DRAFT AMENDMENT 8 TO THE ATLANTIC HERRING FISHERY MANAGEMENT PLAN

PUBLIC HEARING DOCUMENT

Prepared by the New England Fishery Management Council
50 Water Street, Mill #2; Newburyport, Massachusetts 01950

The New England Fishery Management Council (Council) is conducting seven public hearings to solicit comments on the alternatives under consideration in Draft Amendment 8 to the Atlantic Herring Fishery Management Plan (FMP). More specifically, the Council is seeking feedback from the public on which alternatives should be selected and why. These hearings are being held by the Council in accordance with the Magnuson-Stevens Fishery Conservation and Management Act and the National Environmental Policy Act (NEPA). Following these hearings, additional opportunities for review and comment on Amendment 8 and Draft Environmental Impact Statement (DEIS) may be provided by the National Marine Fisheries Service (NMFS). The Council plans to take final action on the amendment during its September 25-27, 2018 meeting in Plymouth, MA.

Atlantic herring are migratory fish that live in large schools along the continental shelf from Labrador, Canada through Cape Hatteras, Virginia. Atlantic herring have supported an important commercial fishery since the late 19th century and play a very important role in the ecosystem as forage fish for many predators including marine mammals, larger fish, and seabirds, which support additional commercial, recreational and ecotourism industries. Atlantic herring also provide effective and affordable bait to the lobster fishery, as well as other commercial and recreational fisheries. Finally, a smaller component of herring is landed and sold for human consumption, typically overseas. Atlantic herring has been managed in this region for decades, and this action is being developed as part of an overall plan to prevent overfishing and manage Atlantic herring at long-term sustainable levels.

This public hearing document is a summary of the complete DEIS. **Relevant sections and page numbers from the main Amendment 8 DEIS document have been highlighted in red.** The public is encouraged to review the full DEIS when evaluating the potential impacts of alternatives and making comments on the measures under consideration in Amendment 8. This public hearing document has been prepared as an overview only and does not cover the wide range of issues that are more thoroughly described in the DEIS.

When the Council approved the range of alternatives and analyses in Amendment 8 for public comment in December 2017 it declined to identify preferred alternatives; therefore, at this time there are no preferred alternatives for this action.

SCHEDULE OF PUBLIC HEARINGS

Date and Time	Location
Tuesday, May 22, 2018 6:00-8:00 p.m.	**Narragansett, RI** University of Rhode Island, Graduate School of Oceanography Coastal Institute Bldg. Hazard Room 215 S. Ferry Road Narragansett, RI 02882
Thursday, May 24, 2018 6:00-8:00 p.m.	**Rockport, ME** Samoset 220 Warrenton Street Rockport, ME 04856
Wednesday, May 30, 2018 6:00-8:00 p.m.	**Gloucester, MA** Beauport Hotel 55 Commercial Street Gloucester MA 01930
Tuesday, June 5, 2018 4:00-5:00 p.m. *Immediately following the MAFMC meeting*	**Philadelphia, PA** DoubleTree by Hilton 237 South Broad Street Philadelphia, PA 19107
Tuesday, June 12, 2018 5:00-7:00 p.m. *Immediately following the NEFMC meeting*	**Portland, ME** Holiday Inn by the Bay 88 Spring Street Portland, ME 04101
Tuesday, June 19, 2018 6:00-8:00 p.m.	**Chatham, MA** Chatham Community Center 702 Main Street Chatham, MA 02633
Wednesday, June 20, 2018 2:00-4:00 p.m.	**Webinar Hearing** Register to participate - https://attendee.gotowebinar.com/register/6985865165132506115 Call in information: +1 (415) 930-5321 Access Code: 346-818-026

HOW TO COMMENT

During each hearing, Council staff will brief the public on the draft amendment before receiving comments. The hearings will begin promptly at the time indicated above. If all attendees who wish to do so have provided their comments prior to the end time indicated, the hearing may conclude early. To the extent possible, the Council may extend hearings beyond the end time indicated above to accommodate everyone who wishes to speak.

Members of the public may submit oral and/or written comments at any of the public hearings. You may also choose to submit written comments directly to the Council, in lieu of or in addition to comments provided at the hearings. Written comments must be received on or before close of business, Monday, June 25, 2018. All written and oral comments will be reviewed by the Council's Herring Committee at a meeting before final action by the Council at the September 25-27, 2018 Council meeting.

Written comments can be submitted via mail, email, or fax:

Thomas A. Nies, Executive Director
New England Fishery Management Council
50 Water Street, Mill 2
Newburyport, MA 01950

Email: comments@nefmc.org

Fax: (978) 465–3116

Please note on your correspondence
"DEIS for Amendment 8 to the Atlantic Herring FMP"

Written comments must be submitted
before 5:00 pm on Monday, June 25, 2018.

The complete DEIS and information about the amendment is posted on the Council's website at https://www.nefmc.org/library/amendment-8-2.

For questions, contact the Council office at (978) 465-0492.

CONTENTS

1.0 BACKGROUND

1.1 HERRING MANAGEMENT

Herring is managed in federal waters by the New England Fishery Management Council, and in state waters by the Atlantic States Marine Fisheries Commission (ASMFC). Individual states may set different regulations, such as possession/landing restrictions or spawning area closures. The Council's Herring FMP became effective on January 10, 2001 and included administrative and management measures to ensure effective and sustainable management of the herring resource. The federal FMP has been improved by several subsequent amendment and framework actions over the years (Amendments 1-7 and Frameworks 1-4).

The herring fishery is a primarily a limited access fishery managed under a stock-wide annual catch limit (ACL) that is allocated among four management areas (sub-ACLs, also known as management area quotas). Two areas are in the Gulf of Maine (Areas 1A and 1B), Area 2 includes southern New England and the Mid-Atlantic, and Area 3 is the Georges Bank area (Figure 1, p.27 of DEIS). The fishery catch limits are currently set every three years, and in recent years about 30% of total catch has been allocated to Area 1A and 1B combined, about 30% to Area 2, and about 40% to Area 3. There are many other measures in place that restrict herring catch and reduce bycatch.

1.2 HERRING FISHERY

Herring is used primarily in the U.S. as bait for the American lobster and tuna fisheries but is also frozen whole and canned for human consumption. Atlantic herring landings have been variable in the last decade, averaging about 90,000 mt, with the highest amount in 2009 (about 104,000 mt) and lowest in 2016 (about 65,000 mt). The herring fishery uses predominantly single and paired midwater trawl, bottom trawl, purse seine, and to a lesser extent, gillnet gear throughout the entire range. Most landings are by midwater trawl gear (about 70%), followed by purse seine gear used exclusively in the Gulf of Maine (about 25%), and from bottom trawl gear (5-10%). The average dockside price of herring has increased over the last decade, from $238 per mt in 2007 to $426 per mt in 2016. Total revenues for the fishery have been above $20 million dollars per year for some time, peaking above $30 million in 2013.

1.3 HERRING AS FORAGE

Atlantic herring play an important role as forage in the Northeast U.S. shelf ecosystem. They are eaten by a wide variety of fish, marine mammals, birds, and (historically) by humans in the region. The Northeast shelf has a complex and diverse food web and herring share the role of forage with many other species including sandlance, mackerels, squids, and hakes. However, herring are distinguished by a high energy density (caloric content) relative to other pelagic prey in the ecosystem. The relative importance of herring as forage varies by predator group, due to differences in predator life history, foraging style, and bioenergetics.

2.0 WHAT IS THE PURPOSE OF AMENDMENT 8?

The primary purpose of Amendment 8 is to modify the fishery management plan for the Atlantic herring fishery by:

1. Proposing a long-term acceptable biological catch (ABC) control rule for the Atlantic herring fishery that may explicitly account for herring's role in the ecosystem and to address the biological and ecological requirements of the Atlantic herring resource.
2. Proposing measures to address potential localized depletion of Atlantic herring to minimize possible detrimental biological impacts on predators of herring and associated socioeconomic impacts on other user groups.

Definition of an Acceptable Biological Catch (ABC) Control Rule

An acceptable biological catch (ABC) control rule is a formulaic approach for setting annual ABCs. For Atlantic herring there is an overfishing limit (OFL) that cannot be exceeded under federal law, and the ABC is generally set below the overfishing limit to prevent overfishing. The law also requires that the Council's Scientific and Statistical Committee (SSC) recommend to the Council the annual ABC, and the control rule helps provide guidance to the SSC and the Council in this process. Annual herring fishery allocations (i.e. area catch limits) are then set based on the approved ABC.

Definition of Localized Depletion and Problem Statement

Localized depletion occurs when harvesting takes more fish than can be replaced either locally or through fish migrating into the catch area within a given time period.

