SUMMARY REPORT

WORKSHOP ON ATLANTIC HERRING ACCEPTABLE BIOLOGICAL CATCH CONTROL RULE MANAGEMENT STRATEGY EVALUATION

MAY 16-17, 2016
Portland, Maine

INTRODUCTION

The New England Fishery Management Council (Council) is currently developing Amendment 8 to the Atlantic Herring Fishery Management Plan. Through Amendment 8, the Council expects to establish a long-term control rule for specifying the Acceptable Biological Catch (ABC) for the Atlantic herring fishery. A control rule is a formulaic approach for establishing a catch limit or target fishing level that is based on the best available scientific information. It provides guidance to the Scientific and Statistical Committee (SSC) regarding how to specify the ABC for Atlantic herring based on what is known or remains unknown about the stock and the Councilôs risk tolerance. Moreover, the ABC control rule is needed to create a buffer between the overfishing limit (OFL) and ABC to account for scientific uncertainty, such that there is an acceptable level of risk regarding whether the Atlantic herring OFL will be exceeded in any given year.

The goals of Amendment 8 are to:

1. Account for the role of Atlantic herring within the ecosystem, including its role as forage.
2. Stabilize the fishery at a level designed to achieve optimum yield.
3. Address localized depletion in inshore waters.

An objective of Amendment 8 is to develop and implement an ABC control rule that manages Atlantic herring within an ecosystem context and addresses the goals of Amendment 8. The purpose of Amendment 8 is also to address the biological needs of the Atlantic herring resource as well as the ecological importance of Atlantic herring to the greater Atlantic region in a manner that is consistent with the requirements and intent of the Magnuson-Stevens Act. Amendment 8 is being developed to address concerns raised by the Amendment 4 lawsuit and the issues raised by the SSC during the development of the 2013-2015 Atlantic herring specifications, when the SSC was asked by the Council to examine some alternative control rules that recognize the special ecosystem status of herring as important forage.

In January 2016, the Council approved conducting a Management Strategy Evaluation (MSE) to support the development of alternatives regarding the ABC control rule. MSE can be a collaborative decision-making process, involving upfront public input and more technical analysis than is normally possible through the amendment development process. Stakeholders collaboratively identify the characteristics necessary to construct a simulation tool that will evaluate some aspect of the assessment and management system (e.g., ABC control rules) for achieving objectives.

MSE is being used here to help determine how a range of control rules may perform relative to identified objectives. This is the first application of the MSE approach for a fishery managed by the New England Fishery Management Council. An early step of this MSE was a public workshop on May 16-17, 2016 in Portland, Maine to develop recommendations to the Council for a range of potential objectives of the Atlantic herring ABC control rule, how these objectives may be evaluated (i.e., associated performance metrics), and the range of control rules that would undergo simulation testing. The workshop agenda is included in Appendix I. This report summarizes the workshop and its outcomes.

WORKSHOP GOALS

The Council hosted this workshop to:

1. Develop a common understanding of Management Strategy Evaluation.
2. Develop recommendations to the Council for:
    a. A range of potential objectives of the Atlantic herring ABC control rule,
    b. Quantitative metrics to evaluate the performance of control rules relative to the objectives, and
    c. A range of control rules to be evaluated and/or the general characteristics of a control rule.
3. Develop a common understanding of the potentials and limitations of models that may affect simulation testing, and given those, identify which uncertainties are most important to resolve.
4. Provide an opportunity for stakeholders of the Atlantic herring fishery to provide greater input than typically possible at Council meetings, in an environment that supports constructive and open dialogue between users of the resource, scientific experts, fishery managers, and other interested members of the public.

WORKSHOP PARTICIPANTS

The workshop was organized by a steering committee comprised of Council members and staff of the Council, Northeast Fisheries Science Center (NEFSC), and the Greater Atlantic Regional Fisheries Office (GARFO). The workshop was conducted by a primary facilitator and four small-group discussion facilitators. The workshop drew diverse participation of 69 individuals, including: herring fishermen and industry representatives; lobstermen; commercial, party/charter and private angler fishermen of tuna, groundfish, and striped bass, fishing community and environmental non-profit organization staff; scientists; whale-watch businesses; federal and state agencies; Herring Committee and Advisory Panel members, and Council staff. Of those 69, 61% attended for two days, 29% attended for just the first day, and 10% attended for just the second day. Workshop participants are listed in Appendix II.

