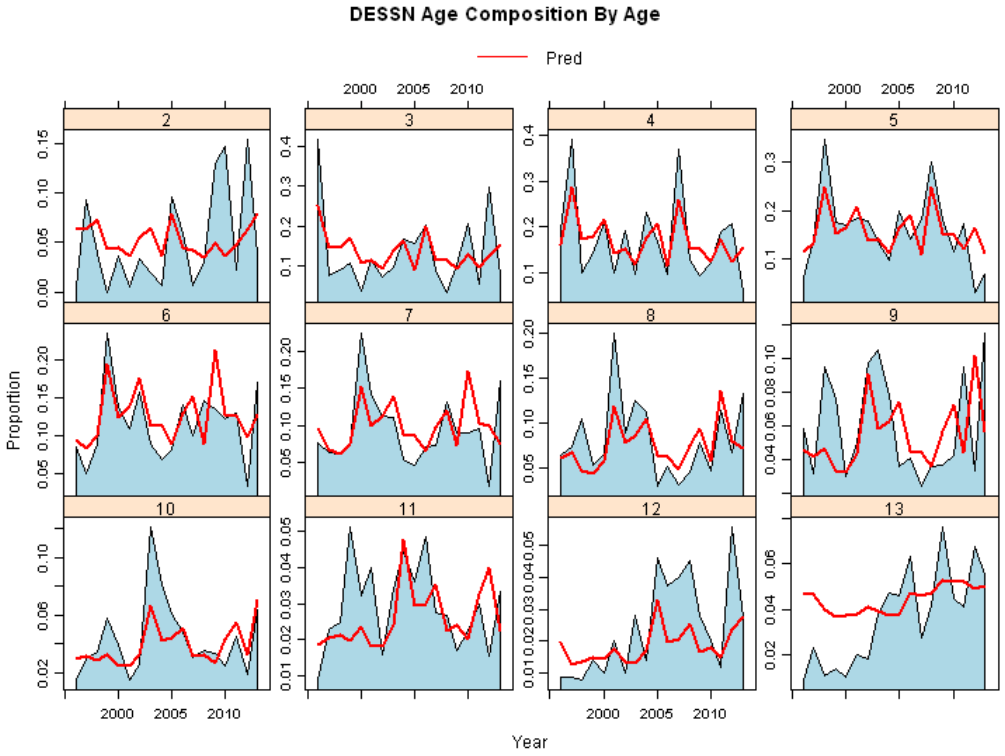


Figure 16. Observed and predicted proportions-at-age and standardized residuals for each year by age for the DE SSN electrofishing survey.



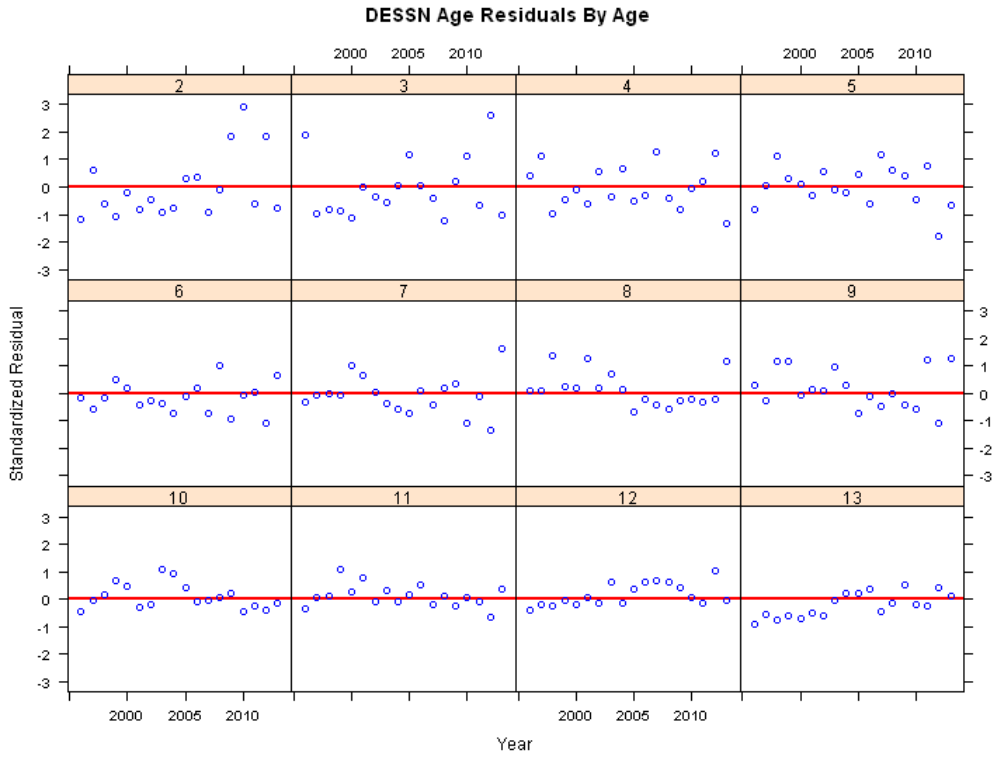


Figure 17. Observed and predicted proportions-at-age and standardized residuals for each age by year for the VAPNET survey.