Council Problem Statement:

"Scoping comments for Amendment 8 identified concerns with concentrated, intense commercial fishing of Atlantic herring in specific areas and at certain times that may cause detrimental socioeconomic impacts on other user groups (commercial, recreational, ecotourism) who depend upon adequate local availability of Atlantic herring to support business and recreational interests both at sea and on shore. The Council intends to further explore these concerns through examination of the best available science on localized depletion, the spatial nature of the fisheries, reported conflicts amongst users of the resources and the concerns of the herring fishery and other stakeholders."

3.0 OVERVIEW OF AMENDMENT DEIS

Amendment 8 is extensive and the DEIS includes detailed analyses required by various federal laws. Volume I of the DEIS is about 500 pages, the content of which is briefly described here.

- ***Section 1.0*** - background information, the goals of the Herring FMP, why Amendment 8 was initiated, and a summary of the scoping process.
- ***Section 2.0*** - the alternatives under consideration; there are ten ABC control rule alternatives with two options for how ABCs are set in three-year time periods, and nine alternatives to address potential localized depletion and user conflicts with various seasonal and spatial sub-options.
- ***Section 3.0*** - the Affected Environment, summarizes the components of the ecosystem: 1) the herring resource; 2) non-target or bycatch species caught incidentally in the herring fishery; 3) protected species in the region such as marine mammals and seabirds; 4) other predator species of Atlantic herring such as Bluefin tuna and striped bass; 5) essential fish habitat (EFH) and physical environment of this ecosystem; and 6) human communities including the herring fishery and related industries (mackerel and lobster), predator fisheries, and ecotourism industries.
- ***Section 4.0*** - the potential impacts of the alternatives under consideration on all the various components of the ecosystem described in Section 3.0.
- ***Section 5.0*** - data and research needs – to be completed after the Council selects final measures.
- ***Section 6.0*** – how the proposed measures comply with various federal laws – to be completed after the Council selects final measures.

In addition, Volume II of the DEIS includes eight appendices with more detailed information including the individual scoping comments, several appendices related to the Management Strategy Evaluation used for the ABC control rules alternatives in this action, and several appendices with analyses related to localized depletion.

What is Management Strategy Evaluation (MSE)?

The Council developed Amendment 8 alternatives for the ABC control rule using Management Strategy Evaluation (MSE). MSE is a decision-making process for comparing the performance of alternatives (management strategies) under multiple, competing objectives. MSEs typically involve computer simulations of a model designed to represent a full system. The model tests various management approaches, in this case ABC control rules, to see how they perform in achieving management objectives (e.g. variability in yield, maintaining high biomass, predator considerations, employment, etc). Because there is not a complete understanding of the ecosystem and all the sources of uncertainty, MSEs are useful to test and compare how alternatives will perform under different states of nature. Atlantic herring, in particular, is a federal resource with many competing interests and tradeoffs with respect to achieving maximum net benefits to the nation. Furthermore, there is some uncertainty related to the current assessment of the resource, which can be a source of contention in the management arena. Therefore, the Council decided to use an MSE approach to help illustrate the uncertainty in the system and evaluate the performance of various ABC control rules across multiple objectives.

As part of this process, the Council held two public workshops to generate stakeholder input to help identify objectives for the MSE analysis. The ideas brought forward by the workshops were presented to the Council, and for the most part, input was adopted and included into the analyses and alternatives for Amendment 8.

4.0 WHAT IS THE TIMELINE FOR AMENDMENT 8?

Amendment 8 has been under development by the Council for four years (2015-2018). The first scoping period was February 26 – April 30, 2015. A number of concerns were raised during the initial scoping period about the potential impacts of localized depletion of Atlantic herring, and therefore, the Council expanded the scope of Amendment 8 and a second scoping period was held from August 21 – September 30, 2015. To date, the Council has hosted over 60 public meetings related to this action including scoping meetings, and opportunities for public comment at Advisory Panel, Committee, and Council meetings.

2015	Council initiates action, revises goals & objectives, two public scoping periods.
2016	Council reviews scoping comments, hosts two MSE workshops, develops alternatives.
2017	MSE peer review, approves range of alternatives, impacts analysis prepared, approves document for public comment.
2018	Submits DEIS to NMFS, hosts seven public hearings, reviews comments, selects final action (Sept), submits final DEIS to NMFS.

What's Ahead?

The Council is conducting public hearings during May-June 2018 to solicit comments on the management measures under consideration. The Council will be accepting public comments on the Draft Amendment 8 document through June 25, 2018. When selecting final management measures for inclusion in Amendment 8, the Council will review and consider *all* public comments – those received during the Council's public hearings as well as any additional comments received during the 45-day comment period on the Amendment 8 DEIS. The Council will also consider comments and recommendations from its Herring Committee, Herring Advisory Panel, and Herring Plan Development Team. Those meetings will likely take place late summer through mid-September.

The Council is then scheduled to select final management measures for Amendment 8 at its September 25-27, 2018 Council meeting in Plymouth, MA. Following that meeting staff finalizes the EIS and submits it to NMFS. After review and approval NMFS would publish proposed and final rule announcements in the Federal Register. If the action stays on that timeline, Amendment 8 is expected to be implemented during the 2019 fishing year, about May 2019.

5.0 MANAGEMENT ALTERNATIVES UNDER CONSIDERATION (SECTION 2.0 OF DEIS)

5.1 ABC CONTROL RULE (SECTION 2.1 OF DEIS)

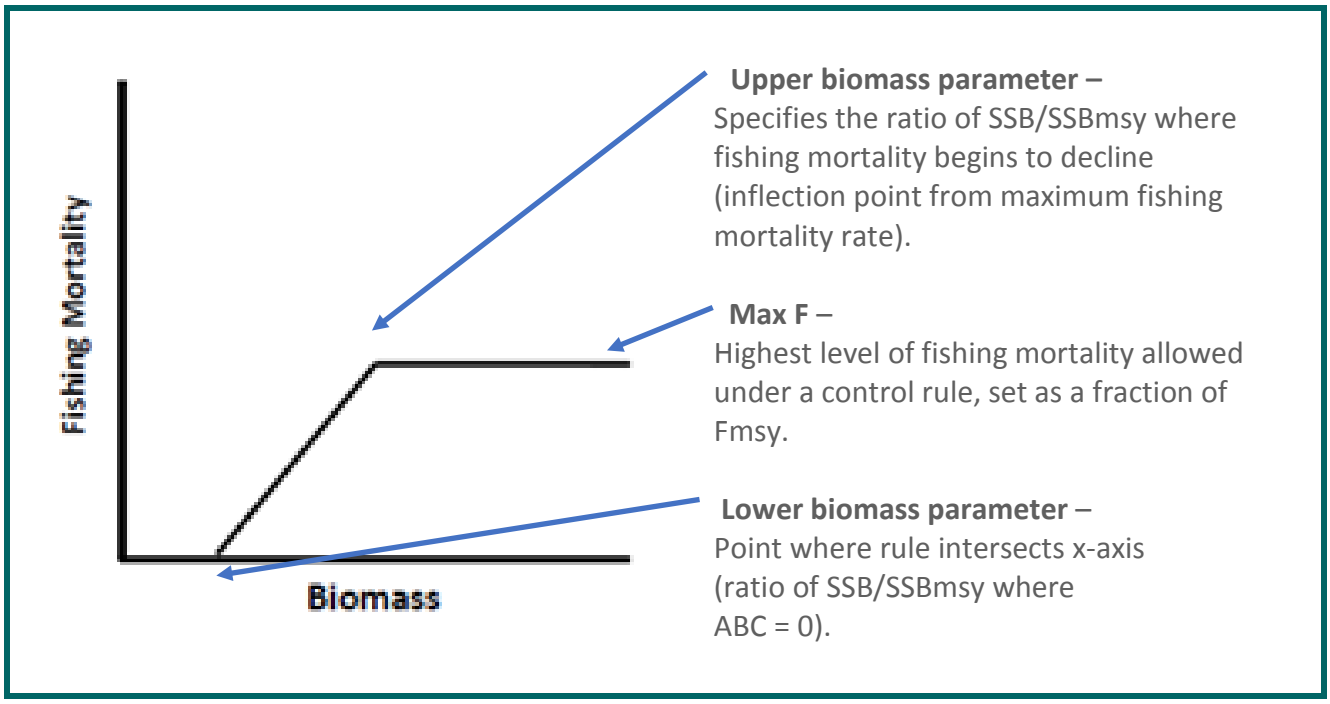
The ABC control rule used in the Atlantic Herring FMP has been modified over time and the FMP is currently using an "interim" control rule (for more details see No Action on page 33 of DEIS). This action is considering alternatives that may replace the interim control rule with a rule that is more permanent in nature, and could be applied on a longer term basis. The Council can always modify the control rule in a future action, but the intent of this amendment is to identify a control rule that will manage herring sustainably over the long-term. The stated goals of this action relative to the ABC control rule are to:

1) account for the role of Atlantic herring within the ecosystem, including its role as forage; and
2) stabilize the fishery at a level designed to achieve optimum yield.

