Atlantic States Marine Fisheries Commission

Winter Flounder Management Board

February 5, 2019
11:30 a.m. – 12:00 p.m.
Arlington, Virginia

Draft Agenda

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

1.	Welcome/Call to Order *(D. Pierce)*	11:30 a.m.
2.	Board Consent • Approval of Agenda • Approval of Proceedings from May 2018	11:30 a.m.
3.	Public Comment	11:35 a.m.
4.	Consider Specifications for the 2019 Fishing Year *(M. Ware)* **Final Action**	11:45 a.m.
5.	Consider Approval of 2019 FMP Review and State Compliance Reports *(J. Kuesel)* **Action**	11:50 a.m.
6.	Discussion of Bell et al. 2018 Paper "Rebuilding in the Face of Climate Change" *(D. Pierce)*	11:55 a.m.
7.	Other Business/Adjourn	12:00 p.m.

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

MEETING OVERVIEW

Winter Flounder Management Board
February 5, 2019
11:30 a.m. – 12:00 p.m.
Arlington, Virginia

Chair: David Pierce (MA)	Technical Committee Chair: Paul Nitschke (NEFSC)	LEC Representative: Kurt Blanchard
Vice Chair: David Borden (RI)	Advisory Panel Chair: Bud Brown	Previous Board Meeting: May 2, 2018
Voting Members: ME, NH, MA, RI, CT, NY, NJ, NMFS, USFWS (9 votes)		

2. **Board Consent**
    - Approval of Agenda
    - Approval of Proceedings from May 2018

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

4. Consider Specifications for the 2019 Fishing Year (11:45 – 11:50 a.m.) Final Action • Per Addendum III, the Board can adjust, through Board action, the following management measures for the 2019 fishing year: o Recreational (size limit, bag limit, season) o Commercial (size limit, season, trip limit, trigger trip limit, and area closures)
Presentation • Winter Flounder specification overview by M. Ware **(Briefing Materials)**
Board Actions for Consideration at this Meeting • Consider specifications for 2019 fishing year

5. Fishery Management Plan Review (11:50– 11:55 a.m.) Action • State compliance reports were due on December 1, 2018 • The annual FMP Review was compiled based on state compliance reports. **(Briefing Materials)**
Presentation • Overview of the FMP Review by J. Kuesel
Board Actions for Consideration at this Meeting • Accept 2019 FMP Review and State Compliance Reports

6. Discussion on Bell et al. 2018 Paper (11:55 a.m. – 12:00 p.m.)
• The 2018 paper "Rebuilding in the face of climate change" examines the rebuilding potential of winter flounder under changing environmental conditions. **(Briefing Materials)** • Projections presented in the paper suggest that, when using an environmentally driven model, rebuilding of the SNE/MA stock to historic levels is unlikely.
Board Actions for Consideration at this Meeting
• Task PDT or TC to review this paper

7. Other Business/Adjourn

Winter Flounder Technical Committee Task List

Activity Level: Low

Committee Overlap Score: Low

Committee Task List
• There are no on-going tasks for this Winter Flounder TC at this time • Annual state compliance reports are due December 1

TC Members
Paul Nitschke (NEFSC – Chair), Tony Wood (NEFSC), Dr. Robert Pomeroy (UCONN), Sally Sherman (ME DMR), Greg Decelles (MA DMF), Rebecca Heuss (NHFG), Linda Barry (NJ DFW), Paul Nunnenkamp (NYS DEC), John Maniscalco (NYS DEC), John Lake (RI DFW)

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

WINTER FLOUNDER MANAGEMENT BOARD

The Westin Crystal City
Arlington, Virginia
May 2, 2018

These minutes are draft and subject to approval by the Winter Flounder Management Board.
The Board will review the minutes during its next meeting.

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INDEX OF MOTIONS

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

2. **Move to accept the RI proposal allowing any SNE/MA state to enact, as a 2 year state-enacted pilot program, a permit program allowing for a 250 lb. weekly aggregate limit subject to daily reporting requirements, VMS and background checks** (Page 1). Motion by Bob Ballou; second by Ritchie White. Motion fails (Roll Call: In Favor – ME, RI; Opposed – NH, MA, CT, NJ, NMFS, USFWS; Null – NY). (Page 8).

3. **Motion to adjourn** by consent (Page 12).

ATTENDANCE

Board Members

Pat Keliher, ME (AA)
Steve Train, ME (GA)
Doug Grout, NH (AA)
G. Ritchie White, NH (GA)
Dennis Abbott, NH, proxy for Sen. Watters (LA)
Raymond Kane, MA (GA)
Rep. Sarah Peake, MA (LA)
David Pierce, MA (AA)
Jason McNamee, RI (AA)
Bob Ballou, RI, proxy for J. McNamee (AA)
David Borden, RI (GA)
Matt Gates, CT, proxy for P. Aarrestad (AA)
John McMurray, NY, proxy for Sen. Boyle (LA)
Maureen Davidson, NY, proxy for J. Gilmore (AA)
Emerson Hasbrouck, NY (GA)
Jeff Brust, NJ, proxy for L. Herrighty (AA)
Adam Nowalsky, NJ, proxy for Asm. Andrzejczak (LA)
Tom Fote, NJ (GA)
Alison Murphy, NMFS
Mike Millard, USFWS

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

Ex-Officio Members

Staff

Robert Beal
Toni Kerns
Mark Robson
Megan Ware
Jessica Kuesel

Guests

Joe Cimino, NJ DFW
Craig Pugh, RI DEM

The Winter Flounder Management Board of the Atlantic States Marine Fisheries Commission convened in the Jefferson Ballroom of the Westin Crystal City Hotel, Arlington, Virginia; Wednesday, May 2, 2018, and was called to order at 3:30 o'clock a.m. by Chairman David Pierce.

(Recording begins following Welcome and Call to Order, and then begins at Approval of the Agenda.)

APPROVAL OF AGENDA

CHAIRMAN DAVID PIERCE: I see no interest in making any changes; so therefore we will accept the agenda by consent.

APPROVAL OF PROCEEDINGS

CHAIRMAN PIERCE: The proceedings from February, 2018, they've been made available for a while. Do I have a motion to approve the proceedings from February, 2018?

Okay so moved by Doug Grout, is there a second? Okay, by Bob Ballou. Are there any objections to adopting the motion? I see none; therefore the proceedings from February, 2018 are approved.

PUBLIC COMMENT

CHAIRMAN PIERCE: Next on the agenda is an opportunity for Public Comment regarding any issue pertaining to the winter flounder management that is not on today's agenda.

I don't have anyone signed up to speak, therefore I will assume that there is no interest; unless a hand shoots up, and I see none. Therefore, we will go on to the next item.

REVIEW AND CONSIDER RHODE ISLAND'S PROPOSAL ON COMMERCIAL TRIP LIMITS

CHAIRMAN PIERCE: This is a meeting of the Board that is to deal with one issue; and it's an issue that has been raised by Rhode Island, and that is to Review and Consider Rhode Island's Proposal on Commercial Trip Limits.

This is final action on that which has been proposed by Bob Ballou and his colleagues; in order to deal with that proposal, and Megan is going to provide an overview. At the same time she is going to provide the Technical Committee report in response to their proposal. Afterwards, we'll turn to Bob Ballou and ask for any comments he may have regarding the proposal that he has presented. With that said we'll turn to Megan for her presentation.

OVERVIEW OF PROPOSAL

MS. MEGAN WARE: As a reminder, Rhode Island submitted a proposal requesting the consideration of aggregate weekly limits in the Southern New England/Mid-Atlantic commercial winter flounder fishery. At the February meeting the Board tasked the TC with investigating potential impacts of the proposal.

Today the Board will consider a response to this proposal. I'm going to start by reviewing the current measures. I'll go through the Rhode Island proposal, also go through the TC report, and then Mark Robson will be able to provide the LEC report. Addendum I implemented a 50 pound per day possession limit in the Southern New England/Mid-Atlantic commercial fishery.

This was in response to the 2008 stock assessment; which concluded that the Southern New England/Mid-Atlantic winter flounder stock was severely depleted, with a spawning stock biomass at only 9 percent of the target biomass. At the time the Board did consider a moratorium. However, there were concerns about discarding and the collection of fisheries dependent data. Overall the intent of Addendum I was to achieve the lowest possible F rate; while minimizing economic and social impacts, and solely to allow for bycatch.

In 2013 NOAA removed the moratorium in federal waters; and allowed for the directed harvest of winter flounder. However, in state waters the 50 pound possession limit remained. The Rhode Island proposal is proposing aggregate weekly limits in the Southern New England/Mid-Atlantic commercial fishery.

It is intended to first provide greater flexibility to state waters fishermen; and increase their efficiency, so that they could land similar amounts of fish in fewer trips to reduce the bycatch generated in state waters fisheries, to allow federally permitted vessels to pursue other species in state waters without being constrained by a low winter flounder possession limit.

Overall, it is to even the playing field between state and federally permitted harvesters in the winter flounder fishery. There are three options presented in the proposal. The first is a 250 pound per week limit; which would be year round. The second is a 350 pound per week limit, between the months of April and June, and November and December.

Then, during all other months it would go back to the 50 pound possession limit per day. This second option is aimed at limiting harvest to periods when winter flounder move in and out of state waters. Then the third option is a 250 pound per week limit; again year round, with the development of a permit program that would require captains to report daily via SAFIS, and acquire vessel monitoring hardware.

This third option affords management and enforcement the most control over the program.

TECHNICAL COMMITTEE REPORT

MS. WARE: Moving into the TC report, the TC met via conference call March 6, and April 17, to analyze the potential impacts of this proposal. The data used in the analysis includes trip level landing reports for state-only permit holders from 2014 through 2016.

While the proposal is from Rhode Island, the TC did look at data from Massachusetts through New Jersey; since that is the Southern New England/Mid-Atlantic stock. The data includes any trips which landed at least one pound of winter flounder, as well as the species name and poundage of other species landed on the trip.

Vessels with a federal permit were not included in the analysis; since those vessels are limited by hard quotas. I'll just note; as we go through some of the figures. The New Jersey data was confidential. It's shown in any aggregate figures; but there was some analysis on a state-by-state level, and I'm not able to show that.

As a first step, the TC analyzed trends in the data. This figure is showing the number of winter flounder trips in 2016 by week and state. The Y axis is the number of trips; and the X axis is the week and the year. The four colors represent the four different states. The TC report does show these figures for 2014, 2015, and 2016. However, the trends are pretty similar, so I'm just going to focus on the 2016 figures today. The figure illustrates that most trips are occurring in Rhode Island; which is the purple color, with a significant number of trips also occurring in New York, which is the green color. The figure also shows clear seasonal trends in the fishery; with most of the trips occurring in late spring. Then there is a smaller pulse of effort at the end of the year. If we go to the next slide, the figure is very similar; but this time it's showing the pounds of winter flounder landed in 2016, by week and state.

Here the Y axis is pounds and the X axis is again weeks in a year. Similar trends here; the figure is showing that most of the landings are occurring in Rhode Island and New York, which are the purple and blue colors. The figure also highlights; and perhaps a little more prominently, the increase in effort in the spring and at the end of the year.

The TC also explored trends in individual states to determine if fishing behavior or activities differ throughout the stock. This slide is showing the distribution of catch per trip in Connecticut and New York; with the X axis being pounds of winter flounder landed per trip, and the Y axis being number of trips.

On the next slide I will show Massachusetts and Rhode Island. Together these states are exhibiting somewhat of a bimodal pattern; in which there are a number of trips which landed very few winter flounder, and then a number of trips which harvested at or near that 50 pound possession limit.

You will also notice a few trips which were above the 50 pound limit. This could suggest that there are some issues with compliance in the fishery. These are similar plots for Rhode Island and Massachusetts. With the exception of 2014, Rhode Island does not seem to have that similar bimodal pattern; with the majority of trips in 2015 and 2016 landing less than 20 pounds of winter flounder.

In Massachusetts, particularly in 2014 and 2015, there are a large portion of trips which harvested at the trip limit; and it's these cluster of trips near that 50 pound mark, which may indicate regulatory discarding in the fishery. As a next step the TC investigated the current targeting behavior for state permitted fishermen.

For the top figure here the X axis is pounds per trip; and the Y axis is the proportion of trips in that bin. Only 10 percent of trips were at or near the 50 pound mark; and 2 percent of trips were above that limit. The bottom figure shows the proportion to which winter flounder contributed to total landings on a trip.

Of all the pounds of species landed on a trip, what percentage was winter flounder? Overall, relatively few trips appear to be exclusively directing on winter flounder; so in 2016 less than 6 percent of trips were majority winter flounder. Together these figures are showing that there is little directed fishing effort in the Southern New England/Mid-Atlantic stock by state waters fishermen.

This means that that 50 pound trip limit is achieving its stated goal of solely accounting for bycatch. As a third part of the TC report, the TC did attempt to predict changes in fishermen behavior under an aggregate weekly limit; and they did this through projections. There were two projections considered. The first is the 250 pound per week limit, and the second is the 350 pound per week limit between April/June and November/December. Those two projections are coming from the Rhode Island proposal. The TC also considered two scenarios for each projection. These two scenarios are intended to represent different changes in fishermen behavior.

The first one assumes that each harvester lands the full aggregate limit in a given week. I'm going to refer to that as the Full Participation Scenario. The second is a bit more conservative. It assumes that harvesters who landed greater than 50 pounds in a week will land that full aggregate limit.

However, a harvester who landed less than or equal to 50 pounds in a given week will just land 50 pounds a week. I'm going to refer to this as the Tiered Participation Scenario. For some quick methods, the calculations were based on pooling all of the 2014 to 2016 data by year, and then breaking the pounds of winter flounder caught by participant trip into week-sized bins.

For Scenario 1, which is that Full Participation Scenario, we multiplied each participant in a given week by the aggregate limit and summed. For Scenario 2, which is that Tiered Participation, for participants in the Tier 1 we multiplied by the aggregate weekly limit, and participants in Tier 2, we multiplied by 50 pounds.

This figure is showing the results of the projection for the 250 pound per week aggregate limit. The different color bars represent different scenarios. The blue bars represent Scenario 1, which is that Full Participation Scenario. The red bars represent the Scenario 2, where it's Tiered Participation, and then the orange bars represent the reported landings.

Here we have the X axis is the week and the year; and the Y axis is pounds. Overall this projection suggests that an aggregate weekly limit could lead to increases in landings. If you sum all the bars you would get the projected landings for the full year. If you sum all of the blue bars, you would get the projected landings for that scenario.

In that Full Participation Scenario, which is again the blue bars, it is 6.4 times higher than the reported landings. In the Tiered Participation Scenario, which is the red bars, it's 2.6 times higher than the reported landings. This is the projection for the 350 pound per week aggregate limit; so very similar.

Again, the blue bars are the Full Participation Scenario; the red bars are the Tiered Participation, and the orange bars are the reported landings. Similarly the projections are suggesting that that 350 pound per week aggregate limit during parts of the year could lead to increases in landings. If you sum the bars again, you would get the projected landings for the full year.

Under that Full Participation Scenario, it's roughly 6.3 times higher than the reported landings. For the Tiered Participation Scenario, it's roughly 3 times higher than reported landings. Based off the projections and the current low levels of targeting in the Southern New England/Mid-Atlantic winter flounder fishery, the TC does believe that the behavior of state waters fishermen will change, and landings will increase under an aggregate weekly limit. The influence of an aggregate weekly limit on discards is a bit harder to predict. If there is greater incentive to catch the full limit, then there may be more fishermen harvesting at or near the weekly limit. That could perpetuate regulatory discarding. It's also difficult to determine if expected increases in landings will lead to overfishing. These are two plots from the 2017 stock assessment. That assessment concluded that overfishing is not occurring. However, SSB is at or near record low levels; with little evidence of rebuilding.

Finally, the TC just had some additional notes for the Board to consider. The first is that an aggregate weekly limit may result in increased fishing by federally permitted boats in state waters. That would change the geographic distribution of effort. The second is that increased landings from state permit holders could alter the state waters subcomponent; as well as the sub ACLs for federally permitted vessels.

The reason for this is that a three-year average of landings from the Southern New England/Mid-Atlantic state waters is used to develop a state waters subcomponent. State water subcomponents do not have any accountability measures; and they are intended to estimate catch in state waters; so that they can be accounted for in the overall ACL. As a result, if landings increase the state waters subcomponent would also be expected to increase.

While this may be an advantage for state waters fishermen, this could be to the disadvantage of federal fishermen; given their overall ACLs might decrease to compensate for the increase in state waters landing. Finally, for some states including Rhode Island, winter flounder is not a limited entry fishery. As a result, aggregate weekly limits could result in increased effort and participation. That is the TC report. I will pass it to Mark for the LEC report.

CHAIRMAN PIERCE: Before Mark gives his report, I wanted to thank Megan for all the work she and the Technical Committee put into this particular issue; and frankly I'm very glad that Rhode Island raised this as an issue, because winter flounder really hasn't gotten much attention in the Southern New England and Mid-Atlantic area for a long time.

As a consequence of this analysis, this review, we know a lot more than we knew before. It's very important for us to have this appreciation; the New England states notably. Certainly Rhode Island and Massachusetts, because so much attention has been paid to the subcomponent set aside by the New England Council for state waters fishing for non-federal permit holders.

This analysis definitely will be of use to the New England Council as it moves forward with this discussion on groundfish. Thanks to the Technical

Committee for this very comprehensive analysis and review of the Rhode Island proposal. With that said I'll take questions of the Technical Committee; as soon as Mark gives his presentation. If you would, Mark.

