Atlantic States Marine Fisheries Commission

Atlantic Herring Section

May 1, 2018
3:00 – 3:45 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 *(P. Keliher)* 3:00 p.m.

2. Section Consent 3:00 p.m.
   - Approval of Agenda
   - Approval of Proceedings from February 2018

3. Public Comment 3:05 p.m.

4. Discuss Potential Impact of Possession Limits in the Atlantic Mackerel Fishery on the Atlantic Herring Area 1A Fishery *(M. Ware)* 3:15 p.m.

5. Technical Committee Report on Spawning Fish Sampling Protocols *(M. Ware)* **Possible Action** 3:30 p.m.

6. Consider Approval of 2018 FMP Review and State Compliance *(M. Ware)* **Action** 3:40 p.m.

7. Other Business/Adjourn 3:45 p.m.

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

MEETING OVERVIEW

Atlantic Herring Section
Tuesday, May 1, 2018
3:00 – 3:45 p.m.
Arlington, Virginia

Chair: Pat Keliher (ME) Assumed Chairmanship: 02/18	Technical Committee Chair: Renee Zobel (NH)	Law Enforcement Committee: Michael Eastman
Vice Chair: Dr. David Pierce (MA)	Advisory Panel Chair: Jeff Kaelin (NJ)	Previous Board Meeting: February 6, 2018
Voting Members: ME, NH, MA, RI, CT, NY, NJ (7 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from February 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. Discuss Potential Impact of Mackerel Fishery Possession Limits on the Atlantic Herring Area 1A Fishery (3:15-3:30 p.m.)

Background

- On February 27th, river herring and shad catch caps were harvested in the Atlantic mackerel fishery, prompting a 20,000 pound per trip/day possession limit.
- In addition, as of April 11, 89% of the mackerel fishery quota has been landed. The fishery moves to a zero possession limit once the Atlantic mackerel quota is caught.

Presentations

- Overview of 2018 caps and mackerel fishery possession limits by M. Ware **(Supplemental Materials)**

5. Technical Committee Report (3:30-3:40 p.m.) Potential Action

Background

- At the February Meeting, the Section tasked the TC with developing a method to scale-up spawning samples of herring which are less than the required 100 fish sample size.
- The TC met via conference call on March 9th to discuss this task.

Presentations

- Technical Committee report by M. Ware **(Briefing Materials)**

Board actions for consideration at this meeting

- Consider changes to spawning closure sampling requirements

6. Fishery Management Plan Review (3:40 -3:45p.m.) Action

Background

- State Compliance Reports are due on February 1st
- The PRT reviewed each state report and compiled the annual FMP Review.
- New York has requested and meets the requirements for *de minimis.*

Presentations

- Overview of the FMP Review Report by M. Ware **(Briefing Materials)**

Board actions for consideration at this meeting

- Accept 2018 FMP Review and State Compliance Report.
- Approve de minimis requests

7. Other Business/Adjourn

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

ATLANTIC HERRING SECTION

The Westin Crystal City
Arlington, Virginia
February 6, 2018

These minutes are draft and subject to approval by the Atlantic Herring Section
The Section will review the minutes during its next meeting

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ATTENDANCE

Section Members

Pat Keliher, ME (AA)
Steve Train, ME (GA)
Sen. Brian Langley, ME (LA)
Doug Grout, NH (AA)
G. Ritchie White, NH (GA)
Dennis Abbott, NH, proxy for Sen. Watters (LA)
Rep. Sarah Peake, MA (LA)
David Pierce, MA (AA)
Raymond Kane, MA (GA)
Eric Reid, RI, proxy for Sen. Sosnowski (LA)
Bob Ballou, RI, proxy for J. Coit (AA)
David Borden, RI (GA)
Colleen Giannini, CT proxy for M. Alexander (AA)
Emerson Hasbrouck, NY (GA)
Adam Nowalsky, NJ, proxy for Asm. Andrzejczak (LA)
Jeff Brust, NJ, proxy for L. Herrighty (AA)

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

Ex-Officio Members

Rene Zobel, Technical Committee Chair

Staff

Robert Beal
Toni Kerns
Megan Ware
Jessica Kuesel

Guests

The Atlantic Herring Section of the Atlantic States Marine Fisheries Commission convened in the Jefferson Ballroom of the Westin Crystal City Hotel, Arlington, Virginia; Tuesday, February 6, 2018, and was called to order at 1:30 o'clock p.m. by Chairman Robert E. Beal.

CALL TO ORDER

CHAIRMAN ROBERT E. BEAL: I would like to call the Atlantic Herring Section to order. We've got a relatively small group today; but the rest of the Commissioners will join us in a moment. My name is Bob Beal; I am the Executive Director of ASMFC. Currently the Herring Section does not have a Chair or a Vice-Chair; due to retirements and health issues and a number of other things.

I am standing in as the acting Chair of the Herring Section until we get to Agenda Item Number 4, which is elect a Chair and a Vice-Chair, and then after that point the newly elected Chair will come up and take over the meeting at that point. That is where we are.

APPROVAL OF AGENDA

CHAIRMAN BEAL: An agenda was distributed in the briefing materials. Are there any changes or additions to the agenda as presented? Seeing none; the agenda stands approved.

APPROVAL OF PROCEEDINGS

CHAIRMAN BEAL: Are there any changes or adjustments to the proceedings from the October, 2017 meeting of the Herring Section? Seeing none; those stand approved as well.

PUBLIC COMMENT

CHAIRMAN BEAL: Agenda Item Number 3 is public comment. Is there any public comment on any items that are not on the agenda for the Atlantic Herring Section?

ELECTION OF CHAIR AND VICE-CHAIR

Seeing no hands; we'll go on to Agenda Item Number 4, which is the election of a Chair and Vice-Chair of the Atlantic Herring Section. Are there any nominations for Chair and Vice-Chair? Ritchie White.

MR. G. RITCHIE WHITE: I have the great honor of nominating two distinguished candidates; Pat Keliher for Chair and David Pierce for Vice-Chair.

CHAIRMAN BEAL: Wonderful, is there a second to those nominations? Bob Ballou seconds the nomination of Pat Keliher for Chair and David Pierce for Vice-Chair of the Atlantic Herring Section. Are there any other nominations? Seeing none; any objections to the nominations, none? Congratulations Pat Keliher and David Pierce. This is all yours now, Pat.

CHAIRMAN PATRICK C. KELIHER: At least he didn't say one of the two is distinguished. I'm going to try to get us back on task and on time. A couple things, I know Dennis Abbott will talk a lot about process. But we don't go by Robert's Rules; we go by Pat's Rules associated with running the Herring Section.

We'll dispense Robert's Rules and we'll see if we can't move this right along. Perfect.

REVIEW EFFECTIVENESS OF CURRENT SPAWNING CLOSURE PROCEDURES

CHAIRMAN KELIHER: With that we will go to Item Number 5, **Review Effectiveness of Current Spawning Closure Procedures**. Renee, are you ready for that?

MS. RENEE ZOBEL: I am, thank you Mr. Chair. The TC was tasked with reviewing the spawning closure program that was initiated in 2016; our forecast TSI-30 based program. As a reminder, our task was to review the efficacy of the current spawning closure method; which is the forecasting method based on the goals and objectives of the program, and make suggestions

for any improvements to better meet those objectives.

First up, what were the objectives of this program; or what are the objectives? The first is to reduce the interaction between the fishery and spawning. We know that it is impractical to eliminate interaction completely between spawning and the fishery; but that we should prohibit fishing when greater than 25 percent of fish are spawning.