Long-term ABC control rules need to include specific parameters, or aspects, that enable them to be used in all conditions (increasing or decreasing biomass). The three fundamental aspects of an ABC control rule are: 1) an upper biomass parameter; 2) maximum fishing mortality; and 3) lower biomass parameter. The values assigned to each of these parameters dictate the overall "shape" or function of an ABC control rule. These values drive whether fishing mortality can increase or decrease depending on the current estimate of biomass. For example, if the lower biomass parameter is greater than zero, that means ABC would be set to zero (no fishery) when biomass falls below that value; this is often referred to as a "fishery cutoff". Some of the alternatives in Amendment 8 include fishery cutoffs, and some do not.

Table 2 in the DEIS on page 39 includes a table comparing the specific ABC control rule parameter values for all of the alternatives in Amendment 8.

Figure 2 in the DEIS on page 39 compares the shapes of the ABC control rule alternatives based on the different parameter values.



Generic biomass based ABC control rule that reduces fishing mortality as biomass declines

	Brief Description of ABC Control Rule Alternatives in Amendment 8
No Action	The ABC is set at the same level for three years equivalent to the catch that is projected to produce a ≤50% probability of exceeding F_{MSY} in the third year. This policy has been used in the last two specification cycles (set at 50%).
Alt 1. Strawman A	A control rule was defined that would resemble No Action, but would be converted into a long-term policy having the parameters needed to set ABC in all cases (increasing or decreasing herring abundance). Includes a maximum fishing mortality rate of 90% of Fmsy, an upper biomass parameter of 0.5, and lower biomass parameter of 0.0, no fishery cutoff.
Alt 2. Strawman B	A control rule was defined that would prioritize herring predator forage needs based on limiting fishing mortality to 50% of Fmsy (Fmax = 0.5). This alternative also includes an upper biomass parameter of 2.0, and lower biomass parameter of 1.1. That means fishing mortality would begin to decline from the maximum of 0.5 when biomass falls below the value equivalent to two times Bmsy (2 * Bmsy), and ABC would be set to zero when biomass is less than 1.1 * Bmsy (fishery cutoff at 1.1).
Alt 3. Parameters defined upfront	A control rule was defined that would have similar fishing mortality limits to the current rule (Fmax = 0.9), but reduce fishing mortality when biomass levels are lower to better account for forage. This rule includes an upper biomass parameter of 0.7, and a lower biomass parameter of 0.3. In general, this alternative performs very similar to Alternative 1.
Alt 4a.	This series of alternatives is based on the desired performance of specific metrics, or objectives defined by the Council. Four specific metrics were highlighted from a longer list of 15 metrics evaluated in the MSE for this action. These six alternatives are expected to meet those desired outcomes, and their performance for all 15 can be evaluated. The desired outcomes are: 1) MSY = 100% (but could be as low as 85%), 2) variation in annual yield <10% (but could be as high as 25%); 3) probability of overfishing = 0%, but could be as high as 25%; and 4) probability of no fishery (ABC=) should be 0%, but could be as high as 10%. All six have slightly different parameters, and rank slightly different in terms of performance across all metrics. In general, this group of alternatives falls somewhere between Alternative 1 and Alternative 2.
Alt 4b.	
Alt 4c.	
Alt 4d.	
Alt 4e.	
Alt 4f.	

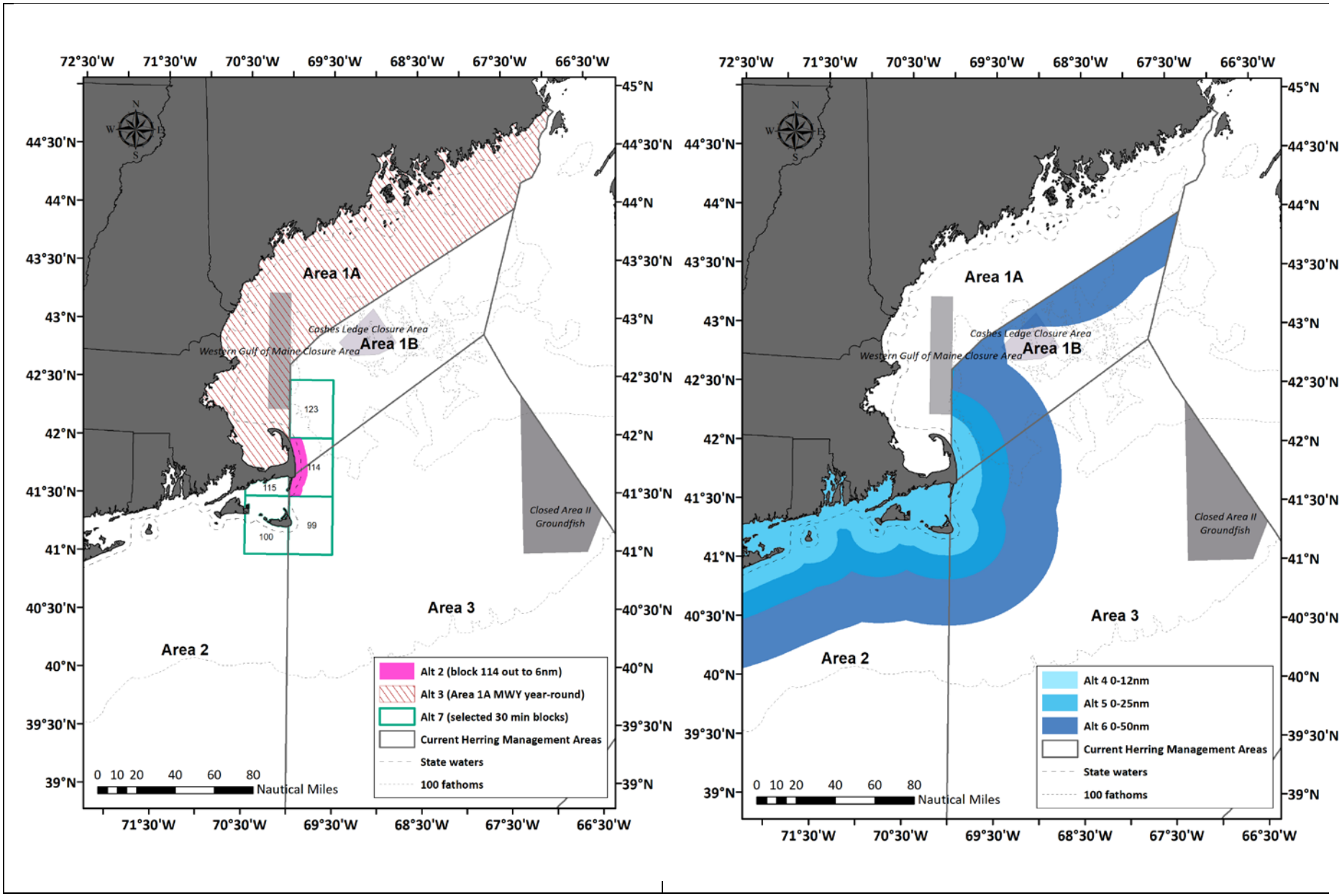
This action also includes two alternatives for how ABCs should be set for three-year time blocks **(See Section 2.1.2, page 40-41)**

- Alternative 1 – No Action - set ABC for three years at the same level for each year.
- Alternative 2 – Set ABC for three years, but with annual application of control rule, ABCs may not be the same value each year, expected to vary based on updated short-term projections.