LAW ENFORCEMENT COMMITTEE REPORT

MR. MARK ROBSON: The LEC got an excellent presentation yesterday during our meeting by Megan; outlining the proposal from Rhode Island, and we had an opportunity to discuss it at length. It was pointed out; in particular for Rhode Island that they currently have an aggregate limit situation for the summer flounder fishery. That is an enforceable program. What helps that program, as it was pointed out, is that the permit holders in that summer flounder fishery are also required to undergo a background check; which helps to ensure that you get good compliance and that you've got good folks in the program with those aggregate limit allowances. We did want to highlight that as we've indicated before in our enforceability guidelines, sometimes weekly aggregate limits can be troublesome from an enforcement perspective; and the main reason for that is because it does reduce some of the agility of an enforcement officer at the docks to deal with a situation where there may be a violation occurring.

Because in addition to just looking at, or measuring, or counting fish, you would have to then go back and do some independent verification using logbooks or some other mechanism; to see if they're still within their aggregate limit. That does create a bit more of an enforcement challenge for officers working at the docks.

But in looking at the three proposals from Rhode Island, the Law Enforcement Committee was supportive of Option 3; which would include for the winter flounder weekly aggregate limit the vessel monitoring and permit program. If possible, even including the background check system, similar to what is used for the summer flounder fishery in Rhode Island.

There was some follow up discussion on the good aspect of looking at an individual fishery like this; particularly in state waters. If there's an opportunity to add a vessel monitoring system to those kinds of fisheries. In general the Law Enforcement Committee was very supportive of those kinds of activities; if they could be developed, Mr. Chairman that is my report.

CONSIDER APPROVAL OF RHODE ISLAND'S PROPOSAL

CHAIRMAN PIERCE: Questions of Megan or Mark. Tom Fote.

MR. THOMAS P. FOTE: Megan, in New Jersey we don't allow any mobile gear; it's all fyke net fishery for winter flounder, with you know a 50 pound limit. Are the other states fyke nets and mobile gear or just mobile gear, Rhode Island and Massachusetts?

MS. WARE: I would have to look to the other states to answer that. I think it's primarily mobile gear. I'm getting a nod for primarily mobile gear; at least from the Rhode Island contingent.

MR. FOTE: What about Massachusetts?

CHAIRMAN PIERCE: Primarily mobile gear; any other questions of Megan or Mark? David Borden.

MR. DAVID V. BORDEN: A couple of quick points. The analysis I guess, there is a little bit of disconnect. Maybe I'm misinterpreting this; but there is a little bit of disconnect. The way I understand the proposal, if the Board approved this under Alternative 3, which was recommended by the Enforcement Committee, then basically Jason and his staff would have the option of starting a program and looking for people to opt into the program.

In other words they would keep the current 50 pound limit in place; but individuals that wanted to exceed the 50 pound limit would have to fish in accordance with the provisions of Option 3, which means they have to have VMS. It's probably going to be a one minute ping rate; so enforcement will know exactly where the boats are. As soon as it's all in state waters they'll know where the boats are at all times. They would have to report via the reporting system that is associated with the VMS unit. In fact, I think the Rhode Island staff has met with Ferabiti to work out the details of how that reporting would take place. Where I think there is disconnect is when the technical analysis was done, I think they assume that they scale up the landings based on historic participation.

But in my own view there is very little likelihood that everyone is going to participate in this program; it would be a small subset. Most of these people are not going to want to pay $700.00 to access that type of technology in order to go out and catch a couple of fish. It's going to be a small group.

I think that the analysis of that option is too conservative; but we could all debate how much more conservative it is. The second point is that Rhode Island has limited access. It's not that they don't have limited access. They've had a limited access program for most permits. Halfway through my career there we basically instituted limited access. What they don't have is a winter flounder only permit; that's different. There is a limit on the number of permits.

CHAIRMAN PIERCE: Excuse me David, but I've given you latitude. These are not questions these are comments.

MR. BORDEN: Okay, my question then is; is my assumption correct about the analysis that really the analysis is more conservative than what will actually take place and what was proposed by Rhode Island. That's a question.

MS. WARE: The analysis only looked at those two fishermen behavior scenarios. It did look at the one where if a fisherman landed less than 50 pounds he stays at the 50 pounds; and if it's greater than 50 pounds he or she would go up to that aggregate limit. But it didn't look at VMS or things like that that might already exist on a vessel.

CHAIRMAN PIERCE: Jeff Brust.

MR. JEFF BRUST: I appreciate the presentations from Megan and Mark. If I may, I do have a question for both of them. Megan, this might be a tough one for you. Maybe someone in the room will know; Jay, you're still here right? Do we know what proportion of the total harvest the inshore commercial fishery contributes?

MS. WARE: To all of winter flounder landings?

MR. BRUST: Yes. If the inshore, the state waters commercial landings increased by 2.5 or 6 times, what might that mean for total landings overall?

MS. WARE: I have the numbers here; give me one second.

MR. BRUST: Maybe while she's looking that up, a question for Mark. To the Law Enforcement Committee, your recommendation was for Option Number 3. Is that your preferred option over status quo, or is that your preferred option of the three options that were presented?

MR. ROBSON: That was our preferred option of the three options that were presented.

MS. WARE: All right, so I'm just going to read off numbers; and hopefully these answer your question in some capacity. For 2016 those are the numbers I have. The total catch in the Southern New England/Mid-Atlantic winter flounder fishery was 597 metric tons. For state waters it was 26 metric tons; and then of those state waters, 11.8 were from the commercial fishery.

CHAIRMAN PIERCE: Go ahead, Jeff.

MR. BRUST: The 26 was commercial and recreational combined?

MS. WARE: And discards.

CHAIRMAN PIERCE: Any further questions of Megan or Mark? Follow up question, go ahead.

MR. BORDEN: Yes, follow up to that question. Megan, when you looked that up, what portion was Rhode Island, is the question; 26 total from state waters and then what portion is Rhode Island?

MS. WARE: Yes, I don't have that number right in front of me. Looking from the figure I would say it was at least 50 percent; but that would be my best guess, at least 50 percent or higher. Sorry, I don't have that exact number.

CHAIRMAN PIERCE: Adam.

MR. ADAM NOWALSKY: Are we looking at doing this through specification; or would this require an addendum? If we're not doing this through an addendum, how would we reconcile this action with the most recent language we have in Addendum I, that says we're achieving the lowest possible F, and our goal is solely to allow bycatch?

MS. WARE: Acceptance of the proposal would take a Board motion; not an addendum. I think reconciling that language is something for the Board to consider in your deliberations. If you feel that the proposal still meets that language in the addendum.

CHAIRMAN PIERCE: All set, Adam? You look like you're thinking. All right, if there are no further questions of Megan or of Mark, I'll turn to Bob Ballou and ask Bob; if there is anything else you would like to add for Board consideration.

MR. BOB BALLOU: First and foremost, on behalf of the entire Rhode Island delegation, we want to thank the TC for their excellent work; and I would echo your sentiments expressed earlier, and that is I think we've already learned a lot just from this proposal and the response to it from both the TC and the Law Enforcement Committee. Whether there is an opportunity to advance is what we're about to find out. But again, I want to really credit the excellent work done in developing some very good information; that frankly we didn't have available to us prior to this proposal. I think we've already made some advances. Secondly, I just want to remind the Board of the context of this proposal; and that is when Addendum I was adopted in 2009, establishing the 50 pound per day limit that was during a time when at the federal level a moratorium was in place. It was indeed intended to maintain the state water fishery as a bycatch only fishery; to complement the federal water fishery, if you will, which was essentially closed.

That changed in 2013 when NOAA Fisheries lifted the moratorium; and allowed fishing in federal waters under the Sector Program, where there really are no possession limits whatsoever. The vessels participating in the Sector Program obviously are fishing in accordance with their ACE. Then those fishing in the common pool are subject to daily possession limits which are often set at 2,000 pounds per day.

At that point, starting in 2013, there arose significant disparities between the federal waters program and the state waters program that have perpetuated over the years; and really created a disconnect in terms of management of the commercial winter flounder fishery in Southern New England/Mid-Atlantic region. In part this proposal is aimed at addressing that.

But importantly, this proposal is aimed at maintaining the state waters fishery as a bycatch fishery; recognizing that with an allowance for a weekly aggregate program, there may well be benefits with regard to fishing mortality associated with reduced discard mortality. With that focus, and with the benefits of the analysis and the LEC review in mind, I would like to make a motion. I've provided it to staff; so I believe it's ready to be put up. I'm going to tweak it a bit, Jess, so if you could follow along with me.

Move to accept the Rhode Island proposal allowing any SNE/MA to reflect Southern New England and Mid-Atlantic state to enact, as a 2 year state-enacted pilot program, a permit program allowing for an aggregate 250 pound weekly aggregate limit subject to daily reporting requirements, VMS and background checks. I want to add background checks. If there is a second to the motion I'll be happy to speak more to it.

CHAIRMAN PIERCE: All right, is there a second. Ritchie has seconded the motion. All right, before you speak to the motion I've just got a question for you. It's relevant to the discussion we will have. The motion that you have made that departs from the charge that was given to the Technical Committee, to some extent. You're including all states as well. Are you concerned that this particular motion will require additional work by the Technical Committee; since this opens the door for other states to get involved, if they so choose?

MR. BALLOU: Respectfully Mr. Chairman, I'm not aware that it was ever advanced as a Rhode Island only proposal. In fact I believe the record reflects I went back and looked at the meeting minutes and there was I think a brief exchange, indicating that it was certainly our intent to make this a program that would be available to any state fishing in the Southern New England/Mid-Atlantic region.

We're looking to carry that forward. My representation, and I would certainly look to Megan for her sense, is that the Technical Committee analyzed the proposal with this in mind that is the program applying to any Southern New England state, not just Rhode Island.

MS. WARE: Yes that's correct. At the February meeting the request to the TC was to consider this not just with Rhode Island in mind; but for any of the Southern New England/Mid-Atlantic states.

CHAIRMAN PIERCE: Thank you, Megan, all right Bob, continue to speak to the motion.

MR. BALLOU: I really don't have much more to add. Frankly, I was just going to highlight that very issue that we just had an exchange on; that it is intended to apply to any Southern New England/Mid-Atlantic state, and there are only a small number. But they know who they are. What we've added here is that this would be the new element, if you will is a two-year pilot program.

This is a proposal that's limited in scope and time; very restrictive in terms of entry into the program, noting all of the requirements that one would have to meet in order to gain entry into the program. Very much a de facto limited entry program; and one that we think will generate additional information and data to augment and build upon the very good work already done by the Technical Committee.

The intent of this would be to see if there is interest; and to be honest with you we don't know the level of interest given the very stringent requirements for entry into the program. But to the extent that there is interest in participating on the part of Rhode Island fishermen, Connecticut, Massachusetts, New York, New Jersey.

This would allow for data collection with particular emphasis on discard, harvest to discard ratio information that I think would really enhance our understanding of the state waters program, and potentially lead to an opportunity to maybe expand this if there is a basis for doing so. That is the key focus here; is two-year pilot program with stringent entry requirements available for any state in the region to implement if they see fit.

CHAIRMAN PIERCE: All right thank you, Bob. Does anyone care to speak to the motion? I'll speak with you, Ritchie, and then Tom.

MR. G. RITCHIE WHITE: I seconded the motion; because it's a two-year pilot program, so it sunsets, and it would take a vote of this Board to expand it beyond that. I guess one question is should the motion include what the two years are? When does it start, what fishing years?

CHAIRMAN PIERCE: Clarification.

MR. BALLOU: I think that is a very fair request. I would actually welcome Jason McNamee's thoughts on this; and perhaps at the public microphone. I'm going to suggest that it would be for the 2019-2020 period.

CHAIRMAN PIERCE: It would also be helpful as we comment upon the motion as presented by Bob Ballou; and as seconded to offer up Board perspectives as they pertain to the Technical Committee review, especially what was noted in the discussion part of the report, and also the unintended consequences that the TC has raised. I would be derelict in my duty as Chair if I didn't emphasize the fact that the TC has expressed some serious reservations about this particular proposal. Tom Fote.

MR. FOTE: I'll give a little history lesson. It was also at the advice of the Advisors that basically on winter flounder they came to this Board, and basically recommended a moratorium back in that period of time, because they saw the crash of the winter flounder stocks. I know, because I personally was the person that made the motion to allow it open for 2 fish recreationally and 50 pound daily limit.

Mainly because I was looking at most of our gear was fixed gears, fyke net fishery, so the gear was going to be in the water catching white perch and everything and then we would have a bycatch of winter flounder. I didn't think it would cause any more problems to the moratorium. As a matter of fact I did the same thing on weakfish.

As soon as I did it on weakfish, before it was even in place a year, one of the states came back and said oh, because you didn't say conservation equivalency couldn't be used, came back with 1,000 pounds instead of 100 pounds in the weakfish. All of a sudden that changes that fishery from a bycatch fishery to a directed fishery.

Again, this is what we're doing here. We're basically taking a bycatch fishery that just happens to be on bycatch, and we're going to turn it to a directed fishery. When you look at 250 pounds of winter flounder at $4.00, $5.00 a pound boat vessel price probably at that period of time, because there isn't any other fish. It also becomes as it's an inshore fishery, so it's not where they're traveling offshore. They can make a dollar at this so they're going to do it.

This is a stock that has not recovered. It is no better off than when we put this in place; well how many years ago? I kind of forget what the years are, but I remember what I said back then, and we haven't seen any recovery whatsoever. Is this sending the right message on stocks that are fully depressed? We came in with weakfish with the same problem or the same suggestion. I have the same concerns.

There is no showing that it's going the other direction. I'm not sure why. Well, I think I know why, but it doesn't look like fishing pressure. When we opened up the federal government through New England Council for the direction of our former Northeast Director, basically said that we should have 5,000 pound trip limits on winter flounder.

We all went crazy around this table; because we were afraid of what the impact of that would be on the stocks. We don't know, because they took it off on the error. Some of us felt it was a response of the yellowtail fishery collapsing, so they wanted to give a little bone to them. I mean this is a stock that is in serious, serious trouble.

We consider we really almost, moratorium was this close to coming off, and that was a last minute thing. Has anything changed since that period of time? Are we now looking that this might have 2.5 times the effect or 6 times the effect on a stock that is fully depressed; that should be in a moratorium, but we're allowing it to stay open, just to collect some biological data? I don't know what we're doing here then. I mean I really can't believe we're proposing this; because when you go to 250 pounds or 350 pounds, it is a directed fishery, because the money involved is there. If it was as stock that could handle it, but this is a stock that we know is down the tubes. I don't see anything right now, any sign from NMFS, any sign from the stock assessment that show that it's recovered by one iota.

Now, if it was basically where you can concentrate on the offshore stocks, the Georges Bank stocks, they don't seem to have the same problem. We're having that problem with estuarine dependent fish that are basically spawned in the estuary with all the other factors; estrogen and everything else that is in there, and seen the effects of their sex lives.

I mean the study that was done in Jamaica Bay, and I wish we would have done some more studies, looked at the female to male relationship in Jamaica Bay. It was 16 to 1, 17 to 1, 14 to 1, and 15 to 1 female to male; which probably most of the time should be just the opposite, it should be more males trying to attack the females and basically make the eggs fertile.

I cannot support this. Really, it surprised me that we're basically doing this, or even thinking about doing this on a stock that is so depressed. You always know where fishing isn't taking place, because we have the controls in. Would this amount of extra catch all of a sudden push our overfishing? Then we'll be saying oh, this is a stock that we're now overfishing. Until we see some recovery, we should not look for any opportunity to basically put more pressure on the winter flounder stocks. Sorry if I took so long.

CHAIRMAN PIERCE: That's fine, Tom. Doug Grout.

MR. DOUGLAS E. GROUT: Just a question for the maker of the motion. I think I know where you're coming from; but I would like to hear some specifics about it, and that is these background checks that you added in there. Is the intent behind that that you would check their fisheries enforcement records, and if they had a violation in some period of time you wouldn't allow them in the program? Is that what you're trying to say with this?

MR. BALLOU: Certainly the Rhode Island standard currently in place for entry into our existing aggregate programs, I think would be an applicable standard, certainly for Rhode Island, and we could potentially make it applicable for this program region wide, and that is no violations of state or federal fisheries laws or regulations within the past three years.

CHAIRMAN PIERCE: Adam.

MR. NOWALSKY: I'm definitely sensitive to the issue that's been brought forward here; and the inequities described between state waters and federal waters fishermen. I'm having the most difficulty with the language that we have in the last addendum that directs us how we should be acting.

I think it's very clear on the record that this goes beyond a bycatch fishery. But I think there is a case that could be made that we as a Board can move in that direction. Clearly the Service has moved in that direction in federal waters. I think there is a reasonable argument that can be made that we can move past that. The TC report in evaluating these proposals, found the second proposal of 350 pound per week limit during two periods, would be about half the catch. I noted that Rhode Island's third proposal, which is basically what is up on the Board, uses the 250 pound week limit year round. I was wondering if Rhode Island felt that the 350 pound per week limit over two periods, with all of these other requirements, might be a palatable middle ground here.

Given the information that we have from the TC, how it would constrain catch, and in my opinion is more consistent with the current addendum we're working under to achieve the lowest possible F rate. I would be interested in hearing if that would be something they would consider.

MS. WARE: Adam, just to clarify. I think actually the halving of the pounds landed was from the two scenarios; whether it was Full Participation or Tiered Participation. The 250 versus the 350 during parts of the year, ended up with pretty similar pounds for each of the different scenarios. I'm looking at Table 1 versus Table 2 on Pages 11 and 12.

CHAIRMAN PIERCE: Yes Bob, a response.