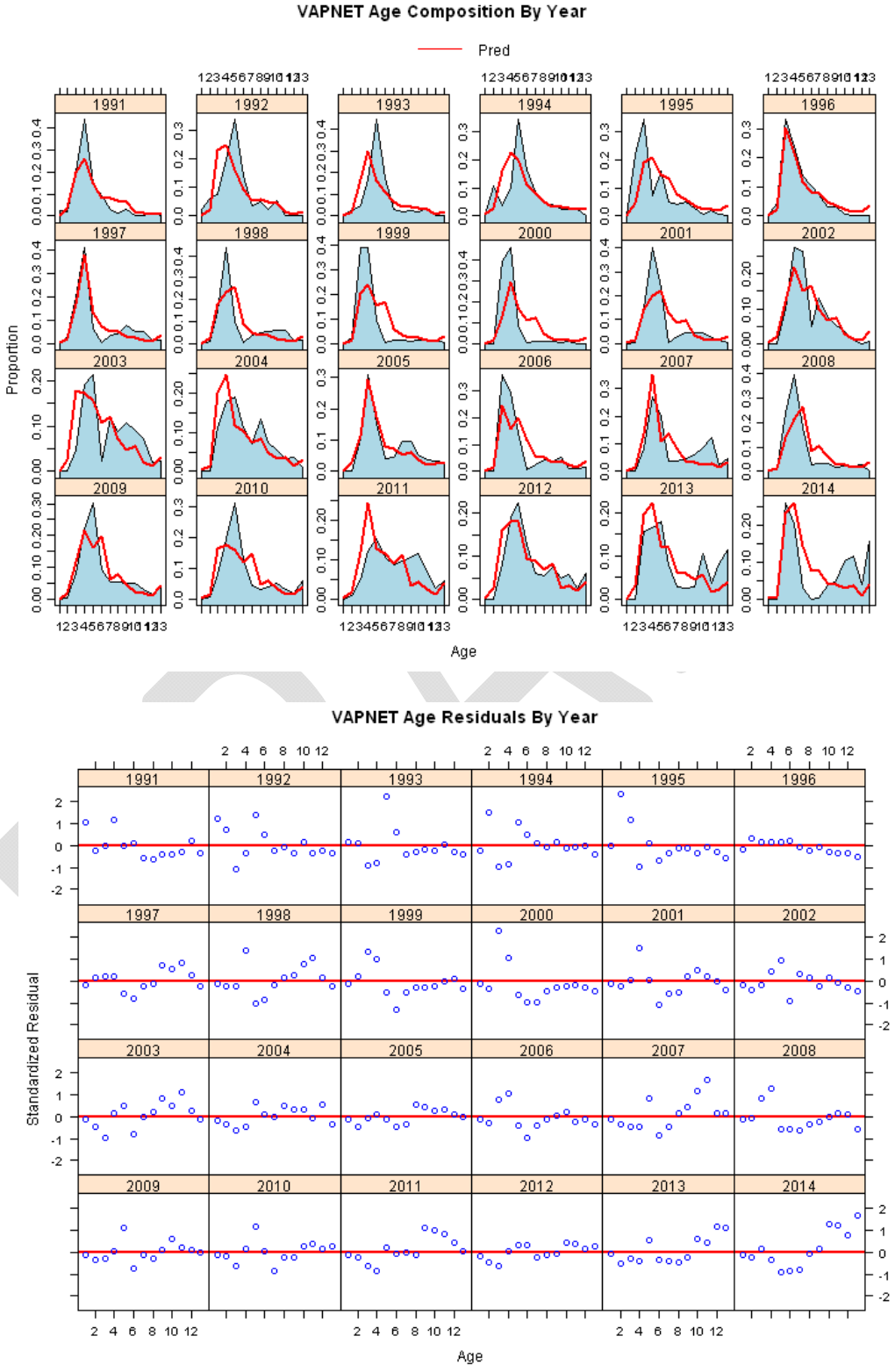
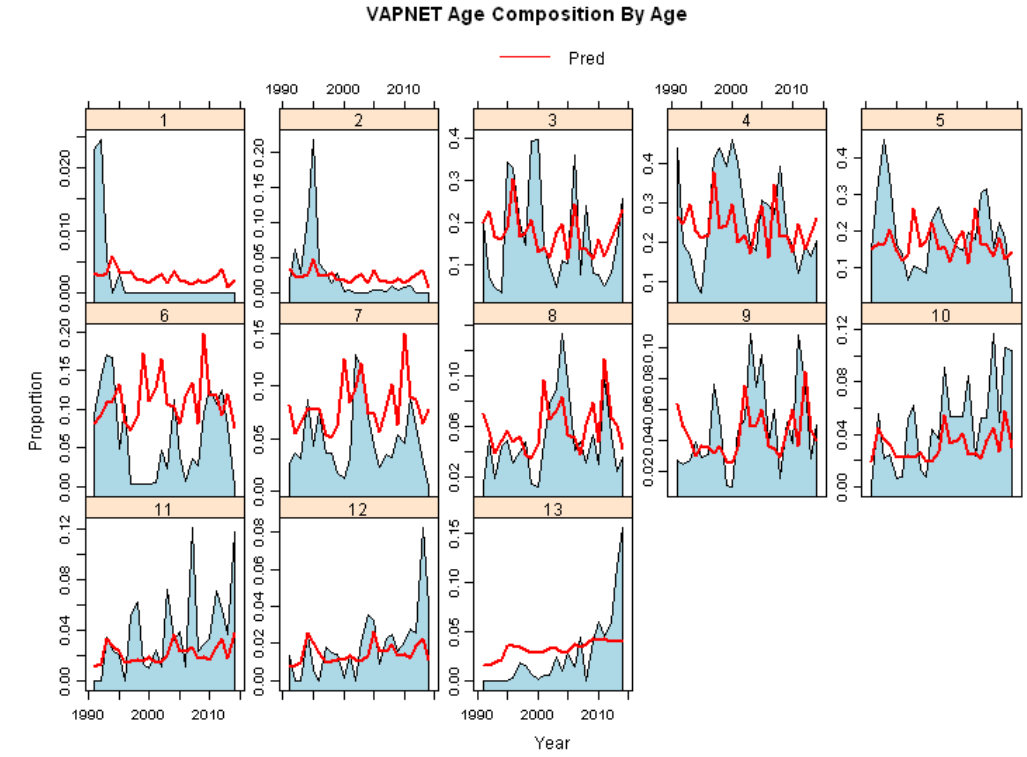
