

Atlantic States Marine Fisheries Commission

Atlantic Herring Section

*August 4, 2015
10:15 – 11:45 a.m.
Alexandria, Virginia*

Draft Agenda

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

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| 1. Welcome/Call to Order (<i>T. Stockwell</i>) | 10:15 a.m. |
| 2. Board Consent | 10:15 a.m. |
| • Approval of Agenda | |
| • Approval of Proceedings from May 2015 | |
| 3. Public Comment | 10:20 a.m. |
| 4. Develop Guidance to the Plan Development Team for Draft Amendment 3
(<i>T. Stockwell</i>) | 10:30 a.m. |
| • Technical Committee Report | |
| 5. Update on New England Fishery Management Council Herring Committee
Activities (<i>T. Kerns</i>) | 11:30 a.m. |
| 6. Other Business/Adjourn | 11:45 a.m. |

The meeting will be held at the Westin, 400 Courthouse Square, Alexandria, Virginia; 703.253.8600

Vision: Sustainably Managing Atlantic Coastal Fisheries

MEETING OVERVIEW

Atlantic Herring Section Meeting
August 4, 2015
10:15 – 11:45 a.m.
Alexandria, Virginia

Chair: Terry Stockwell (ME) <i>Assumed Chairmanship 10/13</i>	Technical Committee Chair: Renee Zobel	Law Enforcement Committee Michael Eastman
Vice Chair: Ritchie White (NH)	Advisory Panel Chair: Jeff Kaelin	Previous Section Meeting: May 4, 2015
Voting Members: ME, NH, MA, RI, CT, NY, NJ (7 votes)		

2. Section Consent

- Approval of Agenda
- Approval of Proceedings from May 2015

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

4. Develop Guidance to the Plan Development Team for Draft Amendment 3 (10:30 – 11:30 a.m.)

Background

- The Section tasked the Plan Development Team with developing a Draft Amendment to the Atlantic Herring Fishery Management Plan containing the following issues:
- *Spawning areas efficacy*: to evaluate the effectiveness of spawning area boundaries and closures.
- *Fixed gear set-aside*: to reconsider the rollover of unused quota into Area 1A's sub-quota.
- *Gear declaration*: to consider requiring vessels to declare intended fishing gear prior to a trip.
- *Empty fish hold provision*: to consider requiring vessels to empty holds of fish prior to leaving for a trip as a measure to discourage dumping of unsold herring at sea.
- After review of the PID, the Section tasked the Plan Development Team to develop the draft amendment with all the above except for the gear declarations. The Section also asked for additional analysis of management options for spawning area efficacy, the PDT conducted an analysis of the spawning area closure program with recent

science and data on herring spawning and proposes a new GSI-based monitoring program.

- The Section approved the Draft Amendment for public comment at the May 2015 meeting but then withdrew the document from public comment in June when Section members expressed concern about the highly technical nature of the proposed measures and the potential impacts of these measures to the fishing industry.

Presentation

- Terry Stockwell will present guidance on needed changes to the proposed spawning protection measures that clearly define the goal of spawning protections and detail the benefits and impacts of spawning closures to the resource.

**5. Update on New England Fishery Management Council Herring Committee
(11:30 – 11:45 a.m.)**

Background

- The NEFMC Herring Committee met on July 22 to make recommendations to the full Council on the 2016-2018 Atlantic herring fishery specifications and the proposed recommendations for seasonal sub-ACLs in management areas.

Presentation

- Staff will present a summary of recommendations from the Herring Committee.

6. Other Business/Adjourn

**DRAFT PROCEEDINGS OF THE
ATLANTIC STATES MARINE FISHERIES COMMISSION
ATLANTIC HERRING SECTION**

**The Westin Alexandria
Alexandria, Virginia
May 4, 2015**

**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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INDEX OF MOTIONS

1. **Motion to approve agenda** by Consent (Page 1).
2. **Motion to approve proceedings of October, 2014** by Consent (Page 1).
3. **Move to approve draft Amendment 3 for public comment** (Page 14). Motion by Bill Adler; second by David Borden. Motion carries unanimously (Page 16).
4. **Move to approve the 2014 FMP Review and state compliance reports and *de minimis* status for NY** (Page 17). Motion by Dr. David Pierce; second by Jim Gilmore. Motion carries unanimously (Page17).
5. **Move to accept John Stanley joining the Advisory Panel** (Page 18). Motion made by Stephen Train; second by Emerson Hasbrouck. Motion carries unanimously (Page 18).
6. **Motion to adjourn** by Consent (Page 18).

Draft Proceedings of the Atlantic Herring Section Meeting May 2015

ATTENDANCE

Board Members

Terry Stockwell, ME, proxy for P. Keliher (AA)	Rep. Craig Miner, CT (LA)
Steve Train, ME (GA)	Paul Risi, NY, proxy for Sen. Boyle (LA)
Cheri Patterson, NH, proxy for D. Grout (AA)	Emerson Hasbrouck, NY (GA)
G. Ritchie White, NH (GA)	Jim Gilmore, NY (AA)
Dennis Abbott, NH, proxy for Sen. Watters (LA)	Adam Nowalsky, NJ, proxy for Asm. Sgt. R. Andrzejczak (LA)
Rep. Sarah Peake, MA (LA)	Brandon Muffley, NJ, proxy for D. Chanda (AA)
David Pierce, MA (AA)	Tom Fote, NJ (GA)
Bill Adler, MA (GA)	Steve Meyers, NOAA
Eric Reid, RI, proxy for Sen. Sosnowski (LA)	
David Borden, RI (GA)	

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

Ex-Officio Members

Jeff Kaelin, Advisory Panel Chair	Michael Eastman, Law Enforcement Representative
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Staff

Robert Beal	Jeff Kipp
Toni Kerns	Melissa Yuen

Guests

Micah Dean, MA DMF	Meghan Lapp, Seafreeze
Bob Glenn, MA DMF	Raymond Kane, CHOIR
Jeff Deem, MAFMC	Eric Buck, Silver Spring, MD
Alli Murphy, NOAA	Patrick Paquette, MSBA
Mila Ruccio, NOAA	Shaun Gehan, SNPC
Stephanie Hunt, NOAA	Mary Beth Tooley, Lincolnville, ME
Jon Cornish, ME DMR	

The Atlantic Herring Section of the Atlantic States Marine Fisheries Commission convened in the Edison Ballroom of the Westin Hotel, Alexandria, Virginia, May 4, 2015, and was called to order at 12:45 o'clock p.m. by Chairman Terry Stockwell.

CHAIRMAN TERRY STOCKWELL: Good afternoon, everyone. I'd like to start off by welcoming at one least one new member, Eric Reid. Cherie is here for Doug and Senator Langley is replacing Representative Kumiega. He will be here at some point this afternoon. Jim, I don't know the gentleman sitting to the right of you.

MR. JAMES J. GILMORE, JR.: It is Paul Ricci. He is sitting in for Senator Boyle.

CALL TO ORDER

CHAIRMAN STOCKWELL: I call the Herring Section to order. Before we approve the agenda, are there any other issues for other business? I have one which is to have a brief discussion from the states of Massachusetts, New Hampshire and Maine to select a new date for our call-in to monitor the rate of catch for the days out under other business. Is there anything else?

APPROVAL OF AGENDA

Seeing none, are there any other changes or additions to the agenda? Seeing none; let's consider the agenda approved.

APPROVAL OF PROCEEDINGS

CHAIRMAN STOCKWELL: Are there any changes or edits to the proceedings from October 2014? Seeing none; consider the proceedings approved.

PUBLIC COMMENT

CHAIRMAN STOCKWELL: Are there any public comments for items that are not on the agenda? Okay, we're to consider Draft

Amendment 3 for public comment. I'll turn it over to Melissa who is going to turn it over to Micah.

CONSIDER DRAFT AMENDMENT 3 FOR PUBLIC COMMENT

TECHNICAL REPORT ON GSI-BASED SPAWNING MONITORING SYSTEM

MR. MICAH DEAN: This is just a reminder of the annual maturity cycle of herring and the corresponding rise and fall in GSI. The point of this is to try to close the fishery when the GSI is just prior to its peak, just before spawning occurs, which is at our maturity stage six there. Most of the samples that we collect for monitoring this fishery come from stages four and five, towards the end of their late maturation.

The way the system currently works is that once we get two consecutive samples above our threshold, the fishery closes for four weeks. Now, if we don't have enough samples to inform this, a default closure date applies. When this system was developed in the late nineties, we didn't have the depth of information that we have now to evaluate the parameters of this closure system, the trigger levels, the duration or the default closure dates.

The task was assigned to me to look over the past 20 years of new GSI samples that we have collected to try to evaluate how effective and appropriate this system is. This is a look at those data combined from Massachusetts and Maine GSI sampling. Part of this relies on the assumption that GSI tracks this development and ultimately will lead up to spawning; and we definitely see that in our GSI sampling data; that as a pro goes through the maturation stages, you get this increase in GSI. This is convenient here that the increase in GSI leading up spawning is linear or approximately linear in these last few stages between stage four and five.

We definitely see that here both in Gulf of

Maine and other parts of the world. It has been long recognized that there is a relationship between the size of the herring that you sample and the GSI that you observe and those larger herring typically achieving larger GSIs. Because of this, there has been two size bins for these triggers of what GSI constitutes the point at which you want to close the fishery.

This relies on the assumption that these different size classes achieve a different maximum GSI for spawning. When I reviewed these data, that does not appear to be the case; that all herring, regardless of size, achieve a similar maximum GSI. This has been seen elsewhere in other herring stocks and it has been explained because of size-dependent arrival on the spawning ground, with larger herring spawning first and smaller herring spawning later.

You can see those red lines there are the existing threshold levels that we use to close this fishery. You can see for the smaller fish, less than 28 centimeters, that threshold is quite a bit lower than the GSI that they attain. Trying to confirm this, I went to see if the average size of herring over the course of the season is decreasing; and in fact it is in a significant way.

You have the larger fish first and sequentially smaller fish as you progress through the season. To try to explore all the other factors that might be affecting herring GSI and that we might need to incorporate or account for in our closure system, I explored some generalized linear models. I apologize for the technical output here; but if you just pay attention to the red notes, I think the point will get across.

I did do another model where we looked at the gear type, whether purse seines or bottom trawls. It really did not affect anything so I pooled those together. For now I'm omitting midwater trawls because we don't really have midwater trawls GSI samples at the same time as any of the other gear types; so I don't really

have this simultaneous collection of data to be able to compare the effect of that factor.

What we see is this – J is Julian Day, the day of the year – there is this steady increase of GSI of 0.2 per day after controlling for all the other factors. From year to year you see that the actual day of spawning can shift by six GSI points, which using that rate is about 30 days. This is the reason why we need to have this GSI monitoring system; because if you rely on just a fixed date each year, you may be off by six weeks, which can be a problem with a four-week closure.

Here is the length effect and there is a pretty strong length effect where one centimeter increase in length has a corresponding increase in GSI of 1.8 points, which is about ten days of timing of spawning difference. Using this we can now correct for this difference in length of herring between the samples and standardize everything to a fixed length. I'll return to that.

Finally, the spawning area where the fish are collected; the eastern Maine area appears to be strongly significantly different earlier spawning than the other two areas; but there is no evidence of a significant difference between the western Maine and Massachusetts/New Hampshire areas, which are better sampled anyway. Then to choose a sensible trigger level of when to close the fishery, I looked to the stage five distribution of GSI samples.

And if you think about that first plot, I show that stage five is the last phase before they reach actual spawning. The distribution of GSI values that you get during that stage are really the final accumulation of GSI up to spawning; but something towards the right or tail end of this distribution would make sense to be something to indicate when spawning would occur.

So I arbitrarily picked three levels from this distribution; the 90th percentile, 80th and 70th percentile. These colors will remain consistent as I go through the rest of the slides. You can

think of further to the right, the blue level represents a trigger associated closer to the actual spawning date; whereas, points to the left, the red, the 70th percentile represents a closure that would be protecting more pre-spawning fish.

This may be a little small to see for some of you in the back of the back of the room, so I took these points and I looked at our previous ten or twelve years of samples to see when these three potential triggers would have been reached. This will give you an idea of when you would have achieved that threshold in past years; and that distribution can help you inform what an appropriate default date would be.

If you're going for something that is closer to closing right prior to spawning, over the past twelve years that was the blue box there, October 17th. If you want to provide more protection for pre-spawning fish and closing earlier, that is closer to September 25th. You can see that interannual difference there where some years it is quite a bit later than other years.

You can see the steady linear increase where there is pretty little deviation from those points in the line after you correct for the length discrepancy between samples. There has also been quite a bit of studies done back in the seventies on herring spawning in the Gulf of Maine; so I wanted to get a sense for what other information was out there for when herring spawning occur.

This is what I found that was relevant to our spawning areas. In the Massachusetts/New Hampshire area, they did submersible missions. They did scuba diving out on Jeffrey's Ledge, grabbed samples, and they were identifying when they found demersal herring beds on the bottom. There is a range there between September 20th and October 30th.

That is right in the ballpark of what our GSI sampling has shown may be somewhat earlier.