MR. BALLOU: Just a quick response. Thank you for the opportunity, Mr. Chair. I also want to just point out that the TCs essentially did not analyze Option 3. They only analyzed Options 1 and 2. Granted this is a version of, I forget which it is now, Option 1 or 2; the 250 pound weekly limit. But it's subject to significant entry constraints. I appreciate the comments that are being made; but I want to remind the Board that the analysis done by the TC did not consider the likelihood of very limited participation in the program based on the motion that is up on the board now.

CHAIRMAN PEIRCE: I wasn't going to comment, but in light of the fact that you've offered up a motion that potentially includes Massachusetts as a state that would want to participate. I'm obliged to offer up a perspective; and that is that Massachusetts, I will not be offering up any proposal to do this, for a number of reasons.

The first and foremost reason is the Technical Committee review of the proposal. The second is the fact that I do believe this would result in a departure from the bycatch fishery that we are promoting, trying to continue, as opposed to a directed fishery. This likely would result in some more directed fishing; to what extent I'm not sure.

Nevertheless, I'm not willing to take that risk, certainly in Massachusetts. In addition, there is the issue of recreational fishermen versus the commercial fishermen; and with this particular pilot program being allowed for commercial fishermen, does that in a sense put the recreational fisherman at yet a disadvantage?

The recreational fishermen are already significantly restricted for the Southern New England area. Finally, as I noted before, there is the issue of the set aside, the state water subcomponent for winter flounder, and I've already dealt with New England Council concern about Massachusetts; non-federal permit holders, and the take of cod and a few other species in Massachusetts waters. I don't want to further the concern that might be expressed regarding the take; real or otherwise of winter flounder in state waters by non-federal permits holders. Those are some of the reasons why I would not be promoting this. Other states of course, if this passes, they would have the option to pursue it. But to me there are too many compelling reasons for Massachusetts not to support this approach, any further comments on the motion? Yes, Matt.

MR. MATTHEW GATES: I was going to speak against this motion. I'm generally in favor of providing increased efficiencies for commercial fishermen; but for all the reasons that everybody else has said around the table. I don't think this is the right time or the right stock to do that with. That's all.

CHAIRMAN PIERCE: Any other hands? Anyone who has not yet spoken? I'll give people another shot at it if there are no other takers, so I'll go back to you, Tom.

MR. FOTE: It would have been interesting to take this out to the Advisors to get their input on this; because the last time we went to the Advisors, every state recommended a moratorium, if I remember right. There was nobody objecting to it at that period of time. Have their feelings changed at all, because we didn't go out to the Advisors to ask them what their concerns were over this. They haven't had an Advisory meeting in a while.

CHAIRMAN PIERCE: If there are no other comments, well David Borden one more time.

MR. BORDEN: I'll make this quick, Mr. Chairman. I just point out to everybody, 95 percent of the stock is being taken in federal waters in a directed fishery, period. The Board has tried on two or three occasions to wrestle with that factor. The fishery and our in-state waters are almost irrelevant compared to what's going on in federal waters.

The second point is, and I want to talk about this for a long period of time. The analysis is way overly conservative. If you assume the most conservative, if you look at the analysis in the most conservative light, it would cause like an 8 percent increase in total catch. The way the system would react, as we discussed at our last Board meeting, is the New England Council and NOAA would have to look at that increased catch and basically deduct it from federal waters ACLs is what would happen.

There may be some poetic justice to doing that; given how we've struggled with this issue. The third point is since I didn't see the motion before it went up on the board. I would be personally more comfortable with it if it said a one-year program with a right to renew for one year; and after the one year we get a report from the state agency. Then the Board could decide whether or not there was value in the program, of there as not value in the program. I would ask Bob to consider revising his proposal to reflect that.

CHAIRMAN PIERCE: All right, if there are no further comments to make on the motion, I'll call the question and read it into the record. I'm going to read it into the record now, Tom. I think we've certainly spoken at length about this. Move to accept the Rhode Island proposal allowing any SNE/MA state to enact, as a 2-year-state-enacted pilot program, a permit program allowing for a 250 lb. weekly aggregate limit subject to daily reporting requirements, VMS, and background checks.
Motion by Mr. Ballou and seconded by Mr. White. I assume there is a need to caucus, so we'll give you 45 seconds or so. Yes there will be a roll call vote. All right, enough time has been allotted. I assume every state has taken a position. Megan will now call the roll.

MS. WARE: Maine.

MR. PATRICK C. KELIHER: Yes.

MS. WARE: New Hampshire.

MR. GROUT: No.

MS. WARE: Massachusetts.

REPRESENTATIVE SARAH PEAKE: No.

MS. WARE: Rhode Island.

MR. BALLOU: Yes.

MS. WARE: Connecticut.

MR. GATES: No.

MS. WARE: New York.

MR. EMERSON C. HASBROUCK: Null.

MS. WARE: New Jersey.

MR. BRUST: No.

MS. WARE: U.S. Fish and Wildlife.

U.S. FISH & WILDLIFE: No.

MS. WARE: NOAA Fisheries.

NOAA FISHERIES: No.

CHAIRMAN PIERCE: **All right the vote is 2 in favor, 6 against and 1 null. The motion is defeated.**

ADJOURNMENT

CHAIRMAN PIERCE: Is there any other business to come before the Board? I see none; therefore with no objection we will adjourn.

(Whereupon the meeting adjourned at 4:25 o'clock p.m. on May 2, 2018)

Winter Flounder Specifications Briefing Document

Per Addendum III, the Winter Flounder Management Board may make annual changes to the management measures below via Board action. The specifications may be set for up to three years.

- **Recreational measures:** size limit, bag limit, season
- **Commercial measures:** size limit, trip limit, season, area closure, trigger trip limit

Below is a table with the current management measures for winter flounder:

Stock	Sector	Trip Limit/ Possession Limit	Size Limit	Season	Gear
GOM	Commerical	500 lbs per trip per day	12”	Maintain closures	Minimum 6.5” square or diamond mesh in cod-end
	Recreational	8 fish	12"	NA	
SNE/MA	Commerical	50 lbs/ 38 fish per trip per day	12”	Maintain closures	Minimum 6.5” square or diamond mesh in cod-end. 100-lb mesh trigger.
	Recreational	2 fish	12”	March 1 – December 31	

Implemented in Amendment 1 in 2005
Implemented in Addendum I in 2009
Implemented in Addendum II in 2012; GOM trip limit increased from 250 lbs (via Addendum I) to 500 lbs.
Varying closure dates were in place via Amendment 1, the new dates became effective through Board Action on Febuary 2014

The most recent data on winter flounder catch comes from the 2017 fishing year.

- In the **Gulf of Maine (GOM) stock**, total catch in FY 2017 was 308.1 mt, with 185.3 mt landed under the state waters sub-component. The annual catch limit (ACL) for FY 2017 was 776 mt and the state waters sub-component was 122 mt. As a result, 39.7% of the total ACL was caught and 151.9% of the state waters sub-component was caught.
- In the **Southern New England/Mid-Atlantic (SNE/MA) stock**, total catch in FY 2017 550.5 mt, with 23.2 mt landed under the state waters sub-component. The ACL for FY 2017 was 749 mt and the state waters sub-component was 70 mt. As a result, 73.5% of the total ACL was caught and 33.2% of the state waters sub-component was caught.

In 2018, the New England Fishery Management Council’s Framework 57 set 2018 – 2020 ACLs for the GOM and SNE/MA winter flounder stocks.

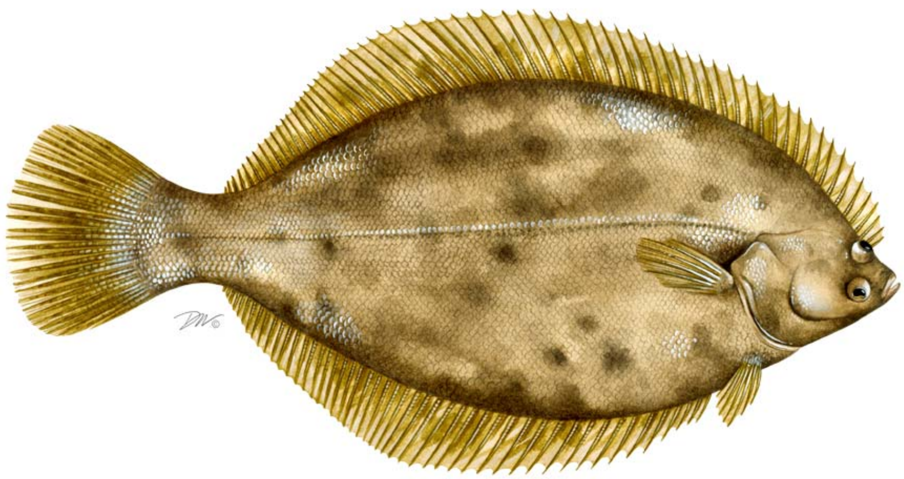
- The **GOM** ACL was reduced to 428 mt (from 776 mt), with the state waters sub-component set at 67 mt (from 122 mt).
- The **SNE/MA** ACL was reduced to 700 mt (from 749 mt), with the state waters sub-component set at 73 mt from 70 mt).

REVIEW OF THE
ATLANTIC STATES MARINE FISHERIES COMMISSION'S
INTERSTATE FISHERY MANAGEMENT PLAN FOR

WINTER FLOUNDER

(Pseudopleuronectes americanus)

2017



Prepared by Jessica Kuesel

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I. Status of Fishery Management Plan

Date of FMP Approval	Original FMP (October 1988)
Amendments	Amendment 1 (November 2005)
Addenda	Addendum I (May 1992) Addendum II (February 1998) Addendum I to Amendment 1 (May 2009) Addendum II to Amendment 1 (October 2012) Addendum III to Amendment 1 (May 2013)
Management Units	Three stocks units: Gulf of Maine (GOM), Southern New England/ Mid-Atlantic (SNE/MA), and Georges Bank (GBK). Commission participates in management of GOM and SNE/MA stocks.
States with Declared Interest	Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey
Active Boards/Committees	Winter Flounder Management Board, Advisory Panel, Technical Committee, Plan Review Team

The Atlantic States Marine Fisheries Commission (Commission) and the New England Fishery Management Council (Council) manage winter flounder in state and federal waters. The Commission participates in the management of two inshore winter flounder stocks: 1) the Gulf of Maine (GOM) stock, which consists of waters north of Cape Cod; and 2) the Southern New England/Mid-Atlantic (SNE/MA) stock, which consists of waters south of Cape Cod to the Delaware-Maryland border. The decision to consider only inshore stocks of winter flounder was based upon the Commission's focus on fisheries in state waters, and the differences in biological characteristics from the offshore stock in Georges Bank.

Interstate Fishery Management Plan (1988)

The Commission authorized development of the first Fishery Management Plan (FMP) for Winter Flounder (*Pseudopleuronectes americanus*) in October 1988. The purpose of the plan was to: 1) address management of inshore stocks of winter flounder; and 2) prominently consider habitat and environmental quality as factors affecting the condition of the resource. The original FMP and Addendum I called for reductions in fishing mortality on winter flounder. It allowed states the flexibility to achieve those reductions based on the life history characteristics of the particular stocks inhabiting each region. Implementation of the plan required cooperation between state fishery management agencies, National Marine Fisheries Service, the Council, and the Commission.

Although all states submitted plans that were approved by the Winter Flounder Management Board (Board), results from a 1995 stock assessment concluded that none of the states achieved a fishing mortality rate corresponding to F_{30}. Subsequent analyses in early January 1997 indicated that fishing mortality on a coastwide basis was slightly higher than the F_{30} target for the SNE/MA stock complex. Fishing mortality in the GOM stock was presumed to be higher than in the SNE/MA stock, and the spawning stock biomass was estimated to be at a low level, indicating that the GOM unit might be in greater need of rebuilding than the SNE/MA unit.

In February 1998, the Board approved Addendum II to the FMP. Addendum II adjusted the implementation schedule for management measures by the participating states and called for plans to reach the target fishing mortality goal for rebuilding (F_{40}).

Amendment 1 (2005)

In May 1999, the Board acknowledged that it was necessary to update the Interstate FMP for Inshore Stocks of Winter Flounder through an amendment. The original plan and addenda did not prove successful in rebuilding inshore winter flounder populations. In addition, the FMP did not reflect the goals and objectives of the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA), which was established in 1993 after the original FMP was approved. The Board further noted that an upcoming stock assessment would likely provide new information on the status of winter flounder stock complexes. After the assessment was completed in late 2002, the Commission began development of Amendment 1 in February 2003.

Amendment 1 to the Interstate FMP for Inshore Stocks of Winter Flounder, approved in November 2005, replaced all previous Commission management plans. It focused on joint management of winter flounder between the Commission and Council, and was designed to rebuild and maintain spawning stock biomass at or near target biomass levels. In addition, Amendment 1 prioritized restoration and maintenance of essential winter flounder habitat.

Amendment I required a minimum size limit of 12 inches for commercial and recreational fisheries for both GOM and SNE/MA stock units. Recreational creel limits were ten (10) fish in the SNE/MA stock area and eight (8) fish in the GOM. There were no required closed recreational seasons in the GOM, while a closed season of 20 days during March and April was required in SNE/MA. The 60-day open season for recreational winter flounder fishing could be split into no more than 2 blocks. States were required to implement a minimum size of 6.5 inches square or diamond mesh for the cod-end in both GOM and SNE/MA inshore waters. Additionally, a 100-pound trip limit was required if smaller mesh was being used in the SNE/MA. This “mesh trigger” was intended for the landing of a small amount of winter flounder as bycatch in small-mesh fisheries.

Addendum I to Amendment 1 (2009)

Addendum I was approved in May 2009, following the 2008 GARM III stock assessment which indicated that the SNE/MA spawning stock biomass was only 9% of the target and the GOM stock was likely to be overfished and experiencing overfishing. For the GOM commercial fishery, Addendum I established a maximum possession limit of 250 pounds per vessel. This limit was estimated to reduce 2006-2007 harvest levels by 31% for state water fishing vessels.

For the GOM recreational fishery, Addendum I required states to implement regulations to reduce fishing mortality by 11% from the average of 2006-2007 levels. This 11% reduction was estimated to reach F_{MSY}. States were allowed to achieve reductions through possession limits, seasons, or a combination of both, and also had the option to submit conservation equivalency proposals to achieve the necessary reductions through alternative management measures, subject to approval by the Board.

For SNE/MA, Addendum I's management measures were designed to reach the lowest F rate possible with minimal economic and social impacts. The Addendum also sought to reduce dead discards and prevent an influx of effort into state waters. Non-federally permitted commercial vessels were allowed to possess a maximum of 50 pounds of winter flounder. This F rate was projected to reduce harvest by 65%, and was intended solely to allow for bycatch. Recreational fishermen were permitted to possess a maximum of two (2) winter flounder from inshore waters of the SNE/MA stock area. This bag limit was established with the expectation that it would reduce harvest by 46%.

Addendum II to Amendment 1 (2012)
In response to updated stock status information and federal action to substantially increase the GOM winter flounder state waters annual catch limit (ACL) subcomponent, the Board initiated Addendum II to Amendment 1 of the Winter Flounder Interstate FMP. This Addendum changed commercial and recreational management measures for the state waters component of the GOM stock only. Specifically, it increased the maximum possession limit for non-federally permitted commercial vessels to 500 pounds. It also removed the 11% reduction in F for the recreational fishery and allowed states the option to open their recreational fishing season year-round.

Addendum III to Amendment 1 (2013)
Addendum III established an annual specification process to set commercial and recreational management measures for the GOM and SNE/MA fisheries. Each year, with advice from the Winter Flounder Technical Committee, the Board can adjust trip limits, size limits, and seasons for the commercial fishery; the Board can also adjust size limits, bag limits, and seasons for the recreational fishery. The Addendum enables the Commission to quickly respond to federal actions and changes in the winter flounder fishery.

II. Status of Stocks

The most recent peer reviewed stock assessment for all three winter flounder stocks was conducted by the Northeast Fisheries Science Center in 2017. These operational stock assessments included data through 2016.

Gulf of Maine

The 2017 operational stock assessment determined that GOM winter flounder stock biomass status is unknown and overfishing is not occurring. 2016 biomass (30+ cm) was estimated to be

2,585 metric tons (mt) and the exploitation rate was estimated to be 0.086, below the exploitation threshold of 0.23. The assessment noted that there have been significant declines in commercial and recreational removals since the 1980's; however, this has not resulted in an increase in the survey biomass indices, or an expansion of the age and size structure of the catch. Significant sources of uncertainty include gear catchability and deriving absolute estimates of biomass from trawl surveys. (Source: Groundfish Operational Assessments 2017)

Southern New England/Mid-Atlantic

The 2017 operational stock assessment concluded that the SNE/MA winter flounder stock is overfished but overfishing is not occurring. Specifically, the 2016 spawning stock biomass (SSB) was estimated to be 4,360 mt, well below the biomass threshold of 12,343.5 mt. In addition, fishing mortality was estimated to be 0.21 in 2016, below the threshold of F_{MSY}=0.34. The assessment noted that there is an overall declining trend in SSB throughout the time series; however, recruitment has increased from a historic low in 2013. Notable sources of uncertainty include the estimate of natural mortality and the length distribution of recreational discards, which are not well represented by the current sampling program. (Source: Groundfish Operational Assessments 2017)

III. Status of the Fishery

Stockwide

Across all stocks (GOM, SNE/MA, and GBK), the winter flounder fisheries are a fraction of their historic productivity. Specifically, commercial and recreational landings have declined since the early 1980s (Table 1, Figure 6). Landings are reported for the 2017 calendar year unless otherwise stated.