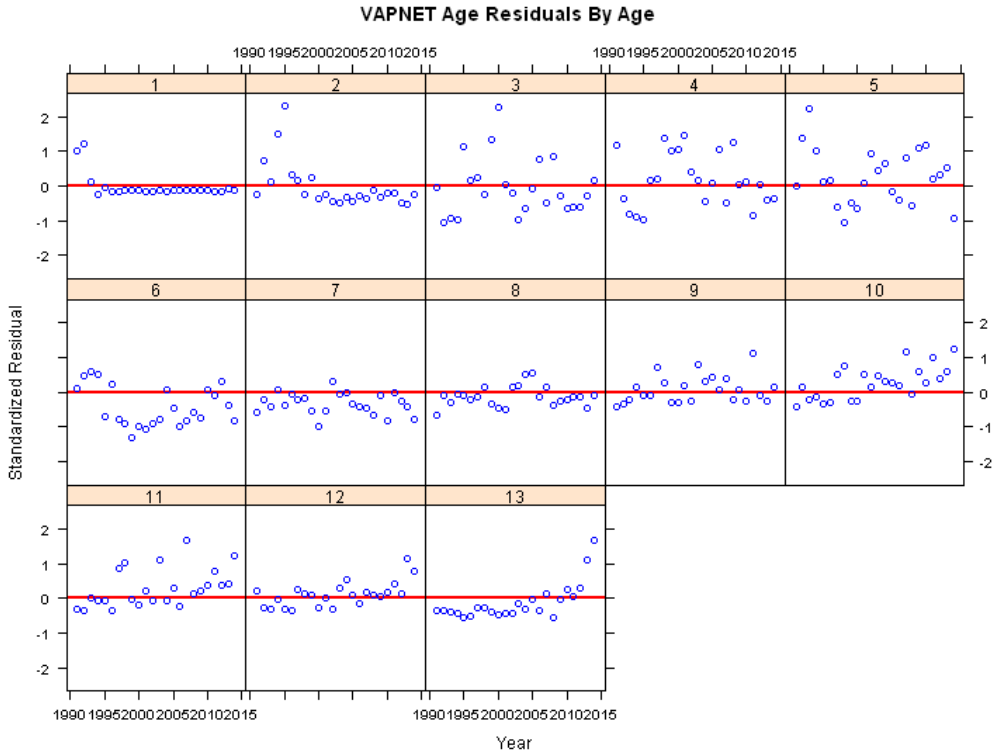