We don't have the depth of samples in the eastern Maine area; and I wouldn't rely on our GSI samples to inform what an appropriate default date would be for that area. I think it is probably more reasonable to rely on the studies that were done in the eighties there when they looked for when they found the demersal egg beds, they're on lobster traps in eastern Maine.

August 28th was the average first spawning in those years. Another thing is that the range and when they found these egg beds was around 40 days for all of these areas except for this one on Jeffery's Ledge, which was a relatively smaller sample in a smaller location. The current closure is four weeks; 40 days is closer to six weeks; 42 days; so it appears that the herring spawning season length is somewhat larger than the current system.

If we were to use this evaluation of our GSI data to steer the closure system in a new direction, these are the recommendations that would come out of it. Since there is no significant difference in spawning times between western Maine and Massachusetts/New Hampshire, it seems appropriate to combine those two.

This can be beneficial in a few ways. One, instead of dividing our samples now between smaller bins when we deal with sampling issues and whether we have enough to be able to inform the closure, we now have a larger pot of samples to go from. We should have a target of 25 fish per sample. Right now we don't have something that is listed in the plan of what to do, and I think putting out a paper makes sense. It is a good practice.

Using the GLM model, which included lengths, if we standardize everything to a single length that takes account for the differences that have been between samples from areas, there has been a perceived difference between samples collected by Maine DMR and Massachusetts DMF; and I think that is a largely explained by the difference in length that those two fisheries encounter.

And so if we standardize to a larger size herring – here I'm standardizing the 30 centimeters – the larger herring spawn first; you're starting the closure when the herring first start to spawn. That is the idea there. There are options in selecting a new trigger value with those points in the distribution of whether you wanted something closer to when spawning is actually occurring or whether you wanted a point closer to earlier in the season to protect more pre-spawning fish.

The recommendation is that once you have enough samples to detect a sufficient increase in GSI; that you use that rate to forecast a closure date when you cross that threshold; and have some amount of days that you would have to be this number of days away to predict when that closure date would occur.

Using the previous sampling data, we would alter the default dates to this schedule here, which is dependent on which GSI trigger you would go with. A closure period of six weeks is likely more aligned with the biology of herring than the current four-week closure. If we were to pursue something like this, the benefits would include that we would now have some advanced notices when the spawning closure would likely occur.

Now that we are predicting a rate based on samples collected from the beginning of the season, we follow that through and update it as we collect more samples, so we have some indication of whether this is to be an earlier year or a later year. This also reduces the pressure to obtain samples just at the right time.

The current system is you have to get two consecutive samples within a week above that threshold so it is just prior to spawning; and sometimes it can be difficult to get these samples. We may not get them in the same week or we may not have sufficient sample sizes. This system relies on all the information

contained in all the samples you collect throughout the season.

Since you're including length and the other variables that I included there were more aligning it with the reproductive ecology of herring, hopefully it is more effective for its stated goal of protecting spawning herring. Lastly, it reconciles this perceived discrepancy between the two states that are collecting these data.

There have been discussions before of whether there are different spawning times from the areas where the Maine fishery occurs and the Massachusetts fishery occurs; but when you account for the different in lengths between those samples, you don't have a difference between them. If we have time, I just have some examples of how this proposed system would unfold using previous years' data.

I used three different case; one with good, not so good and worse data. In 2011 we had consistent regular sampling. The first five samples were not sufficient to be able to detect an increase in GSI. It wasn't until that sixth sample that we were able to detect a slope to that increase in GSI to forecast a date that it would pass that threshold.

I just used arbitrarily five days as the buffer to when you're going to pick that date. I'm just using the lower threshold pre-spawning closure; you would on September 1st have forecasted the closure on September 5th. If you go with the 80th percentile on that distribution for the trigger levels, on September 11th, after our eighth sample we would have – after September 5th we would have predicted a September 11th closure.

If you go with one that is protecting fish right up to the point of the spawning, you wouldn't have announced the closure until the 22nd for one starting on the 27th. Here in another year we've had difficulty acquiring samples in stretches of weeks; and so we would have first forecasted a

closure date of the 16th. We have done on September 7th.

You can see an addition of another sample causes that update to shift now by several weeks; and this is because we don't have consistent sampling. This underlines the need to have regular sampling if appropriate. Then, finally, where we have poor sampling, we were unable to collect many samples, we wouldn't be able to detect that increase in GSI and the default date would apply in this case with any of the trigger values.

I apologize for the amount of technical details that were in there, but I just wanted to relay the full potential changes that would happen to the closure system and where they came from and the justification behind them. I'm happy to take any questions if there are any.

CHAIRMAN STOCKWELL: Thank you, Micah; I suspect there might be. Questions for Micah?

MR. G. RITCHIE WHITE: I think in the beginning of your presentation you said that there was not any bias as to method of harvest, the difference between bottom trawl and purse seine; did I hear that correctly or is that not correct?

MR. DEAN: There was no detectable difference in GSI between bottom trawl and purse seine; that is correct.

DR. DAVID PIERCE: Micah, in your presentation you said I believe that there is a ten-day difference between the onset of spawning for 28-centimeter fish versus the 27-centimeter fish. Can you elaborate on that; what would account for something so different in terms of timing with only one centimeter.

MR. DEAN: Well, a one-centimeter bin is pretty big for herring where most of the population is between 24 and 28 centimeters; but that is what is showing, the strong significance of the relationship between length and GSI, which we

take to mean as being the timing of spawning. That is accounting for all other factors of length on GSI; so an increase in one centimeter in length is essentially saying about a ten-day later spawn time. I used 27 to 28 as an example.

MR. JEFF KAELIN: It is an interesting analysis. I think the projection idea makes a lot of sense if you're not going to increase sampling, but my question is did you analyze at all what the benefits would be to the spawning stock biomass going from four to six weeks? I mean, clearly, there would be a cost to the fishery, but can you project a biological benefit to the already large spawning stock biomass? I mean in terms of cost benefit; did you look at that at all as the PDT?

MR. DEAN: No; we didn't draw that connection here. We were just basically taking it that the – the assumption is that the goal of the system is to try to adequately protect spawning fish; and we were evaluating the performance and the adequacy of the current system in protecting spawning fish. We didn't go by extension to determine the impact on the total stock; the benefit of increasing protection or aligning it better with the life history.

DR. PIERCE: Micah, can you put this in a nutshell. You've just asked the question that we've asked you; the degree to which spawning herring are being protected with the current approach that we use; so to what degree?

MR. DEAN: What do I see the current system is lacking compared to the proposal?

DR. PIERCE: Right; to what degree are we not protecting spawning herring as a consequence of the analysis you did, which was in concern with someone else or did you do this yourself; I can't recall?

MR. DEAN: No; this was with Matt Cieri. Maine and Massachusetts have collected a large number of samples, just like 8,000 GSI observations over the past 12 years. We pooled

our raw data to do this analysis, which is something new for us. We've always compared the results of the sampling and used those to inform this current system.

In the end the analysis of the combined dataset I think identifies that we've likely been closing several weeks before spawning in the average year; that the current threshold of 15 for younger fish and 20 for larger fish often is closing quite a bit earlier than spawning actually is occurring if we think that they're all attaining a maximum GSI of somewhere around 28 to 30. With the four-week closure, we may be closing long before they're actually achieving spawning; and then the overlap between the spawning period and the true spawning activity may be limited.

DR. PIERCE: If I may, Mr. Chairman, so if we've been closing several weeks before actual spawning takes place, your analysis indicates that if we use the approach that has been assembled and put into the documents, we potentially will improve.

We will dramatically increase accuracy regarding the timing of when they actually do spawn; so we wouldn't be closing several weeks before spawning; we would be close to when they are actually spawning; and to add to that, that would mean that we would not run the risk of having to extend the spawning closure beyond the expected opening –

MR. DEAN: Right.

DR. PIERCE: – because they will have concluded spawning. Okay, what you said, the analysis that you've done strongly suggests that this would be an approach we should seriously consider. Okay, thank you.

CHAIRMAN STOCKWELL: Are there any further questions from the section? Questions from the audience? Mary Beth.

MS. MARY BETH TOOLEY: Mr. Chairman, I had a couple of questions. One was perhaps a follow-up to Dr. Pierce's comment. I'm wondering how many times we've had to extend the spawning closure two weeks after it has reopened. Particularly in the Massachusetts/New Hampshire there is a lot of fishing activity that takes place after that opening; and I don't recall it happening very often, if at all, but I'm sure I'm missing something.

MR. DEAN: It has happened at least once in my tenure. I've only been covering herring for the past five years or so; but it has happened at least once during that time. I don't have like the full library of history there. The rule that is currently in place to cause a re-closure, an extension, is based on if we see greater than 25 percent of fish in spawning condition in a sample afterwards.

The sampling intensity and effort that occurs after the closure is far less than what occurs in the lead up to try to inform the initiation of that closure. The GSI sampling is the primary amount of work; and then there is more opportunistic and scant samples coming in afterwards. The fishery doesn't last nearly as long on the tail end; and so I don't think we have as good information on that end to be able to inform that, unfortunately.

MS. TOOLEY: And then just a question on Table 3. I noticed in the studies that you cite, three out of the four are references to eggs; and the program has never, in my history with it, ever considered eggs. Certainly, egg mats on the bottom are not disturbed by the fishery at all; and it certainly does seem to have quite a long season length. Is there some reason that you incorporated egg beds and larvae into your calculations?

MR. DEAN: They weren't incorporated into the calculations. It was just a check to see what other information was out there that could inform the timing of spawning in the Gulf of

Maine. Those were the other studies that were done that were relevant; so when egg beds that were found at those specific locations, those were the dates on average of the years that they visited them.

MS. TOOLEY: And just one last question. What do you think is the biggest impact to increase from the four to six weeks? First I thought it might be the inclusion of small fish with large fish, and I heard you reference larger fishing coming in earlier and the smaller later; and I'm not sure if we've looked at it that way in the past. Is that what is the main driver of the extension to six weeks?

MR. DEAN: Yes; so six weeks appears to be the range of time where there is evidence of spawning activity from the literature; and elsewhere in the world six weeks is toward the low end. It is typically more, six to eight weeks, elsewhere in the world, but locally six weeks is the signal that comes through.

By standardizing the sampling to large fish, which we believe spawn first, the idea is to start the closure when the first ones are spawning, the large fish, and then follow that through to when the smaller ones spawn at the tail end. The initiation is at the larger fish and then you follow through to all size classes.

CHAIRMAN STOCKWELL: Are there any further questions for Micah? Seeing none; thank you very much.

REVIEW OF THE OPTIONS

CHAIRMAN STOCKWELL: We're going to move on to the review of the options from Melissa.

MS. MELISSA YUEN: Now we will go over the options that are in Draft Amendment 3. The three issues, as a brief review, are spawning area efficacy, fixed-gear set-aside provision and the empty fish hold provision. This is the timeline for development of Draft Amendment

3. Today the section will consider approval of this amendment for public comment.

If approved, the public comment period will occur in May to June. Then the board will review comments and consider the draft amendment for final approval in August. These are the chapters in Draft Amendment 3. At the last section meeting I gave an overview of each chapter and a review of the issues, statement of problems, analysis of biological and socio-economic impacts; so today I will just focus on the management options.

The management options for the three issues can be found in Chapter 4 of the amendment. For Issue 1, there are four sub-issues with proposed management options based on the technical report findings that Micah just gave. These are the closure monitoring system, spawning area boundaries, default closure dates and the closure period.

Issue 1.1; the closure monitoring system. Option A is status quo to maintain the current spawning closure protocol for GSI-based triggers and the fixed default closure dates. Closures in a given area will begin based on the spawning condition of Atlantic herring as determined from commercial catch samples.

Commercial catch sampling shall begin at least August 1 for eastern and western Maine areas and by at least September 1 for the Massachusetts/New Hampshire area. If sufficient samples are not available, the closures will begin on the default dates. Continuing on with Option A, closures in a given area will begin seven days after determination that female herring in the gonadal stages of three to five from that specific area have reached the following spawning conditions.

Again, these were broken into two size classes; female herring greater than 28 centimeters in length will have reached a GSI index of 20 percent; and female herring greater than 24 centimeters and less than 28 centimeters in

length have reached a GSI of 15 percent. Here is the formula that is used to calculate the GSI.

For Option B, which the GSI-based spawning closure forecast system that was just presented; the closure date for the spawning areas will be projected based on a minimum of three samples collected from the fishery, each containing at least 25 female herring in the gonadal stages of three to five, with a target of 50 samples.

Acknowledging that the larger herring spawn first, female GSI values will be standardized to that of a 30 centimeter fish. This is the new formula that would be used in this forecast system. Continuing with Option B, once a significant positive linear relationship is detected between GSI 30 and the day of the year, the slope of this line will be used to forecast a closure date.

The forecasted closure date will be the day when GSI 30 is projected to exceed the trigger value; and there will be further sub-options in the next slide. As additional samples are collected, forecasts will be updated; and once the forecasted date is within five days, the spawning closure will be set or announced. If no significant increase in GSI 30 is detected prior to the default closure date, those default closure dates would apply.

For the trigger values, there are three sub-options. Spawning occurs at the completion of maturity of stage five. Therefore, a point at the high end of the distribution of observed GSI values for stage five fish should be used as a trigger. I have indicated with an arrow where the trigger values are. A higher value closes the fishery just prior to spawning; whereas, the lower value provides additional protection for more pre-spawning fish.