Now that 25 percent is an important value to look at; we on the flip side, when there is a spawning closure. In order to reclose or not reclose there is a 25 percent threshold that we follow. The TC took a logical leap to assume that that threshold was appropriate on the front side of a spawning closure as well.

When you hear me refer to a spawning season; we're going to be looking at the 25 to 25 percent on the front and on the backside. The second objective is to maximize spawning coverage and access to the 1A quota. In a perfect world spawning closures cover the spawning season and no more. We know it's an imperfect world; but that's the goal.

Third is to account for interannual variation in spawning season. We do know that there is – and you're going to see this later – there is pretty solid interannual variation in our spawning seasons in this species. We do this by monitoring the development of the ovaries, getting GSI values each year before, during, and after the spawning closure.

Fourth objective is flexibility to extend the closure if necessary; because we do not want to be opening up on more than 25 percent spawning fish. A little bit of a review of the data, so 2015 prior to that we did not sample the full suite of spawning, so prior to2015 the focus was on collecting samples pre-spawning.

Doing the pre-spawning GSI, not worried as much about during the spawning season or after; other than to determine if we needed a reclosure or not. In 2015, there was a concerted effort to start taking samples before, during, and after the spawning closure, which allows us to get a good feel of what the spawning season looks like and what the biology of the fish is throughout the entire timeframe.

Now 2015 we still were under the old program. It wasn't until 2016 and then this previous year, 2017 that we used the new method. Now what we're really evaluating are some assumptions of this program; and there are four that we really took a look at as a TC. The first assumption of the program was that larger herring arrive and spawn earlier than smaller herring.

Second was spawning commences near GSI-30 value of 25, which is the value that the Section picked when we implemented this; that four weeks sufficiently covers the spawning season, and finally that GSI increases linearly during the last two months of spawning, which was part of what went into the modeling. The first question; do larger herring arrive earlier? In the figure you'll see up on the screen. You can see that the large fish are the lighter color; small fish are the darker color. Over the years you can see that in fact the larger fish are replaced with smaller fish as we go through the spawning season. This is another way to look at it. The mean length of Stage 3 through 5 female herring and you can see even more clearly here that the length of fish declines over the course of time. They do in fact decrease in size throughout the spawning season; so that assumption we found to be sound.

Second question; does spawning commence near the GSI-30 value of 25; which is the value that was chosen by the Section? To get at the answer to that we have to determine when is the spawning season? This is a very busy figure; but what you really want to be paying attention to is the orange line and the red line. Those two lines are really the fish that are in spawning stages; and the black lines (black vertical bars) are the actual spawning closures.

You can see that we're doing a pretty good job capturing the spawning fish during those closure dates. Another way to look at this is this is the observed fraction of sampled herring that had started spawning; which is the red line. Those are Stage 6 plus fish; and those in purple are those that had completed spawning, with fitted logistic regression lines.

Shaded in blue is what the spawning season was determined to be via sampling. Again, the black vertical bars are the actual spawning closures. We're going to talk a little bit about these three different years individually. One thing to note is that 2016, and I'll bring this up again, very few samples during and after the spawning closure. There was only one.

What you see there is a very short spawning season of 16 days. We don't have a whole lot of faith in that; because we don't have enough samples to really feel confident about that value, so just a side note for everybody. The other thing to observe in this figure, those 25 percent values that I talked about earlier, so where more than 25 percent of fish are spawning and then where less than 25 percent of fish have remained to spawn after the closure.

There are two circles; one at the beginning of the spawning season, and one at the end of the spawning season. That is what those are referencing. Our goal is to try and basically look at the spawning season between those two values; that is our end goal. This is 2015 under the old method and what it looked like.

Again, you can see shaded in blue is the actual spawning season; based on the biology of the fish. The vertical bars are again what we implemented for a spawning closure. This season was two weeks early; as far as we missed the spawning fish by two weeks, which is indicative of us opening up smack in the middle of spawning and having to implement a reclosure.

Had we used the new method in 2015, this is what it would have looked like. Instead of two weeks early we would have been three days late from that 25 percent spawning threshold; so much more precise. In 2016 again, it appears we had a very short spawning season. But this is the year where we have very, very few samples; just one sample during the spawning closure and one sample after. Good samples leading up to it, but not during and after to help us categorize what the spawning season looks like.

This year it would have been five days late. It really would have been four days late, but managers decided to push this out one additional day from what the model predicted. In 2017, our most recent year, this is our most comprehensive year with 29 samples taken during this year. This year actually did a very nice job. It was two days early from that 25 percent spawning threshold; and you can see that we did have to have a reclosure, because this spawning season was about five weeks. You can already see here the variability in the length of the spawning season; based on the biology of the fish in any given year. Third assumption, is a four week closure sufficient?

I already showed you that there was some variability between the different years; based on the length of the spawning season, which we already knew going into this, but it was again confirmed for us. Here what we're looking at is if managers were not comfortable with those 25 percent values, which has been on the books for us for a long time post spawning closure and we have now introduced it as a beginning period for spawning closure.

Then managers could elect to do something different with those percentages. However, the thing to keep in mind is that a percentage change would extend time both on the front end and the back end of a spawning closure. If the choice was to be more conservative than the 25 percent that's currently on the books, we could do that.

But there would be a tradeoff in the amount of time that the spawning closure would cover; and likely a four week closure would result very frequently in a reclosure. What we're looking at here is that if managers also decided they could go with a different GSI-30 value. For the 2016 initiation we went with a GSI value of 25; which as I showed you earlier fit the spawning season very well, with just a matter of being off by two to four days versus a matter of weeks, which it was off before we implemented the new method.

Here you can see what would happen if we chose a different GSI-30 value; and obviously the lower the value the further up in time it would bump that up. If the Section did decide to go with a lower value, it would likely result in reclosures more frequently, unless a longer timeframe for a spawning closure was also adopted.

Based on what I just said, so those different GSI-30 values as you dropped the timeframe would get earlier and earlier for the spawning closure, and would also have to come with different default dates. The default dates that were selected prior were based on a GSI-30 value of 25. If we went with a different value then we would also have to implement a different default closure date.

One thing you'll notice here is that the default closure for a value of 25 is October 1, and not October 4, which is currently on the books for all of us. We have more data now. We were able to go back and take a look with updated data at what the default date would be; including the last three years, and that has changed the value some.

The value for the 25 threshold is now October 1st instead of October 4th. The last assumption does GSI increase linearly during the last two months prior to spawning? These are the three years. The line that you want to pay most attention to is the blue line; that is the fit of the samples. You can see in all years there is an increase in the slope of that line headed up to the spawning closure, which is indicated with the red vertical bar.

The notification date is what is indicated by N, and the black on the figure is the closure date as it changed over the number of samples that we were able to work up and implement. The last year is the only one that differs a little bit; and the slope decreases right after the notification date. But headed up to that notification date, it follows a nice linear path. Conclusions and recommendations, the first conclusion is the current spawning closure model appears to be meeting the Sections objectives. The second conclusion, which I think you were able to see is that the spawning season is variable both in time and length of time.

In 2015 there was approximately a 28 day spawning season, 2016 had a 16 day spawning season, again very low sample sizes so low confidence in that number, 2017 had a 34 day spawning season, so a lot of variability between years. Two week reclosures may occur frequently as a result of this; with just a four week spawning closure initially.