Commercial landings peaked at 18,279 mt (40.3 million lbs) in 1981, the highest since 1950, but have generally declined throughout the 1990's and 2000's. In 2017, commercial landings were 1,065 mt (2.3 million lbs), an 8.4% decrease from 2016 landings of 1,162 mt (2.6 million lbs). A majority of the landings were taken in Massachusetts (Table 2). It is important to note that management action has impacted yearly landings as annual catch limits increased in 2011 and 2012, and a moratorium was in place for the SNE/MA stock between May 2009 and April 2013. (Landings source: NMFS)

The primary commercial gear used to harvest winter flounder in 2017 was the otter trawl, followed by gill nets and dredge. Landings of winter flounder primarily occurred in the months of May – October.

Recreational harvest was 62.8 mt (138,477 lbs) in 2017, a 28.9% increase from 2016 harvest of 48.7 mt (107,458 lbs) (Table 1). These recent recreational catch values represent a significant decrease from the 7,446.8 mt (16,417,409 lbs) caught in 1982. In 2017, Massachusetts, Maine, and New Hampshire comprised the majority of coastwide recreational winter flounder landings, at 84.2%, 5.4%, and 4.5%, respectively. The PSE values around the Maine (97.1) and New

Hampshire (56.4) recreational data are very high and indicate very imprecise estimates. (Landings source: MRIP)

Note: recreational harvest was calculated using the pre-calibration values from MRIP. Figure 7 shows a comparison of the pre- and post-calibration MRIP values.

Gulf of Maine

Commercial landings of Gulf of Maine winter flounder have substantially declined since the early 1980s, with recent landings being roughly 7% of harvest levels in the 1980s. From 1964 through the mid-1970s, commercial landings were near 1,000 mt. Productivity peaked at nearly 2,793 mt in 1982, and steadily decreased to a record low of 139 mt in 2010. For the 2017 fishing year (as opposed to calendar year, May 1 – April 30), landings in the GOM winter founder stock were 296.3 mt (does not include discards), of which 183.2 mt were landed in state waters (Source: NMFS). 2017 total discard estimates were 11.7 mt (Source: NMFS).

Recreational landings also peaked in 1982, at 3,024 mt. Landings have generally declined, and in 2017 were 59 mt. Recreational releases make up a small portion of catch.

Southern New England/Mid-Atlantic

Commercial landings of SNE/MA winter flounder generally declined throughout the time series from 1964 to 2010, with periodic peaks and dips. After reaching a historical peak of 11,977 mt in 1966 and then declining through the 1970s, total U.S. commercial landings again peaked at 11,176 mt in 1981. After 1981, SNE/MA commercial landings declined to 2,159 mt in 1994 and then increased to 4,672 mt in 2001. Commercial landings have generally decreased since the 2001 peak, and were just 134 mt in 2012 (in part due to the zero possession limit in federal waters). Landings in the 2017 fishing year (as opposed to calendar year) were 428.5 mt (does not include discards), of which 22.2 mt were landed in state waters (Source: NMFS). 2017 total discard estimates were 122.0 mt (Source: NMFS).

Recreational landings of SNE/MA winter flounder peaked in 1984 with 5,510 mt and substantially declined to 4 mt in 2017. The principal mode of fishing is private/rental boats, with most recreational landings occurring during May and June.

IV. Status of Research and Monitoring

Amendment 1 to the Interstate Fishery Management Plan for Winter Flounder requires the following research and monitoring activities by certain states (Table 3):

- Massachusetts, Rhode Island, and New York are required to conduct annual surveys of juvenile recruitment to develop an annual juvenile abundance index.
- Massachusetts, Rhode Island, Connecticut, and New Jersey are required to conduct annual trawl surveys to develop an index of spawning stock biomass.

In 2017 (and early 2018), states with interest in the winter flounder FMP conducted the fisheries-independent surveys summarized below.

Maine

The Maine Department of Marine Resources conducts spring and fall bottom trawl surveys in cooperation with the New Hampshire Fish and Game Division. The Maine-New Hampshire (MENH) Inshore Trawl Survey collects length, weight, maturity stage, and age samples for winter flounder. Winter flounder biomass in the spring survey increased in 2014 (>5 kg/tow) but was slightly lower in 2015 and 2016 at 4 kg/tow. Biomass in the fall survey has been fairly steady since 2011 at roughly 3 kg/tow. Results from the 2017 survey are not yet available.

New Hampshire

The New Hampshire Fish and Game Department (NHFG) conducts an annual seine survey of juvenile fish in its estuaries from June through November. The survey produces an index of relative abundance for each species encountered using a geometric mean catch per seine haul. The 2017 index value (0.9) decreased from 2016's value of 1.48 and is below the 1997-2017 average of 1.24. In addition, NHFG has worked with Maine Department of Marine Resources (ME DMR) since the fall of 2000 to conduct an inshore trawl survey off of Maine and New Hampshire.

Massachusetts

The Massachusetts Division of Marine Fisheries (MADMF) completed spring and fall bottom trawl surveys covering its state waters. During the spring survey, winter flounder were present in all tows completed in the GOM region; however, the abundance index was slightly below the time series median. In SNE, the biomass and abundance of winter flounder remained well below their time series medians during the 2017 spring trawl survey. Declines in the abundance and biomass indices of winter flounder have been observed in SNE over the past two decades and that trend continued in 2017.

During the 2017 fall trawl survey, winter flounder were present in all of the survey tows in the GOM and the biomass and abundance indices were slightly above their time series means. For the SNE stock, the abundance and biomass indices increased slightly from 2016 to 2017, with both indices near their time series medians.

DMF completed its annual seine survey for young-of-the-year (YOY) winter flounder in June and July. This survey has been conducted annually since 1976, and it provides an index of recruitment for the SNE/MA winter flounder stock. The 2017 YOY index was the highest observation since 2000 and was above the time series median; however, the relatively large confidence intervals around the YOY index suggest that the catch rates were variable across the six estuaries that were sampled.

Rhode Island

Excluding the ichthyoplankton survey, which was discontinued in July of 2008, Rhode Island's Division of Fish & Wildlife conducted five studies to monitor juvenile and adult winter flounder in its state waters. The seasonal trawl survey samples 42 fixed and random stations in the spring and fall. The spring trawl survey had a 2017 CPUE of 5.25 winter flounder per tow, a decrease from 2016. The monthly survey samples 13 fixed stations each month. The Narragansett Bay Juvenile Finfish Survey samples 18 stations once a month from June through October. The 2017 CPUE was 4.07 winter flounder per seine haul, a slight increase from 2016. The Coastal Pond Seine Survey samples 24 stations in 8 coastal ponds from May through October. The 2017 survey had a CPUE of 11.08 winter flounder per seine haul, a slight increase from 2016. The Coastal Pond Spawning Stock Survey samples 6 stations with fyke nets from January to May in Point Judith pond. The 2017 survey indices remain at or near the lowest values recorded in the time series. The overall trend in winter flounder abundance for all surveys indicates a declining abundance of this species in Rhode Island waters.

Connecticut

Winter flounder have been monitored through the Long Island Sound Trawl Survey (LISTS) since 1984. Spring (April, May and June) and Fall surveys (September and October) are conducted each year. The 2017 LISTS spring (April-May) index (geometric mean fish/tow) for all ages of winter flounder was 0.99, the lowest value in the 34 year time series (lowest previous value = 3.94 in 2015). Similarly, the 2017 spring index for age-4+ winter flounder was 0.31, also the lowest value in the time series. CT DEEP also conducts a fall estuarine seine survey that provides an index of abundance for young-of-year winter flounder. The geometric mean fish/tow in 2017 was 1.03, the highest index value in the past six years of the 30-year time series.

New York

The NYSDEC has been conducting a small mesh trawl survey targeting juvenile finfish since 1987. The weekly survey runs from May through October in Peconic Bay using a small mesh sixteen foot semi-balloon shrimp trawl. A total of 127 randomly chosen stations were sampled during June and July. The YOY CPUE for winter flounder in 2017 was 0.055, the lowest ever recorded in the survey time series. CPUE for this species continues to be well below the time series average of 9.4.

The Department also conducts a seine survey in western Long Island bays, which has been ongoing since 1986, using a 200 foot ¼ inch mesh seine. Sampling is conducted at multiple stations twice a month within each bay from May through October. On average, 40 tows occur in Jamaica Bay each year during this period, and 24 tows each in Manhasset Bay and Little Neck Bay. The YOY CPUE for Jamaica Bay in 2017 was 8.21, lower than 2016 (12.3). The YOY CPUE for Little Neck Bay in 2017 was 2.33, an increase from 2016's low of 0.22. The YOY CPUE for Manhasset Bay in 2017 was 0.58, the second lowest CPUE in the time series.

New Jersey

The Bureau of Marine Fisheries has conducted an Ocean Trawl program in nearshore ocean waters since 1988. Winter flounder are most abundant in New Jersey during April, and data from this cruise have been used to develop an index of abundance for winter flounder in New Jersey waters. For each tow, information is collected on total number, total weight, and individual lengths. Stratified catch per tow (numbers) in 2018 increased by 98.1% to 1.77 from the time-series low geometric mean of 0.89. The biomass indices for 2018 resulted in a geometric mean of 0.51 kg/tow, an increase of 14.6% from the 2017 index of 0.45. For the eleventh year in a row, these indices remained significantly below the time series means of 4.67 fish and 1.91 kilograms per tow.

V. Implementation of FMP Compliance Requirements and De Minimis

De Minimis

Amendment I allows a state to be granted *de minimis* status if their fishery constitutes less than 1% of the coastwide commercial or recreational landings for the preceding three years for which data are available. A state that qualifies for *de minimis* status based on their commercial landings will qualify for exemptions in the commercial fishery only, and a state that qualifies for *de minimis* based on their recreational landings will qualify for exemptions in their recreational fishery only. States that apply for and are granted *de minimis* status are exempted from biological monitoring/sub-sampling activities for the sector for which *de minimis* has been granted.

Request for De minimis Status

There were no requests for de minimis status in the winter flounder fishery.

State Compliance

All of the states with a declared interest in the management of winter flounder have implemented commercial and recreational regulations that are consistent with ASMFC's Winter Flounder FMP (Tables 3 and 4).

VI. Research and Monitoring Recommendations

The 2017 Operational Stock Assessments noted several data needs that would improve future population estimates.

Gulf of Maine

- Additional studies on federal and state survey gear efficiency and catchability
- Quantifying the degree of herding between the doors and escapement under the footrope and/or above the headrope
- Studies quantifying winter flounder abundance and distribution among habitat types

Southern New England - Mid-Atlantic

- Additional studies on maximum age
- Additional studies on recreational discard lengths
- Investigation of localized structure/genetics of the stock

VII. References

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Northeast Fisheries Science Center. 2017. Operational Assessment of 19 Northeast Groundfish Stocks, Updated through 2016, Northeast Fisheries Science Center, Woods Hole, Massachusetts. US Department of Commerce, NOAA Fisheries, Northeast Fish Science Center Ref. Doc. 17-17; 259 p. Available online at https://www.nefsc.noaa.gov/groundfish/operational-assessments-2017/

VIII. Figures and Tables

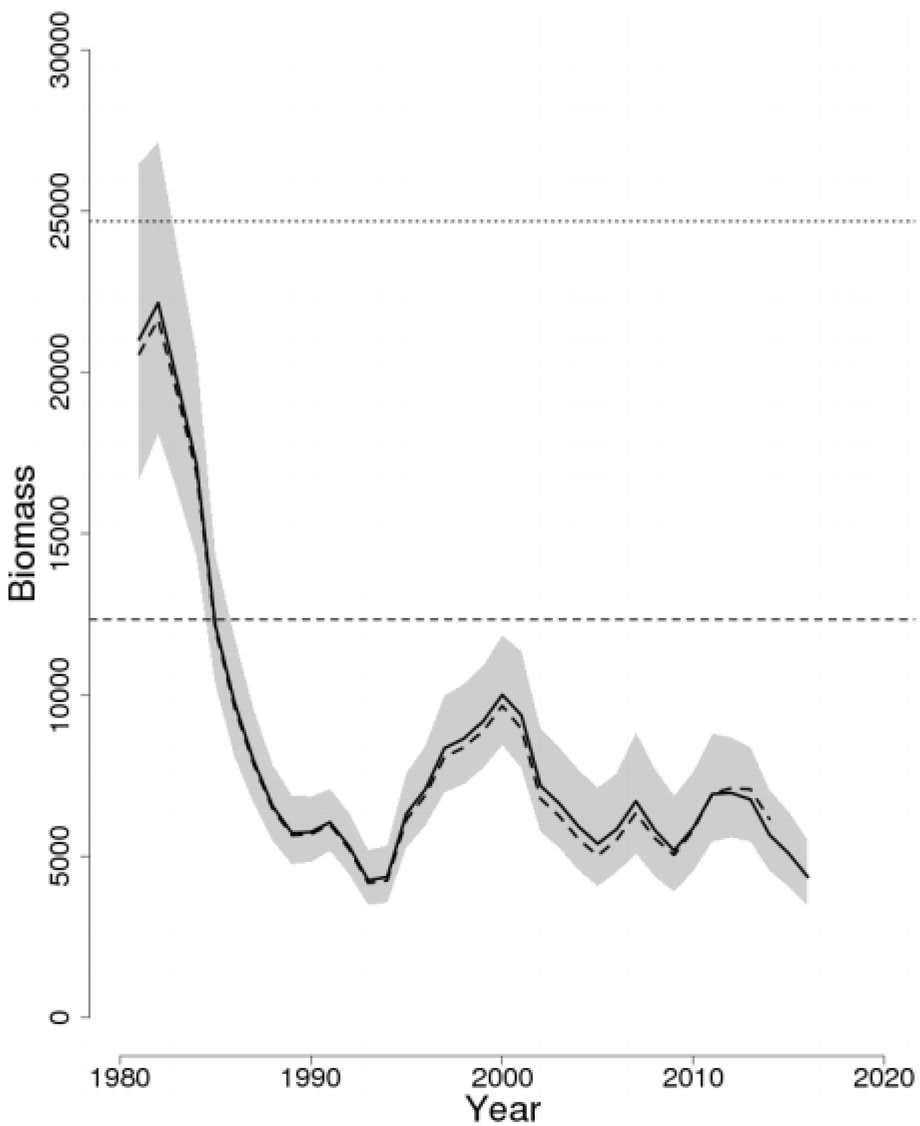

Figure 1. Southern New England/ Mid-Atlantic winter flounder spawning stock biomass between 1981 and 2016. The solid line represents results of the current assessment and the dotted line represents results from the previous assessment. The horizontal dotted line is the SSB-target and the horizontal dashed line is the SSB-threshold based on the 2017 assessment. The 90% confidence intervals are shown in grey. (Source: Groundfish Operational Assessments 2017)

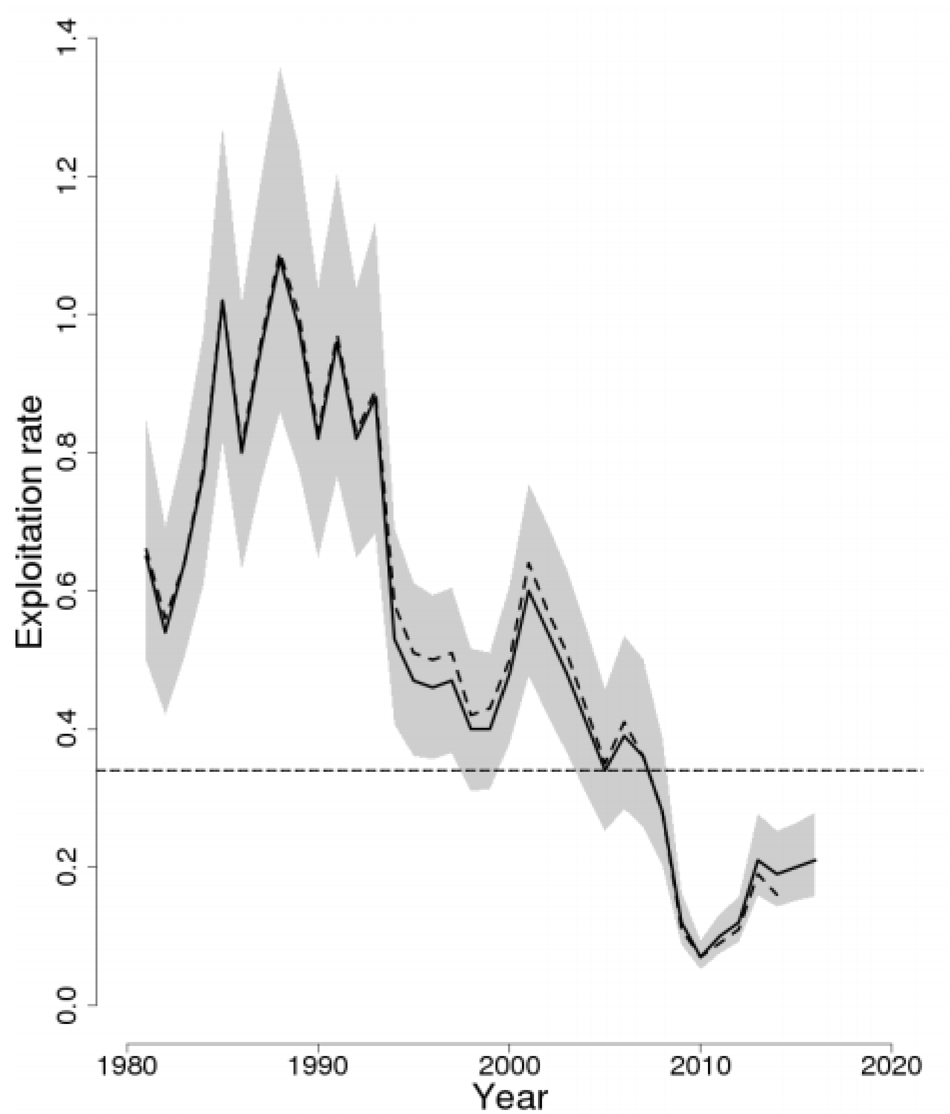

Figure 2. Southern New England/Mid-Atlantic winter flounder fishing mortality between 1981 and 2016. The solid line represents results of the current assessment and the dotted line represents results from the previous assessment. The horizontal dashed line is the F-threshold based on the 2017 assessment. The 90% confidence intervals are shown in grey. (Source: Groundfish Operational Assessments 2017)