Issue 1.2; spawning area boundaries. Option A is status quo is to maintain the current spawning area boundaries for the three areas. Option B would be to combine western Maine

and Massachusetts/New Hampshire areas; so there would be effectively two spawning areas.

Issue 1.3; default closure dates. For Option A, status quo, is to maintain the current default dates as they are set. Options B-1, B-2 and B-3 would be based on the trigger values. As you can see, as the trigger values increase, the default dates start later in the year.

Issue 1.4; spawning closure period. Option A, status quo, is to maintain the default closure of four weeks. Catch sampling of the fishery will resume at the end of the initial four-week period; and if catch sampling indicates significant numbers of spawning herring are still being harvested, then the closure will resume for an additional two weeks.

A significant number of herring is defined as 25 percent or more by number in the catch sample that have yet to spawn. Option B would be to extend the closure period for the Massachusetts/New Hampshire area; or if the western Maine area is combined with Massachusetts/New Hampshire, then the area closure will last for six weeks.

Moving on to the second issue, which is the fixed-gear set-aside. Option A is status quo; so currently the fixed-gear set-aside is available to fixed gear fishermen in Area 1A until November 1. If the set-aside has not been utilized by the fisheries at that time, it is then be made available to the remainder of the herring fleet until the directed fishery in 1A closes. The fixed-gear fishermen can continue fishing and landings will count towards the Area 1A sub-quota.

Option B would be to remove the set-aside rollover provisions. The fixed-gear set-aside will be available to the fishery west of Cutler through December 31st. When 92 percent of the Area 1A TAC has been reached, then all the directed herring fishery in Area 1A will close. Unused portions of the fixed-gear set-aside will not be rolled from one year to the next.

Issue 3; empty fish hold provision. Option A is status quo; there is no requirement for the empty fish hold prior to a fishing trip departure. Option B would establish the empty fish hold provision. This option will require that fish holds in Category A and B Atlantic Herring Vessels are empty of fish prior to leaving the dock on any trip and declared into the Atlantic Herring Fishery.

A waiver may be issued by an appropriate law enforcement officer. The intent is for waivers to be issued for refrigeration failure and non-marketable fish that have been reported by the vessel. Only vessels departing on a fishing trip are required to have holds empty of fish. As such, waivers would not be required for vessels that are just transporting fish from dock to dock. Are there any questions for the management options in Draft Amendment 3?

CHAIRMAN STOCKWELL: Clarifying questions only. Dave Borden.

MR. DAVID V.D. BORDEN: Mr. Chairman, I'm just kind of curious. Did the Enforcement Committee weigh in on the feasibility of inspecting holds and how much of a burden that will place on enforcement staff?

CHAIRMAN STOCKWELL: There will be an Enforcement Committee Report shortly.

MR. BORDEN: Okay, so they will deal with that.

MR. KAELIN: Mr. Chairman, not really a question, but I just wanted to pointed out after looking at the document the other day, Melissa, that the herring EFH maps were updated by a vote by the New England Council last week; so at some point if this does go to public hearing, the maps might want to reflect the new designations. They're not actually approved yet, but intended to be changed.

MR. WILLIAM A. ADLER: That was one of my questions was where do we sit between here and the council's decision? The second thing

was I assume the empty-the-fish-hold thing is for all fishing areas and not just 1A; is that correct?

MS. YUEN: Yes; that's correct.

DR. PIERCE: Melissa or Micah, for that matter, I'm trying to wrap my mind around the options for the spawning closure period in the context of whether or not so we select the new approach for monitoring the GSI. I note on Page 39 of the document, under the spawning closure period, and this paragraph that is under Issue 1.4; there is an important statement.

It is the last sentence in that paragraph that reads, "Therefore, it appears the current four-week closure period is inadequate and increasing to a six-week closure will provide a better match for the available information on the duration in the Gulf of Maine herring spawning." Then we have status quo and then we extend the closure period to six weeks.

My question is if we go with the new approach for monitoring the GSI, and right now we're closing two weeks earlier than we should; would status quo; that is a four-week season be the logical outcome? Do you follow me? Why would we need six weeks if we changed the timing of the spawning closure so we're on target? I'm trying to make sure I'm understanding this correctly; because if we go with the new approach, it would seem to me that Option A would be the logical status quo to adopt. That is my question; how do we reconcile those two?

MR. DEAN: We don't have GSI samples to really tell us the duration of the spawning. We only have information really to inform when spawning starts; so we don't have any of our own data to say how long spawning is likely to occur, unfortunately. We've relied on other sources of information, from the literature, from primarily when egg beds have been found and where it has been documented elsewhere in the world. That is where the six weeks come

from.

I think we have been starting two weeks early under the previous system on average and that we also haven't provided the length of coverage as before. It is also we've relied on default dates very heavily in previous years primarily because of the difficulty to obtain samples that meet the parameters of the closure system as they're currently laid out.

MS. YUEN: And also that's why we have these under separate issues; so, for instance, the new method doesn't get approved, then there is still the option to extend the default closure to six weeks.

DR. PIERCE: If I may, Mr. Chairman, just to clarify; if we don't go with the new sampling approach, we would likely close two weeks early. If we decide to go with Option B under Issue 1.4, extend the closure period to six weeks – okay, it potentially would be longer than six weeks. I'm not stating that correctly. I have to think more about that.

CHAIRMAN STOCKWELL: And actually I've got one clarifying question. If you say there is no samples, we're essentially closing two weeks early – I mean, the existing protocol is we leave the fishery open until we do have sufficient samples; so my sense would be that we were starting with a spawning closure when the ripe fish were ready for closing. At least strictly from the state of Maine's perspective, we are sampling as soon as the season opens back up. Further clarifying questions? Steve.

MR. STEPHEN R. TRAIN: I think I'm following up on Dr. Pierce here. If we've been closing two weeks early, then why don't we just close two weeks later and get the full four weeks? Why do we need to change everything we're doing? Wouldn't that essentially do the same thing?

MR. DEAN: I'm seeing that there is lots of evidence that the timing of spawning changes is pretty variable from one year to the next; and

the current system doesn't do a good job of detecting that and aligning the interannual difference in spawning with the closure system.

The new system is designed to be able to pick up on that, to identify if it is going to be an early year or late year and close when the spawning is actually occurring and rely less heavily on the default date because of the inability to collect samples that meet the current system.

CHAIRMAN STOCKWELL: Are there any further questions? Jeff.

MR. KAELIN: A couple of questions to Micah. I know in the past the AP has recommended – and you'll hear it again – in January that the technical committee look at the potential to go back to the tolerance system, which would improve the sampling ability as it used to at least in terms of targeting when spawning is actually occurring. Did the technical committee evaluate that at all this year or was it just left on the shelf? I have got one other question after that.

MS. YUEN: The technical committee talked about it, but it wasn't actually tasked by the section so we didn't look at it in depth.

MR. KAELIN: That is a good answer. My other one is for this new sampling, is there a commitment between the three states to increase sampling to support the new tristate spawning approach that is discussed in there?

MR. DEAN: Yes; in our discussions it seems to be that is the case; and by combining those two areas, we're already increasing the number of samples available; and by splitting them between size bins, we're increasing the number of samples. All together now we have a much larger pool. Before we were dividing between areas and dividing between size classes; and we'd end up with two herring in one bin, and what do you do with that information? We couldn't use; the default date applies. Here we're using it all together to try to inform an

appropriate closure.

CHAIRMAN STOCKWELL: Any clarifying questions from the audience? Mary Beth.

MS. TOOLEY: I'm kind of back on the same theme again here because I think I just don't understand it. When people were asking questions relative to the length of the closure, he brought up the egg beds again. How do the egg beds have an impact on the proposed length of the closure?

MR. DEAN: That is the only information we have available to identify what the length of the spawning season is around. In the Gulf of Maine and western Maine and Massachusetts/New Hampshire area is the duration of when herring egg beds have been seen in specific years; and those were the average time period that they were observed in the years of those studies.

Unfortunately, we don't have a good way to document the end of a spawning season from our fishery-dependent sampling; because the GSI, it increases up to spawning. Herring are determinant spawners and they lose all of their eggs in one show, so you just see this plummet of GSI. I think if we were able to collect GSI samples throughout the spawning closure and beyond, we might be able to have a better handle on that in the future and could improve that closure length information.

MS. TOOLEY: So did you consider the fact that the majority of the fish that are caught in the Gulf of Maine are by gear types that don't interact with the egg beds at all and that we hadn't considered egg beds in the past?

MR. DEAN: The closure system I don't think is designed to protect egg beds specifically. It is trying to protect the spawning activity. We're just using the egg bed information to identify the closure length.

MS. TOOLEY: I'm still quite confused. I recall when the original spawning measures went into

place in 1983; and I've seen a lot of change over the years; but we've never considered egg beds or impact to egg beds. Most of those impacts are by other gear types and not the herring fishery gears that are used. The length of spawning, when you include the egg beds, is very different. I could say inappropriate, but I'm not supposed to be commenting.

ADVISORY PANEL REPORT

CHAIRMAN STOCKWELL: Okay, seeing no further questions, we're going to move on to the AP Report. Jeff.

MR. KAELIN: I'm Jeff Kaelin, the AP Chair. I work with Lund's Fisheries in Cape May, New Jersey; and I am a Mid-Atlantic Fishery Management Council member. We had a conference call on January 6th on this amendment. Obviously, it was before Micah's analysis. I think we had a quorum. I was on the call, Patrick Paquette, Phil Rhule, Mary Beth Tooley, Stephen Weiner, Madelyn Hall Arbor, Melissa, and Jennie Bichrest.

We obviously focused on this amendment. The PDT was analyzing the various options. The report that you have goes through the layout of the options as Melissa just provided us with additional detail. When we get into the first issues, the spawning area closure in Massachusetts/New Hampshire, AP members continued to unanimously support the status quo option, the four-week option, with continued sampling by the commercial fishery and closure when triggered by significant levels of ripe fish.

Arbitrary closure is not necessary. Closures may force midwater trawlers to displace towards the northeast and fish on smaller fish. There is no biological need for additional spawning protection because the SSB is way above target and threshold according to the 2012 stock assessment. The AP would like to see more analysis to justify a six-week spawning closure.

There was an observation that commercial sampling is not sufficient. The AP discussed again, just as I mentioned a few minutes ago, reinstating a tolerance for spawning fish. One benefit for tolerance is the opportunity to collect samples of herring for gonadal somatic index analysis used to inform the spawning area closures.

A tolerance is not expected to increase fishing pressure during spawning events because there is no market for spawned and feeding fish. Spawned herring is known to decay more rapidly and is not favored by bait dealers and other end users. The AP requested the PDT to explore this program; but as Melissa had said, so far we haven't had the support from the section.

Staff informed the AP that the PDT has completed an analysis of herring spawning efficiency, which we just had in detail. The fixed-gear rollover, a description again of the status quo; and the AP perspective where the AP did not believe adjusting the current fixed-gear rollover provision is necessary at this time.

The fixed-gear set-aside is a very small amount; therefore, not too many people would join this fishery. The proposed measure may create an allocation issue. In the past decade there has been no fixed-gear landings from November to December; therefore, no justification for using resources to implement adjustments to the federal interstate plans at this time.

I note that there is going to be a downeast fisherman who has some perspective in this fishery added to the AP, I believe, and that will be positive because we haven't had anybody active on the AP from the downeast area for some time. The empty fish hold provision; obviously, it came from the Council's Framework 4.

There was discussion about how the waivers could be used and also support by the AP for the requirement maintaining the

recommendation for no limit to the number of waivers at this time to be consistent with the federal plan. To address concerns raised by state and federal law enforcement officers, the AP commented that refrigeration failure events are rare.

This measure may help tighten up and discourage wasteful fishing practices by a few individuals. The AP discussed reasons in which a vessel may not be able to offload herring after a trip. Some vessels, particularly smaller vessels may not have pumps on board, but the ports where additional vessels offload typically do. The AP suggested adding an additional option that specifies ability to pump fish off the vessel. That language is in the AP Report; and if this moves ahead, I think it is the language that bears the section's attention. I think, Mr. Chairman, other than the AP supporting Mr. Stanley becoming a member of the AP, the fixed-gear fisherman from Maine I just spoke of; that concludes my report. Thank you.

CHAIRMAN STOCKWELL: Thank you, Jeff. For everyone's clarification, Maine is recommending for your consideration a stop-seine fisherman from Mount Desert Island. It is one of our last pieces of business today. Questions for Jeff on the AP? Adam.

MR. ADAM NOWALSKY: In your report the AP suggests additional study on the six-week period; and the draft amendment says that earlier studies showed the typical duration in the spawning area is 40 days. What additional study is the AP suggesting and are they directly contradicting that earlier scientific information that the typical spawning period lasts 40 days?

MR. KAELIN: Well, the AP, of course, not being biologists we didn't have that number in front of us. The question that I asked of Micah earlier I think captures what the AP was getting at on Page 2, asking that there be more analysis to justify the additional two-week closure in terms of benefits to the spawning stock of Atlantic herring.