Figure 18. Observed and predicted proportions-at-age and standardized residuals for each year by age for the VAPNET survey.





Atlantic States Marine Fisheries Commission

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

MEMORANDUM

October 14, 2015

To: **Atlantic Striped Bass Management Board**

From: **Atlantic Striped Bass Technical Committee**

RE: **Comparing Atlantic Striped Bass Fishing Mortality Reference Points Using Two Different Time Periods for Selectivity: 2008-2012 (5-Year) and 1996-2012 (17-Year)**

At their August 2015 meeting, the Atlantic Striped Bass Management Board reviewed the Technical Committee report for developing fishing mortality (F) reference points for the Chesapeake Bay, Ocean, and the Commercial Discard fleets of the Statistical Catch at Age stock assessment model for Striped Bass. The Board further tasked the Technical Committee to redevelop the F reference points using the 1996-2012 time period for developing the composite selectivity curve as opposed to the 2008-2012 time period.

Enclosed is a report comparing the two sets of coastwide and fleet-specific fishing mortality reference points calculated using the 2008-2012 time period and the 1996-2012 time period.

Enclosed: Comparing Atlantic Striped Bass Fishing Mortality Reference Points Using Two Different Time Periods for Selectivity: 2008-2012 (5-year) and 1996-2012 (17-year)

CC: Striped Bass Technical Committee

M15-082

Comparing Atlantic Striped Bass Fishing Mortality Reference Points Using Two Different Time Periods for Selectivity: 2008-2012 (5-Year) and 1996-2012 (17-Year)

Overview:

Addendum IV to Amendment 6 adopted new fishing mortality (F) and spawning stock biomass (SSB) reference points for the coastwide Atlantic Striped bass population as recommended by the 2013 benchmark assessment. The F reference point values were calculated using a composite selectivity that used the geometric mean of the most recent five years of total F-at-age. (Note: the 2013 stock assessment modeled removals from the population as three fleets: a Chesapeake Bay fleet, an ocean fleet, and a commercial discard fleet).

In May 2015, the Board tasked the Striped Bass Technical Committee to develop fleet-specific F reference points so that the impact of each fleet on the total coastwide Atlantic Striped Bass population remains sustainable (i.e., fleet-specific F reference points were calculated via the same five year selectivity time period so that when each fleet fishes at its target F, the maximum total F-at-age on the population is equal to the coastwide F target). Those proposed fleet-specific reference points and 2012 F status based on the 2013 assessment are as follows:

Fleet	F_{target}	$F_{threshold}$	F_{2012*}	F_{2012} based on 2015 assessment update	% Difference from target in 2012
Ocean	0.141	0.172	0.141	0.131	0%
Chesapeake Bay	0.052	0.064	0.059	0.054	10.8%
Commercial Discard	0.019	0.024	0.041	0.036	52.8%

*F2012 values reported here are from the 2013 assessment report. The 2015 stock assessment update resulted in lower F values for 2012 compared to those reported here.

Upon review at their August meeting, the Board further tasked the Technical Committee to redevelop the F reference points using a composite selectivity over a longer time period. The thought being that a longer time period would reflect the regulatory history of the fishery more adequately than a shorter (and more recent) time period. In order to maintain consistency across F reference point values, the coastwide F reference points (as adopted in Addendum IV) were also redeveloped with the longer time period.

Selectivity Pattern:

The full F values for the target and threshold are calculated using a composite selectivity that uses the geometric mean of total F-at-age for two different time periods; the most recent five years (2008-2012), and the most recent 17 years (1996-2012). The mean is divided by the maximum F-at-age to scale the curve to one. This essentially weights the selectivity pattern of each fleet (ocean, Chesapeake Bay, and commercial discard) by the degree to which they are contributing to total fishing mortality on the population. The Chesapeake Bay and commercial discard fleets are dome-shaped, peaking at age 5, while the ocean fleet is flat-topped, peaking at age 13+.

