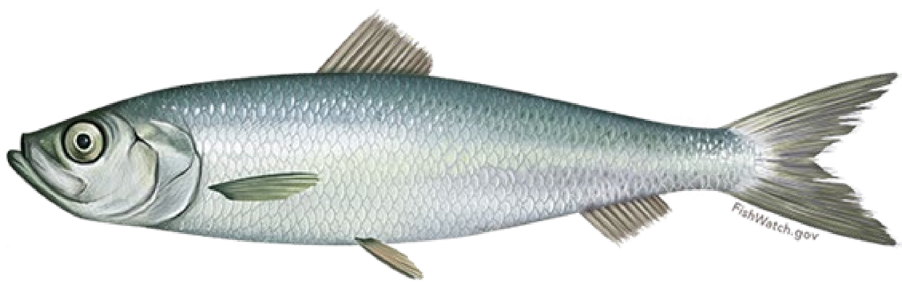
Atlantic Herring Fishery Management Plan

Framework Adjustment 9

Including an Environmental Assessment and
Initial Regulatory Flexibility Analysis



FINAL

Prepared by the
New England Fishery Management Council
In consultation with the
National Marine Fisheries Service and the
Mid-Atlantic Fishery Management Council

New England Fishery Management Council

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NOAA U.S. DEPARTMENT OF COMMERCE

MID-ATLANTIC FISHERY MANAGEMENT COUNCIL

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FRAMEWORK ADJUSTMENT 9 TO THE
ATLANTIC HERRING FISHERY MANAGEMENT PLAN

Proposed Action: Propose a rebuilding plan for Atlantic herring to address overfished status and potentially adjust herring accountability measures to provide more flexibility for the herring fishery and optimize yield.

Responsible Agencies:

New England Fishery Management Council
50 Water Street, Mill #2
Newburyport, MA 01950

National Marine Fisheries Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
Washington, D.C. 20235

For Further Information:

Thomas A. Nies, Executive Director
New England Fishery Management Council
50 Water Street, Mill #2
Newburyport, Massachusetts 01950
Phone: (978) 465-0492
Fax: (978) 465-3116

Abstract: The New England Fishery Management Council, in consultation with NOAA's National Marine Fisheries Service, has prepared Framework Adjustment 9 to the Atlantic herring Fishery Management Plan, which includes a draft environmental assessment that presents the range of alternatives to achieve the goals and objectives of the action. The proposed action focuses on implementing a rebuilding plan for Atlantic herring and potentially adjust accountability measures to promote flexibility and optimize yield in the herring fishery. The document describes the affected environment and valued ecosystem components and analyzes the impacts of the alternatives on both. It addresses the requirements of the Magnuson Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, the Regulatory Flexibility Act, and other applicable laws.

1.0 EXECUTIVE SUMMARY

This document contains the New England Fishery Management Council (Council) recommendations for implementing a rebuilding plan and adjusting how sub-ACL overages are accounted for consistent with the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the Atlantic Herring Fishery Management Plan (FMP), approved by the National Marine Fisheries Service (NMFS) on October 27, 1999. This document also contains information and supporting analyses required under other applicable law, including the National Environmental Policy Act (NEPA) and Regulatory Flexibility Act.

Preferred Alternatives

The Council's preferred alternatives include:

- Rebuilding Plan Alternative 2 – implement a rebuilding fishing mortality strategy ($F_{rebuild}$) that is consistent with the acceptable biological catch (ABC) control rule adopted in Amendment 8. The control rule is biomass-based, when biomass is high enough such that the ratio of SSB/SSB_{MSY} is more than 0.5, the maximum fishing mortality allowed is 80% of F_{MSY}. As biomass declines, fishing mortality declines linearly, and if biomass falls below 0.1 for the ratio of SSB/SSB_{MSY}, then ABC is set to zero, no fishery allocation.
- Overage Accountability Measure (AM) Alternative 2 – an overage deduction would not be implemented if final estimated catch from a management area exceeds a sub-ACL by less than or equal to 10% of the sub-ACL, unless total catch also exceeds the total ACL. If catch is greater than 10% of a sub-ACL, there would be an overage deduction from the sub-ACL and total ACL in a subsequent fishing year. The pound for pound overage deduction would be for catch over 10% only.

Impacts of the Alternatives

The impacts of the alternatives considered by the Council on each valued ecosystem component (VEC) described in the Affected Environment are in Section 6.0 and summarized in Table 1.

The proposed rebuilding plan alternative is expected to have moderate positive impacts on the resource in the long-term by implementing a fishing mortality strategy that would likely support rebuilding of the Atlantic herring resource, especially if recruitment improves. Fishing mortality rates would be set relatively low in the near term, and these reductions are expected to help the stock recover more quickly with longer term benefits for the fishery. Short-term moderate negative economic impacts are expected, and some businesses may be at risk of failing, especially businesses that are more reliant on herring revenue. Fishery projections for this alternative suggest that Atlantic herring can rebuild in five years, or by 2026 under current assumptions. $F_{rebuild}$ for this alternative would vary based on projected biomass. Current projections estimate $F_{rebuild}$ would vary between F=0.09 to F=0.43 over the course of the rebuilding plan depending on the estimated level of biomass. The proposed rebuilding plan is expected to have negligible impacts on other elements of the ecosystem such as essential fish habitat (EFH). Continued slight positive to slight negative impacts on non-target species (bycatch) based on overall status of bycatch species. And continued slight negative impacts on some protected resources that are at risk of interaction with herring fishing gears.

This action also proposes to modify how limited overages of sub-ACLs are accounted for, allowing up to 10% of a sub-ACL to be exceeded without future deductions so long as the total ACL was not also exceeded. There are minimal risks in terms of overfishing from this measure since the total ACL cannot be exceeded. If one area is consistently fished above target levels, there may be limited risks of excess fishing pressure in one area, but those potential impacts are limited and not expected to have long term effects on the resource. Slight positive economic impacts are expected since overage deductions under 10% would not be applied and this measure would increase flexibility for the fishery to optimize yield.

The proposed overage AM measure is expected to have negligible impacts on other elements of the ecosystem such as essential fish habitat (EFH). Slight positive to slight negative impacts on non-target species (bycatch) and continued slight negative impacts on some protected resources that are at risk of interaction with herring fishing gears.

Table 1. Summary of potential impacts of the alternatives under consideration in Framework 9 across the valued ecosystem components (*Preferred alternatives shaded*).

<table>
<tr><th colspan="2" rowspan="2">Actions & Alternatives</th><th colspan="5">Direct and indirect impacts</th></tr>
<tr><th>Target Species</th><th>Non-target Species</th><th>Protected Resources</th><th>Physical Env. (EFH)</th><th>Human Communities</th></tr>
<tr><td rowspan="3">Action 1: Rebuilding Plan</td><td>Alt. 1 – No Action</td><td>Slight negative impacts if no rebuilding plan in place. Moderate positive impacts if rebuilding F from the ABC CR is used and supports rebuilding.</td><td rowspan="3">Despite possible variations in fishing effort between these alternatives, and because this action maintains the use of catch caps for both haddock and river herring/shad to control impacts on bycatch, these alternatives are expected to have continued slight positive impacts to slight negative impacts relative to one another and non-target species. These impacts are based on current stock status of non-target species (haddock and river herring / shad specifically).</td><td rowspan="3">Interaction risk: Impacts are expected to result in slight negative impacts to MMPA (non-ESA listed) protected species of marine mammals, and negligible impacts to ESA listed species.
Forage:
None of the alternatives have the potential to result in herring catch that would exceed the total ACL. Therefore, none of the alternatives will result in the fishery removing herring at levels that go above and beyond current conditions; negligible forage impacts overall.</td><td rowspan="3">Given the minimal and temporary nature of adverse effects on EFH in the Atlantic herring fishery, these alternatives are expected to have negligible impacts relative to one another on the physical environment and EFH.</td><td>Slight negative if no formal plan in place – may result in distrust in management process. If ABC CR used in absence of rebuilding plan – likely continue negative impacts.</td></tr>
<tr><td>Alt. 2 – ABC CR</td><td>Moderate positive impacts if reduces F when biomass low – rebuilding faster. Lower risks than Alt. 3 if recruitment below average.</td><td>Slight positive to have a rebuilding plan in place – provides mechanism for measuring rebuilding and more trust in process. Continue negative impacts with some constancy and predictability.
Long-term revenue estimates (2022-2032) are $170 – 214 million.
Moderate positive impacts for other industries that rely on herring as prey.</td></tr>
<tr><td>Alt. 3 - 7yr constan t F (F=0.48)</td><td>Slight positive because it would establish formal rebuilding plan. Compared to Alt 2 slight negative if recruitment is average to moderate negative if recruitment below average. In the long-term the impacts are more similar across alternatives.</td><td>Slight positive to have a rebuilding plan in place. Continue negative impacts with some constancy and predictability. More positive than Alt 1 and 2 with higher ABCs earlier in plan. But $P_{rebuild}$ longer and P closure higher, especially if recruitment is below average. Therefore, slight positive impacts on other industries that rely on herring as prey compared to no rebuilding plan, but slight negative compared to Alternative 2.</td></tr>
</table>

<table>
<tr><th colspan="2" rowspan="2">Actions & Alternatives</th><th colspan="5">Direct and indirect impacts</th></tr>
<tr><th>Target Species</th><th>Non-target Species</th><th>Protected Resources</th><th>Physical Env. (EFH)</th><th>Human Communities</th></tr>
<tr><td rowspan="3">Action 2: Overage AMs</td><td>Alt. 1 -

No Action</td><td>Moderate positive. Preventing overfishing and keeps fishery accountable for overages.</td><td rowspan="3">Despite possible variations in fishing effort between these alternatives, and because this action maintains the use of catch caps for both haddock and river herring/shad to control impacts on bycatch, these alternatives are expected to have continued slight positive impacts to slight negative impacts relative to one another and non-target species. These impacts are based on current stock status of non-target species (haddock and river herring / shad specifically).</td><td rowspan="3">Interaction risk. Impacts are expected to result in slight negative impacts to MMPA (non-ESA listed) protected species of marine mammals, and negligible impacts to ESA listed species.

Forage:

None of the alternatives have the potential to result in herring catch that would exceed the total ACL. Therefore, none of the alternatives will result in the fishery removing herring at levels that go above and beyond current conditions; negligible forage impacts overall.</td><td rowspan="3">Given the minimal and temporary nature of adverse effects on EFH in the Atlantic herring fishery, these alternatives are expected to have negligible impacts relative to one another on the physical environment and EFH.</td><td>In the short term, negligible to slight negative. Delay of consequences. Because reductions even if ACL not exceeded - difficult to achieve OY every year so slight negative impacts. Slight positive impacts in the longer term – prevents ACLs from being exceeded.</td></tr>
<tr><td>Alt. 2 -

Up to 10% overage allowed if total ACL not exceeded</td><td>Slight negative impacts compared to No Action.

Minimal risks in terms of overfishing since total ACL cannot be exceeded.

If one area consistently fished above target levels some limited risks.</td><td>Slight positive – Based on 2016-2020 data, average of $160,000 per year from overage deductions.

Increased flexibility for vessels to reach OY.</td></tr>
<tr><td>Alt. 3 -

Overage of sub-ACL allowed, by any amount, if total ACL not exceeded</td><td>Moderate negative impacts compared to No Action.

Potential negative impacts may be greater than Alt. 2 if one area consistently fished above target levels.</td><td>Slight positive –

In the short-term more positive – OY more likely to be achieved each year.

Based on 2016-2020, data average of $264,000 per year from overage deductions.

But less incentive to prevent sub-ACL overages so higher risk of negative distributional impacts if one area consistently fished over target levels.