That was the question; that was the analysis that the AP was looking for; some estimate of what the benefit to the Atlantic herring resource would be with the extension to a six-week closure. While I'm at it, on Page 23 of Amendment 3, it basically says according to the 2012 stock assessment the spawning stock biomass of Atlantic herring in 2011 was over 500,000 metric tons, which is 230 percent above the SSBmsy of 157,000 metric tons. That gets to the nature of the AP's question I think, Adam.

CHAIRMAN STOCKWELL: Other questions for the AP? Steve.

MR. TRAIN: We know that certain times of the year, Jeff, that the fish get, I think we use the word mealy sometimes, they get soft right around the spawning, either before or after; and if we change the date that we harvest on these fish around that spawn, would it affect the usefulness of the fish harvested as far as how they would keep or how they would store?

MR. KAELIN: Well, I think with the feedy fish issue, I think most of the people who are around the fishery believe that waiting to open the fishery until June takes care of a lot of that feed problem. Spawned fish are not desirable. They're more desirable for lobster bait than they are for canning, which doesn't happen very much.

I would think if you put off the spawning closures for two weeks like Dr. Pierce was talking about, looking at the fact that we seem to be closing earlier, I don't see how that would negatively impact the quality of the fish. You'd be moving the closure into the period of time when the fish were spawning predominantly and minimizing that effect, I guess. That is my educated or partially educated answer, Steve. I think you guys will put just about anything in the bait bag if there is enough demand.

CHAIRMAN STOCKWELL: Other questions from the section? Any questions from the audience? Mary Beth.

MS. TOOLEY: Mr. Chairman, if I could, to speak to Adam's question as a member of the AP; and the AP met – I forget what the date was Jeff just said, but we met with the same document that you all met with in January. There was no new information. The information that the AP was seeking that you have today was not available. In fact, the AP met on one day and the PDT met the next day.

Even at our meeting, you know, getting the document out to the membership was really quite late and only upon request. The PDT had what you had in January, which you all thought was not adequate, which is why you sent it back to the PDT. The AP didn't have anything new to respond to.

CHAIRMAN STOCKWELL: Any further questions? Seeing none; we're moving on to enforcement.

LAW ENFORCEMENT COMMITTEE REPORT

CHAIRMAN STOCKWELL: Mike, are you making the Enforcement Committee Report?

LT. MICHAEL EASTMAN: The report speaks actually to your question about reasonableness for the empty holds. In our discussions that we've had, I believe it is reasonable. Once again, it seems that these events would be very few or not frequent. I think it would be reasonable, understanding now that they're not every time, and that certainly would be what we would look to enforce.

CHAIRMAN STOCKWELL: Any questions for Mike? Seeing none; we've heard all the reports; what is the pleasure of the section? Bill.

MR. ADLER: One thing I wanted to get clarified in the document on Page 18; and the 1.3.5.,

bait; there is another reason why the demand for herring as bait has gone up – and it isn't just because of increased fishing effort on lobster – it has to do with the decrease in other baits. I've seen this like in my harbor where we never used to use herring at all. I mean, it never even showed up.

We used groundfish and, of course, the groundfish is going down and it had caused the lobstermen to use other types of bait and herring came into play. I don't think you have to add this in or you could add it in that paragraph that also the decrease in other available lobster baits has also caused the increase in the use of herring. I also noticed it was interesting that herring eat cod eggs and we're in a cod situation. Mr. Chairman, is it time for me to make a motion to approve this document for public hearing; is that what you're looking for?

CHAIRMAN STOCKWELL: Unless there is any further discussion. Seeing none; Bill.

MR. ADLER: I will make the motion to approve this draft amendment for public hearing.

CHAIRMAN STOCKWELL: Seconded by Dave Borden. Discussion from the section? David.

DR. PIERCE: Mr. Chairman, I assume that if we pass this, we're not going to pass it with any preferred alternatives. It will just go out as is. I have my own preferred alternatives that I've selected primarily because of the discussion that has occurred around the table right now and the presentation given by Micah.

I'm not going to make any motion for specific preferred alternatives because we'll go well beyond our 2:15 deadline for adjourning this particular meeting. I do support the motion to approve. If we vote to approve this, we go without any preferred alternatives. If that is your intent, Mr. Chairman, okay.

CHAIREMAN STOCKWELL: That's correct.

DR. PIERCE: I'm satisfied with that.

MR. DAVID SIMPSON: This is something I asked Melissa about this morning. Figure 1 in the amendment, the Y-axis, label the SSB; didn't you talk about that already? This is just something that should be fixed before it goes out for public hearing.

MS. YUEN: Yes, I will be sure to correct the table in the FMP review.

CHAIRMAN STOCKWELL: Other comments from the section. Jeff, you had a question?

MR. KAELIN: Yes; would there be an opportunity for the AP to have at least a conference call during this public process now that we have that analysis from Micah, which we didn't have before. That would be helpful. Okay, thanks.

CHAIRMAN STOCKWELL: And before I go to the audience, I do have a question about the timeline and the necessity of having an August vote. You've tentatively scheduled public hearings in May and June, at the time when the industry is ramping up to go fishing. It may be problematic getting industry members to come to the public hearings at the time period. Is there a reason why we would want to have this action voted on in the summer versus the fall meeting? It would be a question probably to Toni.

MS. TONI KERNS: That can be to the pleasure of the board. It could be to staff's advantage since we are currently hiring someone to replace Melissa since she has moved on to California. If the board would like us to delay hearing until the fall, then we could bring this to the annual meeting in November.

EXECUTIVE DIRECTOR ROBERT E. BEAL: The only other thought is the annual meeting in November is in Florida, which is pretty far outside the range of herring. It doesn't mean we need to accelerate this to August, but it is

just something to think about. Maybe even a Herring Section Meeting outside of this, in conjunction with the council or something – maybe we just need to be a little more creative so we can be closer to where the folks that fish for herring are.

CHAIRMAN STOCKWELL: My sense is it doesn't make a difference whether it is Alexandria or Florida. Ritchie.

MR. WHITE: What about directing that the hearings take place in the evening; would that make a difference?

CHAIRMAN STOCKWELL: Purse seiners fish in the evening. David.

DR. PIERCE: Bob made one of my points about the meeting being in Florida. However, my primary reason for wanting to address this as soon as possible – that is late spring/summer, if at all possible – is I really don't want to go into the fall this year closing two weeks early. If that is what we've tended to do, I would not want to do it again,, especially since I can reflect over the last ten years or so and the numbers of calls I've gotten from fishermen, not necessarily sea herring fishermen but others, saying the close is wrong. Well, yes, it has been wrong; so I would support having the hearings as soon as possible with the hope that we could make changes for this upcoming fall.

CHAIRMAN STOCKWELL: What is the sense of the section; do you want to shoot for the summer or the fall meeting? Ritchie.

MR. WHITE: I'd agree with Dave; let's get it done. Clearly, they have the ability to send us written comments, which can pay special attention to if there is a lack of people at the public hearing.

CHAIRMAN STOCKWELL: Okay, before we move the question; are there comments from the audience? Mary Beth.

MS. TOOLEY: Mr. Chairman, a couple of things about the document. First, the alternatives are not listed in the Table of Contents and so they're very difficult to find. It would be helpful if the Table of Contents could lead the public to them. The analysis that is done for social impacts is two paragraphs plus one sentence; and it is all qualitative information.

There is nothing quantitative there on effort, communities, bait usage, the additional two weeks. There is just a whole bunch of information in that section that should at least be considered. Currently there is really a couple of statements from people and that is about it. Closing two weeks more could be negative; not doing it could be positive; a few people said.

That to me is entirely inadequate and needs to be fixed in the document before you went out for public hearings. It does concern me, this timing that everyone is talking about and doing it at time when people are fishing; and certainly at the summer meeting there will be no herring fishermen here. Maybe I'll be here; I'd rather not be here; but I can assure you there will no herring fishermen here. Florida sounds good, but again probably no herring fishermen there either.

I wonder what is the problem; where is the urgency here to do this? I'm concerned about the utilization of egg beds for justification for extending closures out to six weeks when purse seine gear at that particular time doesn't even interact with them, so what is the benefit there. It is certainly a big negative to the fishery, but I don't see where the benefit arises.

There should be some discussion of that in the document. Currently I don't see that anywhere. The other thing I would remind the section is that if you look at 1983 and the stock was considered overfished with overfishing occurring; this program went into place and the stock started to rebuild. We now have a fully rebuilt resource that has been stable in recent

years, as many as 15 and maybe more. Catch has been stable. I don't really see what the problem is.

We have a program; no, it is not perfect. It was never designed to be perfect. It was designed so that we could provide some protection to spawning herring and allow a fishery to occur. We seem to have gone a long, long way from that original goal and objective here. I don't see taking this out to public hearing in its current state is worthwhile.

CHAIRMAN STOCKWELL: Any other comments from the audience? Seeing none; back to the section. I'll try to do this the easy way. **Is there an objection to moving Amendment 3 forward to public comment? Seeing none; Amendment 3 moves ahead.** Bill.

MR. ADLER: The timelines; are they flexible, like we just talked for a while about having public hearings and we're going to meet and sooner or later; and if we take this out, is it still in flux as to we could have a little leeway here?

CHAIRMAN STOCKWELL: We just agreed to try to move it ahead at the summer meeting. Unless folks want to reconsider that timeline; that is going the goal at which we're moving.

MR. ADLER: Goal, Mr. Chairman, but we've done this in the past; that we've said we're not ready and we're going to hold it for a while. We've done that in the past.

MR. WHITE: The delay that you discussed, Terry, the herring fishery goes until just before the annual meeting; so I guess I don't see – it is either a year delay or we go ahead as designed.

CHAIRMAN STOCKWELL: It's a selfish thing; I don't know whether any states are going to have to change their rules in order to implement a new system. If we come up with a new spawning scenario, despite the best work of our collective staffs, we'll have to do

supporting rulemaking, so that just might be a delayed implementation. Bob.

EXECUTIVE DIRECTOR BEAL: On the timeline issue, since this is an amendment, there are some provisions in the Charter that we have to follow. We have to have the document on the streets for 30 days prior to the first public hearing and then we have to have 14-day open public comment period following the last public hearing.

We can do it between it now and August, but we're going to have to compress the schedule of the hearings, so they're pretty tight. As Toni mentioned, we are transitioning the staff personnel who will be handling herring and it will be a compressed schedule. We may be asking for help from the states to conduct some of the hearings without commission staff there.

I'm not sure exactly how many states will want to do hearings. For an amendment, we're obligated to do at least four public hearings. There shouldn't be a problem covering that; but we'll need to hear from the states on how many states will want to have hearings on this amendment pretty soon so we can start that scheduling.

The document, as Mary Beth requested, correct the Table of Contents, that could be done fairly quickly. We can start the 30-day clock and have the document on the street pretty soon, but we'll have to get that wrapped up and start the clock running and start planning these hearing pretty quickly.

2014 FMP REVIEW AND COMPLIANCE

CHAIRMAN STOCKWELL: Okay, if there is no further discussion, we are going to move along to Melissa's 2014 FMP Review and Compliance. This is an action item.

MS. YUEN: This is the review of the Atlantic Herring FMP and state compliance for the 2014 fishing year. First a couple of corrections in the

document; on Page 4 the spawning stock biomass numbers are incorrect. These are the corrected ones and I will make those changes when the document is approved.

The figure also has a different axis; it is just the units are off. Otherwise, the shape is still the same. Status of the fishery; the Atlantic herring is a commercial fishery and less than 1 percent is taken by the recreational fishery. Over time series from 1964 through 2014, as shown in this graph, annual landings from the U.S. Herring Fleet generally increased. In 2014 it totaled just over 104,000 metric tons or 189 million pounds with the majority taken by trawls and purse seiners.

This is the 2014 breakdown by state landings in thousands of pounds. Maine has landed the majority at 52 percent; Massachusetts following with 37 percent and then Rhode Island – and as a note, the New Hampshire number is confidential this year. Status of the management plan in 2014 was current through Addendum VI, which is the seasonal splitting and triggers.

This is a list of the management measures. The plan review team found that all states had management programs consistent with the FMP. New York requests continued de minimis status. The plan review team recommends granting de minimis status for 2014. In 2013 they landed 82,000 pounds; in 2014 it was 116,000 pounds, almost 117,000 pounds; and averaged 0.06 percent of coastwide since 1991. They do meet the criteria. That is my presentation for the FMP review.

CHAIRMAN STOCKWELL: Any questions for Melissa? Tom.

MR. THOMAS FOTE: Did New Hampshire have only three people landing fish; is that why they were confidential?

MS. YUEN: Cherie is shaking her head yes.

DR. PIERCE: I would move to approve the 2014 FMP Review and State Compliance Reports and New York's request for continued de minimis status.

CHAIRMAN STOCKWELL: Seconded by Jim Gilmore. Is there any discussion? Are there any objections? **Motion to approve the 2014 FMP Review and State Compliance Reports and de minimis status for New York is approved.** Melissa, we're on to our next agenda item.

UPDATE ON THE NEW ENGLAND COUNCIL'S COMMITTEE ACTIVITIES

MS. YUEN: I just wanted to give some updates on what the New England Fishery Management Council and NOAA Fisheries is doing for their Atlantic Herring FMP. First, an update on Amendment 8; this document was intended to establish a long-term control rule for setting an acceptable biological catch for herring. This would take into consideration the ecological role of herring as a forage species. In March through April the council staff held some scoping hearings.