A five or six week closure could reduce the frequency of reclosures. The current GSI-30 threshold of 25 is a good fit to the spawning season. It's within days not weeks, which the old system tended to be off by a number of weeks when we've gone back and taken a look at old data. The Section could consider a threshold of 23 or 24 to reduce the probability of greater than 25 percent spawning fish in each catch; that would result in an earlier default date.

It would also increase the likelihood of reclosure if the four week spawning sample closure is retained; and a longer closure is not implemented. Fishery independent sampling is needed during closures. We have a very hard time getting samples in eastern Maine in particular, but as far as samples during a spawning closure, which help us categorize what the spawning season looks like and what the biology of the fish are doing in any given year.

Those two areas are in particular need of independent sampling. We were able to get quite a bit of sampling in the Mass/New Hampshire closure area during the closure. A lot of those samples came from the small mesh bottom trawl fishery that was operating during that timeframe; in addition to some other sources. That concludes my presentation; I'm happy to take any questions, if anybody has any.

CHAIRMAN KELIHER: Great, thank you Renee. I have Ritchie and then Doug.

MR. WHITE: Great report, Renee, thank you. Two questions, one I assume that any of these changes that we could make would be an addendum process.

CHAIRMAN KELIHER: It's my understanding that an addendum would be appropriate; but we could also if we wanted to make a change and evaluate it, we could also do it as a pilot.

MR. WHITE: Second question, did the Technical Committee talk about the herring accessibility to the fleet this year; in that I know there were market situations that affected it as well, with the Area 3 quota not being caught, and the Area 1A quota constrained early, and then had an extremely hard time trying to catch the remainder of the quota.

Some of the anecdotal information was that the herring were not available to the harvesters when they wanted them; or they were staying hard to the bottom for the seine boats. I just wondered if the Technical Committee had any discussions on that.

MS. ZOBEL: Due to workload and the timeline of taking a look at the tasks which we were presented, which was taking a look at the spawning closure efficacy; that is not something we discussed as of right now. However, the Council Herring Workgroup is going on today and the rest of this week. I'm sure that is something that the TC members who are all involved there will be discussing as a result of that as well.

CHAIRMAN KELIHER: I've got Doug Grout, anybody else on this side, Colleen and David Pierce? Doug.

MR. DOUGLAS E. GROUT: Thank you Renee for this report. I have three questions; one is just a clarification. In your previous slide you said in 2015 the closure was 28 days. Does that include what it would have been under the new method? Do you have an idea of how many days it would have been in 2015 under the new method?

MS. ZOBEL: That is not the spawning closure that was implemented that is a spawning season. Based on the biology of the fish, between that 25 percent on the front end and 25 percent on the back end, it was 28 days long.

MR. GROUT: Thank you for clarifying that for me. Do you have in 2016 when we had low sample size, compared to the year before and the year after. Was there any reason why we had such low sample size, or why their sample sizes were higher in the '15 and '17?

MS. ZOBEL: Often during the spawning closure the samples are coming from either the small mesh bottom trawl fleet or independent means; fishery independent. That year I recall us really having trouble finding fish to sample during the closure.

MR. GROUT: We are getting samples from the fisheries independent surveys too now.

MS. ZOBEL: We are that is correct.

CHAIRMAN KELIHER: Colleen.

MS. COLLEEN GIANINI: Thanks, Renee. Since the sample sizes are so influential in informing the closures dates, was there any thoughts or discussion in the TC as to identifying maybe a minimum or optimal sample size?

MS. ZOBEL: There was no discussion about that specifically. Based on when we developed the

model we set three samples as a minimum; as far as fitting that linear regression to allow us to predict a closure. Obviously more samples are better than fewer samples. We've really been trying to categorize the fishery, so like I said this last year was 29 samples. We really tried to capture as much as we possibly could. But no, we did not talk about an optimal sample size.

CHAIRMAN KELIHER: Colleen brings up a good point in regards to sample size; and one that I've had very quick discussions with both David Pierce and Doug Grout about; in regard to the hundred fish that are collected. Occasionally we fall short; so I would like to discuss that after we deal with all the questions regarding the report, of some way to possibly scale that sample size and maybe tasking the TC. But we'll save that portion for the end of this discussion. David.

DR. DAVID PIERCE: Yes Renee, much appreciation is expressed to you and your colleagues, Micah Dean and Matt Cieri for all the hard work you did; impressive display of the data in graphical figure form. A great deal of thought went into this to evaluate the merits of the changes that we made in the spawning closure approach. I'm glad to see that the changes have proven to be good ones, and that we've had some success. I believe you said that the approach resulted in pretty good capturing of the spawning season. My question is, just so I understand.

In looking at the data that you have provided, Figures 8 and Figure 9 and the different sizes or length of the spawning seasons. You may have already alluded to this. But by spawning season you mean the actual time that we implement it to protect spawning fish; or do you mean the actual time when the fish were seen to have been spawning?

MS. ZOBEL: The latter. You can see in all those figures the spawning closure is indicated by vertical black bars. The spawning season is based on the biology of the fish and the length of time between 25 percent on the front end and 25 percent on the back end of fish spawns.

DR. PIERCE: Thanks for that clarification. Do you or other members of the Technical Committee have any insight, any thoughts as to why the spawning season was so long in 2017; in contrast to previous years, water temperature effects? What can you offer if anything?

MS. ZOBEL: We know based on literature that the spawning season can be very variable. We're seeing that played out. There are a number of factors that contribute to it. Why 2017 was longer than 2015, the last year of confidence, we didn't entirely discuss, and it would only be conjecture. But there are a number of factors that go into it; and we know that based on literature the spawning season often can go up to 40 days or more.

CHAIRMAN KELIHER: Are there any other questions or comments for Renee regarding this? Is there any interest from the Section in seeing a modification to the procedures that we have in place? Ritchie White.

MR. WHITE: I'm not quite sure I'm ready to make a motion to that regard; but the concerns that I raised earlier that we heard from fishermen that there just were not the herring this last year that should be there. Does that mean that they're geographically elsewhere? We don't know. It's not a stock assessment. But we had a lot of very experienced fishermen raising substantial concern about the availability of herring last year.

I think that if menhaden had not been available in Maine, I think there would have been a serious bait crisis in the lobster industry. Should we be taking a more conservative approach; to make sure we're capturing just as much spawning as we possibly can? That is the direction I would lean; but I guess I would like to hear more input, if there are others that feel the concern that I've expressed.

CHAIRMAN KELIHER: Are there any thoughts on Ritchie's comments? David.

DR. PIERCE: Yes Ritchie, I've heard some of those similar remarks from the fishing industry regarding a difficulty in getting herring catch. At the same time I've also heard the fishermen just decided to fish on mackerel as opposed to herring; because the price was far better, so as a consequence there wasn't as much hunting for the herring and therefore it appeared that there were less herring. What the answer is I don't know. But nevertheless we have heard those concerns expressed.
I guess I'm influenced more so by the objectives that we've established for ourselves. I think Megan went over those, Renee or Megan, I forget who gave us those objectives. But one of the objectives was to maximize spawning coverage and access to the Area 1A quota. While I might be tempted to extend the spawning season, at the same time I've got to reflect on that objective.

So far it seems as if we're achieving that objective. Now with that said, we have a sea herring assessment scheduled for this spring. I think it's for this spring. I'm anxious to see what the assessment scientists have got for us relative to an update. Is it a benchmark or an update? If I may, it's benchmark? All right so this is a big deal.