In long-term less certain and slight negative if one area consistently fished over target levels.</td></tr>
</table>

2.0 TABLE OF CONTENTS

APPENDICES

2.1 Tables

2.2 FIGURES

2.3 Maps

2.4 Acronyms

ABC	Acceptable Biological Catch
ACL	Annual Catch Limit
ALWTRP	Atlantic Large Whale Take Reduction Plan
AM	Accountability Measure
AP	Advisory Panel
APA	Administrative Procedures Act
ASMFC	Atlantic States Marine Fisheries Commission
B_{MSY}	Biomass that would allow for catches equal to Maximum Sustainable Yield when fished at the overfishing threshold (F_{MSY})

BiOp, BO	Biological Opinion, a result of a review of potential effects of a fishery on Protected Resource species
CEQ	Council on Environmental Quality
DFO	Department of Fisheries and Oceans (Canada)
DMF	Division of Marine Fisheries (Massachusetts)
DMR	Department of Marine Resources (Maine)
EA	Environmental Assessment
EEZ	Exclusive economic zone
EFH	Essential fish habitat
ESA	Endangered Species Act
F	Fishing mortality rate
FMP	Fishery management plan
FW	Framework
FY	Fishing year
GARFO	Greater Atlantic Regional Fisheries Office
GB	Georges Bank
GIS	Geographic Information System
GOM	Gulf of Maine
HAPC	Habitat area of particular concern
HPTRP	Harbor Porpoise Take Reduction Plan
IFM	Industry-funded monitoring
LOA	Letter of authorization
MA	Mid-Atlantic
MAFMC	Mid-Atlantic Fishery Management Council
MMPA	Marine Mammal Protection Act
MPA	Marine protected area
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSY	Maximum sustainable yield
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
OBDBS	Observer database system
OY	Optimum yield
PDT	Plan Development Team
PRA	Paperwork Reduction Act
RFA	Regulatory Flexibility Act
RPA	Reasonable and Prudent Alternatives
SA	Statistical Area
SARC	Stock Assessment Review Committee
SAW	Stock Assessment Workshop
SIA	Social Impact Assessment
SMB	Squid Mackerel Butterfish FMP (MAFMC)
SNE	Southern New England
SSB	Spawning stock biomass
SSC	Scientific and Statistical Committee
VEC	Valued Ecosystem Component
VMS	Vessel monitoring system
VTR	Vessel trip report

3.0 BACKGROUND AND PURPOSE

3.1 BACKGROUND

3.1.1 Background on Rebuilding Plans

If NOAA Fisheries determines that a stock is overfished, a Council must develop a plan to rebuild it to the level that can support maximum sustainable yield (MSY). A rebuilding plan usually allows fishing to continue, but typically at a reduced level so the stock will increase to a target level to support MSY.

NOAA's Assistant Administrator for Fisheries formally determined on October 2, 2020, that the Atlantic herring stock is overfished based on the best scientific information available. The Council was informed of this change in stock status on October 13, 2020. NOAA Fisheries recommended that the Council submit a rebuilding plan within 15 months to ensure sufficient time to implement the appropriate regulations within two years of the notification letter, by January 13, 2022.

The development of rebuilding plans is guided by §304(c) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), NMFS guidance on MSA implementation, specifically National Standard 1 Guidelines, and judicial review from relevant court cases. There are several key terms and definitions that the Council needs to specify in a rebuilding plan (Table 3). The Magnuson Act states that the rebuilding time should be as short as possible and "shall not exceed ten years, except in cases where the biology of the stock" or some other considerations "dictate otherwise." The National Standard 1 Guidelines include more details about how Councils should develop plans to comply with these requirements (https://www.federalregister.gov/documents/2016/10/18/2016-24500/magnuson-stevens-act-provisions-national-standard-guidelines).

3.1.2 Background on Herring Accountability Measures (AMs)

The MSA's National Standard 1 guidelines explain that AMs are management controls to prevent annual catch limits (ACLs), including sector-ACLs, from being exceeded and to correct or mitigate overages of the ACL if they occur. The guidelines also recommend that AMs should address and minimize both the frequency and magnitude of overages and correct the problems that caused the overage in as short a time as possible.

The total herring ACL is divided into four herring management area sub-ACLs. During the year as catch approaches the sub-ACL in a particular herring management area a possession limit adjustment is implemented to end directed herring fishing activity for the remainder of the fishing year. This in-season (proactive) AM helps prevent overfishing by stopping the directed fishery and leaving a small portion of the sub-ACL for incidental catch. After final year-end catch estimates are available, if there is an overage of a sub-ACL there is a pound for pound reduction of a future sub-ACL to account for that overage (reactive AM) in a subsequent fishing year.

Section 5.5.1.2 summarizes trends in herring fishing effort by herring management area including a summary of overages and underages by year and area. Overall, the AMs in place (both proactive and reactive) have helped prevent the total ACL from being exceeded in this fishery. However, ACLs have been dramatically reduced in the herring fishery since 2018 and the likelihood of exceeding sub-ACLs may be higher for this high-volume fishery working under relatively low sub-ACLs.

3.2 Purpose and Need

The primary purpose of this action is to identify the fishing mortality policy ($F_{rebuild}$) to set future fishery specifications to promote rebuilding of the Atlantic herring resource consistent with MSA requirements and guidelines. This action is needed because the Atlantic herring resource was declared overfished in October 2020 and the MSA requires development of a rebuilding plan within two years after a stock is declared overfished.

Another purpose of this action is to consider measures to adjust how reactive AMs, sub-ACL overages, are accounted for to promote efficient use of the Atlantic herring resource and continue to prevent overfishing. The second need of this action is to adjust herring accountability measures to promote flexibility and optimize yield in the herring fishery.

Table 2. Purpose and Need for Framework 9

Purpose	Need
Identify the fishing mortality policy ($F_{rebuild}$) that will be used in subsequent actions to promote rebuilding of the Atlantic herring resource consistent with MSA requirements and guidelines.	Develop a rebuilding plan to address the overfished status of Atlantic herring, as required by the Magnuson Stevens Act.
Adjust how sub-ACL overages are accounted for to promote efficient use of Atlantic herring and prevent overfishing.	Potentially adjust herring accountability measures to promote flexibility and optimize yield in the herring fishery.

4.0 ALTERNATIVES UNDER CONSIDERATION

4.1 Action 1 – Rebuilding Plan

Action 1 is considering three alternatives related to how catch limits should be set under a rebuilding plan for Atlantic herring: Alternative 1 (No Action) or no rebuilding plan, Alternative 2 that would set fishing mortality targets using the ABC control rule approved in Amendment 8 to the Herring FMP, and Alternative 3 that would use a constant fishing mortality target estimated to rebuild the herring resource in seven years.

This action does not include fishery specifications. The focus of this framework is to consider different rebuilding strategies or fishing mortality rates that will be applied in this fishery to promote rebuilding of the Atlantic herring resource. This action will implement a $F_{rebuild}$ policy that will be used until the herring resource is rebuilt or is modified by a future action. This framework will define the fishing mortality policy of the rebuilding plan and future fishery specifications will use the $F_{rebuild}$ strategy adopted in this action to set catch limits until the resource is rebuilt. The specifications already in place under Framework 8 for fishing years 2020-2022 will remain in place.

4.1.1 Rebuilding Plan Alternative 1 – No Action

Under this alternative, the Council would not recommend implementing a rebuilding plan for Atlantic herring. The Council would continue to set fishery specifications two fishing years at a time with default measures identified for a third year in case implementation of a planned subsequent adjustment is delayed. The Council would likely use the ABC control rule approved in Amendment 8 to set OFL/ABC and other relevant fishery specifications. The rebuilding plan terms defined in Section 4.1.4 would not be incorporated in the Herring FMP if this alternative is selected.

Note: This alternative is not consistent with requirements of the Magnuson-Stevens Act (MSA) to develop and implement a rebuilding plan when a stock is declared overfished.

4.1.2 Rebuilding Plan Alternative 2 – Rebuilding plan that sets fishing mortality target based on Amendment 8 acceptable biological catch (ABC) control rule (Preferred Alternative)

Under this alternative, the Preferred Alternative, a rebuilding plan would be established. The fishing mortality target for the rebuilding plan would be consistent with the ABC control rule approved in Amendment 8. The control rule is biomass-based, that is, when biomass is high enough such that the ratio of SSB/SSB_{MSY} is more than 0.5, the maximum fishing mortality allowed is 80% of F_{MSY}, and 20% of F_{MSY} is left for herring predators. Under this policy as biomass declines, the target fishing mortality used to set the ABC declines linearly, and if biomass falls below 0.1 for the ratio of SSB/SSB_{MSY}, then ABC is set to zero, no fishery allocation. A summary of the elements of a rebuilding plan specified in the National Standard 1 guidelines are summarized in Table 3.

Projections for Rebuilding Plan Alternative 2 suggest that Atlantic herring can rebuild in 5 years, or 2026, the year the probability of rebuilding ($P_{rebuild}$) is estimated to be 50% or more. These projections assume that future herring recruitment is similar to average historical levels.

Because this is a biomass-based control rule that adjusts fishing mortality based on projected biomass, the target fishing mortality allowed under this rebuilding plan ($F_{rebuild}$) varies by year, ranging from F=0.09 in FY 2022 to F=0.43 in FY 2026 using current projection assumptions (Table 26). A fishing mortality rate of 0.43 is the maximum fishing mortality rate currently allowed under the Amendment 8 ABC control rule since 0.43 is 80% of the current estimate of F_{MSY} (0.54). Even if biomass continues to increase, the maximum fishing mortality rate allowed would remain at F=0.43 under this strategy. See Section 6.1.1 for more details about the projections.

If reference points, assessment model parameters and/or assumptions used for fishery projections are adjusted in the future, the $F_{rebuild}$ policy under this rebuilding plan will not be affected. The fishing mortality rate used under this strategy is driven by estimates of projected biomass. If projected biomass is less than 10% of SSB_{MSY} ABC is set to zero, and if projected biomass is equal to or greater than 50% of SSB_{MSY} than fishing mortality is set at 80% of F_{MSY}. Therefore, even if F_{MSY} or SSB_{MSY} values change in the future, or different models or assumptions are used to estimate biomass and fishery projections, this policy remains intact and subsequent adjustments would not need to be made to determine how to set fishing mortality levels.

Rationale: The ABC control rule adopted in Amendment 8 explicitly accounts for both the roles of herring as forage in the ecosystem and for uncertainty by limiting fishing mortality to 80% of F_{MSY}. Simulation testing found that over the long-term it should result in low variability in yield, low probability of the stock being overfished, low probability of closing the herring fishery, and catch at relatively high proportion of MSY. These goals are still important to the Council and continuing the use of the existing control rule for this rebuilding plan prioritizes the benefits of rebuilding Atlantic herring more quickly over the short-term economic costs lower ABCs will have on the herring fishery while Atlantic herring rebuilds.

When the Council considered implementing an ABC control rule through Amendment 8, it discussed what should happen in terms of applying the ABC control rule if the fishery is declared overfished.[1] The Amendment explained that if the linear decline in F between the upper and lower biomass parameters is enough to meet rebuilding requirements, then the control rule should be adhered to and the fishing mortality produced by the linear decline should be used to specify ABC.

Alternative 2 supports the work the Council developed through a Management Strategy Evaluation in Amendment 8 to identify an ABC control rule that is robust to uncertainty and meets specific criteria prioritized by the Council described above. Alternative 2 may have more negative economic impacts on the herring fishery in the near term compared to options with higher fishing mortality rates, but the probability of rebuilding is higher under this strategy. In addition, there are other industries that rely on predators of Atlantic herring that also need to be considered when balancing the economic impacts of rebuilding plan strategies. While the results suggest the overall performance of the alternatives under consideration are not very different, the projections make assumptions about future recruitment that may not pan out. Therefore, the Council supports being more risk averse in this situation when herring biomass is estimated to be at very low levels and multiple industries rely on this resource in various fishing communities throughout the region.