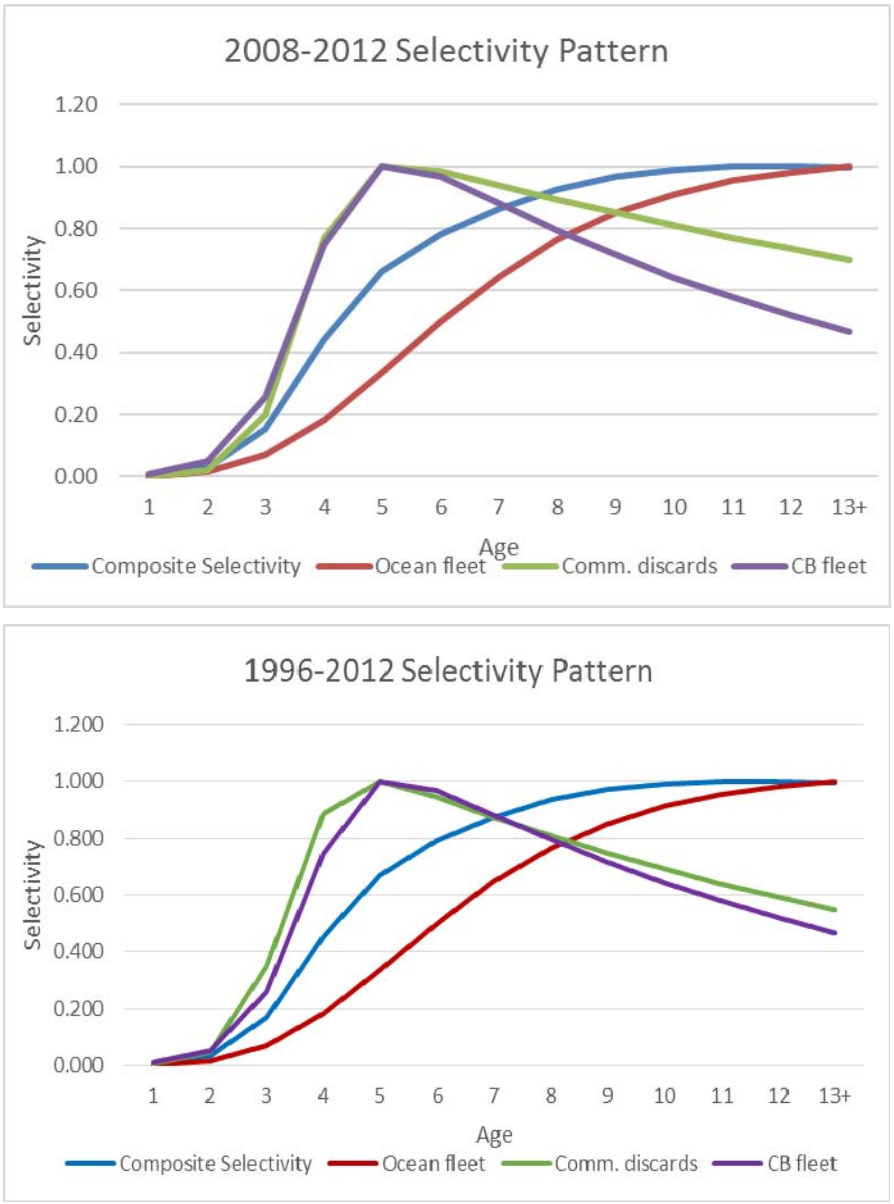


Figure 1. Comparison of the composite selectivity used to calculate the F reference points to the selectivities of the three fleets in the model; 2008-2012 (top), 1996-2012 (bottom).

Fleet-specific F reference Points:

To calculate the Bay-specific F reference points, the ratio of F-at-age-5 from the Chesapeake Bay fleet to total F-at-age-5 was calculated (using the ratio of means over the 1996-2012 and 2008-2012 time periods). This ratio was multiplied by the selectivity-at-age from the composite fleet at age-5 and the F_{target} and $F_{threshold}$ values to obtain the full F target and threshold values for the Chesapeake Bay.

For the commercial discard fleet, the ratio of total F-at-age-5 to fleet F-at-age-5 was also used; for the ocean fleet, the ratio of total F-at-age-12 to fleet F-at-age-12 was used, and the reference points were corrected for the not quite full selectivity on age-12 for this fleet (0.98 as opposed to 1), since full selectivity in the ocean fleet occurs at age 13+.

Table 1. Ratio of means for 1996-2012 and 2008-2012 time periods

	1996-2012	2008-2012
Chesapeake Bay	0.468	0.438
Ocean	0.790	0.770
Commercial Discards	0.111	0.163

Results:

Table 2. Fleet reference points and 2012 F status

	17- year selectivity (1996 - 2012)			5- year selectivity (2008 - 2012)		
	F_{target}	$F_{threshold}$	% Diff from target in 2012*	F_{target}	$F_{threshold}$	% Diff from target in 2012
Coastwide	0.177	0.216	13.1%	0.180	0.219	11.2%
Ocean	0.142	0.173	-1%	0.141	0.172	0%
C. Bay	0.056	0.068	5.0%	0.052	0.064	10.8%
Comm. Disc.	0.013	0.016	68.0%	0.019	0.024	52.8%

*comparison is made to the F2012 values from the 2013 assessment.

- Coastwide F reference points are very similar.
- Ocean fleet F reference points are nearly the same.
- Chesapeake Bay F reference points based on the 17 year period are slightly higher compared to those based on the 5 year period.
- The commercial discard target and threshold are 30% lower for the 17 year selectivity period compared to the five year period.