Framework 4; the purpose was to address disapproved elements of Amendment 5 related to dealer-weighting provisions and net slippage. This is the document that included the empty fish hold provision that is in our Amendment 3. NOAA Fisheries just received the draft and they are reviewing it at this point. They plan to publish a proposed rule in June and follow with the comment period.

And then an update on the stock assessment, which is an operational update; on April 8th and 9th there was a peer review workshop for the operational assessment update. On May 13th the plan development team will be review the assessment and projections for specifications. They will develop acceptable biological catch recommendations for the Scientific and Statistical Committee. This committee will then meet on May 20th to review the results, and

they may recommend catch advice for the 2016 through 2018 specifications. That concludes my presentation.

**REVIEW AND POPULATE
ADVISORY PANEL MEMBERSHIP**

CHAIRMAN STOCKWELL: One update on Melissa's report is that the timeline for the council's vote on Amendment 8 is the June council meeting in Newport, Rhode Island. Questions for Melissa? Okay, seeing none, we're on to almost our last agenda item. Melissa.

MS. YUEN: As Terry mentioned earlier, Maine submitted a candidate who is a member of the fixed-gear fishermen. His application is in the supplemental materials. His name is John Stanley.

MR. TRAIN: Mr. Chairman, would you accept me nominating John Stanley as a herring advisor?

CHAIRMAN STOCKWELL: Seconded by Dennis Abbott. Is there an objection to John Stanley joining our AP? Seeing none; I'll call him and give him the good news.

OTHER BUSINESS

CHAIRMAN STOCKWELL: All right, we're on to other business. This pertains specifically to Maine, New Hampshire and Massachusetts. The July 1st date we had hardwired in for our potential conference call to monitor the rate of catch on July 1st has got a conflict.

Monday, June 29th has been suggested as an alternative date. Does that work for everyone from these three states? Per Doug Grout's request, it will be scheduled in the morning. Do folks have a preference? We will pick a time; how about 10:00 o'clock? Okay, we've got a lot of heads nodding. Before we close out here, as we've heard this is Melissa's last day with us as the FMP Coordinator; and I would like to wish

her a whole lot of luck in her new venture and thank her for all the hard work. (Applause) Ritchie.

MR. WHITE: Terry, the days-out meeting, we talked about possibly discussing the research set-aside; is this an appropriate time for that.

CHAIRMAN STOCKWELL: This would be a good time.

MR. WHITE: I guess we had questions as to the commission's role in the research set-aside, how it is formulated and what part do we play and if we have any ability to affect how it is implemented.

CHAIRMAN STOCKWELL: Well, certainly co-set the specifications with the council and it is a joint decision. I think with Dr. Pierce and myself and Doug on the Herring Committee and the council, we can have a pretty good – and Mark – we've got a pretty good connection there. I think as the council begins their work there, we can probably feed any preliminary discussions back to the section at our summer meeting. Does that game plan make sense to you?

MR. WHITE: Yes, that sounds great. Thank you, Terry.

ADJOURNMENT

CHAIRMAN STOCKWELL: Okay, if there is no further business, the Herring Section stands adjourned.

(Whereupon, the meeting was adjourned at 2:15 o'clock p.m., May 4, 2015.)



Atlantic States Marine Fisheries Commission

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MEMORANDUM

July 22, 2015

To: Atlantic Herring Section
From: Terry Stockwell, Section Chair
RE: Draft Amendment 3 Discussion Points for the August Section Meeting

Background

At the February 2014 Atlantic Herring Section Committee, an Amendment (which would require vessels owners to declare intended fishing gear type in advance of quota periods and fish holds to be empty prior to leaving the dock) and an Addendum (to review the efficacy of spawning areas in area 1A, consider changes to the spawning areas in Area 1A, and remove the rollover provision for the fixed gear quota set-aside) were initiated. To reduce the complexity of simultaneously working on an Amendment and an Addendum at the same time, the Section passed a motion to incorporate both into one amendment, Draft Amendment 3.

In the current form, Draft Amendment 3 proposes (1) changing the spawning monitoring program (default start dates, area boundaries, and length of the closure period); (2) removing the fixed gear set-aside rollover provision, and (3) requiring a vessel's fish hold to be emptied before leaving on a fishing trip.

The Board was seeking clarity on two issues in the Amendment document regarding spawning protections. First, is a state obligated to close a spawning area at the start of the default date if adequate sampling (as outlined in Addendum V) has been occurring but no spawning herring have been encountered? Also is the state obligated to close a spawning area if no spawning herring are detected during sampling but juvenile fish have been detected? For example, the eastern Maine spawning area was closed by ME DMR after no spawning herring were encountered during sampling as described by the FMP. The area was closed because the default closure date had been reached. Last year the eastern area was closed by default approximately two weeks later than the default date so that all the spawning areas would not be closed concurrently in early-mid September, even though no spawning hearing were detected. Secondly, is there a difference in the spawning timing between the western Maine and NH/MA areas? In recent years, sampling in Western Gulf of Maine, has closed fishing earlier than the NH/MA area which are detecting spawning herring later. Should the default closure dates be re-evaluated or should there be a delineations of the two areas.

Questions Concerning the Draft Amendment

Upon review of the Draft Amendment, it does not address the efficacy of spawning protection in the eastern Gulf of Maine as it retains status quo allowing for non-spawning fish to be landed until closing the area by a default date. It is unclear whether it's the goal of the Section to protect spawning fish by prohibiting landing of all Atlantic herring or to prevent fishing operations that might disrupt spawning activities in a large geographic area? This goal must be

defined. If the goal is the latter, then additional guidance from the Technical Committee will be necessary.

Motion to withdraw Draft Amendment 3 from public consideration and review in order to further develop the proposed spawning protection measures:

The Atlantic Herring Section met via conference call on June 15th, and Section members expressed concern about the highly technical nature of the proposed measures and the potential impacts of these measures to the fishing industry.

Next Steps

The outline below is intended to provide guidance to the Section on changes needed to the proposed spawning protection measures at the Section's meeting in August. The intent of these changes would be to clearly define the goal of eastern Maine spawning protection and to describe proposed methodologies and measures for the western Maine and MA/NH areas in a way that is understandable to stakeholders. It is understood that the Technical Committee would like the ability to provide annual projections to close areas for spawning rather than to be dependent upon GSI fishing sampling protocols. These annual projections will depend upon the number of samples so they will not likely be available until late August. Eastern Maine is data limited and potentially argues for a different spawning protection approach such as an immediate closure if/when spawning fish are encountered.

Purpose and need:

Define Eastern Maine Spawning Area goal and describe proposed methodologies and measures for the western Maine and MA/NH areas

1. Introduction
 - a. History of spawning area management
 - i. All the management actions taken (beginning with original FMP in 1993 and subsequently fine-tuned with multiple Amendments and Addendums)
 - ii. Areas and timing were developed on an ad hoc basis using expert opinions from TC rather than data. After over a decade of sample data, the TC has re-examined.
 - b. TC report summary with main points
 - i. Spawning based on fish size rather than location
 - ii. Above maybe confounded when there are strong year classes
 - iii. Not all fish enter Stage V (ripe and running) at the same GSI level
Approximately....
 1. 50% at GSI 20
 2. 70% at GSI 23
 3. 80% at 25
 4. 90% at 28
 - iv. Projections allow for predictability and advanced notice; work best on larger area with more samples
 - v. Literature and sampling suggest 6 weeks for an area to go from spawning to spent

2. Issue 1- Process

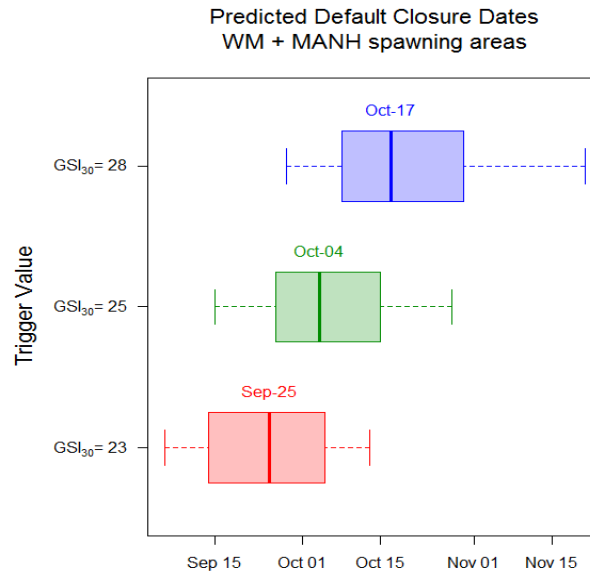
- a. Intro
- b. Options
 - i. Status quo
 - ii. TC -> ASMFC -> State: TC decides, forwards to ASMFC, ASMFC issues notice, State implement closures
- c. Rational: Lots of confusion on how/when things close. Each state currently sends out its own notices. Stakeholders think we don't communicate on the issues. Not a lot of transparency.

3. Issue 2- Area

- a. Intro: see TC document
- b. Status quo.
 - i. Eastern Maine – data availability concerns
 - ii. Western Maine
 - iii. MA/NH
- c. As recommended by TC
 - i. Eastern Maine
 - ii. Combined Western Maine and NH
- d. Rational
 - i. Combined sampling allows for more precise projections
 - ii. Limits staff resources
 - iii. As recommended by the analysis
 - iv. Reduces reliance on default dates due to lack of samples
 - v. Little data on eastern Maine-*leave as is*

Issue 3- Timing

- e. Issue 3a- Spawn stage. At what GSI value (see intro) as not all fish are spawning at a given GSI? (Could be based on either projection or actual sampling depending on outcome of “method” Issue 4)
 - i. GSI 20 to 30
 - ii. Based on level of risk: lower more precautionary
Suggest GSI of
 - 1. 23 -70% of fish spawning
 - 2. 25-80% of fish spawning
 - 3. 28-90% of fish spawning
- f. Issue 3b- Defaults
 - i. Status quo
 - ii. No defaults: Implies that if fishery doesn't catch adult fish to use for either “method” (below) that the area never closes
 - iii. Based on median date (See fig below) Note leave EGOM status quo.
 - iv. Possible add-on: fast track closure mechanism to close any are if a sample collected from the fishery is above the a desired GSI (23, 25, or 28 as above)



- g. Issue 3 c- end of spawning closure
 - i. Status quo- 4 weeks with additional 2 weeks if sampling shows fish still spawning
 - ii. 6 weeks-TC recommendation 6 weeks based on literature and sampling
 - iii. 4 weeks- no provision to reclose.

- 4. Issue 4- Method
 - a. Status quo-but not currently consistent among states
 - b. Use a projection as outlined by the TC
 - c. Flexible: For the TC to determine based on both expert (TC) input and projection-
see Issue 1: Process
 - d. Rational
 - i. Current method not consistent between states (Maine needs samples, MA can do on projection)
 - ii. Current method too rigorous and allows no flexibility
 - iii. Current method provides no advance notice to the industry
 - iv. Current method requires a lot of resources to implement and is expensive
 - v. Projection can help with above
 - vi. Projection indicates longer time needed to achieve management goals of protecting “the majority” or good portion on spawning fish.
 - vii. Projection will set MA/NH and WGOM later than current- may cause gear conflict in EGOM
 - viii. Perception of reduced opportunity
 - 1. But the area is TAC controlled and most years will indicate closing after Oct 1
 - ix. Projection works best with a larger area but can be used under current spawn areas

- 5. Attachment: the TC report

M 15-66

Atlantic States Marine Fisheries Commission

Technical Report on Gonadal-Somatic Index-Based Monitoring System for Atlantic Herring Spawning Closures in US Waters

for Draft Amendment 3 to the Atlantic Herring Fishery Management Plan

by Micah Dean (Massachusetts Division of Marine Fisheries)
and Dr. Matt Cieri (Maine Department of Marine Resources)
of the ASMFC Atlantic Herring Plan Development Team

January 2015

Introduction

While Atlantic herring reproduce in the same general season each year, the onset, peak and duration of spawning may vary by several weeks annually (Winters and Wheeler, 1996). It is believed that this behavioral plasticity is an evolutionary adaptation that takes advantage of optimal oceanographic conditions (e.g. temperature, plankton availability, etc.) to maximize offspring survival (Sinclair and Tremblay, 1984; Winters and Wheeler, 1996). In an effort to protect the integrity of the spawning stock and allow for increased recruitment, the ASMFC developed a system of seasonal spawning closures in the early 1990s that accounted for this interannual variability in spawning time. Historically, managers have focused on protecting the bulk of spawning during the fall season (August through October), but Atlantic herring are also known to spawn from late July through December. Acknowledging that macroscopic identification of the maturity stage of individual fish is a somewhat subjective process, the closure rule was based on a female gonadal somatic index (GSI), which is assumed to increase linearly as herring approach full maturity (Figures 1 and 2; Equation 1).

$$1) \text{ GSI} = 100 \times [W_{\text{gonad}}] / [W_{\text{gonad}} - W_{\text{total}}]$$

At the time of the rule's creation, it was recognized that smaller herring generally have lower GSI values than larger herring (Figure 3). Consequently, separate triggers were established for two size classes: GSI = 15 for 23-27 cm; and GSI = 20 for 28+ cm. According to the closure rule, once two consecutive samples of herring achieve an average female GSI in excess of either trigger, the fishery closes for four weeks. Because all GSI samples are obtained directly from the commercial herring fishery, it is not always possible to collect sufficient data to inform the start of the spawning closure. As such, default closure dates were established for each of three areas that presumed a general north-south progression of spawning (Table 1). Despite the design of the closure system, it is fairly common to find spawning herring in fishery samples after the closure. To counteract this, a closure extension rule was established that mandated a two-week additional closure if fishery-dependent sampling revealed that greater than 25% of a post-closure sample contained fish in spawning condition (Stage V or VI).