This is a benchmark assessment. Therefore, we should know in the not too distant future the status of the stock; and if we get some real negative news, it might prompt us to do something different for this year. I think we would still have time to do something for this year. I'm not quite clear on the timing, but nevertheless we should have some insights.

At this point in time I don't support making a change. But I do support being very attentive to all the early work that goes into the benchmark assessment; because we're all privy to it one way or another, our staff is involved in it. Once we get that insight that may be early in the game, we can then decide what the best next step is for us; specific to reducing fishing mortality and increasing the protection for spawning herring.

CHAIRMAN KELIHER: Are there any additional comments in regards to Ritchie's original? Ray.

MR. RAYMOND W. KANE: Renee, you said that the spawning season can last up to 40 days?

MS. ZOBEL: Based on literature, yes. That is what we presented when we initially presented this model as well.

MR. KANE: That would be a six week spawning closure if we wanted to truly protect the spawning stock biomass.

MS. ZOBEL: On the far end, yes. As you can see, this year it was a 34 day spawning season, and after four weeks we now can reclose before opening, so that is what happened this year. Samples indicated spawning was ongoing so reclosure occurred. Yes effectively this year and many years it ends up being a six week closure.

MR. KANE: Just a comment. Ritchie, at the next meeting if you want to put a motion up I'll definitely support you.

CHAIRMAN KELIHER: Doug.

MR. GROUT: When we first adopted the addendum that put this process in place, one of the options was a six week spawning closure. The Section at that time agreed with a four week, as long as we had essentially an enhanced process for reclosing. I think the benefit of the four week versus six week is really for the industry; and being able to plan, although there is a drawback where you could potentially like in 2016, when you had a short spawning season, you could potentially close it longer than you had to. I think the real advantage, if we're going to move forward with this, might be coming forward with a more conservative GSI percentage that we're going to work with. Move it down to 25 or 24 or maybe even lower;

because then you might catch the early spawners more readily, if I am reading that correctly. That is sort of a question for Renee. Is that the way I'm reading it?

MS. ZOBEL: Yes you would catch earlier spawning fish. But if you maintained a four week closure, you would also likely be opening up on spawning fish, and have to reclose more frequently. That is the risk.

CHAIRMAN KELIHER: Are there any additional questions or comments? Seeing none; a potential Band-Aid that may be beneficial for this from a process standpoint is when we actually have samples that do not equal 100 or more fish in the individual sample. We had some instances where the industry was screaming, particularly at me, because of the fishery happening in eastern Maine when the samples were less than 100 fish.

At the time we had issues of collecting the samples, but also some damaged samples that for dissection purposes were not valid. I've talked to staff a little bit about this. One way to rectify this is to find a way for us to basically scale up; so if we had a sample of 90 or 91 fish that the TC could find a way to statistically scale up that sample so we could accept it, avoiding two or three or four days to collect another sample to be able to go through the process of closing.

One thought I had would be to task the TC to come up and develop that type of a system of scaling up, and bring it back to the Section at the May meeting, for us to utilize that for this upcoming fishing season. I would like some thoughts or comments on that. Doug.

MR. GROUT: I would support that concept, but I think we have with the TCs advice. You would almost have to have the 100 fish now as a target. But we would still have to have some kind of a minimum threshold for a sample. You would have to give confidence to the industry and to us.

CHAIRMAN KELIHER: Yes. I think from internal conversations with state staff, we still wouldn't want to go less than 90. The goal is always 100 fish or 100 fish sampled. But there have been times. The last closure we did for Mass/New Hampshire, I believe ended up being 95 or 96 fish that we all determined that we would accept for the closure.

I think just formalizing that making sure that we're getting that good advice from the Technical Committee, and then accepting it as a Section, as we deal with days out and dealing with the spawning closures would be appropriate. I see some heads nodding; so with that I think we can task the TC to look at that issue of scaling up.

We don't need a motion from that and they can kind of add it to their growing workload with the assessment coming up. With that thank you. That concludes conversations around spawning closures.

ADJOURNMENT

Is there any other business that needs to be brought before the Section? Seeing none; I would accept a motion to adjourn, motion to adjourn by Dennis Abbott, seconded by Ray. I think we have consensus, thank you very much that concludes the business of the Section.

(Whereupon the meeting adjourned at 2:00 o'clock p.m. on February 6, 2018)

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: Atlantic Herring Section

FROM: Atlantic Herring Technical Committee

DATE: March 12, 2018

SUBJECT: Response to Section Task Regarding 100 Fish Samples

At their February 2018 meeting, the Atlantic Herring Section (Section) asked the Atlantic Herring Technical Committee (TC) to investigate a method of scaling-up samples of herring that are less than the required 100 fish minimum, as outlined in the spawning re-closure procedure. This task was prompted by concern that samples of herring greater than 90 fish but less than 100 fish are not considered when determining the need for a spawning re-closure.

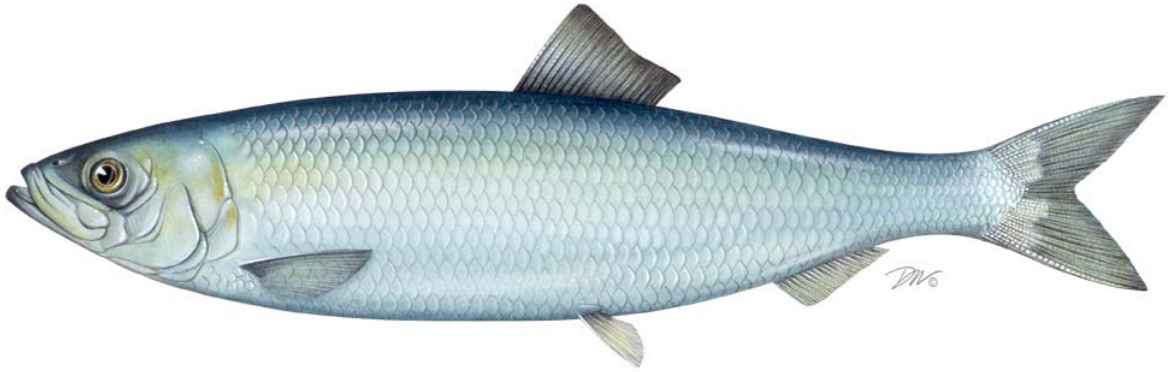
The TC met via conference call on March 9th to discuss this task. Overall, the TC noted that there are two requirements for a sample in the re-closure protocol: 1) the sample be a minimum of 100 randomly selected adult sized fish; and 2) the sample be comprised of a significant number of spawning herring, defined as 25% or more mature herring in a sample. Of these two requirements, the TC concluded that the second requirement to have 25% mature herring in a sample is the priority and should be met in every sample used to evaluate the need for a re-closure. For the first requirement, while the TC recommends the Section maintain a target of 100 fish per sample to ensure a robust protocol, the TC expressed comfort with a minimum baseline of 80 fish per sample, as long as 25% of those fish are mature herring. Since the TC recommends priority be given to the percent composition of the sample, no analysis is needed to scale-up a sample of herring less than 100 fish; the 25% can also be applied to a sample of less than 100 fish.

The TC does highlight that whether there is an 80 fish or 100 fish minimum requirement, a line must be drawn somewhere to define a sample. As a result, there will always be some samples which fall slightly short of the requirement. The TC also notes that the stipulations for a sample in the forecast system (as opposed to the re-closure protocol) are slightly different in that each sample must contain at least 25 female herring in gonadal stages III-V. At present, samples which contain less than 100 fish are included in the forecast system as long as they meet the 25 female fish requirement.