4.1.3 Rebuilding Plan Alternative 3 – Rebuilding plan that sets fishing mortality target based on constant fishing mortality rate estimated to rebuild resource in seven years

Under this alternative, a rebuilding plan would be established. The fishing mortality target of the rebuilding plan would be constant, $F_{rebuild}$ would be set at F=0.48, about 89% of F_{MSY}. This value was determined from the projections based on identifying the fishing mortality rate that would achieve a Prebuild of 50% in year 7 (FY 2028). These projections assume that future herring recruitment is like average levels. Year 1 of this rebuilding plan is FY 2022, the year the action is expected to be implemented. However, the ABC and fishery specifications already approved for FY 2022 would remain in place for Year 1 and a $F_{rebuild}$ of 0.48 would be used to set specifications for FY 2023 through FY 2028, the estimated rebuilding timeframe.

Projections for Rebuilding Plan Alternative 3 estimate that Atlantic herring can rebuild in 7 years if a constant fishing mortality rate of 0.48 is applied in 2023-2028 using the same assumptions as the projection model from the last assessment. Under these conditions, the probability of rebuilding is about 50% in 2028. See Section 6.1.1 for more details about the projections. Additional sensitivity projections to further assess risk and uncertainty.

If reference points, assessment model parameters and/or assumptions used for fishery projections are adjusted in the future the $F_{rebuild}$ policy under this rebuilding plan it is assumed that the same percentage of F_{MSY} would be used (89% of F_{MSY}). Therefore, if the current estimate of F_{MSY} (F=0.54) is modified up or down, this strategy would apply a fishing mortality rate of 89% of the new value. The target of 7-years for

[1] Language was included in Amendment 8 as guidance if a rebuilding plan became required. Section 2.1.3 of Amendment 8 explains that when a fishery is declared overfished the Council must develop a rebuilding plan and, “specify a time period for rebuilding...that shall be as short as possible…and not exceed ten years.” Amendment 8 states that if the fishery enters a rebuilding plan, the linear decline in F between the upper and lower biomass parameters of the ABC control rule may be insufficient to meet rebuilding requirements. In such cases, deviations from the linear decline in F will be required, and projections will have to be completed to determine the ABC that will achieve rebuilding (equivalent to what is now done to specify ABC in rebuilding plans). The Amendment went on further to state that if the linear decline in F between the upper and lower biomass parameters is enough to meet rebuilding requirements, then the control rule should be adhered to and the F produced by the linear decline should be used to specify ABC.

rebuilding (FY 2028) should remain in place even if reference points and/or assessment/projection assumptions are modified in the future.

Rationale: Rebuilding Plan Alternative 3 would be a rebuilding strategy that prioritizes the short-term needs of herring fishing communities higher than rebuilding the herring resource more quickly. The longer rebuilding timeframe of this alternative allows fishing mortality targets to be higher to provide higher ABCs. The Atlantic herring resource is estimated to rebuild in less than ten years under this alternative, but not as quickly as under Alternative 2.

4.1.4 Summary of Required Terms Related to Rebuilding Plan

This is not an alternative in this action; this section summarizes the proposed definitions for required terms associated with development of a rebuilding plan regardless of the fishing mortality target selected above. Table 3 summarizes the definitions for these required terms as well as the proposed specifics relative this this rebuilding plan for Atlantic herring in the right-hand column. Many of these terms stem directly from the last assessment for Atlantic herring (2020). If Alternative 2 or 3 is adopted in this action, the terms described in Table 3 will be incorporated into the rebuilding plan for Atlantic herring.

Table 3. Management reference points for an Atlantic herring rebuilding plan

Term	Definitions	Numerical values of reference point, if applicable
MSY	The largest long-term average catch or yield that can be taken from a stock under prevailing ecological, environmental conditions and fishery technological characteristics, and the distribution of catch among fleets.	MSY_{proxy} = 99,400 mt
B_{MSY}	The long-term average size of the stock measured in terms of spawning biomass or other appropriate measures of the stock's reproductive potential that would be achieved by fishing at F_{MSY}.	$SSB_{MSY\ proxy}$ = 269,000 mt
F_{MSY}	The fishing mortality rate that, if applied over the long term, would result in MSY.	$F_{MSY\ proxy}$ = 0.54
Overfished	A stock or stock complex is overfished when its biomass has declined below MSST.	In 2019, SSB estimated at 77,883 mt, < MSST; therefore, the stock is overfished.
MSST	Minimum stock size threshold – level of biomass which the capacity of the stock to produce MSY on a continuing basis has been jeopardized. This level is not precisely specified in the regulations or guidelines, but in practice, generally set at ½ B_{MSY}.	½ $SSB_{MSY\ proxy}$ =134,500 mt
Overfishing	Occurs whenever a stock is subjected to a level of fishing mortality or total catch that jeopardizes the capacity of a stock to produce MSY on a continuing basis.	In 2019, F estimated at 0.25, < MFMT; therefore, overfishing is not occurring
MFMT	Minimum fishing mortality threshold - level of fishing mortality on an annual basis, above which overfishing is occurring.	F=0.54
T_{min}	The amount of time the stock or stock complex is expected to take to rebuild to its MSY biomass level in the absence of any fishing mortality. The term "expected" means to have at least a 50% probability of attaining B_{msy}.	Using F=0, $P_{rebuild}$ reaches over 50% in 4 years under the assumptions used in the last assessment.
T_{max}	The maximum time for rebuilding a stock or stock complex to its B_{msy}. *If T_{min} for the stock is 10 years or less, then T_{max} is 10 years.* *If T_{min} for the stock exceeds 10 years, then several other methods can be used to determine T_{max}.*	For Atlantic herring T_{max} is 10 years since T_{min} is 10 years or less.
T_{target}	The target time for rebuilding shall be as short as possible, taking into account: the status and biology of any overfished stock, the needs of fishing communities, recommendations by international organizations in which the U.S. participated, and interactions of the stock within the marine ecosystem. The time period shall not exceed 10 years, except where biology of the stock, other environmental conditions, or management measures under an international agreement to which the U.S. participates, dictate otherwise.	This action is considering two alternatives for rebuilding T_{target}: Alt. 2 (Preferred Alternative) uses the ABC CR - projections estimate T_{target} of 5 years. Alt. 3 applies a constant F based on rebuilding in 7 years – projections estimate T_{target} of 7 years.
G	Generation time is the average length of time between when an individual is born and the birth of its offspring.	Age when herring successfully spawn based on Restrepo et al, 1998. Therefore, G = 6 years (See Appendix 2).
$F_{rebuild}$	Fishing mortality associated with achieving T_{target}.	$F_{rebuild}$ for Alt. 2, the preferred alternative, varies because it is biomass based, current estimates are between F=0.09 and F=0.43 during the rebuilding time period. $F_{rebuild}$ for Alt. 3 is 0.48).

4.2 Action 2 – Herring Accountability Measures (AMs)

The Herring FMP has AMs in place to account for overages of the ACL and sub-ACLs, as well as underage or carryover measures. Action 2 is considering three alternatives related overages. The Council also discussed whether alternatives should be developed to potentially adjust measures related to underage or carryover – currently up to 10% of unused sub-ACL can be carried over to a future fishing year, but the total ACL does not increase from carryover. However, the Council decided not to consider alternatives related to carryover at this time, see Section 4.3.1 for more details.

4.2.1 Overage AMs

4.2.1.1 Overage AM Alternative 1 – No Action

Under this alternative, there would be no changes to the proactive, in-season or reactive AMs in place to minimize overages. During a fishing season NMFS monitors catch and when the fishery is estimated to catch a specific percentage of a sub-ACL a reduced possession limit (40,000 lb or 2,000 lb, depending on the area and percentage of the sub-ACL caught) is implemented for that management area for the remainder of the fishing year (implementation of a 2,000 lb possession limit). For areas 1A and 1B, a 2,000 lb possession limit is implemented when the fishery is projected to catch 92% of the sub-ACL. More recently a two-step trigger was implemented for Areas 2 and 3 in Framework 8 (2021). The two-step proactive AM in place is intended to slow the fishery down as it approaches the sub-ACL in Areas 2 and 3 to improve access to the mackerel fishery before areas close to herring fishing. For Areas 2 and 3, a 40,000 lb possession limit is implemented when 90% of the sub-ACL is estimated to be caught, then a 2,000 lb possession limit is implemented when 98% of the sub-ACL for those areas is estimated to be caught

The Herring FMP also has a reactive pound for pound AM to address any overages. After final year end catch estimates are calculated, the amount of any overages of sub-ACLs and/or the total ACL are subtracted from the applicable sub-ACL and ACL in a subsequent year . Section 5.5.1.2 summarizes when and where this has occurred in the herring fishery in the last decade or so.

Rationale: Both the proactive, in-season AMs that adjusts possession limits in a management area for the remainder of the year, and the payback reactive AMs that reduce future allocations to account for overages are designed to keep the fishery below annual catch limits and prevent overfishing. The in-season AM helps prevent this high-volume fishery from exceeding sub-ACLs, and if there are any overages the reactive AMs are a pound for pound reduction to prevent overfishing.

4.2.1.2 Overage AM Alternative 2 – Allowance for herring fishery overages up to 10% of sub-ACL if total ACL not exceeded (preferred alternative)

Under AM Alternative 2, the Preferred Alternative, catch from a management area that exceeds the sub-ACL by less than or equal to 10% of the sub-ACL is not deducted from the ACL and respective sub-ACL in a subsequent year unless total catch also exceeds the total ACL. If catch exceeds a management area sub-ACL by greater than 10%, there would be an overage deduction from the applicable sub-ACL and total ACL in a subsequent fishing year.

If catch exceeds a sub-ACL by more than 10% but does not exceed the ACL, only the amount of the overage above 10% would be deducted in a subsequent fishing year. For example, if the fishery exceeded a sub-ACL by 13% and the total ACL was not fully harvested, the amount equal to a 3% overage would be deducted from the sub-ACL and total ACL in a subsequent fishing year instead of the full 13%.If a sub-ACL was exceeded by 10% or less, there would be no overage deduction applied if the ACL was not also exceeded. If the total ACL was exceeded, the current requirement for a pound-for-pound payback of the full sub-ACL overage (in addition to the total ACL overage) would remain in place.

Rationale: Limiting the sub-ACL overage threshold to 10% acknowledges there are spatially distinct stock/spawning components and constrains the amount of additional fishing pressure allowed in a particular area. This measure also helps prevent overfishing because the total ACL cannot be exceeded, if catch is 10% higher in one area, it needs to be lower by that amount or more in another area. This alternative is expected to provide more flexibility for the herring fishery to better optimize yield and help minimize negative economic impacts of overage deductions while keeping catch under the total ACL and ABC. Capping overages to 10% of a sub-ACL is expected to limit fishing pressure on one sub-component of the overall resource and prevent overfishing one spatial component of the overall stock. The 10% overage allowance serves as a buffer to provide flexibility and help the fishery achieve OY. Not having a deduction for sub-ACL overages less than 10% as long as the ACL is not exceeded recognizes that monitoring sub-ACLs in this high-volume fishery can be challenging. It is difficult to perfectly time when to implement reduced possession limits to end directed herring fishing, especially under lower quotas.