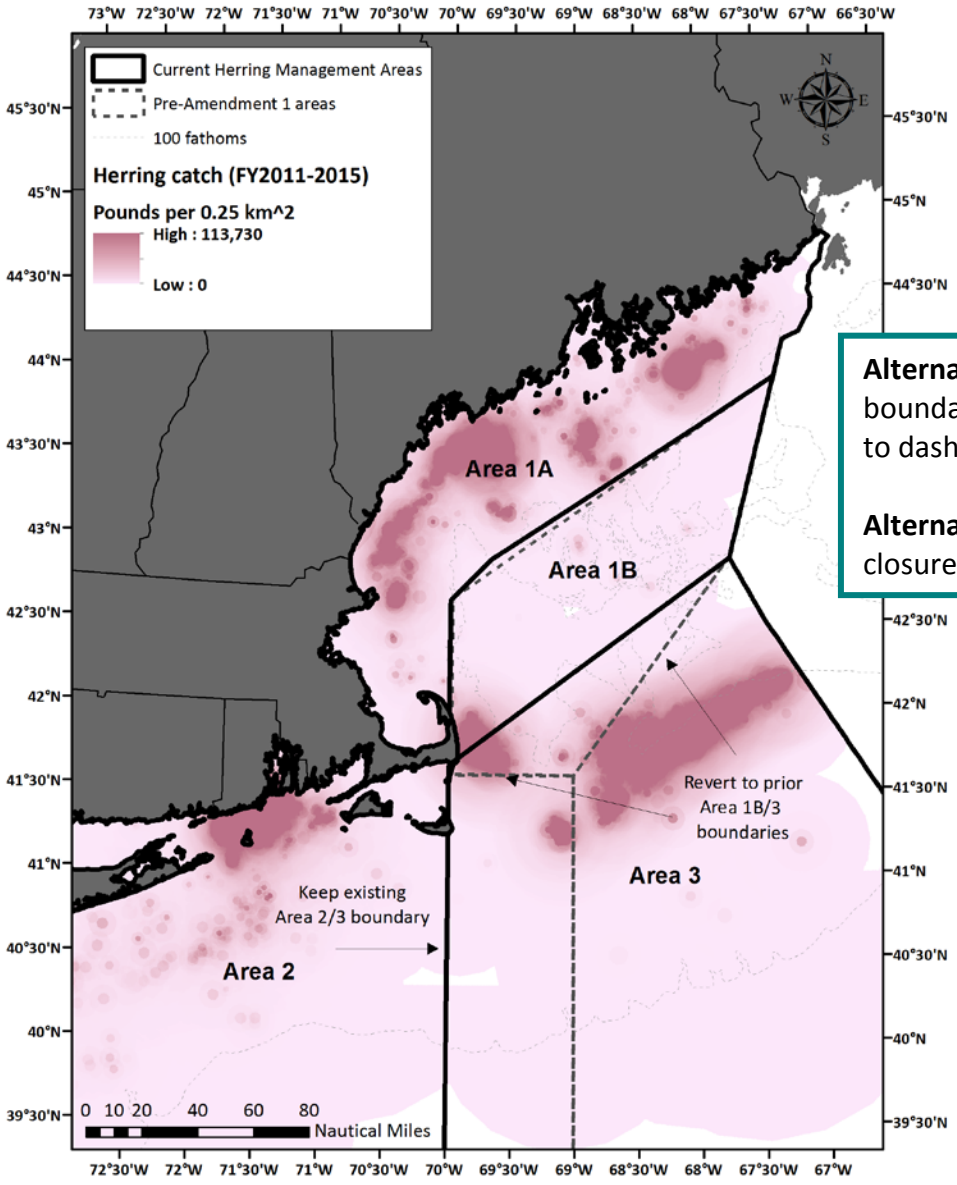
5.2 POTENTIAL LOCALIZED DEPLETION AND USER CONFLICTS (SECTION 2.2 OF DEIS)

A wide range of alternatives was developed to potentially address concerns raised by some stakeholders during the scoping process related to the potential negative socioeconomic impacts on commercial, recreational, and ecotourism businesses that rely on predators of herring from concentrated herring fishing. Figures for these alternatives are included on pages 13 and 14 below.

	Brief Description of Potential Localized Depletion and User Conflict Alternatives in Amendment 8
Alt 1. No Action	Vessels fishing for herring with midwater trawl gear would continue to be excluded from Area 1A from June 1 through September 30. (Implemented by Amendment 1 to the Herring FMP in June 2007)
Alt 2. 6nm closure in Area 114	Waters inshore of 6 nautical miles in the thirty minute square 114 would be closed to all vessels fishing for herring, regardless of gear type or herring permit type. This alternative has 2 seasonal sub-options (June 1-Aug 31 or June 1 – Oct 31).
Alt 3. Extend Area 1A prohibition of MWT gear year-round	The prohibition of midwater trawl gear in Area 1A from June 1 through September 30 would be extended to be a year-round restriction (Jan-Dec); vessels that currently use midwater trawl gear would be permitted to convert to other gear types allowed in the area.
Alt 4. 12 nm prohibition of MWT gear	Waters within 12 nautical miles south of Area 1A would be closed to midwater trawl gear. This alternative has 2 seasonal sub-options (Year-round or June 1-Sept 30 only); and two spatial sub-options (Area 1B, 2 and 3 or Areas IB and 3 only). Vessels that currently use midwater trawl gear would be permitted to use other gear types allowed in the area.
Alt 5. 25 nm prohibition of MWT gear	Waters within 25 nautical miles south of Herring Management Area 1A would be closed to midwater trawl gear. This alternative has 2 seasonal sub-options (Year-round or June 1-Sept 30 only); and two spatial sub-options (Area 1B, 2 and 3 or Areas IB and 3 only). Vessels that currently use midwater trawl gear would be permitted to convert to other gear types allowed in the area.
Alt 6. 50 nm prohibition of MWT gear	Waters within 50 nautical miles south of Herring Management Area 1A would be closed to midwater trawl gear. This alternative has 2 seasonal sub-options (Year-round or June 1-Sept 30 only); and two spatial sub-options (Area 1B, 2 and 3 or Areas IB and 3 only). Vessels that currently use midwater trawl gear would be permitted to convert to other gear types allowed in the area.
Alt 7. Prohibit MWT gear in five 30-minute squares	Vessels with midwater trawl gear would be prohibited to fish within several thirty minute squares around Cape Cod (Areas 99, 100, 114, 115, and 123). This alternative has two seasonal sub-options (Year-round or June 1-Sept 30 only); and two spatial sub-options (30 minute squares in Areas 1B, 2 and 3 or 30 minute squares in Areas IB and 3 only). Vessels that currently use midwater trawl gear would be permitted to convert to other gear types allowed in the area.
Alt 8. Revert boundary between Areas 1B/3	The boundaries between Area 1B and 3 would revert back to what they were under the original Herring FMP, maintaining the current boundary between Areas 2 and 3. This measure is expected to prevent Area 3 catch from being caught relatively close to shore. This action will not change the sub-ACLs.
Alt 9. Remove seasonal closure of Area 1B	The seasonal closure in Area 1B that currently exists from January 1 – April 30 would be removed. Framework 2 implemented it to boost herring landings when the bait market needed it most (in May before the summer lobster fishing season typically begins).



Amendment 8 Alternatives 2, 3, and 7 on LEFT and Alternatives 4, 5, and 6 on RIGHT



Alternative 8 would revert boundaries between Areas 1B and 3 to dashed lines.

Alternative 9 would remove seasonal closure of Area 1B.

Any measures selected in this section would be additive to the existing measure in the FMP implemented to address potential localized depletion of herring in Area 1A, the seasonal prohibition of midwater trawl gear from June 1 – September 30 (from Amendment 1). Furthermore, RSA compensation fishing is currently exempt from seasonal closures (January – May for Area 1A and January – April for Area 1B), as well as any closures after a sub-ACL is reached for a herring management area. However, RSA compensation fishing with MWT gear is *not* exempt from the prohibition of MWT gear in Area 1A (from June-September). The Council clarified that if any new measures are selected in this action, RSA fishing *would be* exempt from any new restrictions selected. Finally, the Council also discussed that any existing or new closures approved to address potential localized depletion and user conflicts could be modified via Amendment or framework action.