2018 REVIEW OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION FISHERY MANAGEMENT PLAN FOR

ATLANTIC HERRING
(Clupea harengus)

2017 FISHING YEAR



Atlantic Herring Plan Review Team

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Melissa Smith, Maine Department of Marine Resources
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I. Status of Fishery Management Plan

Date of FMP Approval	November 1993
Amendments	Amendment 1 (February 1999) Amendment 2 (March 2006) Amendment 3 (February 2016)
Addenda	Addendum I to Amendment 1 (July 2000) Technical Addendum #1A to Amendment I (October 2001) Addendum II to Amendment I (February 2002) Technical Addendum 1 to Amendment 2 (August 2006) Addendum I to Amendment 2 (March 2009) Addendum II to Amendment 2 (December 2010) Addendum V to Amendment 2 (October 2012) Addendum VI to Amendment 2 (August 2013) Addendum I to Amendment 3 (May 2017)
Management Unit	US waters of the northwest Atlantic Ocean from the shoreline to the seaward boundary of the Exclusive Economic Zone (East Coast of Maine), and from the US/Canadian border to the southern end of the species range (Cape Hatteras, North Carolina).
States With Declared Interest	Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey
Active Boards/Committees	Atlantic Herring Section, Advisory Panel, Technical Committee, Stock Assessment Subcommittee, and Plan Review Team

Atlantic herring (*Clupea harengus*), also known as sea herring, are an oceanic fish that occur in large schools and undergo seasonal inshore-offshore migrations. Herring are important to the Northwest Atlantic ecosystem as a forage species and to the fishing industry as bait for lobster, blue crab, and tuna. To a lesser degree this resource also serves as a food, typically canned, pickled, or smoked. The U.S. Atlantic herring fishery is currently managed as a single stock through complementary plans by the Atlantic States Marine Fisheries Commission (ASMFC) and the New England Fishery Management Council (NEFMC).

The stockwide annual catch limit (ACL) is divided amongst four distinct management areas: inshore Gulf of Maine (Area 1A), offshore Gulf of Maine (Area 1B), Southern New England/Mid-Atlantic (Area 2), and Georges Bank (Area 3). The Area 1A fishery is managed by ASMFC's Atlantic Herring Section (Section), which includes representatives from Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York and New Jersey.

The 1993 ASMFC Atlantic Herring Fishery Management Plan (FMP) was implemented to address the growth of the herring resource and interest in Internal Waters Processing (IWP) operations. Amendment 1 to the FMP was developed to complement the goals and objectives of the NEFMC federal management plan. It established total allowable catch limits (TACs) for specific management areas. The Days Out program was established for state waters.

Addendum I (2000) redefined spawning areas in state waters. It also reduced the exploitation of herring spawning aggregations by imposing a limited landing restriction on herring caught in spawning areas (20% tolerance for spawn herring in Maine and Massachusetts). Technical Addendum #1A (October 2001) was approved to change the delineation of the Eastern Maine spawning area.

Addendum II (2002) was developed in conjunction with NEFMC's Framework Adjustment 1 to allocate the Management Area 1A TAC on a seasonal basis. This addendum also specified procedures to allocate the annual Internal Waters Processing (IWP) quota.

Amendment 2 (2006) to the FMP was developed to complement management measures in Amendment 1 to the federal FMP. Identical management area boundaries were adopted, in addition to a joint TAC specification setting process between NEFMC and ASMFC, and management area closure when 95% of the TAC is harvested. Technical Addendum I to Amendment 2 (2006) was developed to address inconsistent interpretation of the zero tolerance spawning provision.

Addendum I (2009) identified tools to address effort in Area 1A in order to maintain a steady supply of herring throughout the fishing season. States adjacent to Area 1A could set bi-monthly, trimester or seasonal quotas and roll the quota into later periods if there was under-harvest. It also required states to implement weekly reporting for timely quota management.

Addendum II (2010) was developed to complement Amendment 4 to the federal FMP. It revised the specifications process (sets measures for three-years) and terminology (e.g., TAC is now called ACL) to be consistent with federal management.

Addendum V (2012) compiled the previously approved spawning regulations into one document and revised the spawning sample provisions.

Addendum VI (2013) was developed to complement the NEFMC's Framework Adjustment 2 to the federal FMP. It established new provisions and consistent measures for the four management areas. States were allowed to seasonally split sub-ACLs for each management area, and up to 10% of unused sub-ACL could be carried over to the following fishing year (after data is available). Addendum VI also established new closure triggers: a directed fishery closes when 92% of an area's sub-ACL is projected to be reached, and the stock-wide fishery closes when 95% of the total ACL is projected to be reached.

Amendment 3 (2016) to the FMP consolidates prior amendments, addenda, and recent management decisions into a single document; it is now the comprehensive document for Atlantic herring management in state waters. The amendment refines the spawning closure system using a modified GSI-based spawning monitoring system. Additionally, the fixed gear set-aside is now available to fixed gear fishermen through December 31.

Addendum I to Amendment 3 was developed to stabilize the rate of catch in Area 1A and distribute the seasonal quota throughout Trimester 2 (June through September). The Addendum includes a variety of management tools which can be used by the Section, including weekly landings limits, restrictions on carrier vessels, vessel declaration requirements, and modifications to the 'days out' procedure for a variety of gear type and permit categories.

II. Status of the Stock

A benchmark stock assessment was published in 2012. An update was released in 2015 to incorporate data through 2014. Both assessments indicate the stock is not overfished and not experiencing overfishing. The next benchmark stock assessment is scheduled for review in 2018.

In the 2015 update, the maximum sustainable yield (MSY) based reference points were updated; the overfishing threshold is F_{MSY} = 0.24 and the overfished threshold is ½SSB_{MSY} = 342 million lbs. (155,573 mt). The 2015 update estimated fishing mortality to be 0.16 in 2014 and spawning stock biomass to be 1.3 billion lbs (623,000 mt). The 2012 age-1 recruitment was estimated to be the second largest in the time series and equaled 42.4 billion fish.

III. Status of the Fishery

There is an Atlantic herring fishery in the United States and Canada. The U.S. Atlantic herring fishery is controlled by annual catch limits (ACL) set by NOAA Fisheries. The stockwide ACL is distributed among the four management areas. Specifications are set every three years and adjusted annually to account for overages or underages from the previous fishing season. Once 92% of the sub-ACL for an area is reached, the respective fishery is closed. The stockwide fishery closes when 95% of the total ACL is projected to be reached. Following a closure, there is a 2,000 lb trip limit to allow for incidental bycatch of Atlantic herring for the remainder of the fishing year. In addition to quota-based closures, the "days out" and spawning closure programs provide additional measures to control fishing effort.

For the 2016-2018 fishing season, the Council and Commission set the ACL at 231 million pounds (104,800 mt), a 2.6% decrease from the 2013-2015 fishing limits. For all three years, the ACL is further subdivided by Atlantic herring management areas as follows: Area 1A = 66.79 million pounds, Area 1B = 9.9 million pounds, Area 2 = 64.1 million pounds, and Area 3 = 90.16 million pounds. The Area 1A sub-ACL is distributed seasonally with 72.8% available from June 1-September 30 and 27.2% available from October 1-December 31. Underages from June through September may be rolled into the October through December period.