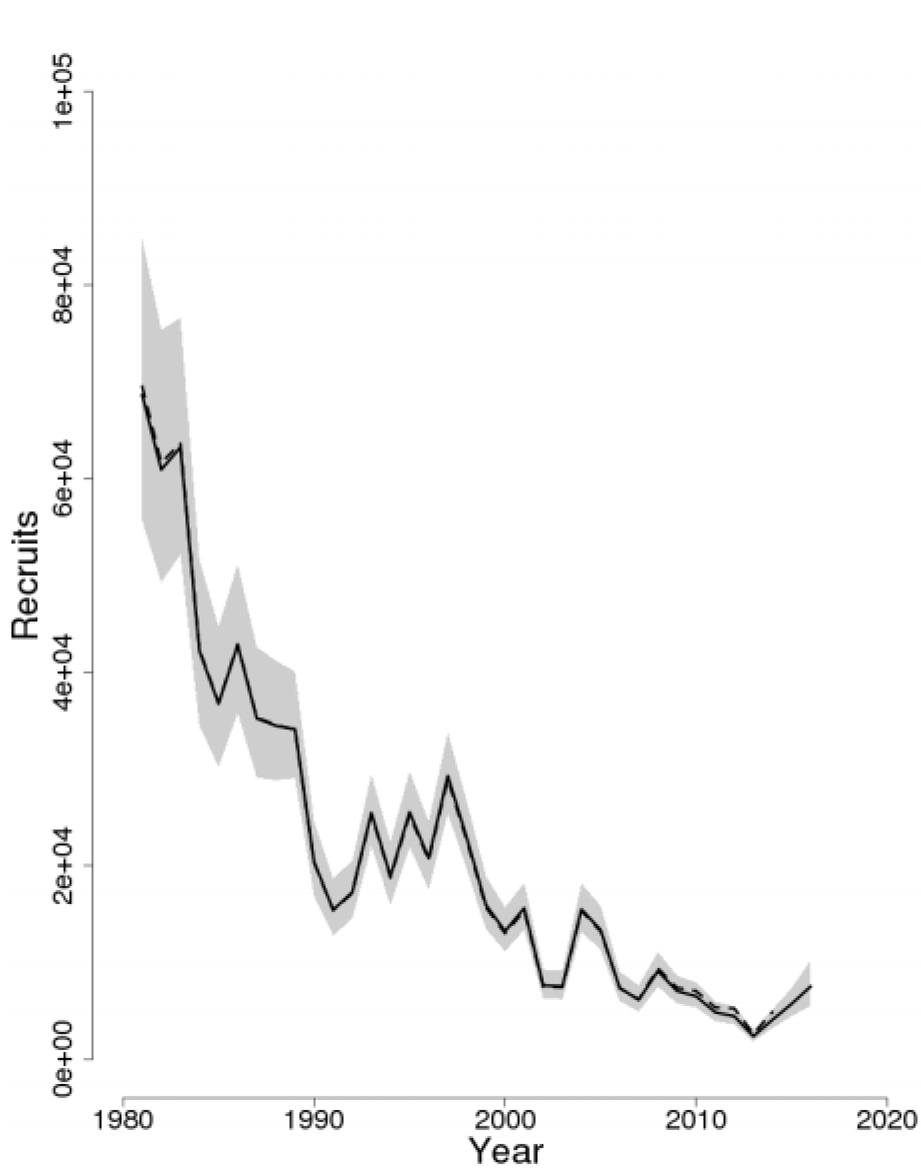

Figure 3. Southern New England/ Mid-Atlantic winter flounder trends in recruits between 1981 and 2016. The solid line represents results of the current assessment and the dotted line represents results from the previous assessment. The 90% confidence intervals are shown in grey. (Source: Groundfish Operational Assessments 2017)

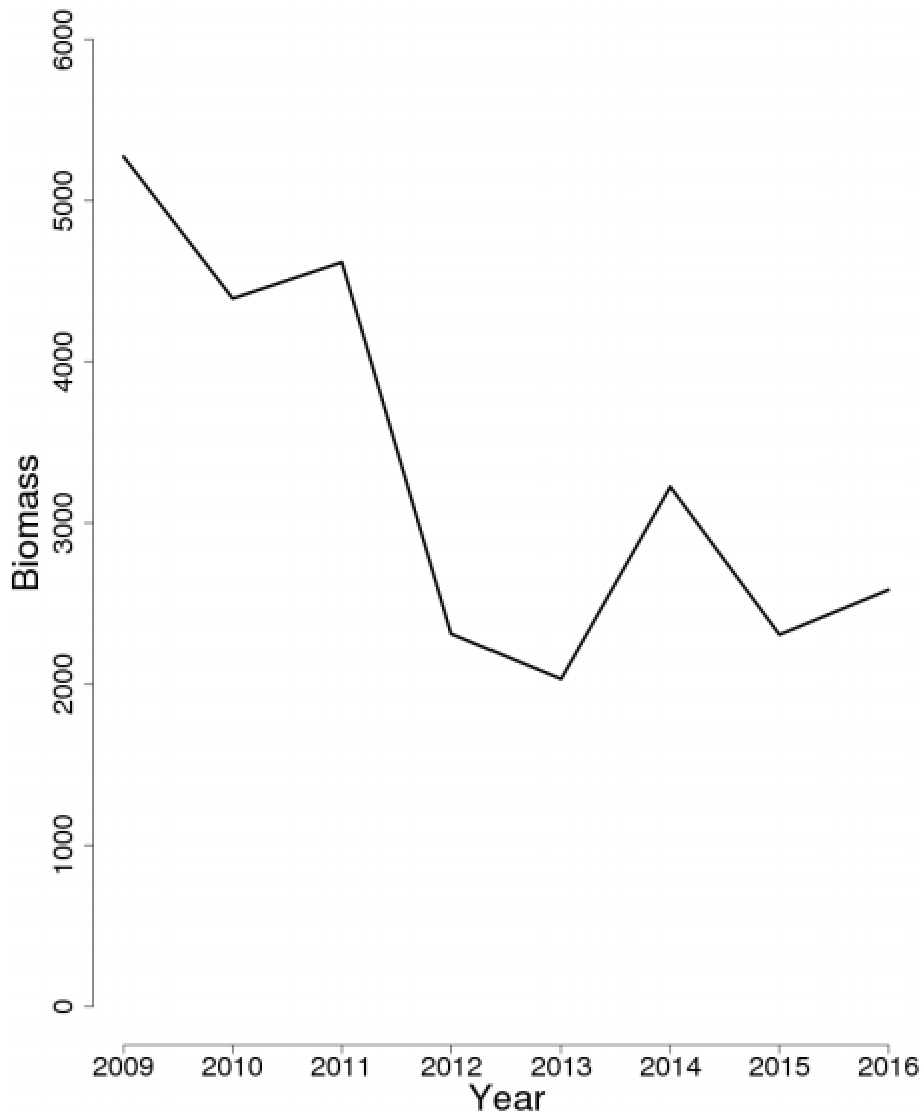

Figure 4. Estimates of exploitable biomass (30+ cm) for Gulf of Maine winter flounder between 2009 and 2016 as estimated from the fall MENH, MDMF, and NEFSC trawl surveys. (Source: Groundfish Operational Assessments 2017)

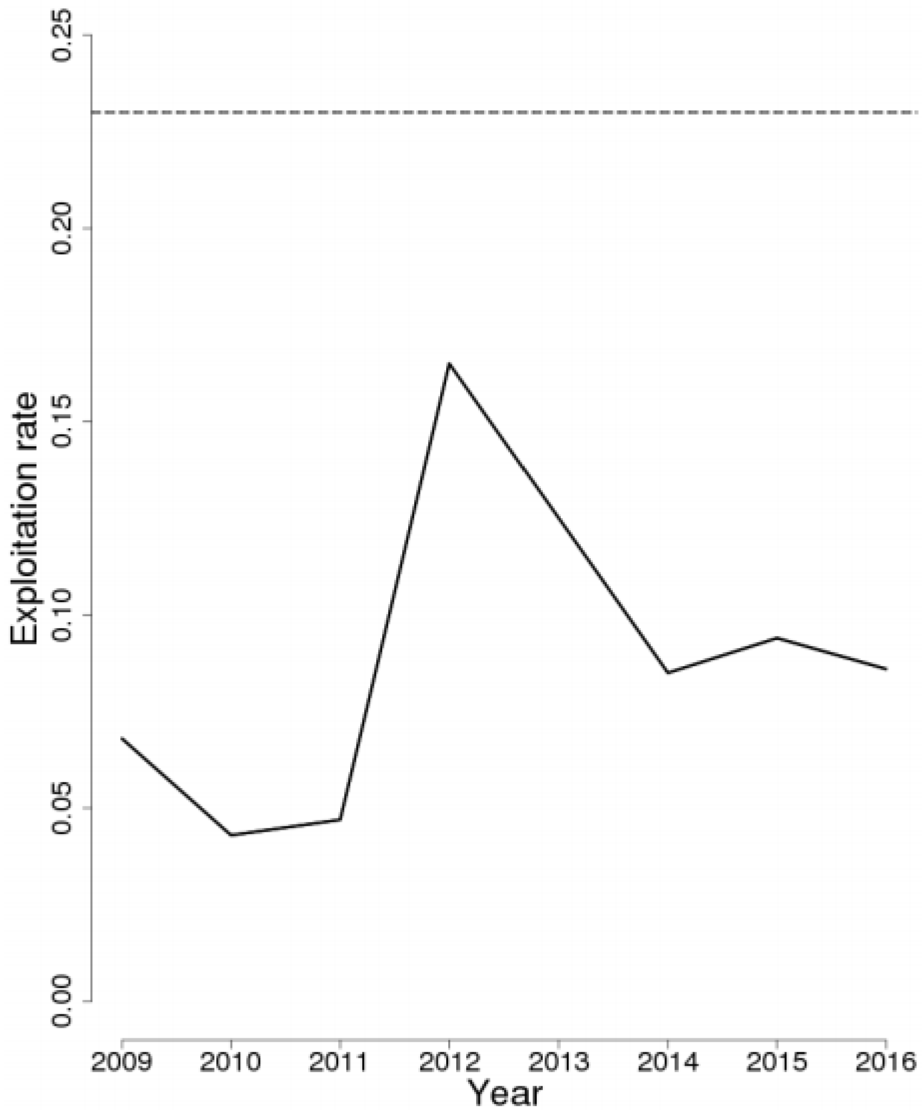

Figure 5. Gulf of Maine winter flounder exploitation rate between 2009 and 2016. The dashed line represents the corresponding F-Threshold from the 2017 assessment. (Source: Groundfish Operational Assessments 2017)

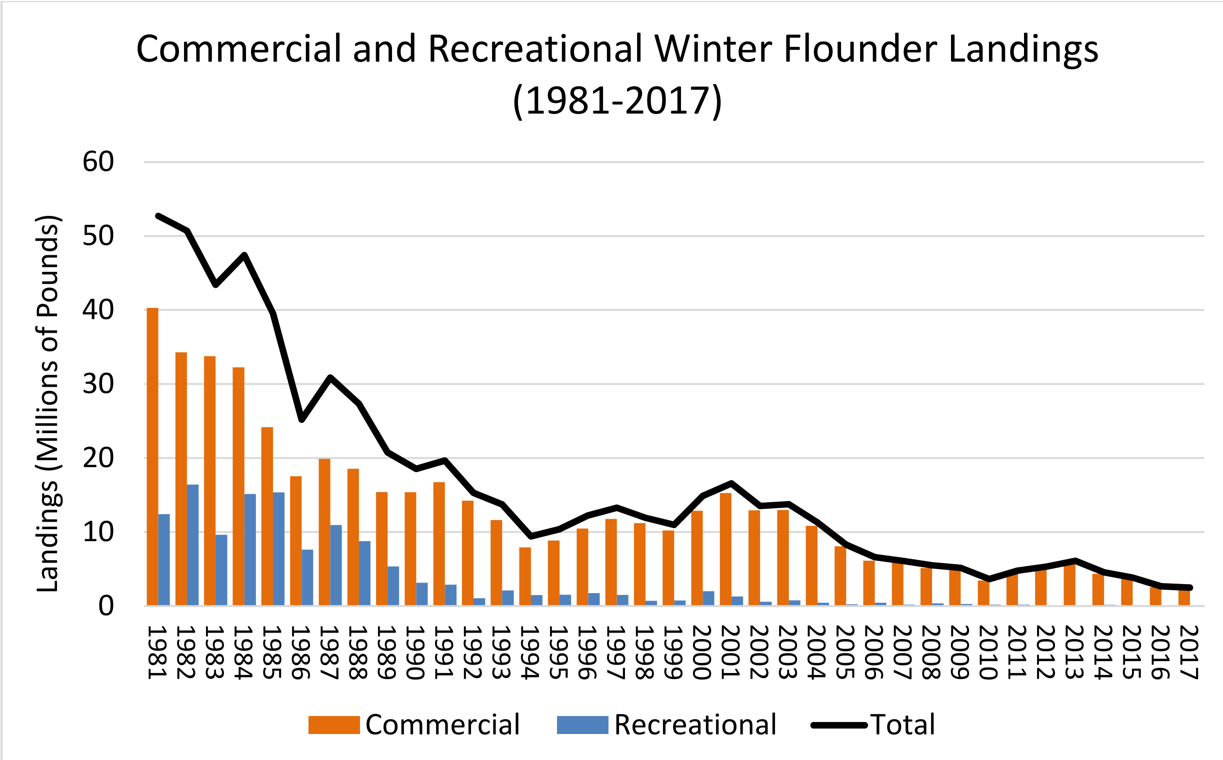

Figure 6. Total landings of winter flounder, commercial and recreational landings. (Source: ACCSP and MRIP)

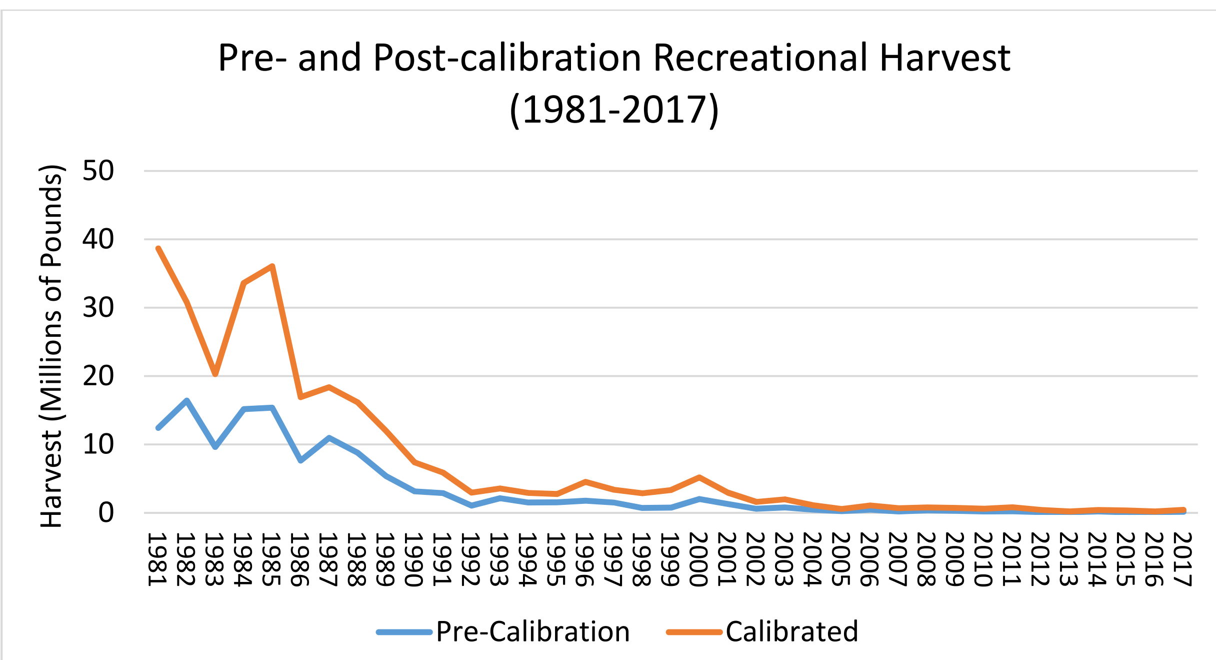

Figure 7. Recreational landings of winter flounder, pre-calibration and calibrated. (Source: MRIP)

Table 1. Coastwide commercial and recreational landings of winter flounder.
Source: ACCSP, MRIP.