4.2.1.3 Overage AM Alternative 3 – Allowance for herring fishery overages of sub-ACLs until the total ACL is harvested

Under AM Alternative 3, herring catch from a management area that exceeds the sub-ACL would be deducted from the total ACL and respective sub-ACL in a subsequent year, only if total catch also exceeded the ACL. Catch can exceed a sub-ACL by any amount so long as the total ACL is not exceeded.

Rationale: This alternative would place accountability at the ACL level, instead of the sub-ACL level. Having AMs trigger at the full ACL level and not the sub-ACL level is allowed and is consistent with National Standard guidelines. The fishery would not be permitted to exceed the total ACL so this measure is expected to help prevent overfishing; however, this alternative could allow higher fishing mortality on sub-components of the stock if sub-ACLs are consistently exceeded. This alternative is expected to provide maximum flexibility to support OY in this fishery by minimizing negative economic impacts of overage deductions while keeping catch under the total ACL and ABC.

4.3 Considered but Rejected Alternatives

4.3.1 Carryover AMs

Currently, if a management area's sub-ACL is not fully harvested and total catch does not exceed the ACL, then the amount of the underage, up to 10% of the initial sub-ACL, is carried over and applied to the respective sub-ACL in a subsequent year. Carryover does not increase the total ACL. Carryover is required unless the Council recommends NMFS temporarily suspend this measure or reduce the allowance from 10% to a lower value, like in 2021 and 2022 (based on catch from 2019 and 2020).

This measure allows the fishery access to unharvested catch but maintains the management uncertainty buffer between ABC and the ACL, while giving the fleet some flexibility in choosing where to harvest the ACL. In several cases the Council has suspended carryover on a temporary basis by setting it at 0% or limiting it to 5% in various specifications over the years.

Rationale for rejection: Currently the Council supports maintaining the status quo approach for carryover due to herring's overfished status and the variability in allocation and fishing effort across herring management areas. When biomass is low, suspending or minimizing the carryover of unharvested catch could help speed stock rebuilding. Furthermore, if allocation by area or season are shifted, there are risks of unintended consequences with potential distributional impacts on fishery participants. Therefore, the Council has not chosen to adjust how carryover provisions are implemented in this plan at this time.

4.3.2 Rebuilding Plan Alternative 3A

Under this alternative, a rebuilding plan would be established that sets fishing mortality based on a constant fishing mortality that is more conservative than the rate estimated to rebuild the resource in seven years. The fishing mortality target of the rebuilding plan would be constant, $F_{rebuild}$ would be set at F=0.358, about 66% of F_{MSY}. This value was determined from the projections based on identifying the fishing mortality rate that would achieve a $P_{rebuild}$ of 50% in year 7 (FY 2028) but using the projection results from the autocorrelated recruitment (AR) scenario. When recruitment is lower, overall herring biomass is lower; therefore, the fishing mortality rate estimated to achieve rebuilding in seven years needs to be reduced, in this case from 0.48 to 0.358, or from 89% of F_{MSY} to 66% of F_{MSY}.

Year 1 of this rebuilding plan is FY 2022, when the action is likely to be implemented. However, the ABC and fishery specifications already approved for FY 2022 would remain in place for Year 1 and a $F_{rebuild}$ of 0.358 would be used to set specifications for FY 2023 - 2028, the likely rebuilding timeframe.

Projections for Rebuilding Plan Alternative 3A estimate that Atlantic herring can rebuild in seven years if a constant fishing mortality rate of 0.358 is applied in 2023-2028 using the autocorrelated recruitment projections. When this same fishing mortality rate (0.358) is applied assuming average recruitment, the rebuilding timeframe is estimated to be five years. Appendix II has more information about the projections and results prepared for this option.

If reference points, assessment model parameters and/or assumptions used for fishery projections are adjusted in the future, the $F_{rebuild}$ policy under this rebuilding plan it is assumed that the same percentage of F_{MSY} would be used (66% of F_{MSY}). Therefore, if the current estimate of F_{MSY} (F=0.54) is modified up or down, this strategy would apply a fishing mortality rate of 66% of the new value. The target of 7-years for rebuilding (FY 2028) should remain in place even if reference points and/or assessment/projection assumptions are modified in the future.

Rationale for rejection: Rebuilding Plan Alternative 3A was considered later during development of Framework 9. This alternative was evaluated to balance the needs of herring fishing communities and rebuilding the herring resource more quickly. This alternative allows a higher fishing mortality in 2023 (F=0.358) compared to Alternative 2, but the constant F under this option would be lower than Alternative 2 in years farther out during the rebuilding timeframe. This alternative acknowledges current low recruitment levels by reducing allowable fishing mortality rates to be more risk averse than Alternative 3 (constant F of 0.48).

Preliminary analysis of this alternative was prepared and reviewed by the Council at the final meeting, and those results are summarized in Appendix III. Ultimately, the Council decided this rebuilding plan strategy was not a better compromise and at the final Council meeting voted to reject further consideration of this alternative. This rebuilding plan was considered and rejected primarily because the Council is not supportive of using a constant fishing mortality rate when herring biomass is very low. While this option is more conservative than Alternative 3, it still uses a constant fishing mortality strategy that is riskier than a biomass-based approach that reduces F when biomass is low. The Council determined the potential economic benefits of allowing a higher F in 2023 under this alternative did not outweigh the potential risks of this alternative. A fishing mortality rate of 0.358, approximately 66% of F_{msy}, was not considered conservative enough at this time given the very low estimates of herring biomass. If herring recruitment does not improve and biomass remains low in the near term this fishing mortality level was not considered risk averse enough. Other important considerations discussed are the role of herring as forage in the ecosystem, as well as negative economic impacts on other industries that rely on predators of herring (recreational fisheries, ecotourism, and other commercial fisheries). In addition, Atlantic herring is an important bait source for the lobster fishery, and the longer it takes herring to rebuild, the greater the potential negative economic impacts could be for these related industries.

5.0 AFFECTED ENVIRONMENT

The Affected Environment is described in this action based on valued ecosystem components (VECs), including target species, non-target species, physical environment and Essential Fish Habitat (EFH), protected resources, and human communities. VECs represent the resources, areas and human communities that may be affected by the alternatives under consideration in this amendment. VECs are the focus since they are the "place" where the impacts of management actions occur.

The Council recently completed Amendment 8 to the Atlantic Herring FMP that included a detailed Affected Environment, with some updates through 2019 in Framework 8 (NEFMC 2020). This action updates several key tables and figures with data through 2020 and in some cases 2021, but for the most part references the information recently included in Amendment 8 (NEFMC 2018b).

5.1 TARGET SPECIES (ATLANTIC HERRING)

This section describes the life history and stock population status for Atlantic herring, as well as herring's role as forage in the ecosystem. A complete description of the Atlantic herring resource is in the FEIS for Amendment 1 to the Atlantic Herring FMP (NEFMC 2006, Section 7.1). Updated information is in Amendment 5 and Amendment 8 to the Atlantic Herring FMP. Information in this section has been updated through 2019.

Life history details about the Atlantic herring resource are described in Amendment 8. In summary, Atlantic herring, *Clupea harengus*, is widely distributed in continental shelf waters of the Northeast Atlantic, from Labrador to Cape Hatteras. Spawning occurs in the summer and fall, starting earlier along the eastern Maine coast and southwest Nova Scotia (August – September) than in the southwestern Gulf of Maine (early to mid-October in the Jeffreys Ledge area) and Georges Bank (as late as November – December; Reid et al. 1999). In general, GOM herring migrate from summer feeding grounds along the Maine coast and on GB to SNE/MA areas during winter, with larger individuals tending to migrate farther distances.

In the past, the herring resource along the east coast of the United States was divided into the Gulf of Maine and Georges Bank stocks (Anthony & Waring 1978). However, no methods are available to identify stock of origin for fish caught in the mixed stock fishery or during fishery-independent surveys. Consequently, herring from the Gulf of Maine and Georges Bank are combined for assessment and management purposes into a single stock complex, although three spawning stock components occupy three distinct locations: in the Gulf of Maine, southwest Nova Scotia-Bay of Fundy, and Georges Bank. A more detailed description of this stock definition is in Amendment 1.

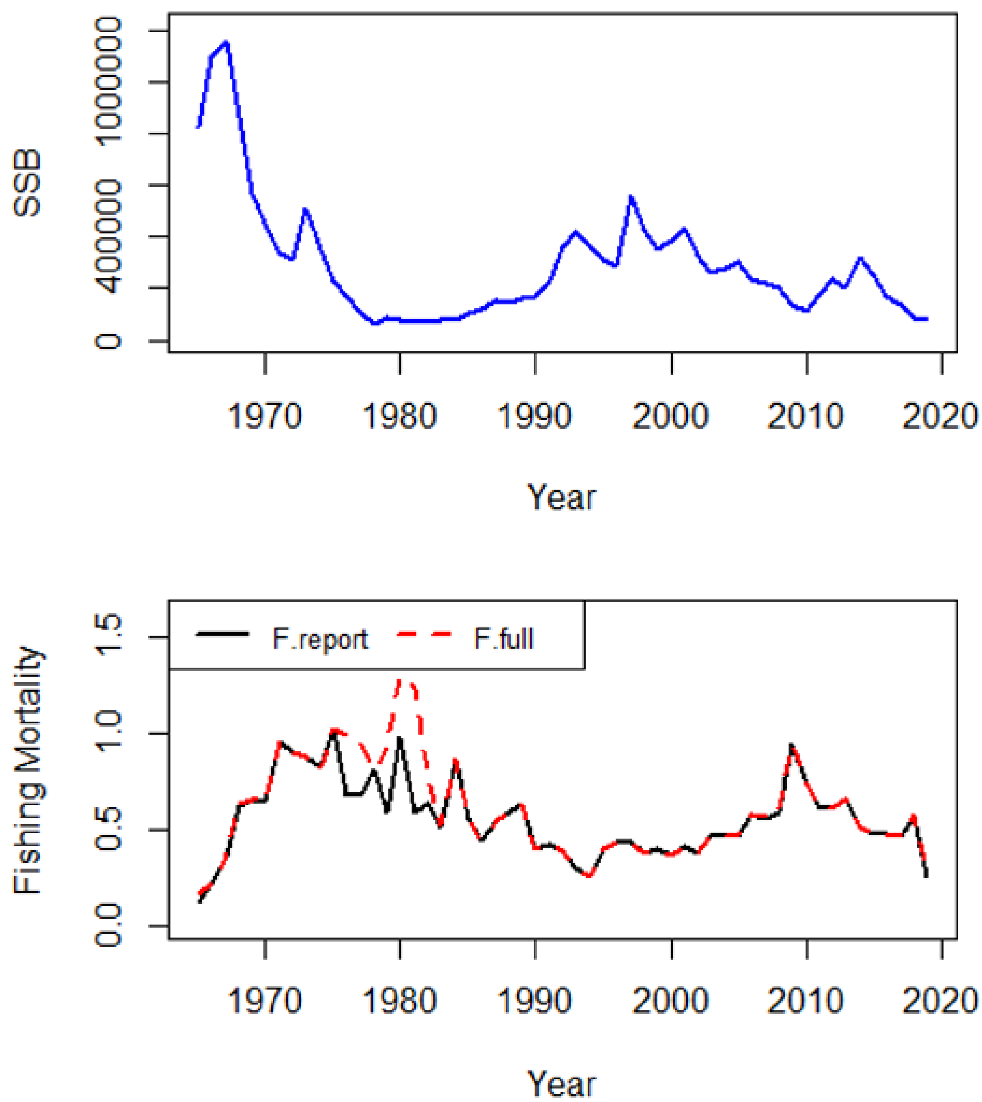
5.1.1 Stock Assessment

The Atlantic herring stock was most recently assessed during spring 2020 Management Track Assessment (NEFSC 2020a). The 2020 assessment used all the same data sources of the previous assessment (NMFS spring, fall, acoustics collected in fall, and summer shrimp bottom trawl survey). Overall, SSB generally declined from 1965 to a time series low in 1978 and then generally increased from 1978 through the mid-1990s. SSB declined again from 1997 to 2010, increased for several years until 2014, and has been declining since. In addition, fishing mortality has been relatively stable since the decreases in the 1990s, with a gradual increase in 2009, followed by a general declining fishing mortality since then (Figure 1).