The domestic Atlantic herring fishery is predominantly commercial; recreational catch accounts for less than 1% of landings. Over the time series of 1965 to 2017, annual landings by the United States Atlantic herring fleet generally increased and averaged roughly 131.4 million pounds (59,612 mt). Landings reached the lowest level in 1983, at 51.263 million pounds (23,253 mt), and peaked in 2006 at 268.533 million pounds (121,804 mt).

Catch, in metric tons, from Area 1A is shown in Table 1. Preliminary information from 2017 indicates that 29,164 mt were caught in Area 1A, representing 90.9% of the sub-ACL. Since a directed fishery closes when 92% of an area's sub-ACL is projected to be reached, there was no closure in the Area 1A fishery in 2017.

Table 1: Area 1A catch, sub-ACL, and associated directed fishery closures from 2013-2017. Source of catch information: NOAA Fisheries Atlantic Herring Fishery Monitoring

Year	Sub-ACL (mt)	Catch (mt)	% Utilized	Sub-ACL Closure
2013	29,775	29,820	100%	Oct-15
2014	33,031	33,428	101%	Oct-26
2015	30,580	29,406	96%	Nov-2
2016	30,524	27,826	91.2%	Oct-18
2017	32,083	29,164**	90.9%**	NA

**Preliminary landings data

2017 Fishing Season

Based on preliminary data provided in state compliance reports, Maine and Massachusetts accounted for 89.4% of the commercial Atlantic herring landings in 2017 (Table 2). Landings generally decreased across the states with the largest decreases occurring in Rhode Island (52% reduction from 2016) and Massachusetts (33% reduction from 2016). The states of New Hampshire and New York did see noticeable increases in landings in 2017, with New Hampshire reporting a 32-fold increase in landings from 2016.

Table 2. 2017 commercial landings by state and percent of total harvest. 2017 landings data is considered preliminary at this time. Source: State compliance reports.

	Commercial Landings (lbs)	**Percent of Total**
ME	61,204,733	59.1%
NH	2,789,406	2.7%
MA	31,357,614	30.3%
RI	4,535,139	4.4%
CT	40,370	0.0%
NY	81,148	0.1%
NJ	3,491,640	3.4%

Table 3 outlines the 'days out' program and effort control measures which were implemented in Area 1A. Based on the accelerated landings of Area 1A quota during Trimester 2 in both 2015

and 2016, and the adoption of Addendum I, the original landing schedule for Area 1A was established at 3 days a week for vessels with a Category A permit. This was subsequently increased to 4, then 5, and then 7 days as it became clear that landings were occurring at a slower pace than the two previous years. Several industry observations indicated that fish were exhibiting atypical behavior and thus were harder to catch. Weekly landings limits for Category A permits likewise increased throughout Trimester 2. On October 1, a 3 days consecutive landings limit was implemented for Trimester 3. This was increased to 7 days once it became clear that landings were below the sub-ACL for Area 1A. Trimester 3 landings continued well into December, creating a longer season than the previous two years (see Table 1).

Table 3: 2017 'days out' program for trimester 2 and 3 in Area 1A.

Trimester	Date Effective	Consecutive Landing Days for Category A Permit	Weekly Landings Limit for Category A Permit	Poundage that can be Transferred to a Carrier Vessel
2	June 1, 2017	3	400,000	80,000
	July 2, 2017	4	600,000	80,000
	July 30, 2017	5	680,000	120,000
	September 17, 2017	7	1,000,000	120,000
3	October 1, 2017	3	NA	NA
	December 18, 2017	7	NA	NA

Spawning Area Closures

The Atlantic Herring Area 1A (inshore Gulf of Maine) fishery regulations include seasonal spawning closures for portions of state and federal waters in Eastern Maine, Western Maine and Massachusetts/New Hampshire. In 2017, the Commission's Atlantic Herring Section permanently implemented the GSI_{30} Based Forecast System for spawning closures in Area 1A. This forecasting method relies upon at least three samples, each containing at least 25 female herring in gonadal stages III-V, to trigger a spawning closure. If sufficient samples are not available, the spawning closure occurs on the default dates outlined in Amendment 3. Prior to 2017, the GSI_{30} spawning protocol had been implemented as a 1-year pilot program in 2016.

The Eastern Maine spawning area closed on the default date of August 28th through September 24th, given there was a single sample from the area at the time. The Eastern Maine spawning closure was extended for two additional weeks, closing October 16th through October 30th, after samples indicated a significant number of spawning herring.

In Western Maine, four samples were collected throughout the summer, allowing the GSI_{30} forecasting model to project a spawning closure starting on September 26th. The closure lasted through October 24th and there was no re-closure in the Western Maine area.

Finally, the Massachusetts/New Hampshire spawning closure began October 1st and continued through October 28th, based on forecasting produced from 15 samples. The closure was extended two additional weeks (October 29th through November 11th) after samples indicated a significant number of spawning herring in the area.

IV. Status of Research and Monitoring

Under Amendment 3, states are not required to conduct fishery independent surveys for Atlantic herring. However, state survey programs designed to catch other species may encounter herring regularly, so some states do collect biological information on Atlantic herring. A summary of these surveys results follow.

Maine and New Hampshire: The states jointly operate an inshore bottom trawl survey in the spring and fall that is designed to catch groundfish, but regularly encounters Atlantic herring. Data from the 2017 survey was not available in time for inclusion in the compliance reports; however, data from 2000-2016 show variance in both the number and weight of Atlantic herring per tow across years.

Maine Department of Marine Resources also conducts commercial portside catch sampling. In 2017, 96 sampling events occurred, covering purse seine, mid-water trawl, and small-mesh bottom trips.

New Hampshire Fish and Game Department also conducts a juvenile finfish seine survey in the Great Bay, its tributaries, and other coastal harbors. In 2017, 690 Atlantic herring were observed during the months of June and July.

In 2015, **Massachusetts** Division of Marine Fisheries and UMass-Dartmouth School for Marine Science and Technology (SMAST) applied for the 2016-2018 Atlantic herring Research Set-Aside (RSA), and were awarded the majority of RSA quota. Portside sampling and the River Herring Bycatch Avoidance program were conducted with both the midwater trawl (MWT) fishery (primarily operating out of Massachusetts ports) and the small mesh bottom trawl (SMBT) fishery (primarily operating out of Rhode Island ports). Due to a lack of funds and staffing, portside sampling and bycatch avoidance program with the small-mesh bottom trawl fishery operating out of Rhode Island was discontinued.

The primary goal of the River Herring Bycatch Avoidance program is to characterize the landings of vessels and advise the fleets of river herring bycatch, in an effort to minimize bycatch independent of management actions. The 2017 harvest of Area 1A quota was delayed due to spawning closure extensions, days-out restrictions, and a shift in target species to mackerel, resulting in less than 100% of the quota harvested. As a result, no RSA compensation trips were conducted in Area 1A, and zero of the 909 metric tons of Area 1A RSA herring quota was caught.

MarineFisheries sampled the Massachusetts MWT fishery, including herring and mackerel landings, at 36% (41 of 114) by trip and 41.5% (7,331 of 17,657 mt) by weight, in 2017. Data from an additional 21 Northeast Fisheries Observer Program (NEFOP) trips and one Maine DMR portside sampled trip landed in MA were incorporated into the bycatch avoidance program. Thus, combined landings coverage of 61.3% was achieved in 2017.