WORKSHOP OUTCOMES

Herring ABC Control Rule Management Strategy Evaluation

The morning of the first day included overview presentations about MSE and the data available to inform our understanding about herringôs role in the ecosystem. MSEs are being used in fisheries contexts where systems are complex, multiple objectives exist, and uncertainties remain. Keys steps of MSE typically include: 1) specifying management objectives and corresponding performance metrics (i.e., how to quantify the degree to which objectives are met), 2) identification of implementable harvest strategies, 3) development of operating models (i.e., simulation tools for forecasting anticipated performance), 4) simulation testing, and 5) reporting of results, which often includes consideration of tradeoffs. MSEs can be both cooperative and iterative, which promotes transparency in how decisions are made. In addition to evaluating the anticipated performance of candidate strategies, the MSE process can help identify important information needs and opportunities to improve information for future decisions. Additionally, a MSE can be revisited in future years, to help understand actual performance of the management strategy (e.g., control rule) that is implemented and consider how to potentially modify it in light of its performance relative fishery objectives. Following the opening presentations, participants were provided an opportunity to review goals for the workshop and ask questions about initiating a MSE.

Spatial Scales

The current specifications process for the Atlantic herring fishery is such that every three years, the annual ABC is set for the following three years using a control rule. This is an ABC for the entire Atlantic herring stock area, which extends from Maine to Cape Hatteras, North Carolina. After a management uncertainty deduction, the resulting Annual Catch Limit (ACL) is divided among four management sub-areas by percentages set by the Council (i.e., sub-ACLs).

A number of workshop participants were concerned with ecosystem needs at finer scales than the stock area and were interested in developing a catch control rule that took into account finer scale information. There was an interest developing a more formulaic approach for how the sub-ACL percentages are determined.

The workshop facilitator, technical experts, Council members and staff chimed in to explain that, while there would be value in incorporating finer scale spatial aspects to the simulations, the models are not sufficiently developed to do so during the current iteration of the MSE (i.e., with simulation testing scheduled to occur in the summer of 2016). However, the Northeast Fisheries Science Center is actively working to improve modeling capacity. While input was welcomed on how the data and models may be improved, the workshop was primarily focused on developing input to shape the current MSE. Additionally, the Council has opted, thus far, to focus Amendment 8 on developing ABC control rules; the Council would need to expand this action to consider sub-ACL control rules, or could do so through a future action. Finally, the Council is currently addressing localized depletion concerns in Amendment 8 through the work of the Plan Development Team, Advisory Panel, and Herring Committee.[1]

[1] See herring-related meeting summaries since December 2015 at: www.nefmc.org.

Fishery Objectives and Performance Metrics

On the afternoon of the first day, the workshop participants identified potential management objectives to be evaluated in the MSE. Participants identified both fundamental and means objectives. Fundamental objectives reflect core values, whereas means objectives are the steps one would take to achieve a particular fundamental objective.

Participants were divided into four small groups to brainstorm management objectives that could be met using an ABC control rule and evaluated through the current MSE of ABC control rules. Such objectives must be quantifiable and able to be modeled as responsive to a control rule. The groups also classified objectives as either fundamental or means objectives. The facilitators allowed participants to develop objectives individually and then discuss the range of objectives within their small groups. Participants were also allowed the scope to discuss fishery objectives that could perhaps be evaluated by a future MSE process, pending development of modeling capabilities (e.g., considering spatial dynamics within the Atlantic herring stock area), as well as objectives that may be met through management tools other than an ABC control rule. Participants were not asked to prioritize or rank the objectives, and encouraged to develop a broad range of objectives, even if they sometimes appeared to be contradictory to each other. The small groups then reported their objectives out to the large group, and commonalities were discussed.

During the morning of the second day, attendees were presented with a compiled list of fishery objectives, organized by those that could most clearly be met with an ABC control rule and evaluated by the current MSE (Table 1), those that may be evaluated in a future MSE pending development of modeling capabilities (Table 2), and those that may be met through management tools other than an ABC control rule (Table 3). As a full group, the participants then focused on identifying performance metrics for the first group of objectives, those that could be met using an ABC control rule and evaluated in the current MSE (Table 1).

Table 1 - Objectives and associated performance metrics recommended by workshop participants that can be met with an ABC control rule and evaluated by the current MSE