Year	Commercial Landings (lbs)	Recreational Landings (lbs)	Total Harvest (lbs)
1981	40,281,800	12,424,306	52,706,106
1982	34,287,800	16,417,409	50,705,209
1983	33,762,300	9,640,481	43,402,781
1984	32,259,500	15,156,823	47,416,323
1985	24,169,500	15,372,731	39,542,231
1986	17,551,600	7,634,913	25,186,513
1987	19,900,600	10,967,183	30,867,783
1988	18,558,400	8,779,904	27,338,304
1989	15,403,400	5,363,356	20,766,756
1990	15,375,295	3,156,378	18,531,673
1991	16,755,114	2,899,482	19,654,596
1992	14,232,802	1,071,535	15,304,337
1993	11,618,074	2,129,667	13,747,741
1994	7,934,950	1,496,956	9,431,906
1995	8,869,168	1,529,595	10,398,763
1996	10,489,726	1,757,069	12,246,795
1997	11,774,996	1,514,640	13,289,636
1998	11,213,153	717,765	11,930,918
1999	10,219,341	768,056	10,987,397
2000	12,876,176	2,020,880	14,897,056
2001	15,274,384	1,304,052	16,578,436
2002	12,955,503	583,547	13,539,050
2003	12,986,593	773,793	13,760,386
2004	10,854,383	451,387	11,305,770
2005	8,074,650	233,718	8,308,368
2006	6,149,946	464,499	6,614,445
2007	5,882,975	205,645	6,088,620
2008	5,158,100	366,261	5,524,361
2009	4,877,566	285,613	5,163,179
2010	3,452,445	195,333	3,647,778
2011	4,593,883	209,318	4,803,200
2012	5,238,701	107,987	5,346,688
2013	6,054,017	74,291	6,128,309
2014	4,375,270	187,292	4,562,562
2015	3,752,672	88,223	3,840,895
2016	2,561,793	107,458	2,669,251
2017	2,347,429	138,477	2,485,906

Table 2. 2017 Winter flounder commercial landings and recreational harvest (A + B1) by weight (lbs) by state. "C" denotes confidential landings. (Source: State compliance reports, ACCSP, and MRIP)

	Commercial		Recreational		
State	**Pounds**	**Percent**	**Pounds**	**PSE**	**Percent**
Massachusetts	1,924,902	82.04%	116,624	33.6	84.22%
Rhode Island	299,375	12.76%	469	75.7	0.34%
New York	57,691	2.46%	963	33.9	0.70%
New Jersey	C		6,141	58	4.43%
Connecticut	52,076	2.22%	683	67.3	0.49%
New Hampshire	C		6,193	56.4	4.47%
Maine	C		7,405	97.1	5.35%
Total	2,346,365		138,478		

Table 3. Commercial winter flounder regulations.

State	Stock Unit	Size Limit	Trip Limit	Seasonal Closure (dates inclusive)	Recruitment Assessment	SSB Assessment	Min. Mesh Size	*De minimis Request*
Maine	GOM	12"	500 lbs	May 1 – June 30	N/A	N/A	6.5”	No
New Hampshire	GOM	12"	500 lbs	April 1 – June 30	N/A	N/A	6.5”	No
Massachusetts	GOM	12"	500 lbs	Open all year	N/A	Bottom Trawl Survey (May, Sept)	6.5”	No
	SNE/MA	12"	50 lbs	Open all year	YOY Seine Survey (June)	Bottom Trawl Survey (May, Sept)	6.5”	No
Rhode Island	SNE/MA	12"	50 lbs	Open all year	Narragansett Bay Juvenile Finfish Survey	Trawl Surveys	6.5”	No
Connecticut	SNE/MA	12"	50 lbs or 38 fish	March 1 – April 14	N/A	Long Island Sound Trawl Survey	6.5”	No
New York	SNE/MA	12"	50 lbs	June 14 – Nov 30 (for all gear besides fyke nets, pound and trap nets)	Small Mesh Trawl Survey, Seine Survey	N/A	6.5”	No
New Jersey	SNE/MA	12"	38 fish	June 1 – Nov 30. Fyke net closed Feb 20 – Oct 31	N/A	Ocean Trawl Survey	6.5”	No

Table 4. Recreational winter flounder regulations.

State	Stock Unit	Creel Limit	Size Limit	Seasonal Closure (dates inclusive)
Maine	GOM	8	12"	Open all year
New Hampshire	GOM	8	12"	Open all year
Massachusetts	GOM	8	12”	Open all year
	SNE/MA	2	12"	January 1-February 28
Rhode Island	SNE/MA	2	12"	January 1 – February 28
Connecticut	SNE/MA	2	12"	January 1 – March 31
New York	SNE/MA	2	12"	May 31 – March 31
New Jersey	SNE/MA	2	12"	January 1 – February 28

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ARTICLE

Rebuilding in the face of climate change

Richard J. Bell, Anthony Wood, Jonathan Hare, David Richardson, John Manderson, and Timothy Miller

Abstract: Decadal-scale climate variability and change can cause trends in oceanographic conditions that impact demographic rates. Rebuilding scenarios, therefore, developed assuming constant demographic rates may not be realistic. Winter flounder (*Pseudopleuronectes americanus*) is an important commercial and recreational species that has declined in the southern portion of its range despite reduced exploitation. Laboratory and mesocosm studies suggest that stock productivity is reduced under warmer conditions and that rebuilding to historical levels may not be possible. Our goal was to examine the rebuilding potential of winter flounder in the face of regional warming. We integrated winter temperature into a population model to estimate environmentally driven stock–recruitment parameters and projected the stock into the future under different climate and fishing scenarios. The inclusion of winter temperature had minor impacts on the estimates of current abundance, but provided greater understanding of the drivers of recruitment. Projections that included the environment suggest that rebuilding the stock to historical levels is unlikely. The integration of both fishing and the environment has the potential to provide more realistic expectations of future stock status.

Résumé : La variabilité et les changements climatiques décennaux peuvent produire des tendances dans les conditions océanographiques qui influencent les taux démographiques. Aussi, les scénarios de reconstitution élaborés en présumant des taux démographiques constants pourraient ne pas être réalistes. La plie rouge (*Pseudopleuronectes americanus*), une espèce importante pour la pêche commerciale et sportive, est en baisse dans la partie sud de son aire de répartition, malgré une réduction de son exploitation. Des études en laboratoire et en mésocosme donnent à penser que la productivité du stock diminue dans des conditions plus chaudes et que le rétablissement des niveaux historiques pourrait ne pas être possible. Notre objectif consistait à examiner le potentiel de reconstitution du stock de plie rouge étant donné le réchauffement régional. Nous avons incorporé la température hivernale dans un modèle de population afin d'estimer les paramètres de recrutement au stock modulés par des facteurs ambiants et avons établi des projections du stock pour différents scénarios climatiques et de pêche. L'intégration de la température hivernale a des effets mineurs sur les estimations de l'abondance actuelle, mais permet une meilleure compréhension des facteurs qui modulent le recrutement. Les projections qui intègrent les conditions ambiantes indiqueraient que le rétablissement des niveaux historiques du stock est improbable. L'intégration de la pêche et des conditions ambiantes pourrait produire des prévisions plus réalistes de l'état futur du stock. [Traduit par la Rédaction]

Introduction

With the reauthorization of the Magnuson–Stevens Act, rebuilding plans were implemented in the United States to provide a legally binding time line to reduce overfishing (NOAA 1996). For many species along the US Northeast Shelf, fishing pressure was the major driver controlling stock status, and regulating fishing mortality has led to recovery (e.g., haddock (*Melanogrammus aeglefinus*), summer flounder (*Paralichthys dentatus*), scup (*Stenotomus chrysops*), striped bass (*Morone saxatilis*), Acadian redfish (*Sebastes fasciatus*); NRC 2014). Fishing pressure, however, is not the only driver of stock abundance, as exemplified by the response of small pelagics to decadal-scale forcing such as El Nino Southern Oscillation events (Baumgartner et al. 1992; Chavez et al. 2003). Oceanographic conditions vary in time and space and modulate intrinsic rates such as growth, mortality, and fecundity, which in turn affect the dynamics of the stock (Manderson 2016). As fishing pressure has declined, the relative importance of the environment on driving changes in productivity and natural mortality has had an increased effect on natural marine resources (Hare et al. 2010). The Magnuson–Stevens Act specifically recognizes the importance of nonanthropogenic factors and indicates that reference points should reflect the prevailing environmental condition.

Owing to increased model complexities, a lack of strong mechanistic links between the environment and stock-specific rates that hold up over time, and often insufficient data, climate variables are rarely included in stock assessments and management (Myers 1998; Skern-Mauritzen et al. 2016). Many assessment models incorporate variability and uncertainty by estimating parameters as white noise about a mean when possible, but due to the difficulties of estimating numerous parameters with short time series and limited data, most parameter estimates are constant over time or fixed (Quinn and Deriso 1999; Szuwalski and Hollowed 2016). The mean parameter estimates, however, typically produce reasonable estimates of the current biomass, particularly in age-structured assessments. Fishing, then, largely becomes the only time-varying parameter that has an influence on stock status. Projections into the future and rebuilding scenarios with reduced fishing mortality, therefore, generally show population growth. Projections do account for the uncertainty in parameter esti-

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mates, but typically do not account for the potential variability due to the environment or species interactions that can be red noise, with autoregressive properties (Steele and Henderson 1984; Steele 1985).

Recruitment variability is an important aspect of forward projections, and annual estimates are often randomly selected from the empirical data or a theoretical distribution (Hennemuth et al. 1980; Brodziak et al. 1998; Brodziak and Rago 2008). The median future recruitment over thousands of simulated projections, however, is typically stationary with the width of the confidence intervals being dependent on the range of values that went into the input. Stationary, median recruitment puts constraints on stock productivity and results in fishing being the main factor driving stock trends.

Around much of the globe, the climate is changing, and temperatures are predicted to increase due to anthropogenic carbon emissions (IPCC 2013). Species at the edge of their range often experience greater impacts as interannual, and seasonal changes in the physical conditions cause their geographic location to shift between suitable and unsuitable habitat (Travis and Dytham 2004; Hampe and Petit 2005; Bates et al. 2014). In the Northern Hemisphere, stocks at the southern extent of their range are likely to experience warmer conditions that could impact their intrinsic rates and reduce productivity leading to a decline in abundance (Hampe and Petit 2005; Holt and Punt 2009; Nye et al. 2009; Pinsky et al. 2013). However, at the northern extent of their range, habitat quality may increase leading to increased productivity (Beaugrand and Kirby 2010; Bates et al. 2014). It is at these marginal habitats, the limits of a species range, that the environment is likely to have its greatest influence on stock dynamics and be simple enough to understand (Myers 1998).

We sought to examine the impact of climate variability and change on fisheries rebuilding plans. As a test case, we used the Southern New England – Mid-Atlantic (SNE–MA) stock of winter flounder (*Pseudopleuronectes americanus*). SNE–MA winter flounder is at the southern extent of its range and has declined over the last 30 years (NEFSC 2011). Winter flounder are a cold-water species, and the coastal stock enters bays and estuaries in the winter to spawn (Collette and Klein-MacPhee 2002). The eggs and larvae develop during the coldest time of the year, and there is a working hypothesis that the low temperature (<6 °C) creates a thermal refuge from predation (Jeffries and Johnson 1974). Lab and mesocosm studies have found increased predation in warmer waters (Keller et al. 1999; Taylor and Collie 2003), and coast-wide recruitment has been linked to broad-scale environmental conditions (Bell et al. 2014; Manderson 2008). In 2010, it was estimated that the spawning stock biomass (SSB) of SNE–MA winter flounder was ~16% of its SSB_{MSY} (i.e., the level of spawning stock biomass that can enable maximum sustainable yield) reference point and had a less than 1% chance of achieving its biomass target by the 2014 rebuilding date (NEFSC 2011). To allow time for recovery, the rebuilding date was changed to 2023 (NEFMC 2009, 2013).

Our goal was to examine rebuilding potential in the face of climate change. We are not attempting to conduct an independent stock assessment of SNE–MA winter flounder, but simply exploring the ways in which different assumptions about the impact of the environment and fishing pressure could affect rebuilding to the current reference points from the SNE–MA winter flounder stock assessment (Holt and Punt 2009; NEFSC 2015). As an exploratory exercise, we incorporated winter estuarine temperature into a winter flounder population model to estimate temperature-dependent recruitment parameters. The temperature-dependent recruitment parameters could then be used with climate model output to project the SNE–MA stock forward in time under different fishing scenarios.

Methods

A standard and an environmentally driven age-structured population model were fit to the catch and survey data of SNE–MA winter flounder. Estuary water temperature was incorporated into the stock–recruitment relationship within the environmentally driven model. The output of each model was projected to 2050 with estimates of temperature derived from an ensemble of earth system models from the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC 2013). The ability of SNE–MA winter flounder to rebuild to its current biomass reference point was assessed under three fishing scenarios: (1) no fishing (F = 0), (2) moderate fishing representing a small fishery and (or) incidental catch (F = 0.1), and (3) fishing at the current reference level to achieve MSY ($F = F_{MSY}$ = 0.325; NEFSC 2015).

Temperature

Historical, weekly estuary water temperature time series were compiled for five estuaries covering the range of the Southern New England–Mid-Atlantic winter flounder stock: Woods Hole, Massachusetts (Nixon et al. 2004); Narragansett Bay, Rhode Island (Collie et al. 2008); Long Island Sound (Milford Laboratory, National Oceanic and Atmospheric Administration (NOAA)); Delaware Bay (Susan Ford, Haskin Shellfish Research Laboratory); and Chesapeake Bay (Gary Anderson (VIMS 2003)). A model linking historical air temperature to historical estuary temperature was used to fill in gaps (see Bell et al. (2014) for details). The mean weekly temperature from January through March for each estuary was averaged to produce the annual winter estuary temperature. The mean water temperature across each estuary was included as the environmental driver in the population model. Air temperature over the east coast of the United States is highly coherent (Hare et al. 2010; Joyce 2002), resulting in estuary water temperatures that are highly coherent and strongly correlated with air temperature (Bell et al. 2014; Hare et al. 2012*b*).

The output of 14 earth system models that were part of the IPCC AR5 (IPCC 2013) were obtained through the Coupled Model Intercomparison Project Phase 5 (CMIP 2017; see online Supplementary material, Table S1[1] for a list of the models). The variable of interest was near-surface air temperature (tas) from the monthly mean atmospheric fields and some surface fields (Amon). One ensemble member (r1i1p1) was obtained for Historical and Representative Concentration Pathway 8.5 (RCP8.5) runs from each model; RCP8.5 represents a "business-as-usual" scenario. The climate forecast delta method was used to bias correct the climate models. The regridded hindcast model runs were compared with observed winter-estuary temperatures to calculate a delta for bias correcting the future projections (Stock et al. 2011). For each grid cell corresponding to the estuaries, a winter mean (January, February, and March) of the hindcast model surface air temperature over the period 1985–2004 was calculated. Similarly, the January, February, and March observed winter-estuary temperature over the period 1985–2004 were averaged (Bell et al. 2014). The difference between these observed and modeled averages for each of the 14 earth system models (termed deltas) were used to bias-correct each of the climate model projections. Annual projections from each of the 14 earth system AR5 models were calculated. The mean of the January, February, and March delta-corrected air temperatures from the AR5 earth system models were averaged over the Northeast US coast grid cells to produce 14 annual estimates of winter-estuary temperature projected to 2050. The biomass pro-

[1]Supplementary data are available with the article through the journal Web site at http://nrcresearchpress.com/doi/suppl/10.1139/cjfas-2017-0085.

jections were conducted with each of the 14 future temperature time series. The biomass estimates of the 14 different projections were averaged together to produce a mean biomass estimate for the temperature-dependent scenarios.

Population model

The winter flounder population values were estimated with the Age Structured Assessment Program model version 2 (ASAP v.2; Legault and Restrepo 1998; Legault 2008). Two models were run, one with and one without an environmentally driven stock–recruitment function. The environmental ASAP ($ASAP_E$) model was a modified version of the standard ASAP v.2 (Miller 2012). The environmentally driven stock–recruitment function option is currently part of the latest version of ASAP. All the input data (e.g., catch-at-age, survey abundance-at-age, weight-at-age, maturity) were taken from the most recent winter flounder stock assessment (NEFSC 2015).

ASAP is a forward projection age-structured population model available from the NOAA toolbox (NOAA Fisheries Toolbox 2008). The recruits in each year (R_t) are estimated from a Beverton–Holt stock–recruitment relationship formulated with steepness (h) and unexploited recruitment (R_0) (Mace and Doonan 1988). The standard Beverton–Holt relationship combines the SSB with two parameters, stock productivity (α) and compensation (β), to calculate the number of recruits. The Mace and Doonan (1988) formulation uses h and an estimate of R_0, the level of recruitment from the unfished or unexploited spawning stock biomass (SSB_0), or the unexploited spawner-per-recruit ($SPR_0 = SSB_0/R_0$). Steepness (h) is a proportion, calculated as the level of recruitment at 20% of SSB_0 divided by R_0 ($h = R_{SSB20\%}/R_0$). SPR_0 is a function of weight-at-age, maturity-at-age, and natural mortality.

$$(1) \qquad R_t = \frac{\alpha SSB_{t-1}}{\beta + SSB_{t-1}} = \frac{4hR_0 SSB_{t-1}}{SSB_0(1-h) + (5h-1)SSB_{t-1}}$$

The environmental population model ($ASAP_E$) included a time-varying unexploited recruitment parameter ($R_{0,t}$) that is a function of the environmental covariate (x_t). SSB_0 was therefore replaced with $SSB_{0,t} = SPR_0 \cdot R_{0,t}$.

$$(2) \qquad R_{0,t} = e^{\beta_0 + \beta_1 x_t}$$

Previous work (Bell et al. 2014) modified the stock productivity term (α) of the standard Beverton–Holt curve with temperature. The α term is a function of both h and R_0 in the Mace and Doonan (1988) formulation in ASAP, and we modified R_0 with temperature. Within ASAP, the age-1 abundance is not simply the recruits predicted from the stock–recruitment relationship. ASAP estimates recruitment (the numbers at age-1: $\hat{N}_{a=1,t}$) as deviations from the stock–recruitment predicted recruitment.

$$(3) \qquad \hat{N}_{a=1,t} = R_t e^{\delta R_t}$$

A lognormal penalty for each recruitment deviation (δR_t) is added to the objective function in ASAP where the coefficient of variation (CV) of the deviations is user-specified. Larger CV downweights the penalty relative to data components or other components of the objective function. If the δR_t are large or have a strong pattern, it indicates that the recruits are not following the Beverton–Holt stock–recruitment relationship and suggests that recruitment is being driven by processes in addition to the magnitude of SSB. External environmental drivers (Fogarty et al. 2008; Hare and Able 2007), variability in spawner conditions (Leaf and Friedland 2014), predator–prey interactions (Minto and Worm 2012), and stochastic variability (Quinn and Deriso 1999) have all been indicated as potential factors in the spawner–recruit relationship.