6.0 WHAT ARE THE IMPACTS OF THE MEASURES UNDER CONSIDERATION?

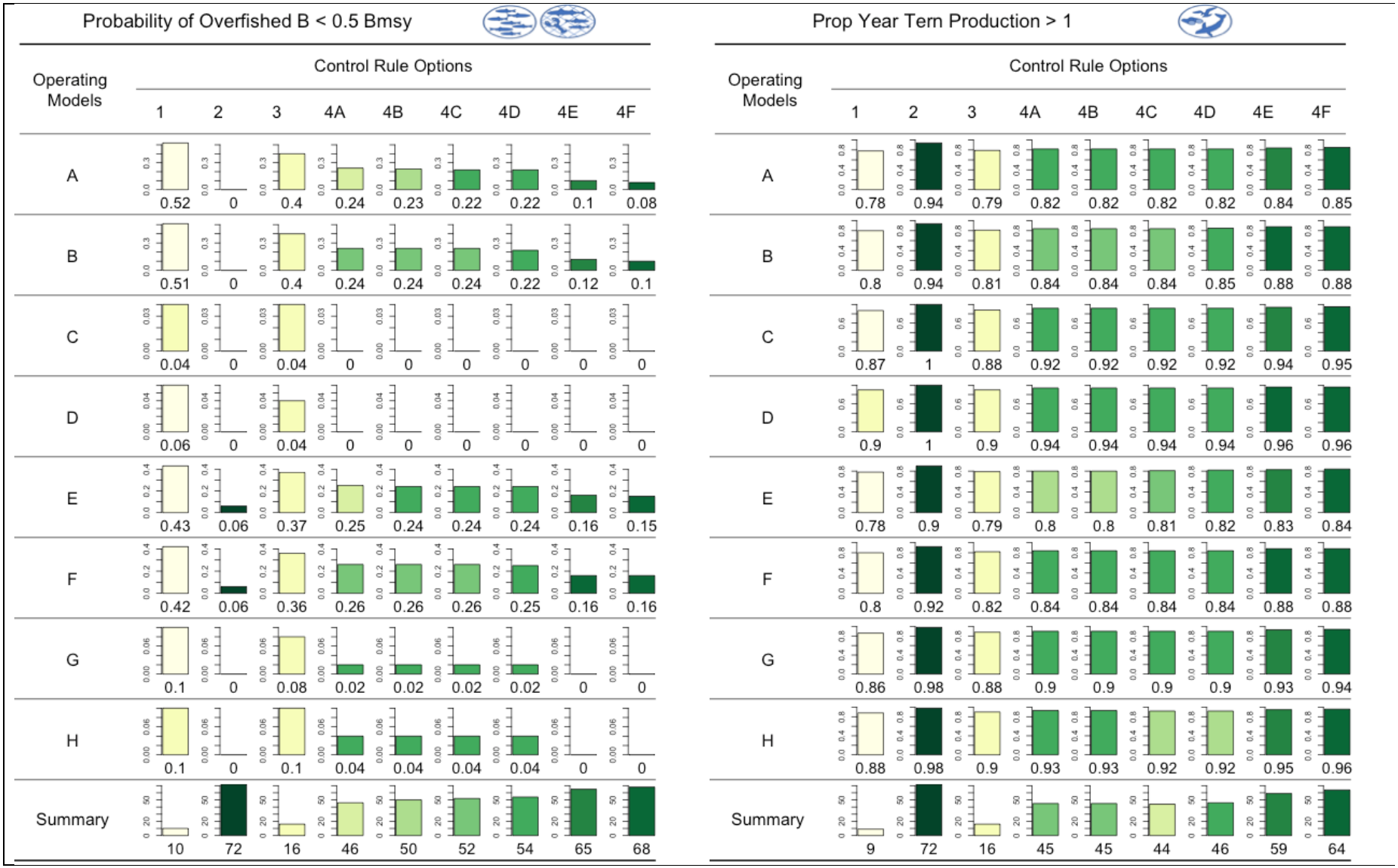
6.1 ABC CONTROL RULE ANALYSES

The primary analyses used to develop and evaluate the ABC control rule alternatives in Amendment 8 are model results from the Management Strategy Evaluation. A general "user guide" was prepared to review why MSE analyses are used in fisheries management, and to help summarize the results (Appendix V).

This MSE included three models: a Gulf of Maine/Georges Bank Atlantic herring model, a model of Atlantic herring predators, and an economic model. To evaluate the effects of uncertainties in this system eight separate "operating models", or different states of nature were developed. The operating models vary in terms of assumptions about herring growth, assessment bias, and productivity of herring. The primary predator types identified at the MSE stakeholder workshops were highly migratory species (tuna), groundfish, seabirds, and marine mammals. The time constraint of this MSE did not permit development of integrated multispecies models, or spatial and seasonal models accounting for migrations of wide-ranging predators in and out of this ecosystem. Therefore, the models are limited, but the primary purpose is to help compare the relative performance of control rules in terms of how a predator may react to different levels of herring in the ecosystem, and not to create perfect population models for predators.

The MSE produced a large volume of results to compare alternatives. These have been synthesized in several ways. The results have been summarized by individual "metric" or management objective, as well as combined results for each valued ecosystem component (VEC) in the ecosystem (i.e. herring resource, fishery, predators, etc.). In addition, results have been presented across multiple metrics to help evaluate tradeoffs of different alternatives. Stakeholders identified fifteen different metrics to evaluate the control rule alternatives (i.e. yield relative to MSY, variation in yield, proportion of years with positive term production, etc.). Separate decision support tables were prepared for each metric (two examples provided on the following page). In each table, control rule Alternatives 1, 2, 3, and 4a-4f are listed across the top row, and the eight operating models are listed down the far left column (A through H). The numeric results for each alternative/model is included in the individual bar charts, and the alternatives are ranked from highest to lowest with dark green representing the highest ranked alternative compared to the others. The taller the bar, the better that alternative/model performed for that metric. The bottom row of each table sums the rank of each alternative for all eight operating models. This row is a sum of the rank for an alternative compared to the other alternatives; it is not related to the data for a particular metric (it is just a sum of the relative ranks).

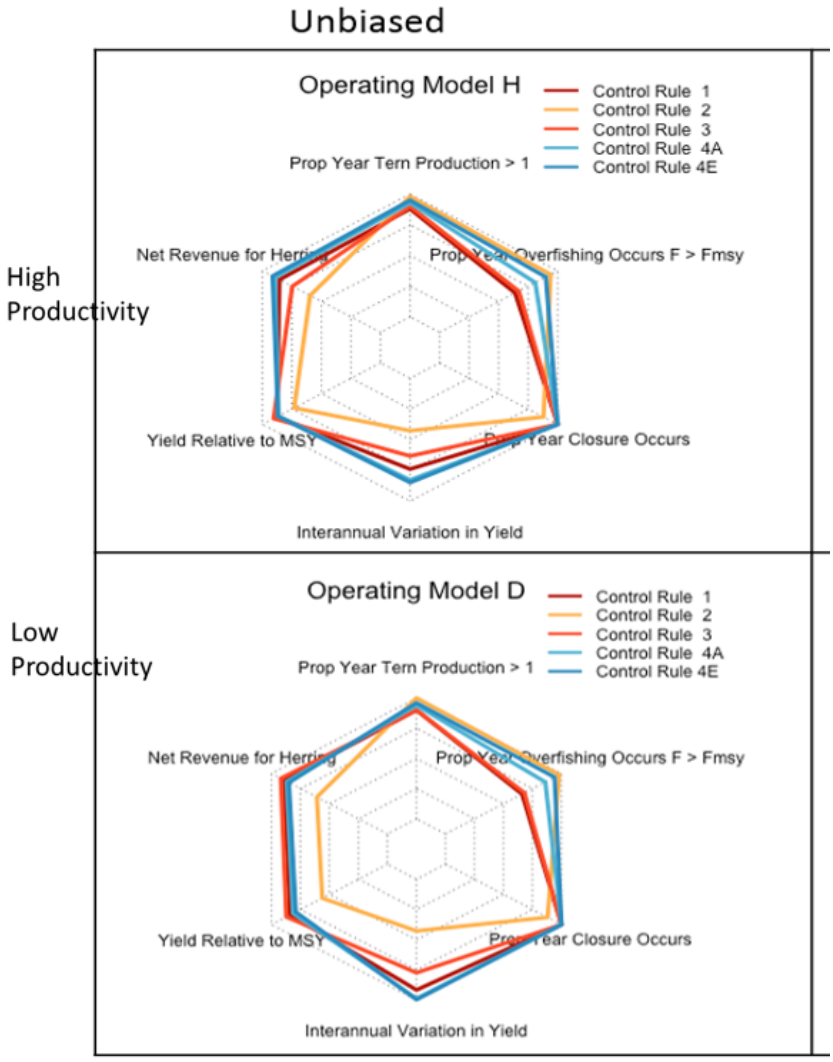
For the examples on the next page, the metric on the left is the probability herring would become overfished under the various control rules and states of nature. For this metric, the lower the value the better the performance. Overall, Alternative 2 (Strawman B) ranks the highest across all operating models. This alternative has essentially a zero chance of causing the stock to be overfished for most operating modes. Another example table has been provided estimating tern productivity, on the right side of the figure on the next page. For this metric, the higher the value the better the performance; a productivity of 1.0 means roughly that the population can replace itself. In general, all control rules maintain tern productivity above the threshold of 0.8 the majority of the time. All of the ABC control rule alternatives rank very high and have minimal differences. Similar tables have been produced for all fifteen metrics (Section 4.1.1.3 of the DEIS, starting on page 225).



Examples of Decision Support Tables in Amendment 8 per metric (overall rank across different states of nature in bottom row)
LEFT – Probability of herring stock becoming overfished under each control rule and operating model;
RIGHT – proportion of years terns have positive productivity

A benefit of MSE is the ability to compare results of different metrics simultaneously. While the quantitative results are in different units, the models enable comparisons of results across the same time frames and conditions. Radar plots or web diagrams are often used in MSEs to help compare a handful of metrics at once. These plots are useful to see how alternatives stack up against each other for a handful of metrics at once and help inform various tradeoffs for each alternative. The example below compares five different control rule alternatives for a handful of metrics under two operating models (unbiased assessment with either high herring productivity or low herring productivity). Each control rule is a different color, and options that appear toward the outer edge of the web are "best" performers, and options that appear closer to the center perform "worse".