With data updates, the 2019 SSB was estimated to be 77,883 mt (80% probability interval: 57,150-111,125 mt), compared to the full range of estimated biomass of 62,007 mt in 1978 to 1,152,400 mt in 1967 (Figure 1). The average F between ages 7 and 8 was used for reporting results related to fishing mortality (F7-8) because these ages are fully selected by the mobile gear fishery, which has accounted for most of the landings since 1986. F7-8 in 2019 equaled 0.25 (80% probability interval: 0.17-0.37) and ranged from 0.12 in 1965 to 1.02 in 1975 (Figure 1).

Age-1 recruitment has been below average since 2013 (Figure 2). The time series high for recruitment was in 1971 (1.4 billion age-1 fish). The time series low (2.8 million fish) occurred in 2016, and the second lowest (4.1 million fish) occurred in 2018, although this estimate is highly uncertain. Five of the six lowest annual recruitment estimates have occurred since 2015 (2015, 2016, 2017, 2018, and 2019).

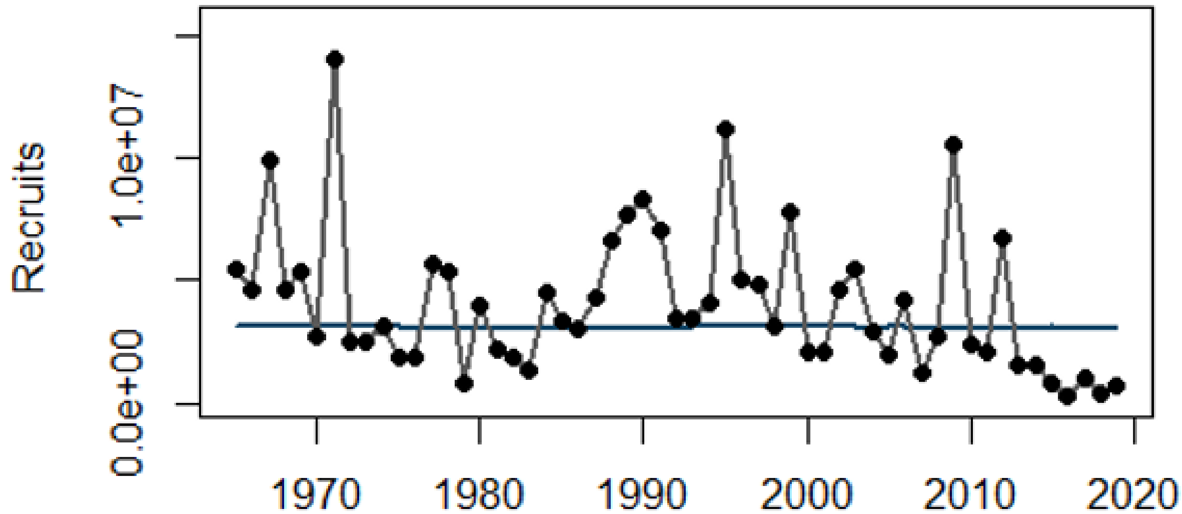
Figure 1. Atlantic herring spawning stock biomass (mt) and fishing mortality time series from the age structured assessment program (ASAP model), 1965-2019.



Note: F.report is the average F for ages 7 and 8 for all gear types and is the parameter used to determine stock status.

Source: NEFSC (2020a).

Figure 2. Atlantic herring annual recruit (000s) time series, 1965-2019.



Note: The horizontal line is the average recruitment estimated by the ASAP model over the time series, the annual recruitment values are estimated as deviations +/- from the underlying average.
Source: NEFSC (2020a).

5.1.2 Stock Status

MSY reference points from the 65th Stock Assessment Workshop (NEFSC 2018b) were based on a selectivity curve aggregated between the mobile and fixed gear fleets. The proportion of the catch coming from the fixed gear fleet has increased in recent years, which made the MSY reference points unduly affected by the Canadian, fixed gear catches, which are not quota controlled. Thus, MSY reference points in the 2020 assessment were estimated based on the mobile fleet selectivity pattern, which is an entirely US fleet. MSY reference points were still premised on a proxy of F40%, as in SAW 65. The newly proposed reference points from the 2020 assessment are no longer affected by the relative amount of mobile and fixed fleet catches.

FMSY proxy = 0.543

SSBMSY proxy = 269,000 mt

(½ SSBMSY proxy = 134,500), and

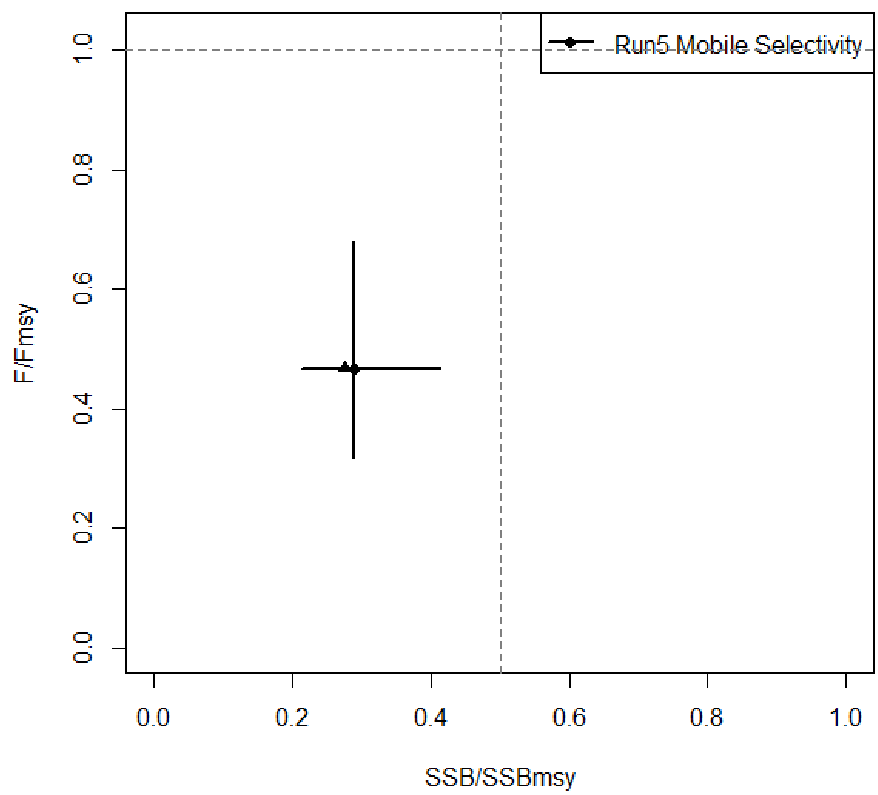
MSY proxy = 99,400 mt.

The 2020 management track assessment concluded that for the terminal year of the assessment, 2019, the Atlantic herring resource is below ½ SSB_{MSY} proxy (2019 biomass of 77,883 mt), and fishing mortality is below the F_{MSY} proxy threshold (2019 F7-8 = 0.253; Figure 3). Therefore, Atlantic herring is ***overfished but not subject to overfishing.***

The assessment did include some cautionary notes about the status of the stock. In the short-term, the relatively poor recruitments in 2013-2019 will increase the probability of the stock remaining overfished. Growth (i.e., weight at age) also continues to be relatively low relative to the 1990s, and this seems to be a longer-term feature of the stock that also reduces production. The stock, however, seems to be capable of producing relatively large and small year classes regardless of growth, and so recruitment is likely the more significant driver of short-term vulnerability.

The major sources of uncertainty are natural mortality, stock-recruit relationship, and stock structure. Natural mortality (M) was assumed constant in the 2020 management track, as in SAW 65, but M is likely to vary among time and age (size). A definitive explanation for the continued poor recruitment has not been identified, and there may be multiple factors causing below average recruitment. Finally, stock structure remains an uncertainty for this stock assessment, particularly mixing with the Nova Scotian stock. Migration can be conflated with changes in mortality or fishery selectivity and contribute to retrospective patterns.

Figure 3. Atlantic herring stock status based on the ASAP model.



Note: Error bars represent the 80% probability intervals. The triangle represents the model result if an adjustment were to be made for the retrospective pattern.
Source: NEFSC (2020a).

The NOAA Assistant Administrator for Fisheries formally determined on October 2, 2020, that the Atlantic herring stock is overfished based on the best scientific information available. The Council was informed of this change in stock status on October 13, 2020. NOAA Fisheries recommends that the Council submit a rebuilding plan within 15 months to ensure sufficient time to implement the appropriate regulations within two years of the notification letter.

5.1.3 Importance of 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 structure of the Northeast U.S. shelf ecosystem features multiple forage species rather than a single dominant forage species. Herring share the role of forage here with many other species including sand lance, mackerels, squids, and hakes, although herring are distinguished by a high energy density (caloric content) relative to other pelagic prey in the ecosystem. This diversity of forage options leads to a complex and diverse food web supporting many different predators. The relative importance of herring as forage varies by predator group, due to differences in predator life history, foraging style, and bioenergetics. Therefore, predator responses to changing herring populations vary, and depend on the extent to which other forage is available.

Amendment 8 detailed the information available on herring as forage including the species that consume herring in the Northeast and the food habits of Atlantic herring (NEFMC 2018b). Similarly, the 2018 assessment updated the estimate of consumption of herring at various life stages (NEFSC 2018b). Total consumption of herring by fish predators has been variable, with lesser total amounts of herring predation earlier in the time series compared to later. Prey length data show that much of the predation is on larger fish, and this is likely due to the design of the bottom trawl survey sampling design that focuses offshore. It is believed that similar or even greater amounts of predation on juvenile herring is likely occurring in nearshore areas by fish predators, as well as other predators such as birds and marine mammals.

Climate and environmental conditions can be major drivers of pelagic fish dynamics. In the Northeast U.S., Atlantic herring and other pelagics have lower sensitivity to climate risks than other species due to high mobility but have high potential to change distribution. The impact of climate change on Atlantic herring is negative to negligible relative to other Northeast species. All Northeast U.S. species have high or very high exposure to climate change risks, as this ecosystem is changing more rapidly than much of the world ocean (Hare et al. 2016).

5.2 Non-target Species (Bycatch)

Non-target species refers to species other than Atlantic herring which are caught/landed by federally permitted vessels while fishing for herring. The MSA defines *bycatch* as fish that are harvested in a fishery, but are not retained (sold, transferred, or kept for personal use), including economic discards and regulatory discards (16 U.S.C. § 1802(2)). The MSA mandates the reduction of *bycatch*, as defined, to the extent practicable (16 U.S.C.§ 1851(a)(9)). Incidental catch, on the other hand, is typically considered to be non-targeted species that are harvested while fishing for a target species and is retained and/or sold. In contrast to bycatch, there is no statutory mandate to reduce incidental catch. When non-target species are encountered in the Atlantic herring fishery, they are either discarded (bycatch) or they are retained and sold as part of the catch (incidental catch). Most catch by herring vessels on directed trips is Atlantic herring, with extremely low percentages of bycatch (discards). In some cases, Atlantic mackerel is targeted in combination with Atlantic herring during some of the year in the southern New England and Mid-Atlantic areas and is therefore not considered a non-target species because in many cases, vessels are targeting and landings herring and mackerel on the same trip.