Objective		Performance Metric
Fundamental	**Means**	
• Maintain sufficient herring population for forage needs • Prevent overfishing of herring	• Ensure that catch limits allow sufficient herring for predators	• % years herring SSB > B_{MSY} • % years herring SSB < ½ B_{MSY} • % years herring SSB is 30-75% of B_0 • B_{target} > B_{MSY} • Are predators at their ~B_{MSY} when not overfished? • Weight/length or fat content of predator groups (birds, tuna, whales, demersal fish) and herring • Degree of herring surplus production • Maintain B_{MSY} at 4x natural mortality
• Maximize yield for herring fleet • Maximize profit for herring fleet	• Achieve Maximum Sustainable Yield or Optimum Yield	• F relative to F_{ref} • Proportion of years ABC > the catch associated with F_{MSY} • Average annual catch • Minimum number of years fishery closes • Revenue or cost over time • Profit per ton or unit effort
• Ensure herring catch temporal stability	• Limit annual variation in quota	• Fluctuations in catch from one time step to the next
• Maintain a herring population with normal size/age structure	• Ensure appropriate fishing selectivity/ intensity	• Herring age structure • Common tern productivity of 0.8[a]
• Maintain predator abundance/ condition	• Ensure that catch limits allow sufficient herring for predators • Establish a forage set-aside	• Abundance or condition of some generic herring predators

Notes:
[a] Productivity measured as the number of chicks per nest that survive to fledge. Common terns are present throughout the range of herring, and their chicks eat <10 cm herring. A May 27, 2016 letter to the Council from the U.S. Fish and Wildlife Service indicated that a productivity of 0.8 might not actually be the best indicator.

Table 2 - Objectives that may be met with an ABC control rule and evaluated by a future MSE

Objective		Performance Metric
Fundamental	**Means**	
• Sustain high employment		
• Sustain bird populations reliant on herring	• Ensure sufficient total and/or nearshore catch	

Note: The workshop participants did not focus on developing performance metrics for these objectives.

Table 3 - Objectives that mat be met through management tools other than an ABC control rule

Objective		Performance Metric
Fundamental	**Means**	
• Maintain steady lobster bait supply	• Monthly catch control to limit within year variation • Change dates of herring fishing for tuna/lobster	
• Minimize user conflicts or avoid localized depletion	• Revise within-stock (sub-ACL) catch limits	• Number of for-hire trips between Provincetown and Hyannis within a 4-week window. Determine expected relationship to herring abundance.
• Sustain nearshore predator populations	• Ensure nearshore herring presence	
• Ensure biodiversity	• Manage considering herrings top-down (e.g., effect on calanus) and bottom-up (e.g., effect on herring predators) impacts	
• Ensure spawning herring protection	• Use temporal harvest restrictions	
• Ensure fleet diversity within and among species user groups		
• Account for climate change		
Note: The workshop participants did not focus on developing performance metrics for these objectives.		

Control Rules

In the afternoon of the second day, the workshop transitioned to identify features of control rules that should be tested in the simulation work. Ideas were again generated through small-group discussion and then reported on to the full group. The small groups were asked to respond to the following questions (the responses summarized here should not be considered consensus). Table Table 4 lists the specific characteristics of control rules that participants would like to see evaluated.

1. *Should herring catch or the fishing mortality rate (F) respond to herring biomass (both increasing and decreasing biomass? If so, how? If not biomass, what?*

Generally, participants felt that herring catch or fishing mortality rate (F) should respond to changes in herring biomass. Most participants were more comfortable thinking in units of catch than F, which may help inform future conversations about control rules.

2. *Are there points at which a catch or fishing mortality rate should change, either in high or low biomass scenarios?*

Upper and lower bounds should be considered, the value of which could be driven by several things: amount for forage, amount for uncertainty, amount for climate change effects, etc. The justification for any threshold value should be clear.

3. *At what frequency should control rules be implemented – every year, every three years, every five years?*

In addition to the current three-year catch setting process, participants would like one- and five-year processes evaluated. Other ideas offered included having the timing of the catch setting process align with assessment updates, or to not have a set interval, but trigger decision processes based on changes in stock status or unusual event.

Table 4 - Characteristics of control rules that workshop participants would like to be evaluated

- Explore a broad range of control rule shapes in terms of how catch or F respond to biomass. Examples include:
  - Set-aside (as unfished) 30% of herring biomass as forage for birds and other predators
  - Reduce catch (F) beginning at 75% of the unfished SSB
  - Close the fishery (catch = 0) when SSB is at or below 40% of the unfished SSB
  - Do not close the fishery.
  - Use B_{MSY} and B_0 as references in control rule and metrics
- Evaluate effect of setting catch annually, versus using the same catch for three or five years.
- Maintain a constant catch at ôhigh biomassô but cap mortality at some point as biomass declines (in control rule literature this is called conditional constant catch).
- Restrict the degree to which catch can change annually.
- Consider including a specific forage buffer within scientific uncertainty (ABC=OFL-forage need), however, the forage need is uncertain.
- Explore constant catch (in perpetuity).
- Identify minimum and max catch amounts at low and high biomass respectively.