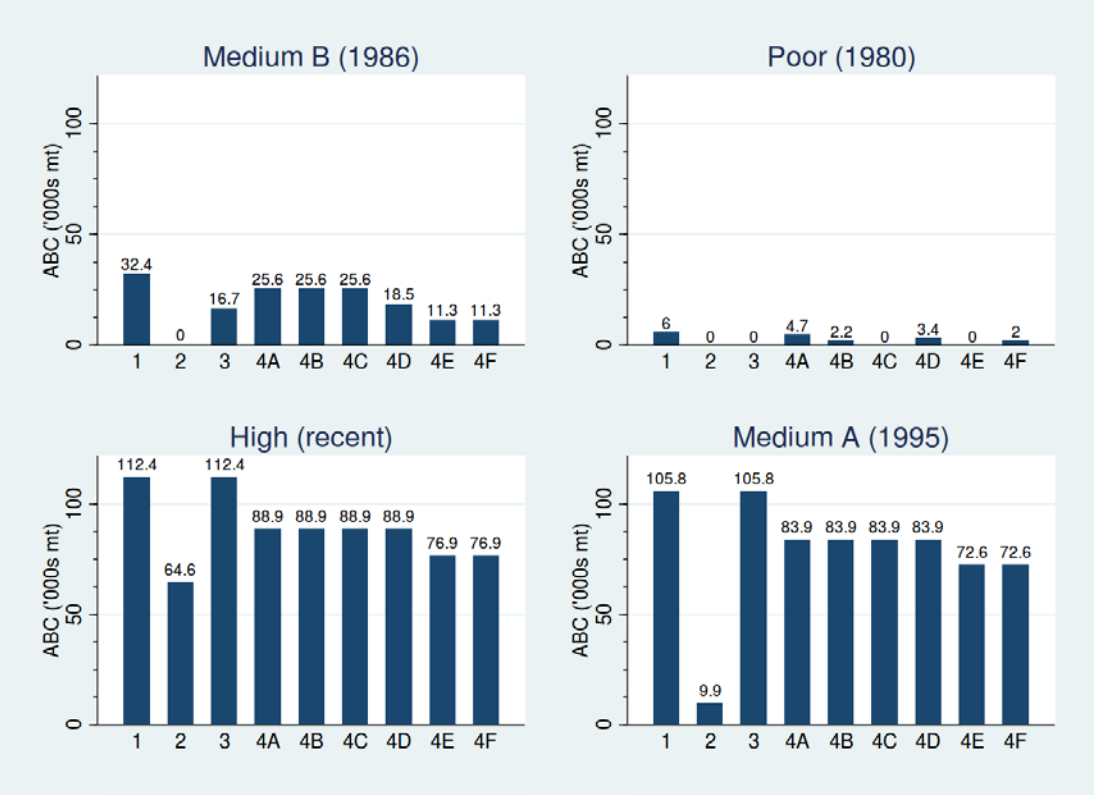
Things to keep in mind when considering the results: 1) these plots show relative performance, the best and worst performing management options may all fall within acceptable performance ranges; 2) the performance of different management options may differ based on the chosen operating model, indicating that our understanding of nature may impact the success of management. An option that does well regardless of operating model is *robust*.



Example of web diagrams evaluating various tradeoffs of several management objectives at once under two different states of nature, or operating models (high and low productivity with an unbiased assessment)

MSE analyses by nature focus on long-term impacts; the model simulations in this case were run for 150 years. However, the Council typically sets fishery specifications on 1-3 year time frames, so people are more accustomed to focus on near-term impacts. Amendment 8 also included an analysis of short-term impacts to help illustrate how various ABC control rules would function in more present day terms. Section 4.1.1.6 on page 260 of the DEIS summarizes the short term impacts. Two approaches were included: 1) four different herring biomass levels were selected from the past and ABC estimates were calculated from those biomass levels for each ABC control rule; and 2) data from the last assessment were used to prepare three-year projections of herring biomass and ABC for FY2016-2018 to help illustrate how these control rules would function compared to the No Action ABC control rule that was recently used.

The figure below is a sample of the information included in the short-term analyses of Amendment 8. If biomass is "poor", as it was in 1980, the ABC control rules produce ABCs that vary between zero and 6,000 mt annually. If biomass is high, as it was estimated to be in the last assessment in 2015, ABCs would vary between 64,000 mt and 112,000 mt, some relatively similar to what the interim ABC control rule produced in the last specification process (111,000 mt). Table 94 in the DEIS on page 265 includes example specifications for FY2016-2018 under the various ABC control rule alternatives, and how those ABCs would be distributed further to each herring management area is summarized in Table 95 in the DEIS, if the same method was used for dividing sub-ACLs by area.



Short term ABC values for Amendment 8 alternatives under four different states of nature (poor biomass in 1980, medium biomass in 1986 and 1995, and high biomass in 2015)

Section 4.0 of the DEIS includes over 250 pages of detailed analyses of the potential impacts of all of the alternatives across all valued ecosystem components. The following pages attempt to boil all that information down to a pages and summary tables. The general impacts are categorized into seven broad categories ranging from negative impacts (colored in red) to positive impacts (colored in green). Separate tables have been developed for the ABC control rule alternatives, as well as the measures to address potential localized depletion and user conflict alternatives. These issues are very complex and it can be misleading to characterize the potential impacts in a few words. Therefore, the Council and stakeholders should review the more detailed analyses in Section 4.0 of the DEIS before making recommendations for preferred alternatives. Several key findings have been included in the bullets below to accompany the general impacts in the summary tables that follow.

Impact Categories for summary of impact tables

negative	low neg	neutral to low neg	neutral	neutral to low pos	low positive	positive

General Findings for ABC control rule alternatives

- The eight operating models developed help evaluate variability in the system, but may not reflect the full range of possibilities.
- **Herring resource** – Figure 78 on page 281 of the DEIS summarizes the long-term impacts on the herring resource based on metrics such as probability of overfished status, biomass relative to unfished biomass, proportion of years overfishing is expected to occur, etc. Overall, the alternatives are expected to perform similar if not better than No Action in terms of positive impacts on the resource.
- However, other factors likely have even greater influence on herring biomass; there is lots of variability in the system and current conditions not likely to persist regardless of control rule.
- **Impacts on bycatch and EFH** – There were no direct metrics developed for impacts on bycatch or EFH. However, generally neutral impacts are expected since fishing levels are similar or lower; bycatch caps used to manage and control bycatch.
- **Predators** - This system is complex and linkages are not as strong between prey and predators because many predators are generalists and the food web in this area is complex. Figure 97 on page 328 of the DEIS compared the long-term impacts of the ABC control rule alternatives on predators. In general, the results were very similar across alternatives. While the amount of herring available for predators varies, the overall magnitude of the differences is small in terms of the fraction of the total estimated herring biomass, especially in the long-term.
- **Protected species** – Not sufficient data available to build a marine mammal model in the MSE analysis, but a metric was developed for tern production (Figure 63 page 251 of DEIS). Figure 98 summarizes the metrics that are indicators of potential impacts on protected species (page 342 of the DEIS).

- **Alternatives for setting three-year ABCs** - Overall, there may be slightly low negative impacts on the herring resource when ABC is set at the same level for three years (Alt2), but the differences are very minor and are not expected to outweigh the low positive impacts on the herring fishery in the short term from more stable catches.

- **Long-term human community impacts** - Economic models aided the long-term impact analysis. Table 99 to Table 106 and Figure 102 to Figure 107 (p. 376-383) show the long-term (MSE) results for the metrics such as net revenue and interannual variability (IAV) of net revenue, which help characterize the potential impacts on the herring, mackerel and lobster fisheries of the alternatives under consideration.

Herring/Mackerel and Lobster industries *- Alternatives 1-4 would be viable under all biomass scenarios, providing a degree of certainty about the long-term management of the fishery, a low positive impact relative to No Action. Generally, high net revenues benefit the herring fishery, but high IAV is assumed bad, as it would produce unstable and unpredictable market outcomes. For the lobster fishery, buyers of herring for bait, benefits are assumed when yield (ABC) is high, volatility (IAV) is low, and prices are low. MSE results indicate that net revenue is lowest for Alternative 2, similar between Alternatives 1 and 3 and generally higher for Alternative 4, but also depend on the state of the herring resource (Figure 61, p.247). IAV of Yield (Figure 59, p.245) for Alternative 1 and Alternatives 4A-4F is similarly low, and higher for Alternatives 2 and 3 (Figure 59, p.245). Alternatives 2 and 3 also result in fishery closures (setting ABC=0 for up to 12% of years, depending on the model; Figure 60, p.247).*

Predator fisheries and ecotourism *- As industries reliant on herring as a prey item in the ecosystem, the predator fisheries (e.g., groundfish, tuna) and ecotourism (whale and bird watching) are expected to fare better with sufficient herring to sustain their predators. Direct and indirect metrics for the predators of Atlantic herring are reported in Sections 4.1.1.3.13 to 4.1.1.3.15. The performance of tuna weight and dogfish biomass (direct metrics) changes little across the alternatives. Tern production (direct metric) is highest for Alternative 2 and slightly lower for the other control rules.*