Due to the high-volume nature of the Atlantic herring fishery, non-target species, including river herring (blueback herring and alewives), shad (hickory shad and American shad), and some groundfish species (particularly haddock), are often retained once the fish are brought on board (NEFMC 2012, p. 173). The catch of non-target species in the directed Atlantic herring fishery can be identified through sea sampling (observer) data collected by the Northeast Fisheries Observer Program (NEFOP). Portside sampling data collected by MADMF and MEDMR can be used to estimate catch of any non-target species that are landed. Dealer and VTR data can be used to identify/cross-check incidental landings of some non-target species that may be separated from Atlantic herring.

The primary non-target species in the directed Atlantic herring fishery are groundfish, particularly haddock, and the river herring/shad (RH/S) species. There are accountability measures in place for both haddock and river herring/shad if area and gear specific catch cap is exceeded. Dogfish, squid, butterfish, and Atlantic mackerel are also common species encountered in the directed Atlantic herring fishery. However, in some cases (especially Atlantic mackerel), while herring is often the target species, mackerel is also landed, and some trips are quite mixed in terms of mackerel and herring landings. Therefore, Atlantic mackerel is not considered a non-target species since there can be substantial landings of that species for various segments of the fishery during certain seasons and in certain areas. Comprehensive information about the catch of these species in the Atlantic herring fishery is in Section 5.2 of Amendment 5 and Sections 3.2 and 3.3 of Framework 3 to the Atlantic Herring FMP.

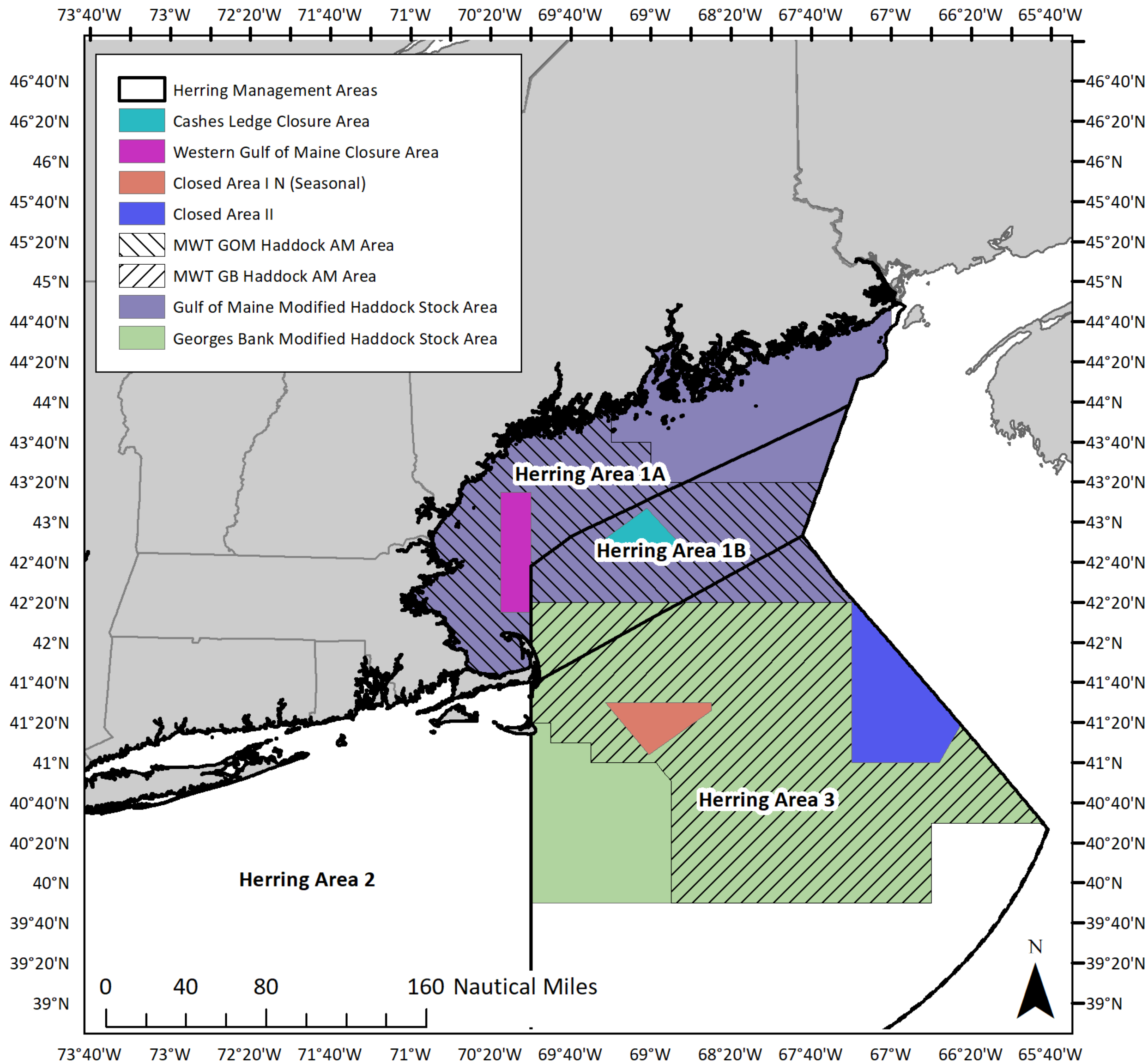
Haddock

Haddock has two stocks: Gulf of Maine and Georges Bank. For Gulf of Maine haddock, as of the 2019 groundfish operational assessments, the stock is not overfished and overfishing is not occurring, with 2018 SSB estimated to be at 82,763 mt, which is 1,035% of the biomass target (NEFSC 2020b). Recreational catch estimates were re-estimated in this update by using the re-calibrated MRIP data. In general, inclusion of the re-calibrated data resulted in an increase in SSB, F, and recruitment. The GOM haddock stock has experienced several large recruitment events since 2010. The population biomass is currently at an all-time high and overall, the population is experiencing low mortality (NEFSC 2017).

The Eastern GB haddock management unit is a transboundary stock; the US and Canada have signed a non-binding agreement to coordinate consistent management of this stock. GB haddock is not overfished, and overfishing is not occurring (NEFSC 2020b). There has been a steady increase in SSB from ~15,000 mt in the early 1990s, to about 252,000 mt in 2007. The dramatic increase 2005 - 2007 is due to the exceptionally large 2003-year class reaching maturity. From 2007 - 2010, SSB decreased 35% as that 2003-year class decreased due to natural and fishing mortality. The fishing mortality rate for this stock has been low in recent years. The retrospective adjusted 2018 SSB was estimated to be at 507,130 mt, which is 365% of the biomass target. The GB haddock stock shows a broad age structure, and broad spatial distribution. This stock has produced several exceptionally strong year classes in the last 15 years, leading to record high SSB in recent years. Catches in recent years have been well below the total quota (US + Canada). While all survey indices support the finding that this stock is at an all-time high, weights at age have been declining since the large 2003-year class and show further declines with the most recent data (NEFSC 2020b).

Haddock is managed by the NEFMC under the Northeast Multispecies FMP. Framework Adjustment 59 to the Northeast Multispecies FMP increased the midwater trawl Atlantic herring fishery sub-ACL for Georges Bank haddock to 2% for FY 2020-2022 (NEFMC 2020), up from 1.5% for a few fishing years before that and, and up from 1% from even earlier years. The GOM haddock sub-ACL has been maintained at 1%. When the haddock incidental catch cap for a particular haddock stock (GOM or GB) has been caught, all herring vessels fishing with MWT gear are prohibited from fishing for, possessing, or landing, more than 2,000 lb of herring in the respective haddock accountability measure area for the rest of the multispecies fishing year (Map 1). There is also a pound-for-pound payback for any overages. This has only occurred once since 2012 for GB haddock (Table 12).

Map 1. GOM and GB haddock stock areas (shaded) with herring MWT accountability measures (hatched) with herring management area boundaries and current closure areas per Omnibus Habitat Amendment 2 (2018).



River Herring/Shad

In 2017, there was an updated river herring assessment that concluded the coastwide meta-complex of river herring stocks on the U.S. Atlantic coast remains depleted to near historic lows. There is evidence for declines in abundance due to several factors, but their relative importance could not be determined. The overfished and overfishing status is unknown for the coastwide stock complex, as estimates of total biomass, fishing mortality rates, and corresponding reference points could not be developed. While status on a coastwide basis remains unchanged, there are some positive signs of improvement for some river systems, with increasing abundance trends for several rivers in the Mid-Atlantic throughout New England region. While abundance in these river systems are still at low levels, dam removals and improvements to fish passage have had a positive impact on run returns (ASMFC 2017b).

The 2020 American Shad Benchmark Stock Assessment and Peer Review Report indicate American shad remain depleted on a coastwide basis. Multiple factors, such as overfishing, inadequate fish passage at dams, predation, pollution, water withdrawals, channelization of rivers, changing ocean conditions, and climate change are likely responsible for shad decline from historic abundance levels. Additionally, the assessment finds that shad recovery is limited by restricted access to spawning habitat. Current barriers partly or completely block 40% of historic shad spawning habitat, which may equate to a loss of more than a third of spawning adults. The "depleted" determination was used instead of "overfished" because the impact of fishing on American shad stocks cannot be separated from the impacts of all other factors responsible for changes in abundance. The benchmark assessment was endorsed by the Peer Review Panel and accepted by the Shad & River Herring Management Board for management use (ASMFC 2020b).

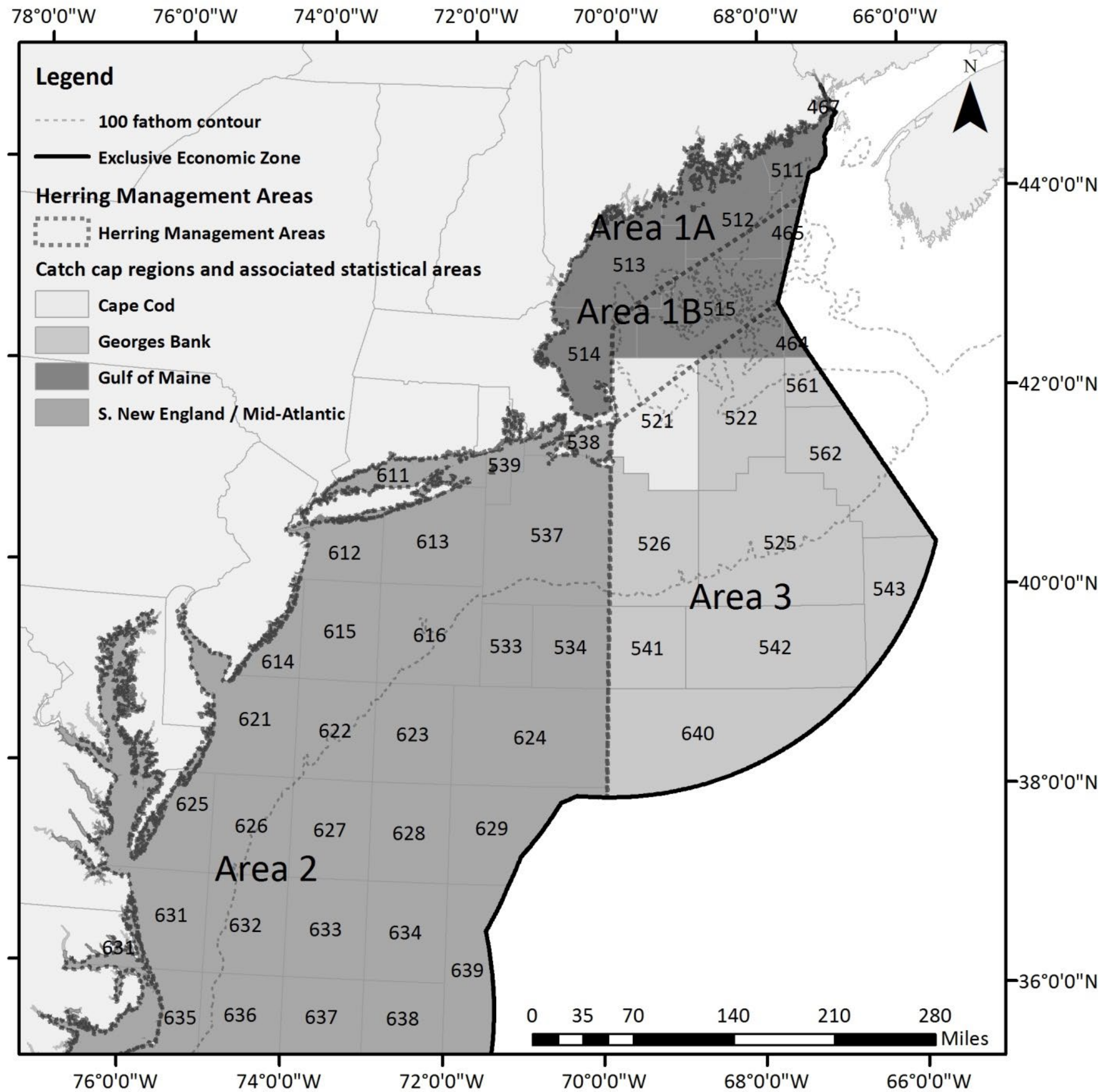
River herring and shad are primarily managed under Amendments 2 and 3 to the ASMFC FMP for Shad and River Herring (ASMFC 2009 and 2010), respectively which address concerns regarding declining populations of these species. For river herring and shad, states and jurisdictions had to develop Sustainable Fishery Management Plans (SFMPs) to maintain a commercial and/or recreational fisheries past January 2012.