When the rules were first established in the early 1990s, limited data were available to derive the critical parameters of the GSI-based spawning closure system (i.e., size categories; GSI triggers; default dates; closure duration). Given recent concerns over the adequacy of the system, which initiated the development of Draft Amendment 3 to the Interstate Atlantic Herring Fishery Management Plan (FMP), the Herring Plan Development Team felt that a re-examination of these parameters was warranted in light of an additional two decades worth of GSI sampling data.

Factors Affecting GSI

There is substantial variability in average GSI from one sample to the next, and it is often unclear whether this change is tracking the expected progression of gonad development of the population or is simply a function of the fish size, sample location, gear type, or year. The combined MADMF/MEDMR dataset of fishery-dependent samples includes 8,474 GSI observations (5,435 maturity observations) from 385 samples and covers three inshore spawning areas (Eastern Maine, Western Maine, Massachusetts-New Hampshire); three gear types (purse seine, midwater trawl, and bottom trawl); 15 years (1998-2013); three months (Aug-Oct); and 13 length bins (from 22 to 34 cm). Unfortunately, data are lacking for many factor level combinations (e.g., MWT samples are generally unavailable at the same time/area as other gear types), thereby preventing an analysis of the simultaneous influence of each factor on GSI/maturity using the full dataset. Nonetheless, we can evaluate the influence of several factors by examining a subset of the data. To this end, a generalized linear model (GLM) relating the GSI of female herring to a suite of factors ($GSI \sim DAY + YEAR + LENGTH + AREA$) was constructed using data from non-midwater trawl trips from the years 2004-2013.

Size

The current size-based closure system assumes that smaller herring achieve full maturity at a lower GSI than larger herring. While this has been demonstrated for the closely related Pacific herring (Ware and Tanasichuk, 1989), there is little evidence for such a relationship in our sample data (Figure 4). An alternative explanation for the observed size-GSI relationship (Figure 3) is a size-dependent arrival on the spawning ground (i.e., larger herring spawn earlier). This phenomenon had been documented in several other herring populations (Boyar 1968; Ware and Tanasichuk, 1989; Oskarsson et al., 2002; Slotte et al., 2000), and is believed to be related to a size-dependent maturation process (Ware and Tanasichuk, 1989), or swimming speed (i.e. larger herring arrive earlier to spawning grounds) (Slotte et al, 2000). Regardless, there is clear evidence of a decreasing average fish size as the spawning season progresses (Figure 5).

While it is true that smaller GOM herring generally have lower GSI than larger fish (at a given point in time), it is likely that all sizes achieve a similar maximum GSI, just at different times. As expected, the GLM estimated a strong positive relationship between length and GSI (Table 2 -

for every 1 cm increase in length, there is a corresponding increase in GSI of 1.84 points). This slope for the LENGTH parameter can be used to standardize GSI observations to a common herring size, thereby removing the influence of length from GSI sample data.

Year

The strongly significant year effect indicates that the GSI for a given length/date may shift by six (6) or more points from year to year (Table 3). This suggests that the onset of spawning can vary by five or more weeks, underscoring the need for a GSI-based monitoring system instead of fixed closure dates. Several other studies corroborate this level of interannual variability in spawning time (Boyar 1968; Grimm 1983; Stevenson 1989; Winters and Wheeler 1996).

Day

The slope of the DAY parameter (0.19) in the GLM model represents the rate at which GSI increases per day, after controlling for the effects of other factors. Theoretically, this rate could be used to forecast the date when GSI (after adjusting for LENGTH) exceeds a trigger value from a single sample of fish. However, there is likely some interannual variability in this rate, and it would be more prudent to use samples from within a season to estimate the slope of the DAY parameter to forecast a closure date.

Area

The Eastern Maine (EM) spawning area was identified as having a significantly higher GSI than the other two areas, meaning that spawning occurs earlier in EM than elsewhere. Interestingly, the Western Maine (WM) and Massachusetts-New Hampshire (MA-NH) spawning areas do not appear to have significantly different spawning times. This suggests that these two areas should have a similar default date, or could even be combined to increase the number of samples available for informing spawning closures. Several earlier studies describe the timing of herring spawning in the GOM through the use of fishery-dependent maturity data and direct observation of demersal egg beds (Table 3 - Boyar et al., 1973; Cooper et al., 1975; McCarthy et al., 1979; Stevenson 1989). While these investigations confirm an earlier spawning time in EM than in MA-NH, there is no historical evidence to inform the timing of spawning in the WM area.

Fishing Gear

An alternative GLM was attempted that included gear type (bottom trawl vs purse seine) as an additional predictor variable ($GSI \sim DAY + YEAR + LENGTH + AREA + GEAR$); While GEAR was a marginally significant predictor of GSI, this more saturated model did not improve fit to the data, as measured by the Bayesian Information Criterion (BIC). This suggests that it is appropriate to combine samples obtained from these gear types. It should be noted that midwater trawl samples were excluded from this analysis, as this gear rarely operates at the same

time/location as the other gears, preventing an objective determination of whether this gear type influences the GSI of a sample.

Proposed Changes to the Closure System

Given that larger herring spawn earlier, it makes sense to standardize GSI observations to a large size class (e.g., 30 cm – 95th percentile of observed lengths), so that the closure period is inclusive of most spawners. Therefore, the observed GSI of each individual fish should be adjusted using the formula (Formula 2), where a is the slope of the length parameter from the GLM ($a=1.84$) and b is the reference length class ($b=30$ cm):

$$2) \text{ GSI}_{30} = \text{GSI}_{\text{obs}} + a * (b - \text{TL}_{\text{cm}})$$

Herring are determinate spawners, releasing all of their eggs in a single batch (Kurita and Kjesbu, 2008). Therefore, spawning can be considered imminent at the end of Stage V (i.e., full maturity). However, a range of GSI values has been observed within Stage V that likely represents the final progression of the maturity cycle (Figure 6). Therefore, a point near the high end of the distribution of Stage V GSI values could be considered a reasonable measure of the onset of spawning. Managers could select different points from this distribution as a trigger value, depending on their objectives or risk tolerance. A higher value would shift the fishery closure nearer to the expected onset of spawning, whereas a lower value would shift the closure earlier to provide more protection to pre-spawning fish.

Once the fishery-dependent sampling program has a sufficient number of samples (e.g., a minimum of three) with a significant positive slope to the $\text{GSI}_{30} \sim \text{DAY}$ relationship ($\alpha = 0.05$), a fishery closure date could be forecasted (i.e., the date when GSI_{30} exceeds $\text{GSI}_{\text{trigger}}$). This forecast could be updated as additional samples are acquired and an official closure date selected when the forecast is within a certain number of days (e.g., 5 days). If insufficient samples are available to predict the $\text{GSI}_{\text{trigger}}$ date prior to the default closure date, the default date would apply.

Using GSI sample data from previous seasons, we can estimate the date at which a $\text{GSI}_{\text{trigger}}$ would have been reached in each year (Figure 7). The average trigger date provides some representation of what an appropriate default closure date might be (Figure 8). Depending on the trigger value used, the average date for the MA-NH area is 4-24 days later than the most robust literature account for this area, which observed the arrival of herring egg beds on Jeffreys ledge between 1972 and 1978 (Table 3 – McCarthy et al., 1979). Most of the contemporary GSI sampling effort has been focused inshore of Jeffreys Ledge, suggesting spatial and/or interannual variation of spawning time within this area. Unfortunately, there are no literature sources available to inform the default date for Western Maine. The GLM model found no significant difference between the two areas; therefore, it appears reasonable to combine the two areas,

increasing the number of samples available to inform a larger Tri-State (WM-MA-NH) spawning area (Table 2). With such few GSI samples available to describe the EM area, the historical information of when herring eggs have been observed on lobster traps is likely more applicable for this area (Table 3 – Stevenson 1989).

Contemporary GSI observations are not particularly useful for describing the duration of the spawning period, because fishery-dependent samples are not available once the closure commences. However, several earlier studies in the GOM concur that the typical duration of herring spawning within a particular area is approximately 40 days (Table 3). Therefore, it appears the current 4-week closure period is inadequate and increasing to a 6-week closure (42 days) would provide a better match for the available information on the duration of GOM herring spawning.

By using the sequence of individual samples obtained in previous years, we can apply the proposed closure rules to simulate the performance of the forecasting algorithm. For example, in 2011 a September 11 closure would have been announced on September 6, assuming a choice was made to select a closure date at five days prior (Figure 9).

There are several benefits to the GSI-based closure system as outlined in this paper:

- 1) By providing a forecasted closure date once an increase in GSI_{30} is detected, all interested parties (samplers, managers, industry) will have advance notice as to when the spawning closure is likely to occur, allowing them to plan their activities accordingly.
- 2) Because the forecasting model uses the GSI information from all samples to project a closure date, there isn't pressure to obtain two consecutive samples just prior to spawning, a task that has proven difficult in many years. For this reason, default closure dates due to insufficient samples would occur less often.
- 3) Aligning the assumptions of the closure system with the current understanding of the reproductive ecology of herring will improve the accuracy of and maximize the effectiveness of spawning closures.
- 4) By directly taking into account the effect of length on GSI, perceived discrepancies between sampling programs (MADMF, MEDMR) can be reconciled.

Ideally, we would have GSI and maturity samples from before, during, and after the spawning season. This would provide a better idea of maximum GSI (i.e. appropriate trigger value), and how that coincides with the presence of Stage V (full maturity) and Stage VI (spawning) fish. Unfortunately, because the GSI-monitoring program is entirely fishery-dependent, there are essentially no samples available once the spawning closure begins. A directed fishery-independent effort to obtain herring samples during and after the closure could provide this information and be used to further refine the parameters of the closure system in the future.

References

- Boyar, H. C. 1968. Age, length and gonadal stages of herring from Georges Bank and the Gulf of Maine. ICNAF Research Bulletin 5:49-61
- Boyar, H. C., Cooper, R. A., and Clifford, R. A. 1973. A study of the spawning and early life history of herring on Jeffreys Ledge. ICNAF Research Document 73/96:1-27
- Cooper, R. A., Uzmann, J. R., Clifford, R. A., and Pecci, K. J. 1975. Direct observations of herring (*Clupea harengus harengus* L.) egg beds on Jeffreys Ledge, Gulf of Maine in 1974. ICNAF Research Document 75/93:1-6
- Graham, J. J., Joule, B. J., and Crosby, C. L. 1984. Characteristics of the Atlantic Herring (*Clupea harengus* L.) Spawning Population Along the Maine Coast, Inferred from Larval Studies. Journal of Northwest Atlantic Fisheries Science 5:131-142
- Grimm, S. K. 1983. Changes in time and location of herring (*Clupea harengus* L.) spawning relative to bottom temperatures in Georges Bank and Nantucket Shoals areas, 1971-77. NAFO Science Council Studies 6:15-34
- Kurita, Yutaka, and Olav S. Kjesbu. 2009. Fecundity estimation by oocyte packing density formulae in determinate and indeterminate spawners: theoretical considerations and applications. Journal of Sea Research 61: 188-196.
- McCarthy, K., Gross, C., Cooper, R., Langton, R., Pecci, K., and Uzmann, J. 1979. Biology and geology of Jeffreys Ledge and adjacent basins: an unpolluted inshore fishing area, Gulf of Maine, NW Atlantic. ICES Marine Science Conference Papers E44:1-12
- Oksarsson, G. J., Kjesbu, O. S., and Slotte, A. 2002. Predictions of realised fecundity and spawning time in Norwegian spring-spawning herring (*Clupea harengus*). Journal of Sea Research 48:59-79
- Sinclair, M., and M. J. Tremblay. 1984. Timing of Spawning of Atlantic Herring (*Clupea harengus harengus*) Populations and the Match-Mismatch Theory. Canadian Journal of Fisheries and Aquatic Sciences 41:1055-1065
- Slotte, A., Johannessen, A., and Kjesbu, O. S. 2000. Effects of fish size on spawning time in Norwegian spring-spawning herring. Journal of Fish Biology 56:295-310
- Stevenson, D. K. 1989. Spawning locations and times for Atlantic herring on the Maine coast. Maine DMR Research Reference Document 89/5:1-19
- Ware, D. M., and Tanasichuk, R. W. 1989. Biological Basis of Maturation and Spawning Waves in Pacific Herring (*Clupea harengus pallasii*). Canadian Journal of Fisheries and Aquatic Sciences 46:1776-1784
- Winters, G. H., and Wheeler, J. P. 1996. Environmental and phenotypic factors affecting the reproductive cycle of Atlantic herring. ICES Journal of Marine Science 53:73-88.