The standard and environmental population models were run to estimate the parameters used for the rebuilding projections and to investigate the impact of an environmental covariate on the estimates of biomass and abundance. In the standard population model, the CV of the δR_t was large (CV = 0.5), resulting in age-1 abundances that were basically unconstrained by the stock–recruitment relationship. The large CV essentially created a model in which the raw data drove the age-1 estimates without regard to the Beverton–Holt stock–recruitment relationship. The environmental model included a time-varying $R_{0,t}$ term that was a function of the winter temperature environment covariate. The CV of the recruitment deviations was specified at two different values (CV = 0.2 and 0.5). The large CV (CV = 0.5) had the same assumption as the standard model, assuming little to no relationship between SSB and recruitment, and the smaller CV (CV = 0.2) constrained the estimated age-1 to deviate little from the environmentally driven stock–recruitment relationship. The smaller CV assumed there was a stock–recruitment relationship, and deviations from the standard Beverton–Holt model were largely driven by temperature. Only the CV of the recruitment deviations was fixed. All the parameters were estimated within the model.

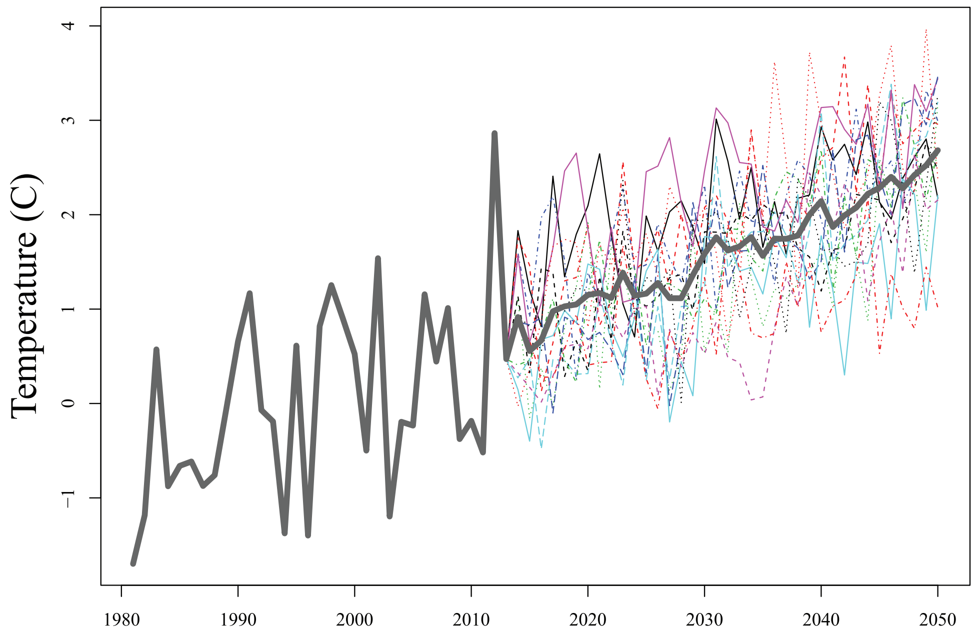
Projections

Stochastic forward projections for the age-structured population were performed in the AGEPRO (Age Structured Projection Model) software program available from the NOAA toolbox (NOAA Fisheries Toolbox 2008). We used the ASAP model to obtain 1000 draws from the joint sampling distribution of the maximum penalized likelihood estimates by retaining every 200th parameter set of a chain of 200 000 iterations produced by Markov chain Monte Carlo (MCMC) on the penalized likelihood. This distribution is equivalent to a Bayesian posterior distribution that implicitly assumes improper uniform priors for all parameters except the recruitment deviations, which is defined by the stock–recruitment penalty (Stewart et al. 2013). Aside from the stock–recruitment penalty, the properties of these estimates are asymptotically equivalent to a joint normal distribution with mean and variance defined by the maximum likelihood estimate and the inverse Hessian of the negative log-likelihood, respectively. We used the values of abundance-at-age in 2013 from this distribution as the input to AGEPRO due to the greater uncertainty in abundance, particularly of recruitment, in the terminal year (2014). Winter flounder biomass was projected from 2013 to 2050 with AGEPRO under three environmental–recruitment hypotheses and three fishing scenarios.

The three recruitment scenarios were as follows: (1) BASE projection — over the course of the historical time series there had been no change in the productivity of the winter flounder stock; (2) ENVIRON projection — over the course of the historical time series there had been a change in the productivity of the winter flounder stock, but any environmental relationship between SSB and recruitment was unknown; (3) TEMP projection — over the course of the historical time series there had been a change in the productivity of the winter flounder stock and there was a temperature-dependent relationship between SSB and recruitment (Bell et al. 2014).

The three different environmental–recruitment hypotheses were modeled in AGEPRO with three different recruitment model formulations: (1) BASE projection — with the assumption of no change in productivity, abundance was projected with a standard Beverton–Holt stock–recruitment model that was used in the stock assessment for short-term projections (NEFSC 2015). (2) ENVIRON projection — with the assumption of changes in productivity over time, the most recent years of the time series were considered the best representation of the future condition of winter flounder. An empirical recruitment model was used in which there was no relationship between SSB and recruitment

Fig. 1. The observed historical temperature time series (1981–2013), along with the delta-corrected temperature projections of the 14 AR5 earth systems models and the ensemble mean (2014–2050). The peak in 2012 is the true 2012 winter estuary temperature. [Colour online.]



(Brodziak et al. 1998; Szuwalski et al. 2015). Recruitment for each year in the projection was randomly selected from the entire time series of the estimated age-1 abundance from ASAP (1981–2013). The probability of selecting a particular estimate of age-1 abundance from ASAP was skewed, however, such that the most recent years had a higher probability of being selected (Fig. S1[1]). Weight-at-age, fishing selectivity by age, natural mortality, and maturity-at-age were the mean of the last 5 years: 2009 to 2013. (3) TEMP projection — with the assumption of temperature-dependent changes in productivity, the future condition of winter flounder was considered a direct function of future temperature. Recruitment was projected with a temperature-dependent Beverton–Holt stock–recruitment model. The α and β parameters were calculated from the temperature-modified R_0 parameter from the $ASAP_E$ population model (CV = 0.2). Steepness, estimated from the $ASAP_E$ population model, was used, and the mean of the SPR_0 value from 2009–2013 was used to calculate SSB_0. Weight-at-age, fishing selectivity by age, natural mortality, and maturity-at-age were the mean of the last 5 years: 2009 to 2013.

Three fishing scenarios were examined: (1) no fishing (F = 0), (2) moderate fishing representing a small fishery and (or) incidental catch (F = 0.1), and (3) fishing at the current reference level to achieve MSY ($F = F_{MSY}$ = 0.325; NEFSC 2015). The rebuilding target was the SSB_{MSY} from the official stock assessment (SSB_{MSY} = 26 928 t; NEFSC 2015). The current fishing reference point (F_{MSY}) was generated from a Beverton–Holt stock–recruitment relationship as part of the official stock assessment process (NEFSC 2015). The SSB_{MSY} reference point was developed from a proxy based on long-term stochastic projections for the assessment (NEFSC 2015).

Results

Temperature

The projected temperature increased over the next half century (Fig. 1). The variability in each individual projection was similar to historical observed values and was used for the TEMP projections. The variability of the ensemble mean, however, was lower than that of observed values.

Population model

The standard and the environmental population models converged and produced qualitatively similar results (Fig. 2). There was reasonable agreement between the catch-at-age and survey-abundance-at-age data, which constrained the estimates of SSB, recruitment, and F for the different models.

The total value of the objective function for each model was similar, with the environmental model (CV = 0.5) having a lower value than the standard model (Table 1). The objective function values are comparable across models with the same CV. The values for the environmental model (CV = 0.2) were included for completeness. The objective function components for observed versus predicted abundance-at-age for the multiple surveys were very similar, as were the year 1 abundances. The δR_t component of the objective function was larger in the standard model compared with the environmental model (CV = 0.5). The root mean square error terms (RMSE) for most components were very similar among the models (not all components listed); however, there were differences among some of the recruitment diagnostics, with certain components being closer to the optimal value of one in the standard model and other components closer to one in the environmental models (RMSE = $\sqrt{\text{mean(residuals}^2)}$). All three models, however, produced a reasonable representation of the data.

The three models have a divergence starting in the mid-1990s in which SSB was lower for the environmental models and fishing mortality was higher. The outputs were similar, but were considered significantly different based on a parametric bootstrap (see Supplemental material[1]). The largest difference between the standard and environmental models was the vector of δR_t (Fig. 2). The deviations in the standard model exhibited a clear declining trend over time, indicating that the standard Beverton–Holt model did not represent the data well. During the early part of the time series, recruitment was above the stock–recruitment model predictions based on SSB and toward the end of the time series was below model predictions. The temperature-dependent stock–recruitment relationship accounted for some of the variability in the recruitment deviations and suggests that stock productivity may be tied to winter estuary temperatures. The declining trend in δR_t was reduced in the environmental model with CV = 0.5,

Fig. 2. The estimated spawning stock biomass (SSB), recruitment, fishing mortality and lognormal deviations from the standard population model and the two environmentally driven population models (recruitment coefficient of variation = 0.2 and 0.5). The confidence envelops are one standard deviation. [Colour online.]

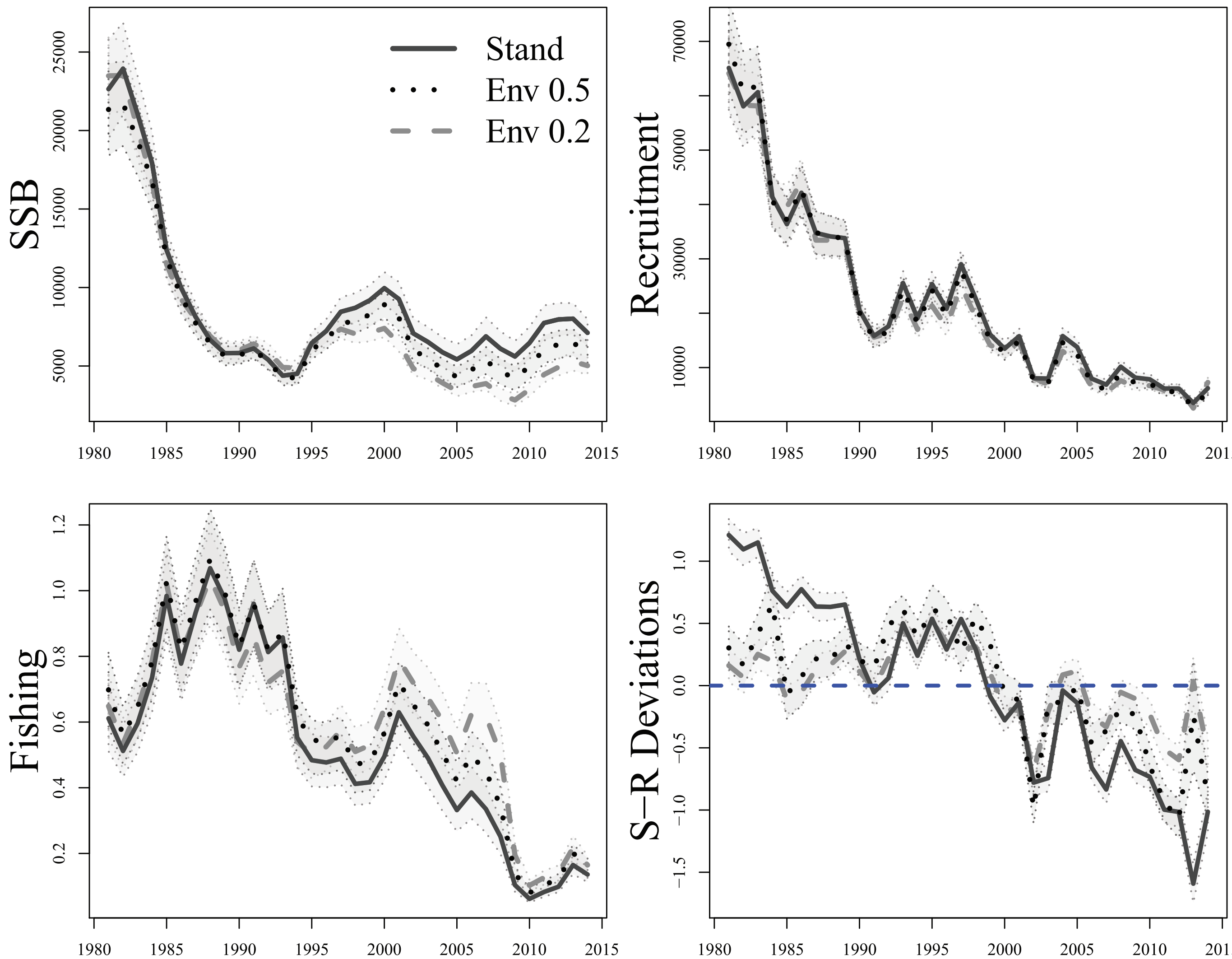


Table 1. The magnitude of the objective function and the root mean square error (RMSE) for specific components of the standard model, coefficient of variation (CV = 0.5), and the two environmental models (CV = 0.5 and 0.2).

	$ASAP_{Stand}$	$ASAP_{0.5}$	$ASAP_{0.2}$
Objective function	4180.3	4155.64	4174.28
Survey age comparisons	3648.81	3644.15	3635.36
$N_{a=1}$	63.6046	63.0843	63.9203
δR_t	12.8241	−8.20357	−17.4427
h	0	−1.79082	−0.110475
RMSE			
$N_{a=1}$	1.36656	0.352673	0.294081
δR_t	1.50143	1.00865	1.48745

Note: Components include the overall objective function, the comparisons of the numbers at age, the numbers at age-1 ($N_{a=1}$), the deviations in recruitment (δR_t), and steepness (h). Objective function values with different CVs are not directly comparable. ASAP, Age Structured Assessment Program.

particularly in the early part of the time series, and was further reduced in the environmental model with CV = 0.2. The smaller magnitude of the deviations was due to the tighter CV (0.2), and the increasing trend in winter-estuary temperature accounted for much of the declining trend in the δR_t present in the standard model. The environmental models did not account for all the variability, however, and there appeared to be a change in the relationship around 2000 and (or) the potential addition of compounding factors.

Projections

Under all the future environmental and fishing scenarios, SSB increased, at least in the short term (Fig. 3). The BASE projection did not include an environmental factor and was driven by fishing and stochastic processes. The reduction in fishing reduced overall mortality and abundance increased. Under the no fishing scenario, the median SSB surpassed the previously established rebuilding target and was larger than historical estimates. With increasing fishing, median SSB was reduced, but still attained SSB_{MSY} with limited fishing pressure (F = 0.1); however, it did not rebuild fully at the F_{MSY} level within the time frame of the projection. The different AR5 temperature projections produced a range of SSB values for the TEMP runs, with two projections producing estimates that were of similar magnitude to the BASE run. The mean SSB across the 14 projections was substantially lower, however. The median SSB increased initially in the ENVIRON and TEMP runs before leveling off or declining. The median SSB reached the current reference point in the TEMP projection, but only for a short time and was reduced under the different fishing

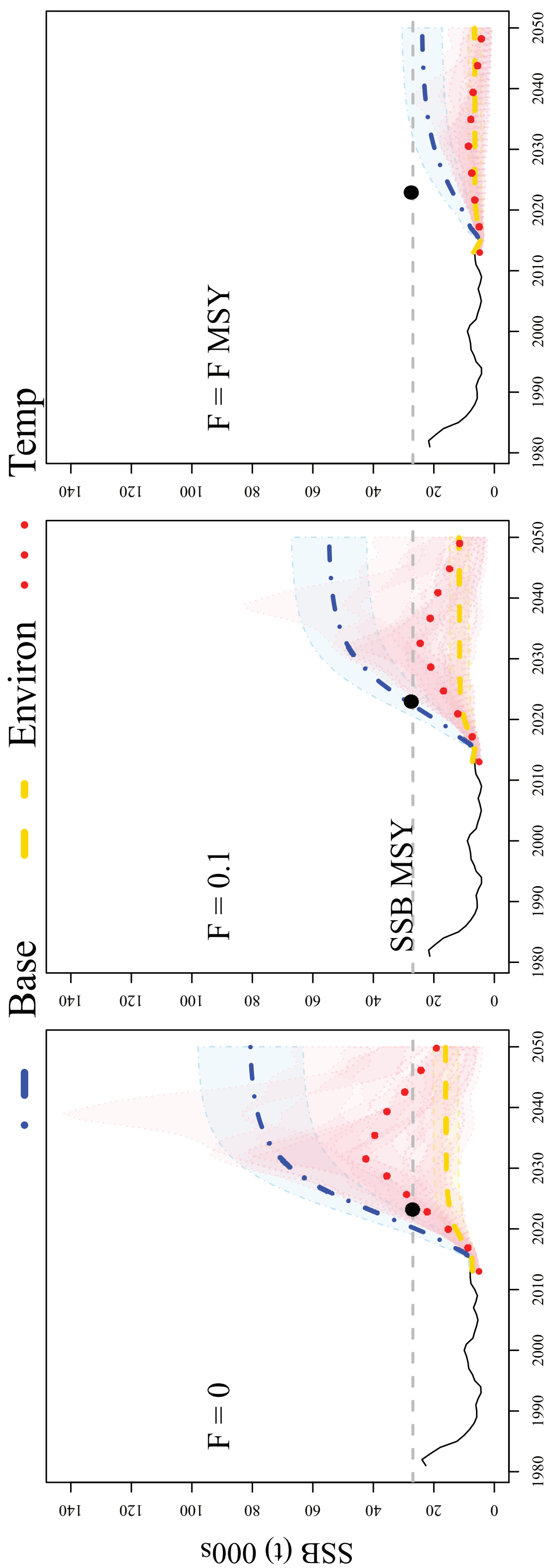


Fig. 3. The estimated and projected spawning stock biomass (SSB) under different fishing rates and environmental assumptions. The black line is the estimated SSB through 2013. The three projections represent the BASE run (no change in productivity), the ENVIRON run (changes in productivity with unknown drivers), and TEMP run (temperature-dependent changes in productivity). The horizontal grey dashed line is the estimated SSB at maximum sustainable yield (SSB MSY). The black dot is the 2023 rebuilding target. [Colour online.]

scenarios. The median SSB increased in the TEMP projection until the 2030s and then declined with increasing temperatures.