Fishing Communities *- Lowering the Atlantic herring ABC could result in short-term revenue reductions, which may, in turn, have negative impacts on the Size and Demographic Conditions of the Atlantic herring fishery within fishing communities, with ripple effects on the communities involved in the Atlantic mackerel and American lobster fisheries. Likewise, increasing allowable harvests is expected to have positive short-term impacts on fishing communities. In the long term, fishing under a control rule that ensures continued, sustainable harvest of the resource not only benefits the directed herring fishery and its communities, but indirect fisheries that rely on herring as prey in the ecosystem. The specific communities potentially impacted are identified in Section 3.6.3.*

- **Short-term human community impacts – Section 4.1.1.6**

Herring/Mackerel and Lobster industries *- If the current, high biomass state of herring continues, No Action and Alternatives 1 and 3 would have neutral impacts, producing essentially the same ABC, and Alternative 2 would produce the lowest ABC. If future biomass is low, there would be negative impacts under all control rules, including No Action, when compared to the current ABC levels of 111,000 mt.*

Predator fisheries and ecotourism *- These industries fare better under positive Atlantic herring resource conditions, and positive impacts on Atlantic herring are highest under Alternative 2. Alternative 2 is expected to produce the best outcomes for the tuna weight metric, the tern productivity metric, as well as several indirect predator and ecotourism metrics, with possible positive impacts on predator fisheries and ecotourism. Impacts are positive for the other alternatives under consideration, but not as high as Alternative 2.*

	Herring Biomass	Non-target species (Bycatch)	Predator Species	Protected Resources	Physical Environment and EFH	Herring Fishery (and related mackerel and lobster fisheries)	Predator Fisheries and Ecotourism
No Action	ST: Low positive LT: more uncertain	Negligible/Neutral	Neutral	Low negative	Neutral	ST: Low positive LT: Uncertain, likely not significant	ST: Neutral to low positive; LT: Uncertain, likely not significant
Alt. 1 (Strawman A)	ST: Low positive; LT: Low positive		Neutral	Low negative, neutral compared to No Action		ST: Neutral to low positive; LT: Low positive	ST: Low positive; LT: Low positive
Alt. 2 (Strawman B)	ST: Positive; LT: Positive		Low Positive	Low negative, Low positive compared to No Action		ST: Low Negative LT: low positive to low negative	ST: Low positive; LT: positive
Alt. 3	ST: Low positive; LT: Low positive		Neutral	Low negative, neutral compared to No Action		ST: Neutral to low positive; LT: low positive to low negative	ST: Low positive; LT: Low positive
Alt. 4A – 4F	ST: Positive; LT: Positive		Low Positive	Low negative, but depending on the option, Neutral to Low Positive compared to No Action		ST: Low negative to low positive LT: low positive	ST: Low positive; LT: low positive

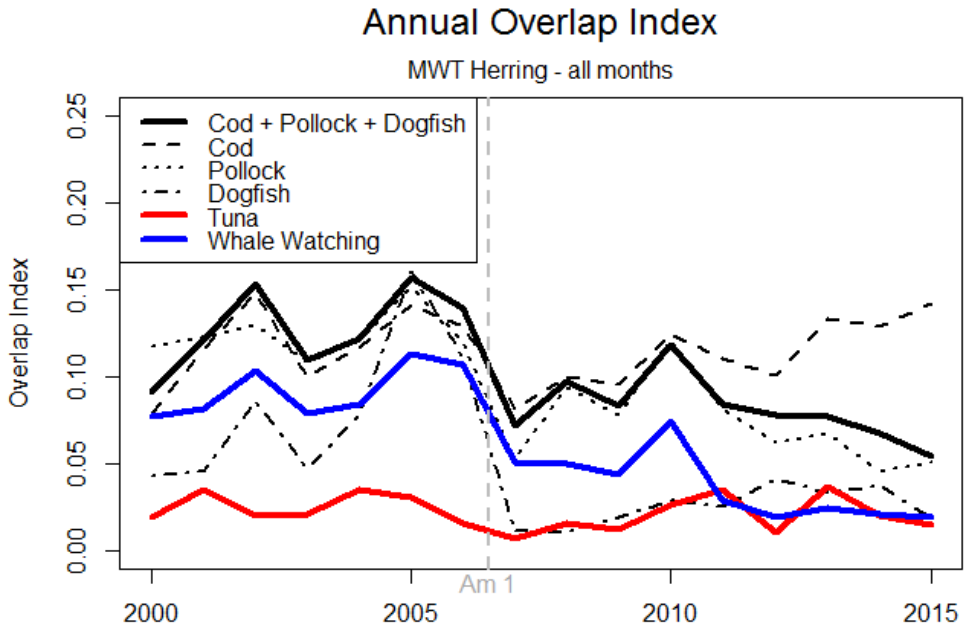
Summary of potential impacts of ABC control rule alternatives across all valued ecosystem components
(ST = short-term; LT = long-term)

6.2 POTENTIAL LOCALIZED DEPLETION AND USER CONFLICT ANALYSES

Section 4.1.2 of the DEIS describes the analyses prepared to assess the impacts of the measures to address potential localized depletion and user conflicts under consideration in Amendment 8. This is not a straightforward issue. It is challenging to identify if and how other fisheries have been impacted by herring catches. There are many constraints that determine where and when a fishery is prosecuted (e.g., area closures, weather windows, mobility of fish) that need to be understood in an investigation of whether there is causality to any correlations. Furthermore, the data that is available is limited, often not detailed enough to fully evaluate whether localized depletion is occurring. To date, there has not been sufficient research in this area to directly assess the potential impacts of different fishing gears on herring abundance and potential related effects of localized depletion on predators of herring.

To support this action, the Herring Plan Development Team (PDT) has summarized what is known about the role of herring as forage in this ecosystem, developed mapping tools to describe the footprint of the herring fishery and key predator fisheries, completed an overlap analysis of these fisheries to identify the areas and seasons that have been most important and quantify the degree of overlap, or potential user conflict. The PDT has also evaluated if there is a correlation between herring fishery removals and negative impacts on predator fisheries based on available data. Finally, the PDT worked with industry advisors to help identify possible effort shifts that may result from area closures. All these analyses are summarized in the DEIS as well as Appendices VI, VII, and VIII. A few highlights of these analyses are described below, but stakeholders are encouraged to review the more detailed discussions in the DEIS.

In general, the level of overlap between the herring MWT fishery and all other predator users analyzed (commercial groundfish, commercial tuna, and whale watching effort) dropped significantly in 2007 with the passing of Amendment 1. But overlap does not necessarily translate into negative biological impacts on predators. Less overlap may reduce potential user conflicts, with potentially low positive impacts, so long as effort does not shift into areas or seasons with higher overlap.



Annual overlap index of predator fisheries and herring fishery based on VTR data

General Findings for potential localized depletion and user conflict alternatives

- **No Action – Biological impacts –** Not possible to determine direct impacts in isolation of other measures adopted in Amendment 1. Catch limits in Area 1A have been reduced 50%, no research available on differential impacts of gear type, larger catches over shorter time period now for both gear types, capacity of the vessel is the driver.
- **No Action – Economic Impacts** – Neutral on herring fishery overall (but positive for PS and negative for MWT); negative for mackerel fishery, neutral for lobster industry, and potentially positive on predator fisheries and ecotourism industries in the GOM.

- **General PDT input:**
  1) *depletion occurs regardless of gear type, all concentrated removals;*
  2) *depletion different than user conflicts;*
  3) *catch rates not a good measure of depletion for schooling, pelagic fish;*
  4) *more direct research needed;*
  5) *effort shifts difficult to predict so impacts somewhat uncertain.*

- **Biological impacts -** Overall, there are generally neutral impacts on the resource if the fishery is able to still harvest sub-ACLs, and low positive impacts if alternatives prevent full harvest of sub-ACLs. When the spatial sub-option to exclude Area 2 is considered for many of the alternatives, any potentially positive biological and negative economic impacts are more neutralized, especially when combined with the summer only sub-option.
- **Bycatch impacts** - Somewhat uncertain because too many unknowns about effort shifts. Negative for RH/S if effort shifts inshore or to Area 2 in the winter; generally negative for GB haddock if effort shifts to GB in the fall. Generally negative if fishing pushed to areas and times with higher bycatch rates; generally negative if switch from MWT gear to bottom trawl; uncertain if effort shifts to places not fished now.
- **Impacts on predators** – This is a complex ecosystem - many species in this region are generalists, and utilize multiple prey items. No research in this region on direct impacts of herring fishing on predator abundance.
- **Protected species** - In general, low negative to negative impacts depending on effort shifts. But if effort declines – positive impacts. If less herring is removed when seabirds are feeding their young in Area 1B (Aug-Sept) there could be positive impacts on seabirds.
- **Essential Fish Habitat –** MWT gear assumed to contact the bottom only occasionally. Under No Action generally neutral impacts overall (low + in GOM because less potential contact with hard bottoms, and low – on GB because effort has increased). If vessels convert to BT could be low negative impacts;

- **Human Community Impacts -** Impacts on the herring, mackerel, and lobster fisheries, predator fisheries and ecotourism, and port communities are described in the DEIS (Pages 398-458).