In December 2014, NMFS implemented river herring and shad catch caps for the Atlantic herring fishery for 2014 and 2015 (Map 2). Catch of river herring and shad on fishing trips that land over 6,600 lb of herring count towards the caps. Caps in the herring fishery are area and gear specific. If NMFS determines that 95% of a river herring and shad cap has been harvested, a 2,000 lb herring possession limit for that area and gear will become effective for the rest of the fishing year. This low possession limit essentially turns the area into a closed area for directed herring fishing until the start of the next fishing year. Bycatch is monitored and reported on the GARFO website: https://www.greateratlantic.fisheries.noaa.gov/aps/monitoring/riverherringshad.html.

In 2018, the Council developed a white paper to support its consideration of adding river herring and shad as stocks in the Atlantic herring fishery. The white paper reviewed previous decisions on this issue, reviewed the legal requirements, summarized the species and fishery information, described updated actions taken related to RH/S, summarized new research, and identified potential actions for this issue (NEFMC 2018d). The Council discussed the issue at its April and June 2018 meetings and decided to maintain the current management structure for river herring and shad, and not add these as stocks in the Atlantic Herring FMP at this time.

In June 2019, NMFS completed a review of the status of alewife and blueback herring. They determined that listing these species under the ESA is not warranted at this time (*Federal Register* notice: https://deferalregister.gov/d/2019-12908). The determination found that while river herring have declined from historical numbers, and overutilization remains a risk to these species, recent fisheries management efforts have helped to reduce risks from fishing mortality. NMFS found that while the abundance of river herring in some rivers continues to be depleted, there are robust populations in other areas.

Map 2. Atlantic herring management areas and RH/S catch cap areas.



5.2.1 Monitoring of Non-target Species in the Herring Fishery

Fishery bycatch is monitored primarily using Federal fishery observers, though observer rates have varied annually and by fishery. Calculating an observer rate by gear type is difficult due to the overlap with other fisheries (e.g., overlap with squid and whiting in the small-mesh bottom trawl (SMBT) fishery). Thus, the data in Table 4 were pulled in a more general approach and included all trips by the three main gear types used in the Atlantic herring fishery. Observed purse seine and midwater trawl trips are predominantly targeting Atlantic herring, while non-herring trips are included in the SMBT coverage rates reported here. Amendment 8 includes detailed analyses of the bycatch species for each gear type used in the herring fishery.

In February 2020, NMFS implemented the New England Industry-Funded Monitoring (IFM) Omnibus Amendment to allow industry-funded monitoring in any fishery managed by the Council to better assess catch and reduce uncertainty around catch estimates. The amendment also established IFM in the herring fishery. Regulations implementing herring IFM were effective on April 1, 2020. Under the herring IFM program, vessels issued Category A or B herring permits are required to secure and pay for at-sea monitoring (ASM) services on trips that are selected for IFM coverage. Some herring vessels may choose to be issued an exempted fishing permit (EFP) authorizing them to use electronic monitoring (EM) and portside sampling in lieu of ASM on trips selected for IFM coverage. Covid-19 delayed implementation of this action, more detail below.

Table 4. Midwater trawl (MWT), purse seine (PS), and small mesh bottom trawl (SMBT) observer coverage rates, SBRM (April-March) years 2012-2019

Gear	2012	2013	2014	2015	2016	2017	2018	2019	2020
Midwater Trawl	40.5%	24.3%	19.9%	5.3%	20.9%	10.7%	4.1%	8.7%	5.1%
Purse Seine	5.2%	6.0%	3.7%	2.1%	2.2%	1.7%	1.0%	*	*
Small-mesh Bottom Trawl	4.3%	8.0%	10.1%	9.1%	10.9%	17.2%	13.8%	14.1%	1.3%

Source: DMIS and OBDBS databases as of August 31, 2021.
Notes: MWT includes both single and paired midwater trawl gears; PS excludes tuna purse seine trip; SMBT includes bottom trawl gear with codend mesh size less than 5.5” excluding bottom otter twin trawl, scallop and shrimp trawl trips.
Includes observer trips with at least 1 observed haul divided by VTR trips reporting kept catch, and all fisheries using these gear types, **not** just herring and mackerel fisheries.
* Confidential vessel activity information.

Since April 1, 2020, herring vessels have been required to notify via the pre-trip notification system (PTNS) prior to beginning any trip to be considered for Standardized Bycatch Reporting Methodology (SBRM) or IFM coverage. NMFS planned to begin selecting vessels issued Category A or B herring permits for IFM coverage at this time. However, training for new portside samplers was delayed due to the health mandates and travel restrictions that were in place in 2020, and as a result, there were no certified individuals available to provide portside sampling services to EFP vessels. NMFS did not select any herring vessels for IFM coverage until after the portside sampling training had been completed in early 2021.

Beginning July 1, 2021, vessels issued Category A or B herring permits began getting selected for IFM coverage. IFM coverage is in addition to observer coverage required by the SBRM. The IFM coverage target for the herring fishery is 50% of trips and is calculated by combining SBRM coverage with IFM coverage. This additional coverage will help reduce uncertainty around catch estimates in the herring fishery, especially catch tracked against haddock and river herring/shad catch caps.

The amendment maintains the requirement that midwater trawl vessels must carry an observer to fish in the Groundfish Closed Areas; however, since July 2021 vessel owners have had the option of purchasing observer coverage to access Groundfish Closed Areas.

The start date for assigning IFM coverage in the herring fishery was delayed until July 1, 2020. The training class for new portside samplers in the herring fishery was delayed due to the health mandates and travel restrictions in place in 2020 and will be rescheduled for later in 2020.

Framework 6 included a detailed description of the monitoring program in place before implementation of IFM as well as the various reporting requirements and methods used to monitor herring and bycatch in the herring fishery.

5.3 PROTECTED SPECIES

Protected species are those afforded protections under the Endangered Species Act (ESA; species listed as threatened or endangered under the ESA) and/or the Marine Mammal Protection Act (MMPA). Table 5 lists protected species in the affected environment of the Atlantic herring FMP and have the potential to be impacted by the proposed action; for example, removal of forage, interactions in the fishery or with gear type(s) like those primarily used in the fishery (i.e., midwater trawl and purse seine gear) have been observed/documented.

Table 5. Species protected under the ESA and/or MMPA that may occur in the affected environment of the herring FMP.

Species	Status[2]	*Potential for action to impact (via interactions (I) with Atlantic herring fishing gear and/or removal of forage (F)) protected species?*
CETACEANS		
North Atlantic right whale (Eubalaena glacialis)	***Endangered***	***No***
Humpback whale, West Indies DPS, (*Megaptera novaeangliae*)	Protected (MMPA)	Yes (I, F)
Fin whale (Balaenoptera physalus)	***Endangered***	***Yes (F)***
Sei whale (Balaenoptera borealis)	***Endangered***	***Yes(F)***
Blue whale (Balaenoptera musculus)	***Endangered***	***No***
Sperm whale (Physeter macrocephalus	***Endangered***	***No***
Minke whale (*Balaenoptera acutorostrata*)	Protected (MMPA)	Yes (I, F)
Pilot whale (Globicephala spp.)[3]	Protected (MMPA)	Yes (I, F)
Pygmy sperm whale (*Kogia breviceps*)	Protected (MMPA)	No
Dwarf sperm whale (*Kogia sima*)	Protected (MMPA)	No
Risso's dolphin (*Grampus griseus*)	Protected (MMPA)	Yes (I)
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Protected (MMPA)	Yes (I, F)
Short Beaked Common dolphin (*Delphinus delphis*)	Protected (MMPA)	Yes (I, F)
Atlantic Spotted dolphin (*Stenella frontalis*)	Protected (MMPA)	No
Striped dolphin (*Stenella coeruleoalba*)	Protected (MMPA)	No
Beaked whales (*Ziphius and Mesoplodon spp*)[4]	Protected (MMPA)	No
Bottlenose dolphin (Tursiops truncatus)[5]	***Protected (MMPA)***	***No***
Harbor porpoise (*Phocoena phocoena*)	Protected (MMPA)	Yes (F)
PINNIPEDS		
Harbor seal (*Phoca vitulina*)	Protected (MMPA)	Yes (I, F)
Gray seal (*Halichoerus grypus*)	Protected (MMPA)	Yes (I, F)
Harp seal (*Phoca groenlandicus*)	Protected (MMPA)	No
Hooded seal (*Cystophora cristata*)	Protected (MMPA)	No

Species	Status[2]	*Potential for action to impact (via interactions (I) with Atlantic herring fishing gear and/or removal of forage (F)) protected species?*
SEA TURTLES		
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	No
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	No
Green sea turtle, North Atlantic DPS (*Chelonia mydas*)	Threatened	No
Loggerhead sea turtle (*Caretta caretta*), Northwest Atlantic Ocean DPS	Threatened	No
Hawksbill sea turtle (*Eretmochelys imbricate*)	Endangered	No
FISH		
Cusk (*Brosme brosme)*	Candidate	No
Giant manta ray (*Manta birostris*)	Threatened	No
Atlantic salmon	Endangered	No
Atlantic sturgeon *(Acipenser oxyrinchus)*		
Gulf of Maine DPS	Threatened	No
New York Bight DPS, Chesapeake Bay DPS, Carolina DPS & South Atlantic DPS	Endangered	No
CRITICAL HABITAT		
Northwest Atlantic DPS of Loggerhead Sea Turtle	ESA (Protected)	No
North Atlantic Right Whale Critical Habitat	ESA (Protected)	No

Notes: Marine mammal species (cetaceans and pinnipeds) italicized and in bold are considered MMPA strategic stocks.[1] Shaded rows indicate species who prefer continental shelf edge/slope waters (i.e., >200 meters).