In the projection models, recruitment, fishing, and stochasticity are the main factors that regulate abundance. Natural mortality, as well as weight and maturity-at-age, are also important, but are the same or similar in the different projections. When fishing is restricted, SSB increases, which drives an increase in recruitment for the BASE and TEMP projections, at least initially (Fig. 4). In the ENVIRON projection model, recruitment is not linked to SSB and is based on the historical estimates from the population model. The median recruitment is therefore stationary and does not vary with changes in fishing or SSB (Fig. 4). Median recruitment was roughly 12 million throughout the projection. The effect of temperature reduces mean recruitment in the TEMP runs compared with the BASE run, though two projections that include temperature are of similar magnitude to the BASE run. Recruitment is lower in the TEMP runs, but does not result in an actual decline in recruitment until the late 2020s. The declining mean recruitment reduces SSB, regardless of fishing, and does not make it possible to maintain SSB_{MSY}.

The catch was largely dictated by the fishing level (Fig. 5). Stationary median SSB in the ENVIRON projection resulted in stationary median catch. SSB declined in the TEMP projection due to temperature, resulting in reduced catch after about 2030, and none of the projected catch levels matched the large catches removed in the early 1980s.

Discussion

Rebuilding targets provide a legally binding time line for increasing the population of depleted species. In the United States, the number of overfished stocks has decreased substantially since the reauthorization of the Magnuson–Stevens Act in 1996 (NMFS 2015; NOAA 1996). The required firm catch quotas have enabled a number of stocks to recover or make progress toward recovery, but not all. The lack of improvement, despite the reduction in fishing mortality, suggests additional drivers beyond fishing pressure can also impact the abundance of natural marine resources (A'mar et al. 2009; Link 2010; Perry et al. 2010; Hollowed et al. 2013). Ecosystem factors such as climate variability and change can affect stock productivity, which in turn impacts rebuilding time lines (Sinclair and Crawford 2005; Hollowed et al. 2009; Holt and Punt 2009; Holsman et al. 2016).

The inclusion of climate factors can provide valuable information about the drivers of stock dynamics, but may not make substantial changes to the estimates of abundance. Where there are good data, population models with time-invariant parameters often produce good estimates of stock abundance (McKenzie 2016). As was seen from this example, the high-quality data available on the US Northeast Shelf produced estimates of abundance that were similar with and without the inclusion of an environmental parameter. The differences were the result of a change to a more dome-shaped selectivity in the mid-1990s and a slightly higher estimate of SSB productivity in the environmental models. Fishing mortality increased in the environmental models, particularly on the oldest age classes, reducing the SSB to produce similar estimates of recruitment across all three models that would agree with the age composition data. In marine systems, the environment typically has its greatest influence on the early life stages of organisms (Houde 1987) and is therefore often incorporated into the recruitment function of population models, enabling time-varying effects in productivity (Quinn and Deriso 1999). In age-structured population models, the catch-at-age and survey-at-age data constrain the estimates of plausible recruitment and subsequent estimates of the population age structure. The environment is not explicitly included, but variable recruitment, which may or may not be the result of environmental conditions, is an output of age-structured models.

Fig. 4. The estimated and projected recruitment under different fishing rates and environmental assumptions. The three projections represent the BASE run (no change in productivity), the ENVIRON run (changes in productivity with unknown drivers), and TEMP run (temperature-dependent changes in productivity). [Colour online.]

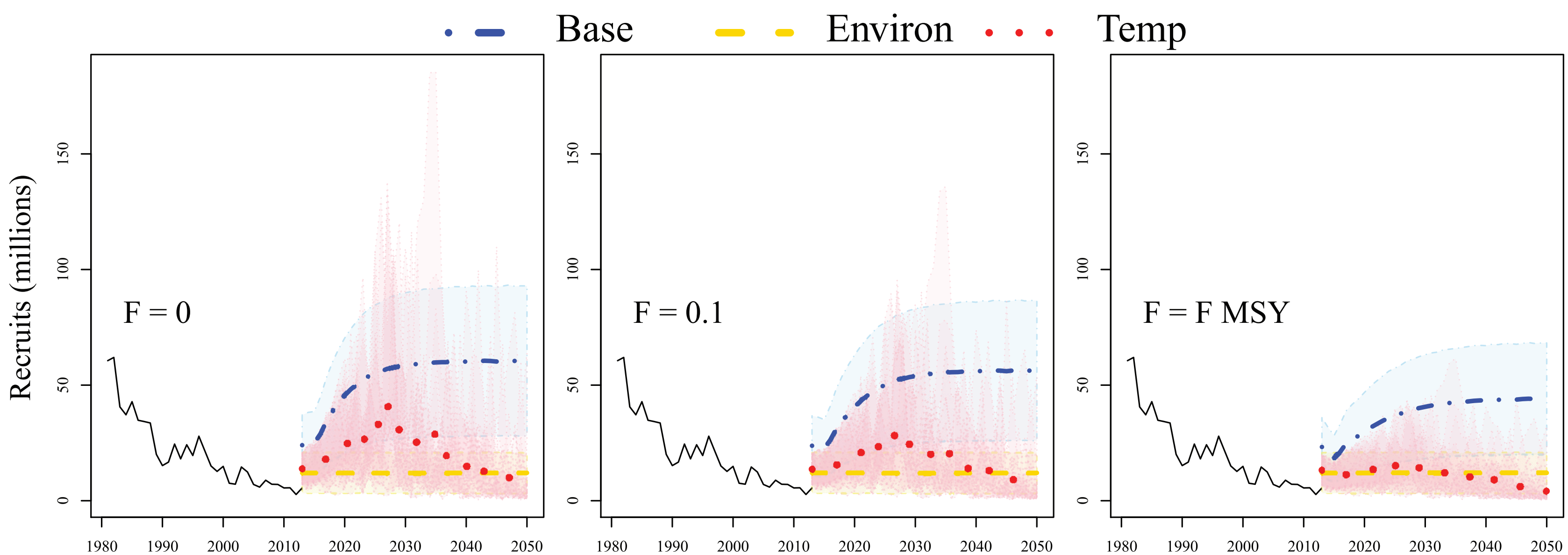
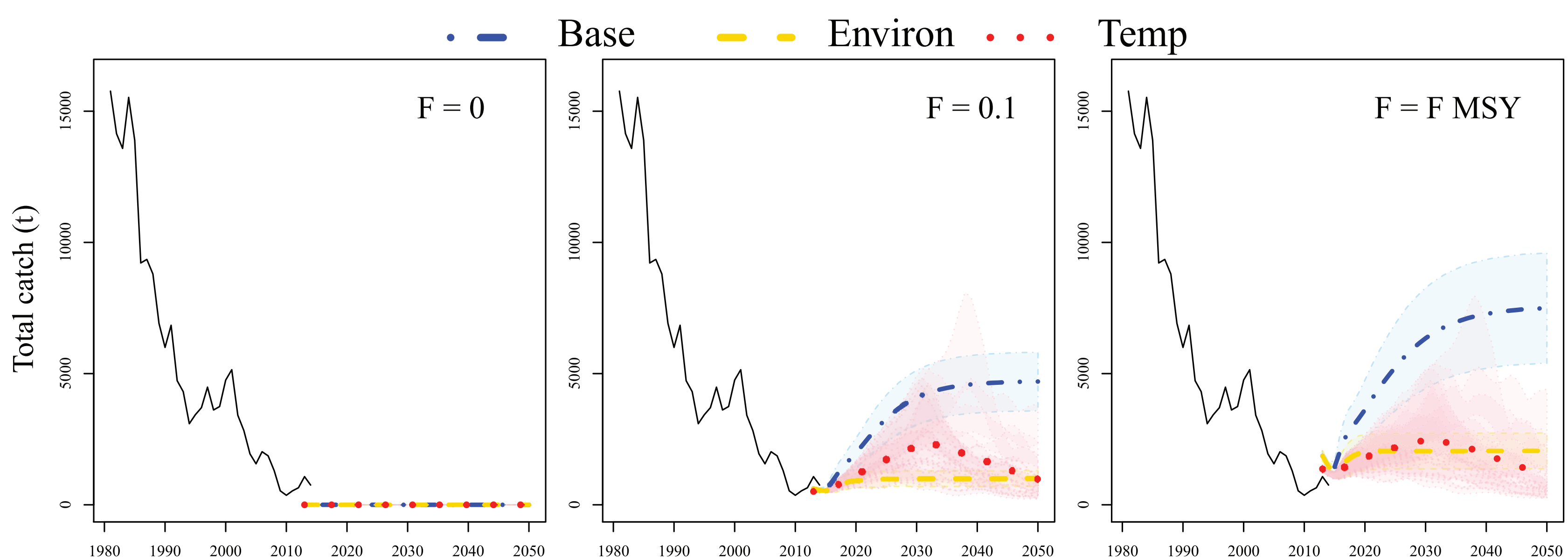


Fig. 5. The true and projected catch under different fishing rates and environmental assumptions. The black line is the true catch through 2013. The three projections represent the BASE run (no change in productivity), the ENVIRON run (changes in productivity with unknown drivers), and TEMP run (temperature-dependent changes in productivity). [Colour online.]



An environmentally driven model, however, may provide some insight into factors regulating abundance and a better understanding of how those factors will impact a stock in the future (Maunder and Watters 2003; A'mar et al. 2009; Holt and Punt 2009; Sagarese et al. 2015). In our winter flounder example, there is evidence that winter conditions are driving changes in productivity. Warmer winter estuarine temperatures enabled greater predation on the early life stages, decreasing the number of recruits expected per spawner from the stock–recruitment relationship (Jeffries and Johnson 1974; Keller and Klein-MacPhee 2000; Taylor and Collie 2003; Bell et al. 2014). The largest difference between the standard model and the environmental models was the deviations in recruitment (δR_t). Though recruitment in the standard model was largely unconstrained with little to no stock–recruitment relationship, the estimated recruitment values exhibited a strong declining temporal trend in the deviation from the Beverton–Holt stock–recruitment model. In the environmental models (constrained: CV = 0.2; and unconstrained: CV = 0.5), the temperature covariate accounted for much of the recruitment variability, largely removing the temporal trend in δR_t. The lower CV forced the deviations to be smaller in magnitude than in the other models, but the recruitment estimates were very similar across all models. The environmental models led to a greater understanding of the system; warmer conditions had a negative impact on the recruitment of SNE–MA winter flounder. The relationship has a relatively minor impact on the estimate of the biomass of the stock, but it does provide a mechanistic link with climate to evaluate how it might respond to future conditions (Cook and Heath 2005).

Environmental relationships often break down over time (Myers 1998), and empirical management strategies that do not rely on a mechanistic environmental driver often perform better (Punt et al. 2013). Environmental relationships, however, generally persist for species at the southern extent of their range (Myers 1998), and environmental drivers could improve management strategies if there is a strong mechanistic relationship (Punt et al. 2013; Holsman et al. 2016). These tenets hold for SNE–MA winter flounder, suggesting that accounting for the environment may be important for management. While the temperature predictions from the different global earth models varied in magnitude, all models indicated an increasing trend in temperature. The particular assumptions made for this study or the exact implementation of the projections could be modified, but different implementations are unlikely to change the general trends. In the Northern Hemisphere, increasing temperature is likely to negatively impact species at the southern extent of their range (Poloczanska et al. 2013). Combining parameter estimates from an environmentally driven population model with temperature projections and fishing scenarios are a potential means for understanding stock status in the future (Hollowed et al. 2009).

With particular respect to the SNE–MA winter flounder example, however, the results are not without question. The initial increases in SSB from the projection models for a stock that is at historical lows and has had very limited fishing pressure appear optimistic. Median recruitment in the BASE run was above estimates from the population model and led to SSB that would exceed the current highest values in the time series. Temperature has historically been an important driver of recruitment in SNE–MA winter flounder (Jeffries and Johnson 1974; Keller and Klein-MacPhee 2000; Taylor and Collie 2003; Bell et al. 2014), and though median recruitment from the TEMP projection was lower than the BASE run, the impacts of temperature in the TEMP projection did not become the dominant driver until the late 2020s. Once the temperature threshold was crossed, recruitment declined, causing SSB to decrease, even in the absence of fishing pressure. The projected temperature-dependent recruitment was well above the values seen over the last 5–10 years, indicating that there are other factors that are impacting the SNE–MA winter flounder stock that are not accounted for in this projection. Temperature is important, but it does not account for all aspects of recruitment variability (Manderson et al. 2004, 2006; Yencho et al. 2015). Despite the problems, the TEMP run substantially deviated from the BASE run, indicating that SNE–MA winter flounder had a low probability of maintaining the rebuilding target.

The ENVIRON projection made no assumptions about the mechanistic relationship between recruitment and the environment (Brodziak et al. 1998; Punt et al. 2012; Szuwalski et al. 2015), but considered the current condition of the stock to be the best representation of the stock in the near term. Recognizing changing productivity over time and using estimates that are the most current has the potential to produce useful short-term projections. Similar to the TEMP runs, future projections with the conditions over the last 5 years suggest that the stock will not be able to attain SSB_{MSY}. While the exact estimate of biomass will vary with the explicit assumption made for the projection models (e.g., using the last 3, 5, or 10 years of data in the ENVIRON run) or the details of the ensemble of climate models, the general trend from this modelling exploration will remain the same. The reduction in recruitment due to changes in productivity, as a function of temperature or other factors, will likely make it challenging for SNE–MA winter flounder to achieve and, more importantly, sustain its biomass above the rebuilding target.

The modelling exercise conducted here is a simple example, demonstrating how external drivers in addition to fishing could impact rebuilding plans. We selected the rebuilding targets from the most recent stock assessment (NEFSC 2015). Static rebuilding targets that do not account for declines in productivity, however, may be an unfair expectation for a depleted stock (Miller et al. 2016). Reference points are a function of the stock–recruitment relationship (Quinn and Deriso 1999), and if that relationship varies with temperature, the reference points should reflect the dynamic relationship. In addition, the exercise does not contain any dynamic feedback, which is a fundamental part of fisheries management. Stocks are assessed, in some cases every year, and new regulations are implemented. In reality, poorly performing stocks would be reassessed with a focus on productivity, catch limits would be altered, and reference points could be re-evaluated. The incorporation of climate factors into population models may not dramatically alter historical abundance estimates, but are important for understanding the drivers of stock dynamics (Hollowed et al. 2013). As warmer temperature isotherms move poleward (Burrows et al. 2011), populations at the leading edge of their range are expected to increase in abundance and move into new territory, while populations at the trailing edge are predicted to decline (Beaugrand and Kirby 2010; Drinkwater 2005). Climate change and variability will affect the quantity and quality of spawning and nursery areas, prey availability, predation risk, and test the physiological constraints of species, both positively and negatively (Drinkwater et al. 2010; Hollowed et al. 2013). Along the east coast of North America, the northerly expansion of suitable thermal habitat has led to greater recruitment success and an increase in the biomass of more warm-water species such as Atlantic croaker (*Micropogonias undulatus*;Hare and Able 2007). Alternatively, cold-water species at the southern extent of their range will likely see their available habitat decrease and fragment with warmer conditions, potentially resulting in population declines (Fogarty et al. 2008; Hare et al. 2012*a*). With a greater understanding of the drivers of productivity, environmentally driven population models provide a tool that can move beyond projections with time-invariant parameters, which average over past conditions and incorporate factors that trend over time (Lehodey et al. 2010). For species with strong environmental influences, the coupling of population models with climate model projections (Stock et al. 2011) can provide a greater understanding of different management decisions and possibly more realistic predictions of rebuilding expectations.

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