- **Approach for economic impacts** - What were the herring/mackerel landings/revenue from an area/season? How likely are effort shifts: to other gear types, areas or seasons? How likely would a closure hamper harvesting OY? What degree of overlap has existed with other user groups?
  Some effort may shift to mitigate impacts – but
    - Added cost (travel/search time).
    - Herring may not be available in other seasons and/or areas.
    - Reduced conflict inside closure; crowding outside.

  Some MWT vessels may consider shifting gear type – but
    - Added cost ($100K for BT and $1-3M PS).
    - Additional training/time and crew needed to convert.
    - PS not feasible in currents or when herring are in deep water.
    - Regulatory constraints for BT in GOM and off Cape.

  Unintended consequences of effort shifts?
    - EFH, bycatch, other fisheries, etc.

- **General High-level findings**
    - The level of overlap between the herring MWT fishery and all other predator users analyzed dropped significantly in 2007 with the passing of Amendment 1 (Figure 76, p.275). The seasonal profile of overlap has also changed since 2007 (Figure 77, p. 276), with less overlap in summer months in recent years. These changes in seasonal overlap are due, in part, to Amendment 1, but also to changes in the distribution of landings in the predator fisheries caused by modifications to the spatial measures for those fisheries.
    - Some herring effort may shift to mitigate impacts, but there are several constrains to doing so (e.g., carrier limits, operational constraints, herring are migratory, increased costs of fishing offshore).
    - Given the regulatory restrictions on small mesh bottom trawls, it is unlikely that this gear would expand substantially into Areas 1B and 3.
    - Use of purse seines is unlikely on the “back side of the Cape” and offshore, as purse seining is difficult in strong tides, rough ocean conditions, and when herring occur in deep water.
    - Most MWT fishing in Area 1B is currently inside of 12 nm.
    - Herring are migratory and may not necessarily be available in other areas or seasons.
    - User conflicts may be reduced inside a closure, but with effort shifts, impacts on user conflicts, bycatch and essential fish habitat may increase elsewhere.
    - Shifting herring and mackerel effort to winter months may reduce user conflicts, but the price of herring is generally lower in winter.
    - Since at least 2007, the price of herring has been highest in July and August (Section 3.6.1.7), so summertime closures may result in lower annual revenue for the fishery.

Alternative	Herring Resource	Non-target	Predator species	Protected resources	EFH/Physical Environment
Alternative 1 (No Action)	Neutral - Hard to assess impacts in isolation of other measures that have been implemented	Neutral Bycatch caps in place limit impacts on bycatch	Low positive in GOM Low negative on GB	Low negative on protected species Neutral on ESA species	Neutral
Alternative 2	Neutral – no impact overall Area is relatively small	Neutral, Somewhat uncertain, but minimal	Neutral Relatively small area	Neutral	Neutral
Alternative 3	Neutral Area 1A TAC would still be harvest by other gear types	Neutral Effort shifts could reduce impacts on RH/S but increase impacts on haddock, but caps in place	Depends on how vessels react – impacts could range from low - to low +. Depends on how vessels react – impacts could range from low - to low +.	Low negative to negative on protected species. Neutral to negative on ESA species if effort shifts to areas and gears with higher interactions.	Neutral to low negative
Alternative 4 Alternative 5 Alternative 6	Neutral to low positive If sub-ACLs not harvested could be low + impacts, but fishing activity may adjust, so could be neutral impacts	Neutral, somewhat uncertain due to unknown effort shifts. Effort more likely to move offshore under Alt 6 and longer season sub option	Somewhat uncertain. Low negative to low positive. Somewhat uncertain. Low negative to low positive. More neutral if vessels convert gear and harvest the same level of herring.		Neutral to low negative for Alt. 4 and 5. Low negative for Alt 6 if vessels more inclined to convert to bottom trawl
Alternative 7	Neutral – little impact, Area 1B likely impacted, a corridor area	Neutral - Effort shifts could reduce impacts on RH/S but increase impacts on haddock, but caps in place	Mostly neutral with low positive impacts inshore and low negative impacts offshore		Neutral to low negative
Alternative 8	Neutral – if sub-ACLs stay the same, more uncertain if they change in future action, but still relatively low impacts.	Neutral Minimal amount of potential effort shift compared to others	Somewhat uncertain, Low positive to low negative Somewhat uncertain, Low positive to low negative	Neutral	Neutral
Alternative 9	Neutral – little impact, when fish removed not expected to have direct impacts	Neutral Minimal impact – just season	Low positive, but somewhat uncertain	Low negative on protected species Neutral on ESA species	Neutral

Summary of potential impacts of measures to reduce potential localized depletion and user conflicts across biological and physical environment

Alternative	Herring Fishery	Mackerel Fishery	Herring/Mackerel MWT revenue[1]	Lobster Fishery	Predator Fisheries/Ecotourism
1	Fishery-wide = Neutral MWT = Low negative PUR = Positive	Low negative		Neutral	Low positive
2A (J-A) & 2B (J-O)	Low negative	Low negative	0.5-0.6%	Low negative	Low positive
3	Fishery-wide = Neutral MWT = Low negative PUR = Positive	Low negative	18%	Neutral	Low positive
4A/A	MWT = Negative PUR = Neutral	Negative	18%	Negative	Low positive
4B/B	MWT = Low negative PUR = Neutral	Low negative	0.3%	Low negative	
5A/A	MWT = Negative PUR = Neutral	Negative	26%	Negative	Low positive
5B/B	MWT = Low negative PUR = Neutral	Low negative	0.6%	Low negative	
6A/A	MWT = Negative PUR = Neutral	Negative	45%	Negative	Low positive
6B/B	MWT = Negative PUR = Neutral	Low negative	5%	Low negative	
7A/A	MWT = Low negative PUR = Neutral	Low negative	8.7%	Low negative	Low positive
7B/B	MWT = Low negative PUR = Neutral		0.5%		
8	Low negative	Low negative	4%	Low negative	Neutral
9	Low negative	Low positive	n/a	Low positive	Low positive

[1] *2007-2015 annualized MWT revenue for the areas/seasons that may be closed/inaccessible as a percent of all MWT revenue for the seasons.*

Summary of potential impacts of measures to reduce potential localized depletion and user conflicts across human environment compared to No Action

7.0 GLOSSARY

Acceptable biological catch: The maximum catch that is recommended for harvest, consistent with meeting the biological objectives of the management plan. The MSA interpretation of ABC includes consideration of biological uncertainty (stock structure, stock mixing, other biological/ecological issues), and recommendations for ABC should come from the NEFMC SSC.

Assessment model: Method for determining stock status, the results of which are used by the control rule.

Harvest control rule: Relationship describing how the results of the assessment are translated into advice for management (i.e. turns the assessment result into an allowable biological catch).

Management Objective: Desirable outcomes from management. Objectives can include ecological, economic, societal goals. High level goals/objectives (e.g. what would like) can be unpacked into operational objectives (e.g. how much?).

Management Strategy Evaluation (MSE): Analytical framework for testing and comparing the performance of management options.

Maximum sustainable yield (MSY): Maximum catch that can be removed from a population over an indefinite period. **Fmsy** – measurement of the rate of removal of fish from fishing that if applied constantly would result in MSY. **Bmsy** – long-term average biomass that would be achieved if fishing at a constant F equal to Fmsy.

Operating model (OM): model which represents the real world resource and fishery dynamics, used as the basis for testing management options. Multiple operating models can be considered, each representing a possible state of nature.

Performance metric: Specific quantitative measure that represents a management objective and can be used to evaluate progress towards that objective.

Spawning stock biomass: total weights of fish in a stock that are old enough to spawn. **SSBmsy** is the level of spawning biomass capable of producing maximum sustainable yield.

Trade-off: Degree to which performance against a set of management objectives are related. A strong tradeoff between two objectives implies that gaining on one means forgoing the other.

Valued Ecosystem Component: an element of the environment that has scientific, economic, social or cultural significance. Example valued ecosystem components are: the species targeted by a particular fishery; the non-target or bycatch species caught incidentally; impacts on predator species.

8.0 ACRONYMNS

ABC	Acceptable Biological Catch
ACL	Annual Catch Limit
ASMFC	Atlantic States Marine Fisheries Commission or Commission
DEIS	Draft Environmental Impact Statement
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act
F	Fishing Mortality Rate
FMP	Fishery Management Plan
FW	Framework
FY	Fishing Year
GB	Georges Bank
GOM	Gulf of Maine
IAV	Interannual variation in yield
MAFMC	Mid-Atlantic Fishery Management Council
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
mt	Metric Tons
MWT	Mid-water trawl fishing gear
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OY	Optimum Yield
PDT	Plan Development Team
PS	Purse seine fishing gear
SSB	Spawning Stock Biomass
SSC	Scientific and Statistical Committee
VEC	Valued Ecosystem Component
VTR	Vessel Trip Report