Secondarily, participants offered the following to consider regarding control rules:

- If fishery closures are part of a control rule, then devise plan to ensure fleet is still intact when the fishery reopens in future (sustaining capital).
- A major uncertainty is predator response to herring abundance. Advance this understanding, so that a herring control rule might respond to predator conditions.

- Similarly uncertain are environmental variables as they relate to the effect on herring abundance and the ecosystem.
- Management responses to low stock sizes important.
- Consistency and stability in metrics also likely to be important to many participants; some small groups discussed use of ñbuffersò or similar variants of control rules that attempt to limit the magnitude of immediate ABC changes.
- Ideally, the performance metrics simulated by the forecasting model would also be monitored in the real world.

ADDITIONAL COMMENTS

- Broad recognition that herring are needed ñat the dock and in the waterò.
- Seabirds have been observed eating butterfish in lieu of herring, but chicks cannot swallow the butterfish.
- Lobstermen need a seasonal distribution of herring, to ensure a consistent supply of bait.
- Assessment uncertainty should be reduced as much as possible, but also clarified to improve transparency. All steps from the biomass estimate to catch allocations should be visible and explained to be sure things are being accounted for, and there is no double counting of a particular uncertainty.
- Added transparency and formalization of a decision-making process was seen as valuable, particularly if process is inclusive and understandable.

NEXT STEPS AFTER WORKSHOP

Workshop outcomes are being vetted through the Herring Plan Development Team (on May 23, 2016) Herring Advisory Panel (on June 1, 2016) and Herring Committee (on June 2, 2016) prior to approval by the Council, likely at its June 2016 meeting. After Council approval, simulation testing of control rules will be conducted by a team of scientists at the Northeast Fisheries Science Center with the support of contractors.

After the simulations, preliminary results will be reviewed at a public meeting, likely in early fall 2016, though the meeting format has yet to be determined (e.g., workshop, Committee meeting). After the MSE is complete, the outcomes will help the Council evaluate tradeoffs between ABC control rule objectives and which control rules would most likely meet the goals of Amendment 8 and form the range of alternatives. It is expected that the MSE will be peer reviewed, likely in 2017.

WORKSHOP EVALUATION

Workshop attendees were asked to fill out an evaluation form. To date, 15 forms have been received. Table 5 includes the nine closed-ended questions with the average response. On a scale of one to five, with one being ñstrongly disagreeò and five being ñstrongly agree,ò the participants on average generally agreed that they were well-informed about the workshop, had sufficient background materials, and that the presenters and facilitators were well prepared and clear. They also agreed that there was sufficient opportunity for input. The lowest responses were between ñneutralò and ñagreeò to the questions of whether the workshopôs goals were met and whether it lived up to expectations. The highest response, between ñagreeò to ñstrongly agreeò was that a follow-up workshop after the simulations would be helpful.

Table 5 - Workshop evaluation questions

Question	Average Response
1. I was well-informed about the workshop and its goals/objectives.	4.1
2. The background material provided was sufficient to feel prepared for the workshop.	3.9
3. The facilitators and presenters were well-prepared.	4.0
4. The presentations were clear and made technical information understandable.	4.1
5. I had sufficient opportunity to provide input.	4.1
6. The workshopôs goals/objectives have been accomplished.	3.3
7. The workshop lived up to my expectations.	3.5
8. A follow-up workshop after the simulations would be helpful.	4.6
9. In general, a workshop is an effective forum to give input in the Council process.	4.0
Response codes: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree	

APPENDIX I - WORKSHOP AGENDA

Day 1 | Monday, May 16

9:00 AM **Workshop registration**

10:00 **Workshop welcome**
Terry Stockwell, Chairman, New England Fishery Management Council

10:05 **Workshop introduction and opening remarks**
Dr. Brian Irwin, Workshop facilitator, University of Georgia/USGS
- Workshop goals, desired outcomes, roles, and expectations
- Management Strategy Evaluation process

10:40 **Full group discussion: Feedback/questions on workshop and MSE process**

11:00 **Presentation: Herring's role in the ecosystem as framed by the data**
Dr. Sarah Gaichas, Northeast Fisheries Science Center

11:20 **Full group discussion: Herring's role in the ecosystem**

12:00 PM **LUNCH**

1:15 **Presentation: Introduction to control rule objectives**
Dr. Brian Irwin
- Fishery objectives that could be addressed by a control rule
- Measuring objectives
- Example objectives identified in other fisheries

1:45 **Breakout discussions: Atlantic herring ABC control rule objectives**
- Identify fishery objectives that could be addressed with a control rule
- Categorize objectives as either fundamental and means objectives