Rhode Island Division of Fish & Wildlife conducts a Seasonal Trawl Survey to develop abundance indices for Atlantic herring. Atlantic herring are mostly observed in the late fall and spring in the RIDFW seasonal trawl survey. Monitoring for 2017 suggested a decrease in the relative biomass and abundance of Atlantic herring in Rhode Island waters. An average of 1.28 kg/tow of Atlantic herring was observed in 2017, lower than the 2.72 kg/tow observed during 2016. Similarly, the Atlantic herring abundance index derived from the trawl data decreased from 135.12 fish/tow in 2016 to 84.65 fish/tow in 2017.

Connecticut Department of Energy and Environmental Protection monitors Atlantic herring through the Long Island Sound Trawl Survey (LISTS), which is conducted each spring and fall since 1984. The Long Island Sound Trawl Survey spring index for 2017 was 0.11 fish/tow or about 92% less than the average of the previous ten years (1.46 fish/tow), and was second lowest in the time series (1984-2017). LISTS 2017 spring abundance was low due in part to the survey missing April sampling. Most of LISTS catches occur in the month of April, prior to herring leaving the Sound. Warming water temperatures in Long Island Sound particularly have affected the timing of Atlantic herring leaving the Sound and Survey catches.

New York has *de minimis* status and does not conduct directed monitoring of Atlantic herring.

New Jersey Division of Fish and Wildlife monitors Atlantic herring through the New Jersey Ocean Trawl Survey, which collects samples during five surveys conducted throughout the year between Sandy Hook, NJ and Cape Henlopen, Delaware. In 2017, 683.6 pounds (5,609 individuals) of Atlantic Herring were caught in the ocean trawl surveys.

V. Status of Assessment Advice

The following research recommendations were included in the 2012 benchmark stock assessment. The 2015 stock assessment update did not provide additional research recommendations.

Research Recommendations from the 54th Northeast Region Stock Assessment for Atlantic Herring (2012)

a. More extensive stock composition sampling including all stocks (i.e. Scotian Shelf).
b. Develop (simple) methods to partition stocks in mixed stock fisheries.
c. More extensive monitoring of spawning components.
d. Analyze diet composition of archived mammal stomachs and sea bird stomachs. Improve knowledge on prey size selectivity of mammals and sea birds.
e. Consider alternative sampling methods such as HabCam.

f. Research depth preferences of herring.
g. Simulation study to evaluate ways in which various time series can be evaluated and folded into model.
h. Evaluate use of Length-based models (Stock Synthesis and Chen model)
i. Develop indices at age from shrimp survey samples
j. Evaluate prey field to determine what other prey species are available to the predators that could explain some of the annual trends in herring consumption.
k. Develop statistical comparison of consumption estimates and biomass from model M.
l. Consider information on consumption from other sources (i.e. striped bass in other areas) and predators inshore of the survey.
m. Investigate why small herring are not found in the stomachs of predators in the NEFSC food habits database.
n. Develop an industry-based LPUE or some other abundance index (Industry Based Survey).
o. Develop objective criteria for inclusion of novel data streams (consumption, acoustic, larval, etc) and how can this be applied.

VI. Management Measures and Issues

Amendment 3 to the Interstate Fishery Management Plan for Atlantic Herring lists the following state regulatory requirements:

1. Each jurisdiction shall prohibit the landing of herring when the management area sub-ACL has been attained.
2. Vessels are prohibited from landing more than 2,000 lbs. of Atlantic herring from Area 1A when the fishery is closed, during a 'day out' or during spawning closures.
3. Jurisdictions will close the directed fishery when 92% of a management area's sub-ACL is projected to be harvested.
4. Each jurisdiction must enact spawning area restrictions that are at least as restrictive as those in Section 4.2.6.
5. States adjacent to Area 1A will implement days out restrictions as identified in Section 4.2.4.1.
6. States are required to implement weekly reporting by all non-federally permitted fishermen on Atlantic herring (including mobile and fixed gear).
7. Any herring vessel transiting a management area that is under a herring spawning closure or a 'day out' must have all of its fishing gear stowed.
8. The harvest of herring for the primary purpose of reduction to meal or meal-like product is prohibited.
9. Internal Water Processing operations will be prohibited from processing herring caught in all state waters.

VII. PRT Recommendations

State Compliance

All states with a declared interest in the management of Atlantic herring have submitted compliance reports and have regulations in place that meet or exceed the requirements of the Interstate Fisheries Management Plan for Atlantic herring as described in Amendment 3.

Request for *De Minimis* Status

A state may be eligible for *de minimis* status if its combined average of the last three years of commercial landings (by weight) constitute less than one percent of the coastwide commercial landings for the same three-year period.

New York has requested and met the requirements for *de minimis* status in 2018. The state's 2015-2017 combined average commercial landings (96,876 pounds) is less than 1% of coastwide commercial landings during the same three year period.

Research and Monitoring Recommendations

In addition to the research recommendations outlined in the 2012 stock assessment, the PDT also recommends the following research priorities.

<u>Fishery-Dependent Priorities</u>

High

- Investigate bycatch and discards in the directed herring fishery through both at sea and portside sampling.
- Continue commercial catch sampling of Atlantic herring fisheries according to ACCSP protocols

<u>Fishery-Independent Priorities</u>

High

- Expand monitoring of spawning components.

Low

- Continue to utilize the inshore and offshore hydroacoustic and trawl surveys to provide a fishery-independent estimation of stock sizes. Collaborative work between NMFS, DFO, state agencies, and the herring industry on acoustic surveys for herring should continue to be encouraged.

<u>Modeling / Quantitative Priorities</u>

Moderate

- Conduct simulation studies to evaluate ways in which various time series can be evaluated and folded into the assessment model.
- Develop new approaches to estimating recruitment (i.e., juvenile abundance) from fishery-independent data.
- Examine the possible effects of density dependence (e.g., reduced growth rates at high population size) on parameter estimates used in assessments.

Low

- Conduct a retrospective analysis of herring larval and assessment data to determine the role larval data plays in anticipating stock collapse and as a tuning index in the age structured assessment.
- Investigate the M rate assumed for all ages, the use of CPUE tuning indices, and the use of NEFSC fall bottom trawl survey tuning indices in the analytical assessment of herring.

Life History, Biological, and Habitat Priorities

Moderate

- Continue tagging and morphometric studies to explore uncertainties in stock structure and the impacts of harvest mortality on different components of the stock. Although tagging studies may be problematic for assessing survivorship for a species like herring, they may be helpful in identifying the stock components and the proportion of these components taken in the fishery on a seasonal basis.

Low

- Research depth preferences of herring.

Management, Law Enforcement, and Socioeconomic Priorities

High

- Continue to organize annual US-Canadian workshops to coordinate stock assessment activities and optimize cooperation in management approaches between the two countries.

Moderate

- Develop a strategy for assessing individual spawning components to better manage heavily exploited portion(s) of the stock complex, particularly the Gulf of Maine inshore spawning component.
- Develop socioeconomic analyses appropriate to the determination of optimum yield.

Low

- Develop economic analyses necessary to evaluate the costs and benefits associated with different segments of the industry.