Table 1. Current default dates for herring spawning closures in the GOM

Spawning Closure Area	Default Closure Date
Eastern Maine (EM)	August 15 th
Western Maine (WM)	September 1 st
Massachusetts/New Hampshire (MA-NH)	September 21 st

Table 2. Output from GLM (GSI ~ DAY + YEAR + LENGTH + AREA).

ANOVA Table:

	Df	Deviance	Resid. Df	Resid. Dev	F	Pr(>F)
NULL			4052	131631		
J	1	18802	4051	112829	1032.017	< 2.2e-16 ***
as.factor(YEAR)	9	4554	4042	108275	27.773	< 2.2e-16 ***
LENGTH	1	32700	4041	75575	1794.853	< 2.2e-16 ***
AREA	2	1990	4039	73585	54.627	< 2.2e-16 ***

Coefficients:

	Estimate	Std. Error
(Intercept)	-83.585212	1.949353
J	0.190262	0.005731
as.factor(YEAR)2005	1.514119	0.595370
as.factor(YEAR)2006	2.999203	0.673709
as.factor(YEAR)2007	1.297457	0.551941
as.factor(YEAR)2008	1.573861	0.630355
as.factor(YEAR)2009	1.881865	0.572551
as.factor(YEAR)2010	0.889922	0.591108
as.factor(YEAR)2011	6.144499	0.572099
as.factor(YEAR)2012	5.147404	0.576039
as.factor(YEAR)2013	5.373736	0.572403
LENGTH	1.838863	0.042996
AREAMA-NH	-2.504169	0.325561
AREAWME	-2.775418	0.265547

Table 3. Literature accounts of the timing and duration of herring spawning in the GOM.

Study	Years	Method	Area	Average First Spawning	Average Last Spawning	Average Season Length (days)
Boyar et al., 1973	1972	Maturity	MA-NH	Sep 10	Oct 20	40
Cooper et al., 1975	1974	Eggs (scuba)	MA-NH	Sep 29	Oct 25	26
McCarthy et al., 1979	1972-1978	Eggs (scuba, sub, grab)	MA-NH	Sep 20	Oct 30	40
Stevenson 1989	1983-1988	Eggs (lobster traps)	EM	Aug 28	Sep 20	40

Figure 1. Observed GSI of female herring by ICNAF maturity stage from 2013 fishery dependent samples from the MA-NH spawning area.

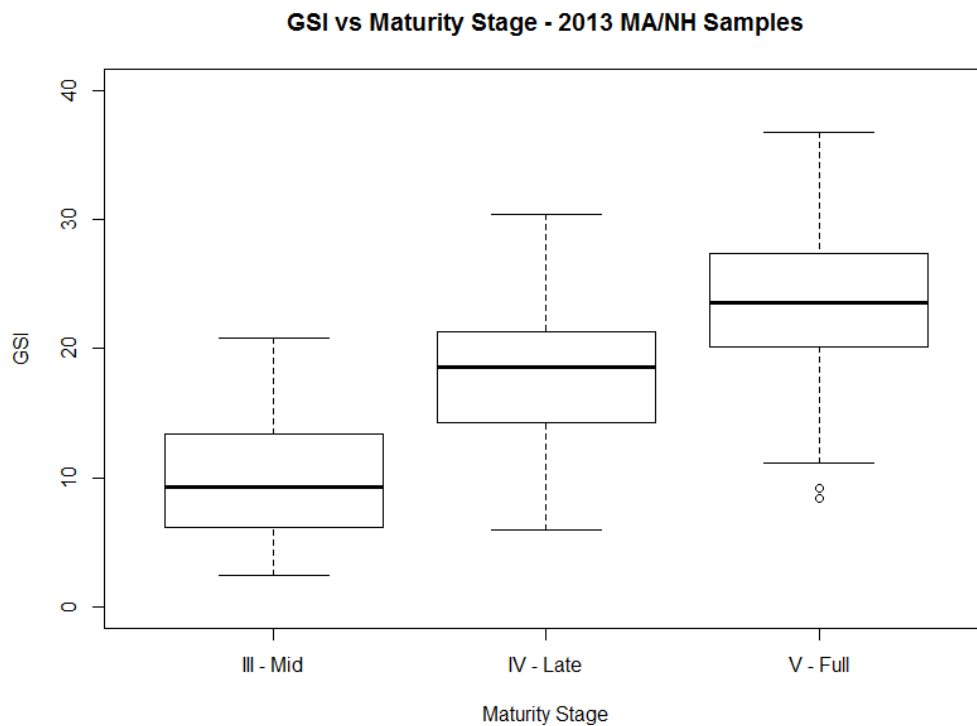


Figure 2. Female GSI by date from 2013 MA-NH samples. The red line indicates a significant positive linear relationship between GSI and sample date.

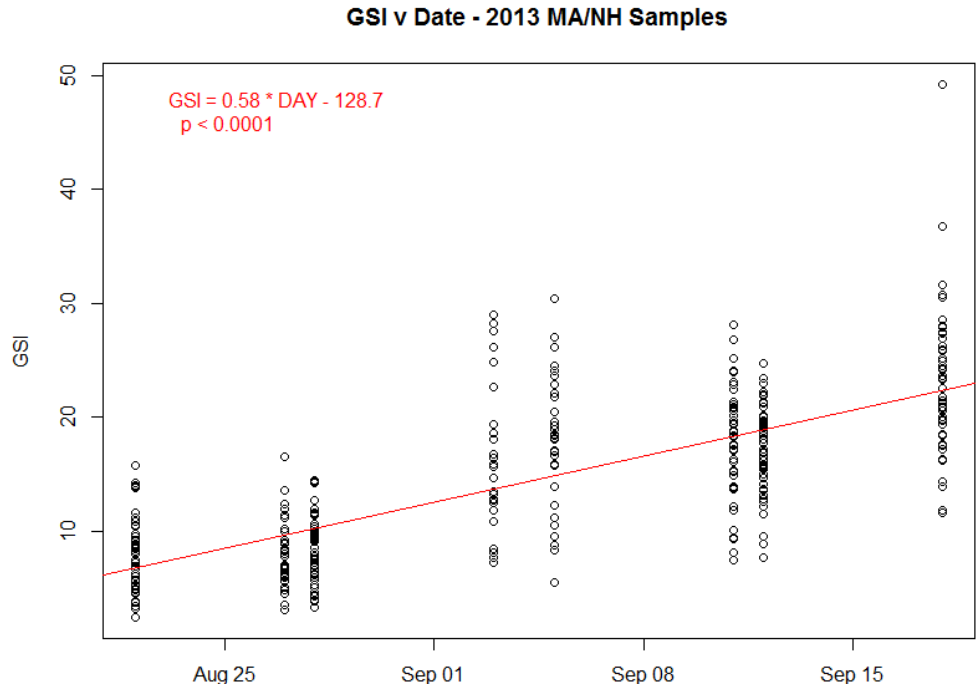


Figure 3. Boxplots of GSI by length bin from all sample data (based on total length).

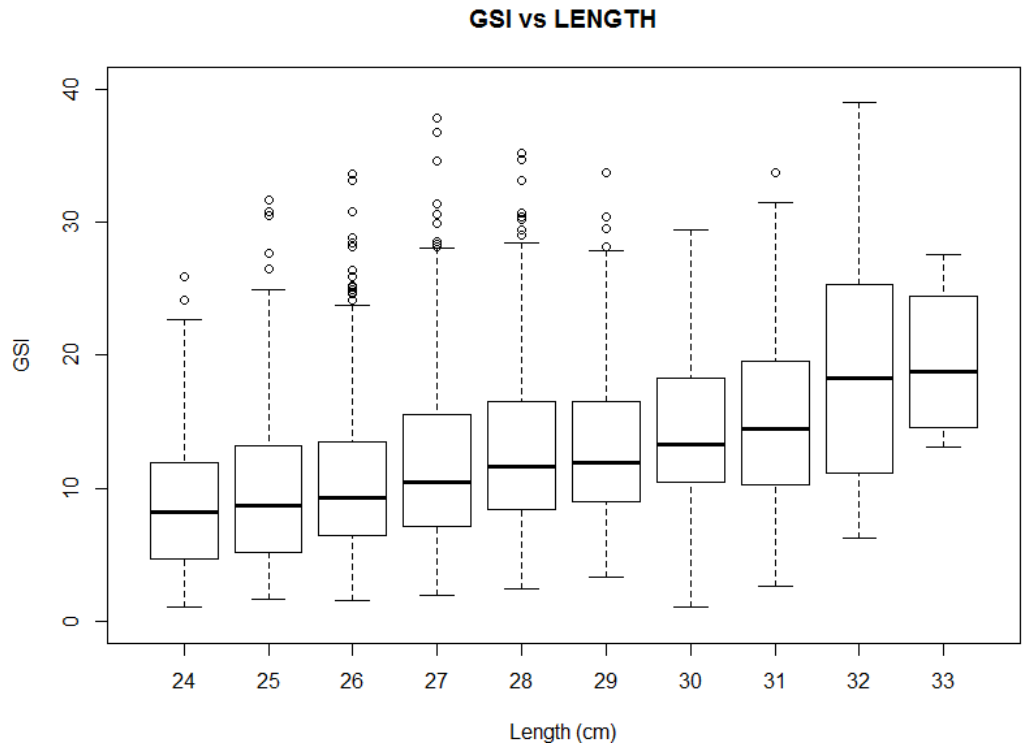


Figure 4. Boxplots of GSI at Stage V (full maturity) by length bin. The current size-based GSI triggers are shown in red (GSI = 15 for 24-27 cm; GSI = 20 for 28+ cm).

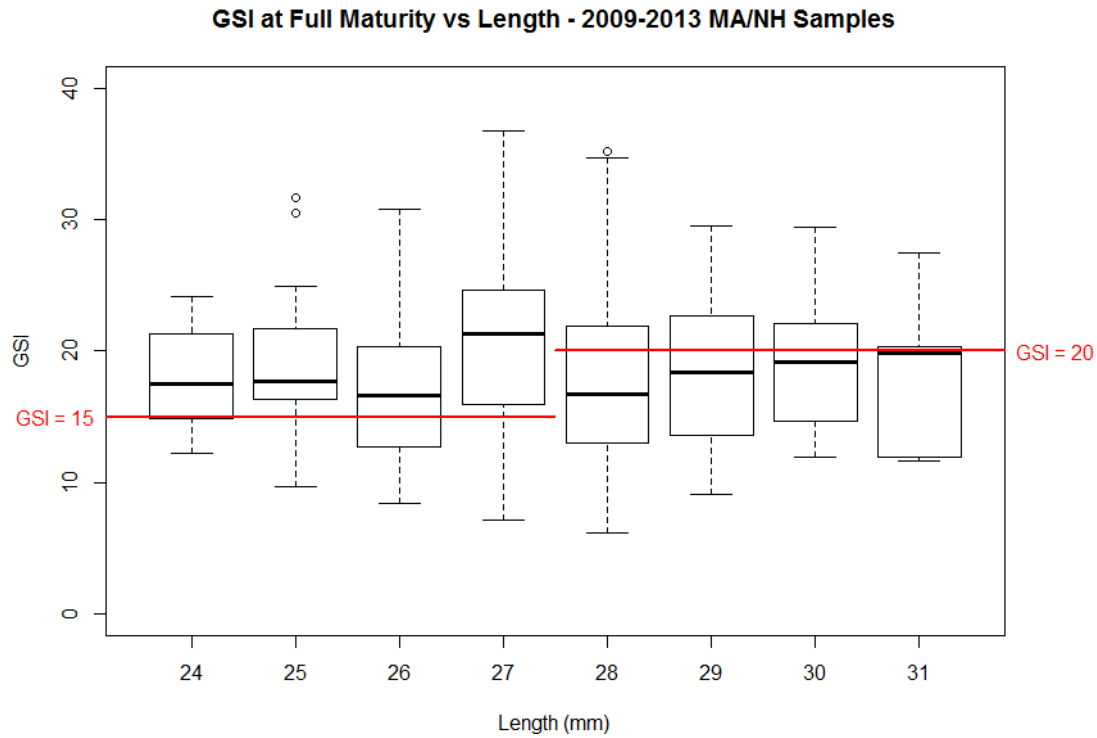


Figure 5. Observed fish length from MEDMR sampling of the MA-NH fishery in 2010. Note the significant decrease in observed fish length over the course of the season.