Discussion:

- The time period used to develop selectivity patterns was discussed extensively during the development of the Chesapeake Bay biological reference points with little consensus.
- The level of precision was not examined, however, it is unreasonable to expect the difference between both sets of F reference points to be statistically significant.

5-Year Time Period	17-Year Time Period
Reflects recent trends in effects of regulations, fishing effort, environment, spatial distribution of fish and the fleet, recruitment, etc. → *better choice to represent future fishery if recent trends in those factors are expected to continue*	Reflects long-term average of the effects of regulations, fishing effort and environment → *better choice to represent future fishery if those factors will vary within the range observed in 1996-2012*
Covers same part of a single selectivity block for all three fleets in the model	Covers a single selectivity block in the model for the Bay and Ocean fleets (+1 year of an earlier block for the Ocean fleet), and two blocks for the commercial discard fleet
Consistent with coastwide reference points adopted through Addendum IV	Would not change coastwide reference points to two decimal places (as established in Add. IV)

The reported differences in reference points for the Chesapeake Bay and commercial discard fleets calculated for different periods is driven primarily by a recent increase in estimated commercial discards. This results in higher contribution of commercial discards towards total mortality. Considering that commercial discard estimates are rather uncertain and that commercial harvest in recent years was declining, the reliability of recent trends in commercial discards is unknown. It is important to note that commercial discards cannot be split between the Chesapeake Bay and the ocean fisheries. Commercial discards are estimated from tag returns, and these estimates are highly uncertain due to low tag return rates each year, among other reasons. Discarding appears to be primarily regulatory, due to size limits, closed seasons, quotas, and gear restrictions.

Given the difficulties of controlling F from discards, a target and threshold for the commercial discard fleet may not be meaningful for management. However, without a control on this source of mortality, the population could still experience overfishing even with the Bay and the ocean fleets fishing at their targets. If F from the discard fleet cannot be reduced through management action, the Bay and ocean fleets will have to take reductions to maintain the coastwide F at the target.

Figure 2. Full F for each fleet relative to the coastwide target and threshold.