3:00 **BREAK**

3:15 **Full group discussion: Synthesis of input regarding control rule objectives**
- Breakout groups report out
- Identify commonalities and differences among small group outcomes
- Discuss how objectives would be measured

5:00 **Adjourn Day 1**

Day 2 | Tuesday, May 17

9:00 AM **Review Day 1 and charge for Day 2**
Dr. Brian Irwin

9:10 **Presentation: Introduction to performance metrics**
Dr. Jon Deroba, Northeast Fisheries Science Center
- Considerations for modeling: available data, types of uncertainties, etc.
- Measuring the objectives developed on Day 1

9:40 **Full group discussion: Performance metrics**
- Identify measurable performance metrics to evaluate control rule performance, given the objectives and likely model structures discussed
- Identify which model uncertainties are most important to consider.

11:00 **BREAK**

11:15 **Presentation: Introduction to ABC control rules**
Dr. Jon Deroba

12:00 PM **LUNCH**

1:15 **Breakout discussions: Control rules for the Atlantic herring ABC**
- Identify features of control rules that are desirable
- Identify specific control rules that should be considered

2:15 **Full group discussion: Synthesis of input regarding control rules**
- Breakout groups report out
- Identify commonalities and differences among small group outcomes

3:00 **BREAK**

3:15 **Workshop outcomes and next steps**
- Summarize brainstormed list of potential objectives, performance metrics, and control rules to recommend to the Council
- Review the process for considering workshop outcomes by Council
- Review plans for continued development of the MSE

4:00 **Adjourn Day 2**

APPENDIX II - WORKSHOP ATTENDEES

Primary Facilitator
Brian Irwin

Small-Group Facilitators
Madeleine Hall-Arber
Jessica Joyce
Laura Singer
Tiffany Vidal

Steering Committee
Deirdre Boelke
Jon Deroba
Rachel Feeney
Sarah Gaichas
Peter Kendall
Matt McKenzie
Carrie Nordeen

Staff Assistants
Andy Applegate
Maria Jacob

Herring Committee
Vincent Balzano
Mark Gibson
Doug Grout
Jeff Kaelin
Cate O'Keefe
John Pappalardo
Terry Stockwell
Mary Beth Tooley

Herring Advisory Panel
John-Paul Bilodeau
Ray Kane
Zach Klyver
Gerry O'Neill
Chris Weiner

Herring PDT
Tim Cardiasmenos
Matthew Cieri
Ashton Harp
Min-Yang Lee
Renee Zobel

Other Attendees
Katie Almeida
James Becker
Michael Blanchard
Kaycee Coleman
Herman Coombs
Dave Cousens
Rip Cunningham
Gavin Fay
Clare Fitz-Gerald
Don Frei
George French
Erica Fuller
Sean Gehan
Barry Gibson
Dave Goethel
Beth Goettel
Pam Lyons Gromen
Dickie Huntley
Lisa Kerr
Keith Landrigan
David Libby
Alexander Marshall
Ben Martens
Patrice McCarron
Jean-Jaques Maguire
Scott Mercer
Theresa Mercer
Hugh Mitchell
Kyle Molton
Nathaniel Moody
Michael Pete Morse
Thomas Nies
Owen Nichols
Patrick Paquette
John Pappas
Ryan Raber
Alison Rieser
Glenn Robbins
Rich Ruais
Arthur Sawyer
Erin Schnettler
Lauren Scopel
Dan Sproul
John Stanley
Pam Thames
Elliot Thomas
Steve Train
Stephen Weiner
Gregg Wells

Attendees other than facilitators, steering committee, and staff:

14% Herring Committee members

7% Herring Advisory Panel members

7% Herring Plan Development Team members

9% Herring fishery

12% Lobster fishery

4% Environmental non-governmental organizations

25% Other fishery (tuna, groundfish)

22% Federal/state agencies, scientists, other

APPENDIX II – ACRONYMS/DEFINITIONS

ABC	Acceptable Biological Catch
ACL	Annual Catch Limit
B_{MSY}	The stock biomass that would produce MSY when fished when F = F_{MSY}.
B_0	The stock biomass F = 0.
B_{target}	A desirable biomass to maintain fishery stocks.
F	Fishing Mortality Rate
F_{MSY}	A fishing mortality rate that would produce MSY when the stock biomass is sufficient for producing MSY on a continuing basis.
F_{ref}	The fishing mortality rate at a particular reference point.
GARFO	Greater Atlantic Regional Fisheries Office
OFL	Overfishing Limit
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
NEFSC	Northeast Fisheries Science Center
SSB	Spawning Stock Biomass ï the total weight of sexually mature fish in a stock.
SSC	Scientific and Statistical Committee