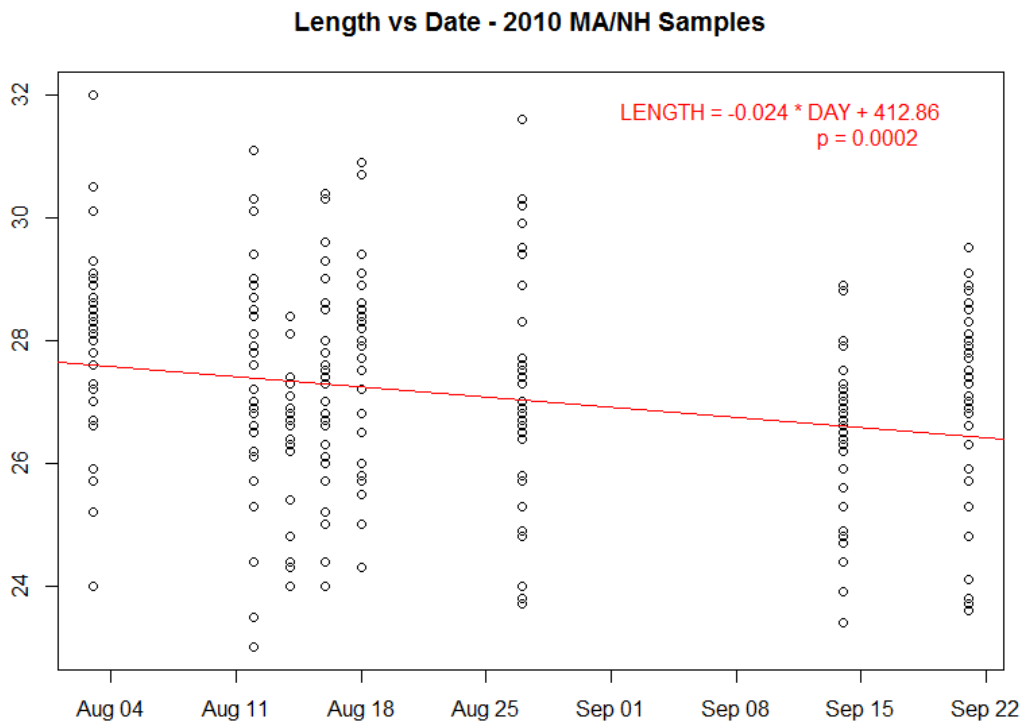


Figure 6. Distribution of GSI values for herring classified as Stage V (full maturity). The GSI value at a series of quantiles are shown in red.

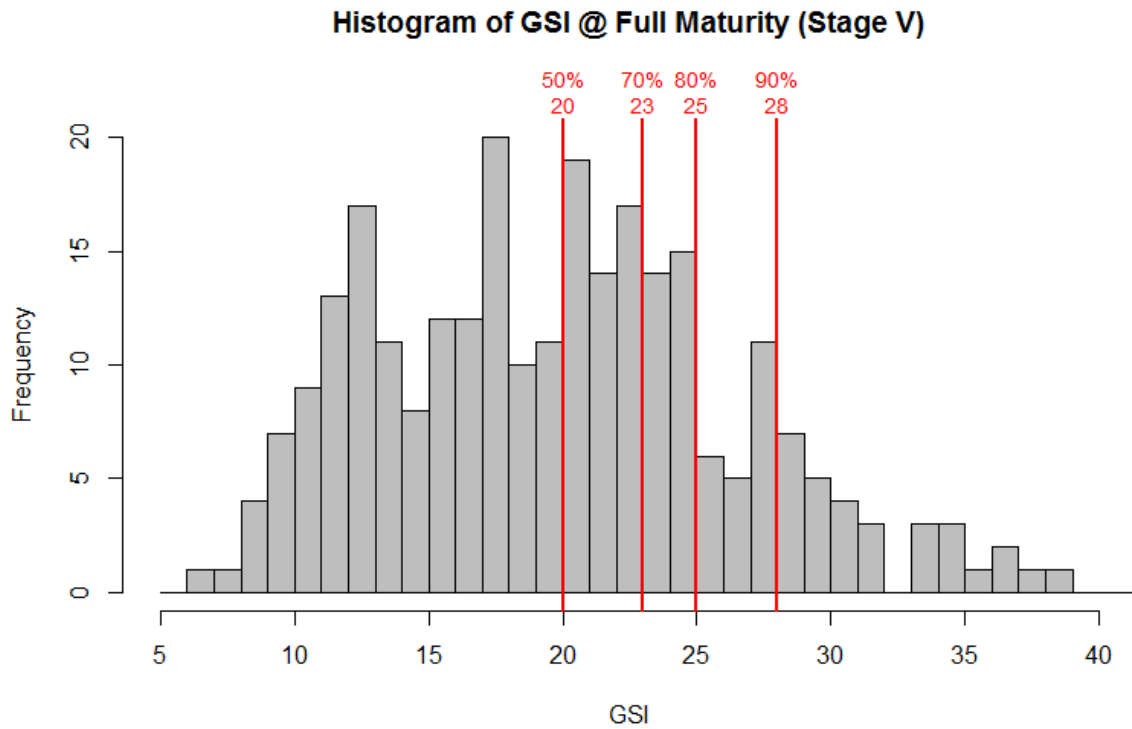


Figure 7. Forecasted dates when GSI₃₀ exceeded a range of GSI_{trigger} values for sample data from the Western Maine (WM) and Massachusetts-New Hampshire (MA-NH) spawning areas combined. A diagonal line represents a significant linear relationship between GSI₃₀ and sample date. Gray points with error bars represent the mean GSI₃₀ per sample +/- 2 standard errors.

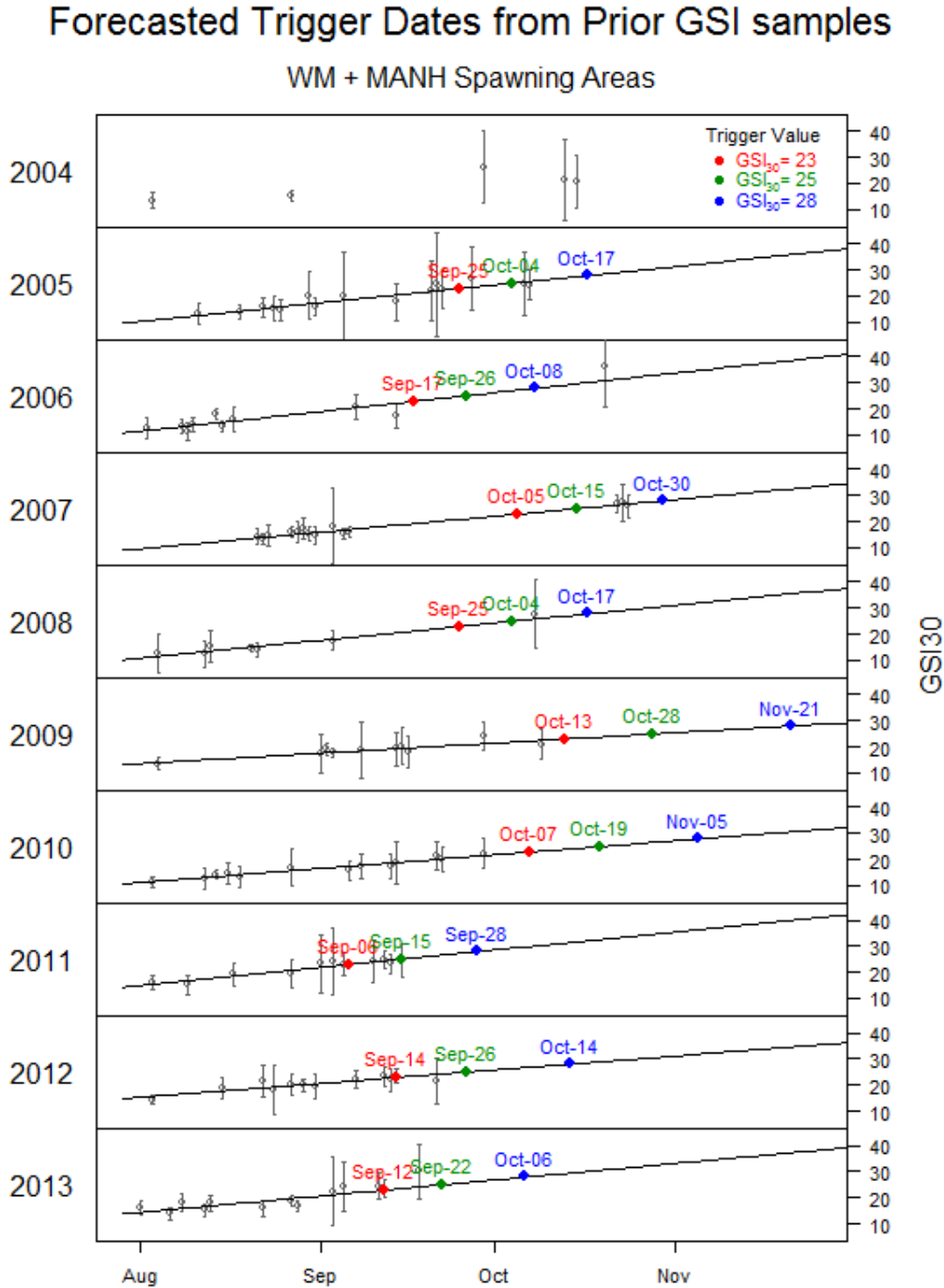


Figure 8. Boxplots of forecasted trigger dates for the WM and MA-NH spawning area combined (same data from Figure 7). The median date for each trigger value is labeled and could be used to set a default closure date for when sufficient samples are unavailable to forecast a trigger date.

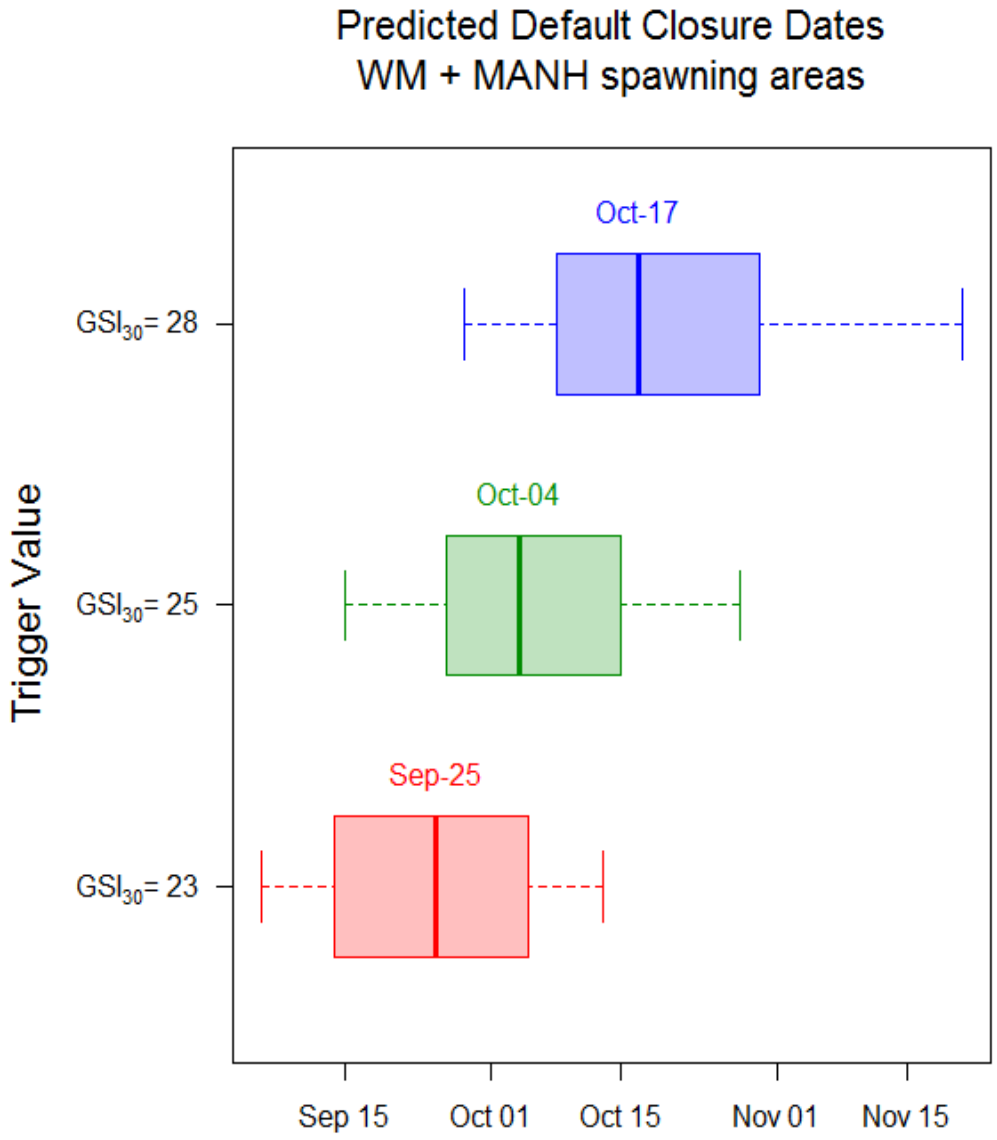


Figure 9. An example implementation of a modified GSI-based closure system using 2013 sample data from the MA-NH spawning area. A significant linear increase in GSI₃₀ is detected after six samples (Sep-1st). Projecting this relationship forward, a closure date is forecast for Sep-13th. As additional samples are collected, the linear relationship and forecasted closure date are updated. If the choice was made to select a closure date at 5 days prior, a Sep 11th closure would have been announced on Sep 6th. The gray region identifies default t closure period associated with the trigger value used in this example (GSI₃₀ = 25).

Trigger Value
GSI₃₀=25

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