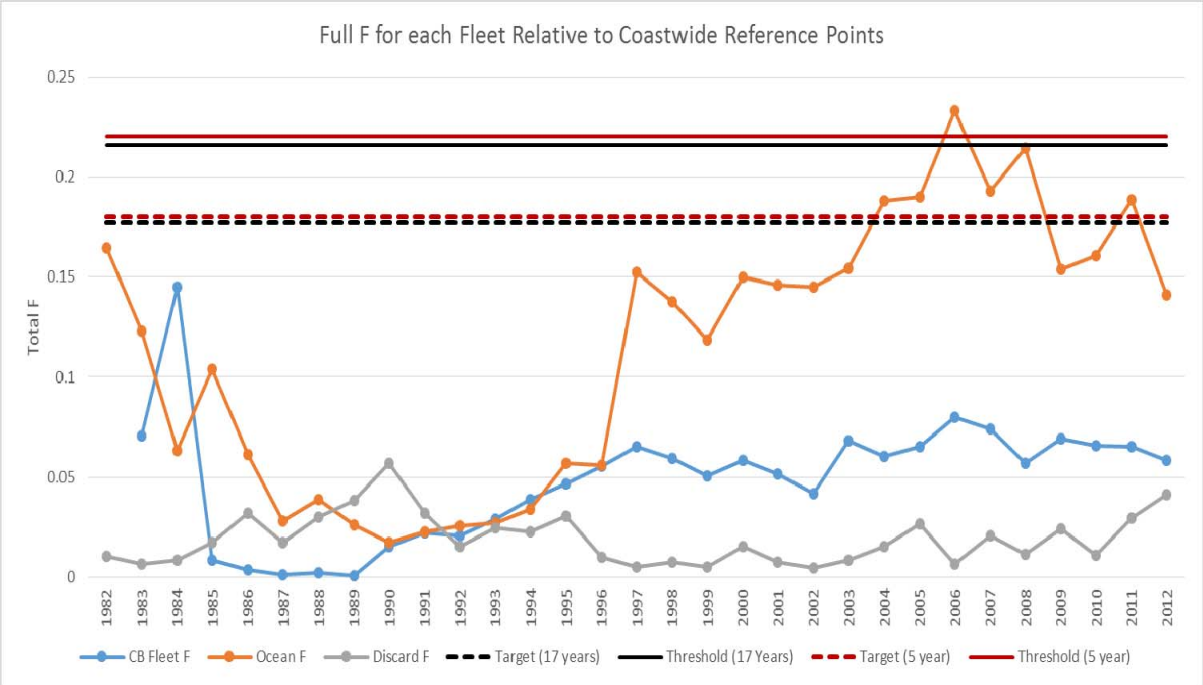
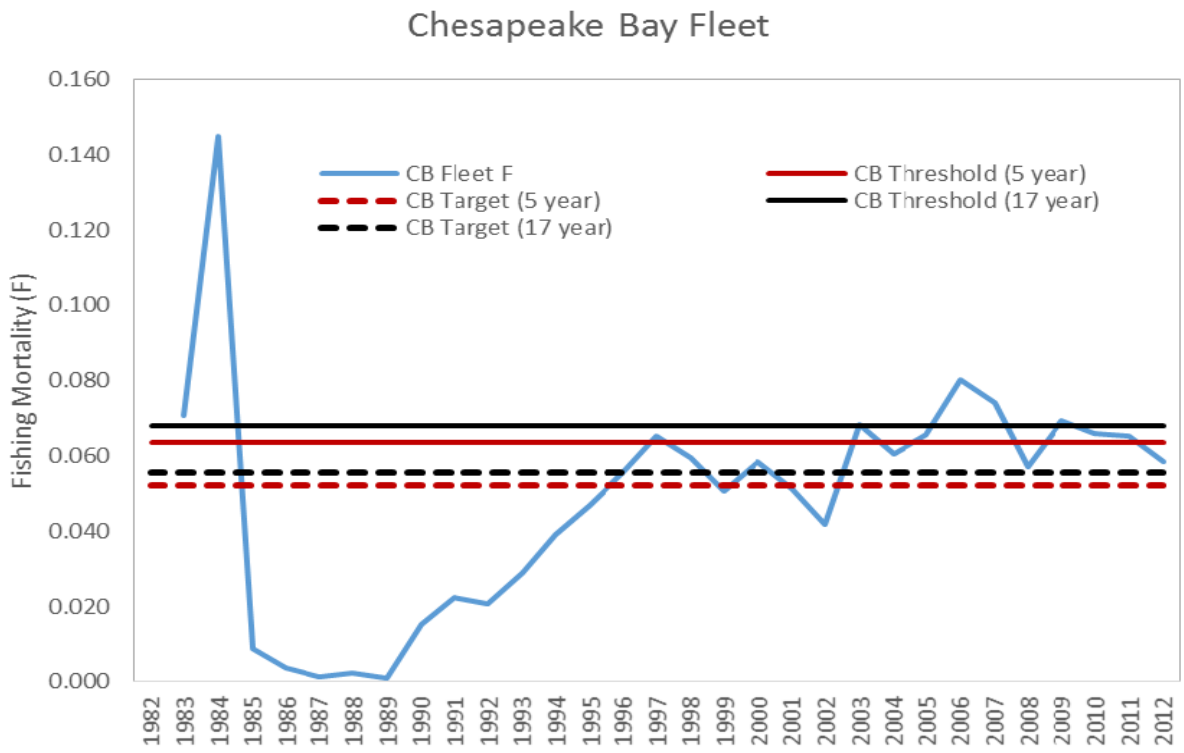
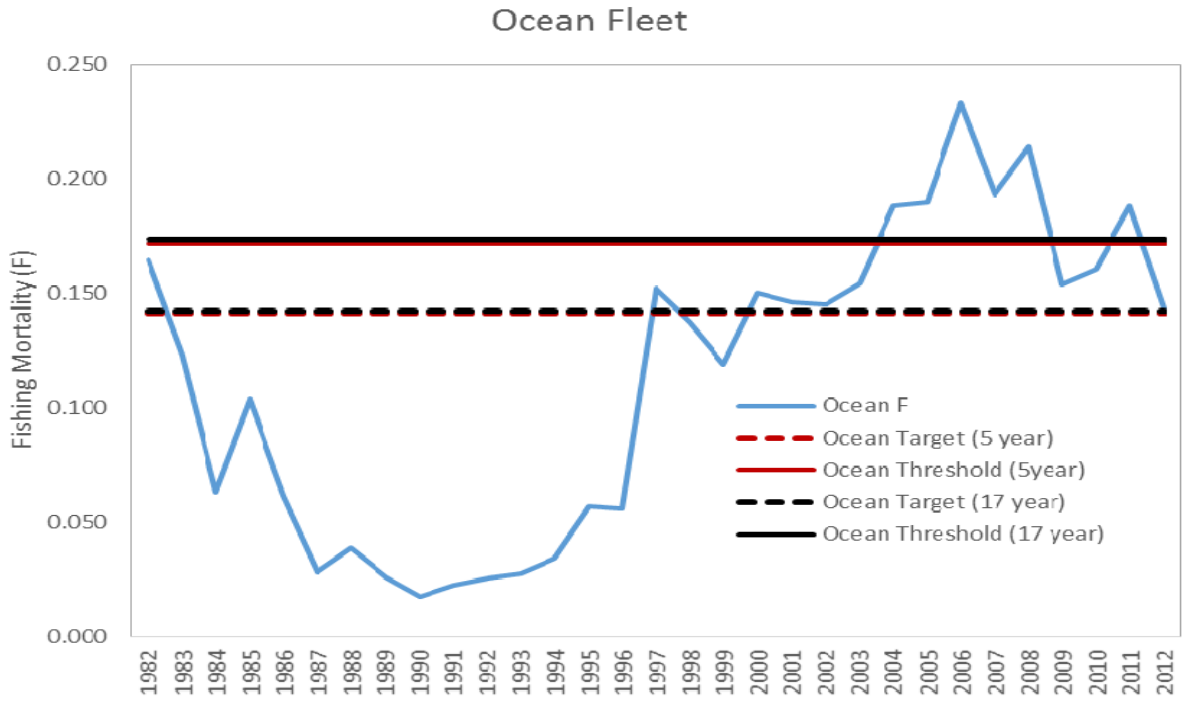
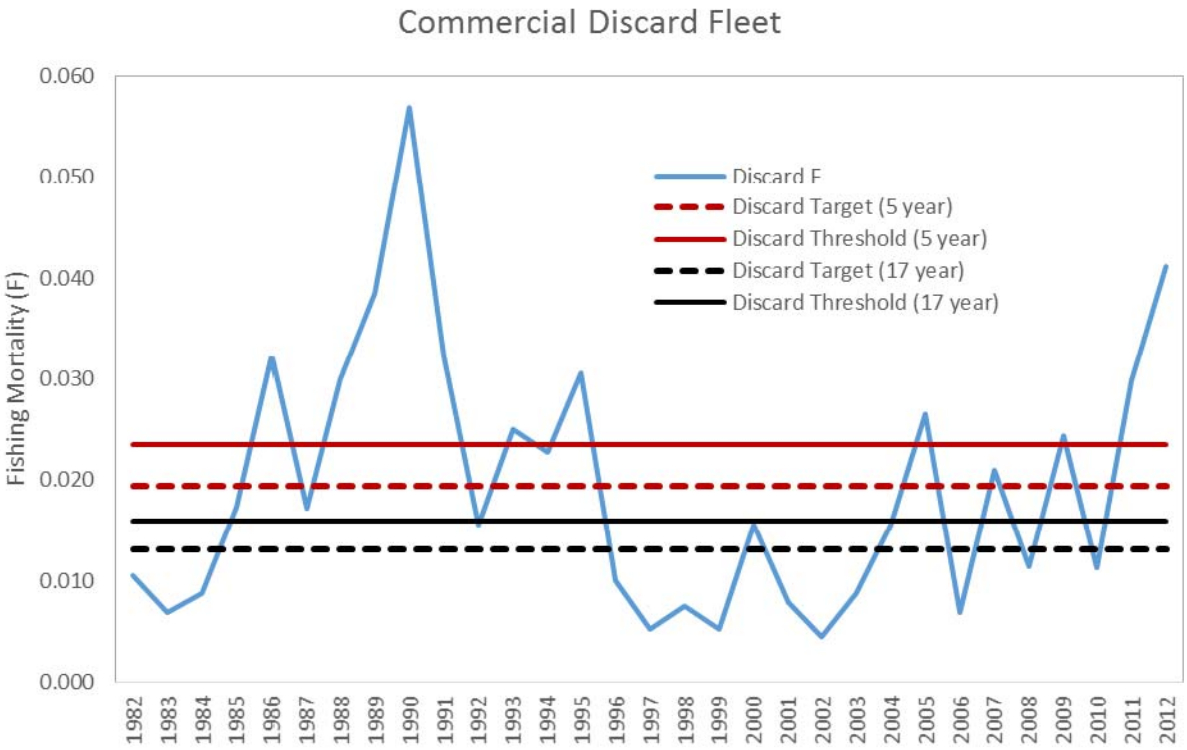


Figure 3. Full F and their respective targets and thresholds for the Chesapeake Bay fleet (top), ocean fleet (middle), and commercial discard fleet (bottom).




Ocean Fleet
Fishing Mortality (F)
0.250
0.200
0.150
0.100
0.050
0.000
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Ocean F
Ocean Target (5 year)
Ocean Threshold (5year)
Ocean Target (17 year)
Ocean Threshold (17 year)


Commercial Discard Fleet
Fishing Mortality (F)
0.060
0.050
0.040
0.030
0.020
0.010
0.000
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Discard F
Discard Target (5 year)
Discard Threshold (5 year)
Discard Target (17 year)
Discard Threshold (17 year)