XI. Figures

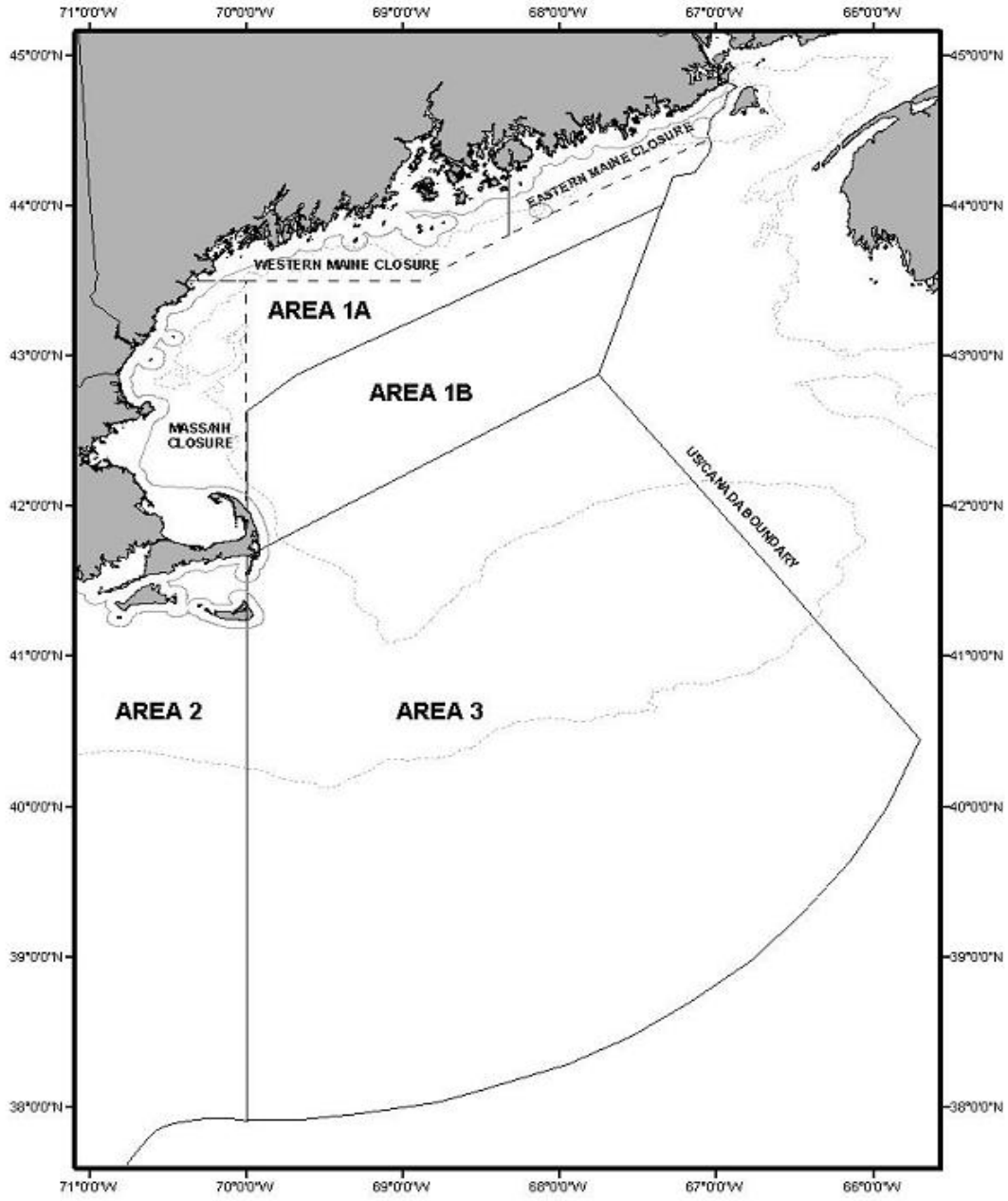

Figure 1. Map of Atlantic herring management areas with boundaries and the three spawning areas are within Area 1A, the inshore region of Gulf of Maine.

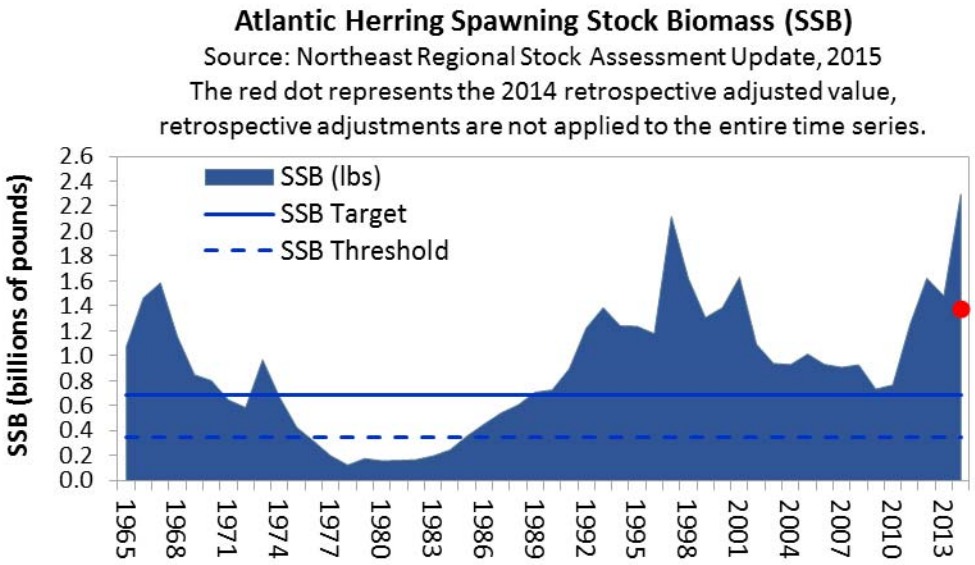

Figure 2. Spawning stock biomass from 1965 to 2014.

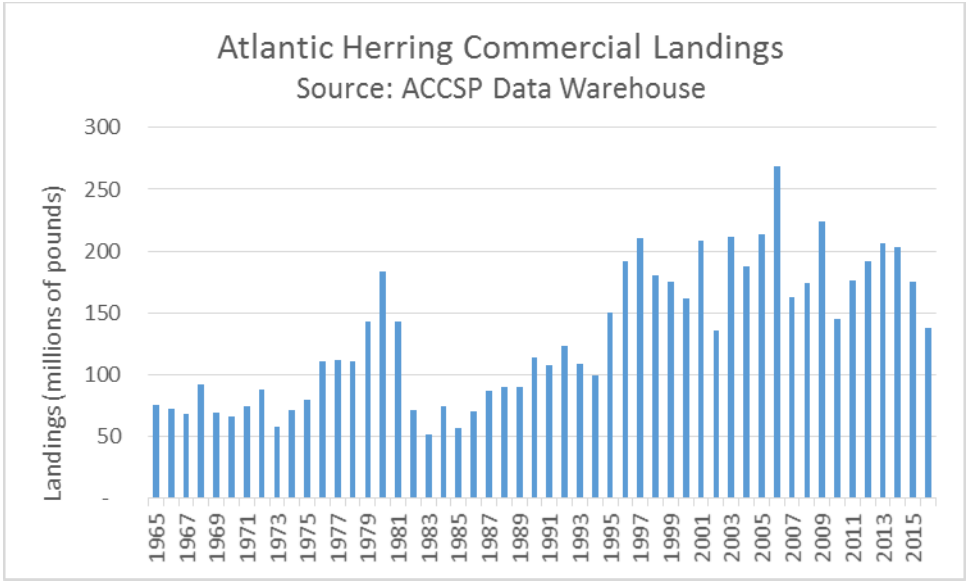

Figure 3. Commercial Atlantic herring landings by the U.S. fleet from 1965-2016