[1] A strategic stock is defined under the MMPA as a marine mammal stock for which: (1) the level of direct human-caused mortality exceeds the potential biological removal level; (2) based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future; and/or (3) is listed as a threatened or endangered species under the ESA, or is designated as depleted under the MMPA (Section 3 of the MMPA of 1972).

[2] Status is defined by whether the species is listed under the ESA as endangered (i.e. at risk of extinction), threatened (i.e. at risk of endangerment), or protected under the MMPA. Marine mammals listed under the ESA are also protected under the MMPA. Candidate species are those species for which ESA listing may be warranted.

[3] There are two species of pilot whales: short finned (*G. melas melas*) and long finned (*G. macrorhynchus*). Due to the difficulties in identifying the species at sea, they are often referred to as *Globicephala spp*.

[4] There are multiple species of beaked whales in the Northwest Atlantic. They include the Cuvier's (*Ziphius cavirostris*), Blainville's (*Mesoplodon densirostris*), Gervais' (*Mesoplodon europaeus*), Sowerbys' (*Mesoplodon bidens*), and Trues' (*Mesoplodon mirus*) beaked whales. Species of *Mesoplodon* are difficult to identify at sea, therefore, much of the available characterization for beaked whales is to the genus level only.

[5] This includes the Western North Atlantic Offshore, Northern Migratory Coastal, and Southern Migratory Coastal Stocks of Bottlenose Dolphins.

Cusk is a NMFS "candidate species" under the ESA. Candidate species are those petitioned species for which NMFS has determined that listing may be warranted under the ESA and those species for which NMFS has initiated an ESA status review through an announcement in the *Federal Register*. If a species is proposed for listing, the conference provisions under Section 7 of the ESA apply (50 CFR 402.10); however, candidate species receive no substantive or procedural protection under the ESA. Thus, cusk will not be discussed further in this and the following sections; however, NMFS recommends that project proponents consider implementing conservation actions to limit the potential for adverse effects on candidate species from any proposed action. Additional information on cusk can be found at: https://www.greateratlantic.fisheries.noaa.gov/protected/pcp/cs/index.html.

5.3.1 Protected Species and Critical Habitat Unlikely to be Impacted (via interactions with gear, removal of forage, or destruction of essential features of critical habitat) by the Atlantic herring FMP

Table 5 has critical habitat designated under the ESA, as well as multiple ESA listed and/or marine mammal protected species that occur in the affected environment of the Atlantic herring fishery but are unlikely to be impacted (via interactions with gear, removal of forage, or destruction of essential features of critical habitat) by the action. This determination has been made because either the species occurrence is unknown to overlap with the area primarily affected by the action, the species does not forage on Atlantic herring, and/or, based on the most recent ten years of observer, stranding, and/or marine mammal serious injury and mortality reports, there have been no documented interactions between the species and the primary gear type used to prosecute the fishery (i.e., purse seine and midwater (including pair) trawl).

To aid in the identification of MMPA protected species not likely to be impacted by the action, the most recent ten years of data provided in the MMPA List of Fisheries (LOF), the Greater Atlantic Region (GAR) Marine Animal Incident Database (unpublished data), and marine mammal stock assessment (SAR) and serious injury and mortality reports were referenced[2] (see Marine Mammal SARs for the Atlantic Region: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region; MMPA LOF: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries; NMFS Observer Program, unpublished data; NMFS NEFSC reference documents (marine mammal serious injury and mortality reports): https://apps-nefsc.fisheries.noaa.gov/rcb/publications/center-reference-documents.html; NOAA Fisheries marine mammal species directory: https://www.fisheries.noaa.gov/species-directory/marine-mammals.

To help identify ESA listed species not likely to be impacted by the action, NOAA Fisheries endangered species directory (https://www.fisheries.noaa.gov/species-directory/threatened-endangered), the most recent 10 years of observer data (2010-2019, NMFS Observer Program, unpublished data), the GAR Marine Animal Incident Database (unpublished data), Marine Mammal SARS, and NMFS NEFSC reference documents (marine mammal serious injury and mortality reports) were referenced. ESA section 7 consultations issued by NMFS on the Atlantic herring fishery over the last 10 years were also used. On February 9, 2010, NMFS issued an ESA section 7 consultation that fully analyzed and considered the effects of the herring fishery on ESA listed species and designated critical habitat (NMFS 2010). This consultation concluded that the herring fishery is not likely to interact with any ESA-listed species and is not likely to adversely affect ESA-listed species or designated critical habitat; given this, no take was anticipated or exempted by NMFS. Since the completion of the 2010 informal consultation, multiple herring fishery management actions have been authorized, new species listed, critical habitat designated, and new information on ESA listed species (North Atlantic right whales; Pace III et al. 2017) published.

[2] For marine mammals protected under the MMPA, the most recent 10 years of data primarily covers the period from 2009-2018; however, the GAR Marine Animal Incident Database (unpublished data) contains large whale entanglement reports for 2019.

In accordance with § 402.16, NMFS has reviewed every herring fishery management action authorized since 2010 and has determined that none of the herring fishery management actions triggered reinitiation of ESA Section 7 consultation. Further, since the 2010 consultation, based on the best available information, NMFS has also determined that none of the new listings, designated critical habitat, or new information on a listed species warranted the reinitiation of consultation on the herring fishery (NMFS 2012; 2014; 2015; 2016a; b; 2021). Given this information, and the fact that there have been no observed or documented interactions between any ESA listed species and gear used in the herring fishery (i.e., primarily purse seine and mid-water trawl) since 1989, the date of NMFS' earliest observer records for federally managed fisheries, we were able to identify those ESA listed species or designated critical habitat not likely to be impacted by the proposed action.

5.3.2 Protected Species Potentially Impacted by the Proposed Action

5.3.2.1 Large Whales

Large whales, such as humpback, fin, sei, and minke whales are found throughout the waters of the Northwest Atlantic Ocean. Humpback, fin, sei, and fin whales are euryphagous, foraging opportunistically on small crustaceans (e.g., krill, copepods), small schooling fish (e.g., Atlantic herring) and/or cephalopods (e.g., squid) (Smith et al. 2015; NOAA Fisheries marine mammal species directory; Marine Mammal SARS for the Atlantic Region). Generally, these species follow an annual pattern of migration between low latitude (south of 35ºN) wintering/calving grounds and high latitude spring/summer foraging grounds (primarily north of 41°N) (Hayes et al. 2019a; NMFS 1991; 2010; 2011). This is a simplification of whale movements, particularly as it relates to winter movements. It is unknown if all individuals of a population migrate to low latitudes in the winter, although increasing evidence suggests that for some species (e.g., humpback whales), some portion of the population remains in higher latitudes throughout the winter (Brown et al. 2002; Clapham et al. 1993; Cole et al. 2013; Khan et al. 2010; 2011; 2012; Khan et al. 2009; NOAA 2008; Swingle et al. 1993; Vu et al. 2012; Waring et al. 2014). Although further research is needed to provide a clearer understanding of large whale movements and distribution in the winter, the distribution and movement of large whales to foraging grounds in the spring/summer is well understood. Large whales consistently return to these foraging areas each year, therefore these areas can be considered important areas for whales (Baumgartner et al. 2003; Baumgartner & Mate 2003; Brown, et al. 2002; Kenney 2001; Kenney et al. 1986; Kenney et al. 1995; Mayo & Marx 1990; Payne et al. 1986; Payne et al. 1990; Schilling et al. 1992). More information on the biology, status, and range wide distribution of whale species is in the Marine Mammal Stock Assessment Reports.

5.3.2.2 Small Cetaceans and Pinnipeds

Table 5 identifies small cetaceans and pinnipeds that may occur in the affected environment of the Atlantic herring fishery and have the potential to be impacted by the operation of the Atlantic herring fishery. Small cetaceans can be found throughout the year in the Northwest Atlantic Ocean, foraging on a diverse range of marine organisms, including, but not limited to, schooling fish (e.g., Atlantic herring, mackerel), cephalopods (e.g., squid), and/or crustaceans (e.g., shrimp, krill) (Smith et al. 2015; NOAA Fisheries marine mammal species directory; Marine Mammal SARs for the Atlantic Region.

The pinnipeds in Table 20 that have the potential to be impacted by the operation of the Atlantic herring fishery are harbor and gray seals. These pinniped species have a predominantly piscivorous diet (e.g., Atlantic herring, flatfish, gadids) and are primarily found throughout the year or seasonally from New Jersey to Maine. (Smith et al. 2015; NOAA Fisheries marine mammal species directory; Marine Mammal SARS for the Atlantic Region. However, increasing evidence indicates that some species (e.g., harbor seals) may be extending their range seasonally into waters as far south as Cape Hatteras, North Carolina

(35ºN). More information on the biology and range wide distribution of each species of small cetacean and pinniped in Table 5 is in the Marine Mammal Stock Assessment Reports.

5.3.3 Gear Interactions with Protected Species

The Atlantic herring fishery is primarily prosecuted with purse seine and midwater trawl (single or pair) gears, and to a lesser extent by small mesh bottom trawl gear (Section 5.5.1). Specifically, since 2008, VTR data indicates that small mesh bottom trawl vessels account for under 10% of herring landings. Given that bottom trawl effort in the Atlantic herring fishery is so small, as seen by the small catches of this species by this gear type, and because the alternatives described in this document are not expected to result in a notable change in fishing effort using this gear types, there is low likelihood that any protected species interactions with the Atlantic herring fishery will be due to interactions with bottom trawl gear. Thus, the following sections only focus on interaction risks to protected species associated with purse seine and midwater trawl (single or pair) gears.

Protected species are at risk of interacting with various types of fishing gear, with interaction risks associated with gear type, quantity, soak or tow duration, and degree of overlap between gear and protected species. Information on observed or documented interactions between gear and protected species is available from as early as 1989 (Marine Mammal Stock Assessment Reports; NMFS Observer Program, unpublished data). As the distribution and occurrence of protected species and the operation of fisheries (and, thus, risk to protected species) have changed over the last 30 years, we use the most recent 10 years of available information to best capture the current risk to protected species from fishing gear. For marine mammals protected under the MMPA, this primarily covers the period from 2009-2018 (Hayes et al. 2017; 2018a; Hayes, et al. 2019a; Hayes et al. 2020; Waring et al. 2015; Waring et al. 2016)[3]; however, the Greater Atlantic Region (GAR) Marine Animal Incident Database (unpublished data) contains large whale entanglement reports for 2019.

5.3.3.1 Gear Interactions with Marine Mammals

Depending on species, marine mammal interactions have been observed in purse seine, and/or midwater trawl gear. Pursuant to the MMPA, NMFS publishes a List of Fisheries (LOF) annually, classifying U.S. commercial fisheries into one of three categories based on the relative frequency of incidental serious injuries and/or mortalities of marine mammals in each fishery (i.e., Category I=frequent; Category II=occasional; Category III=remote likelihood or no known interactions). The most recent 10 years of observer, stranding, and/or marine mammal serious injury and mortality reports are from 2009-2018. MMPA LOF's issued between 2017 and 2021 encompass this timeframe, with each year the LOF was issued categorizing the Gulf of Maine herring purse seine fishery as a Category III fishery, and commercial midwater trawl fisheries (Northeast or Mid-Atlantic) as Category II fisheries.

5.3.3.1.1 Large Whales

Midwater Trawl. Based on the most recent 10 years of observer, stranding, and/or marine mammal serious injury and mortality reports (i.e., 2009-2018), minke whales are the only large whale species in which an interaction with midwater trawl gear has been observed or documented. There has been only one observed minke whale incidentally taken in MWT gear. The incident occurred in 2009 and was a result of a minke whale becoming entangled in NOAA research MWT gear (whale was released alive, but seriously injured; Henry *et al.* 2015). Since this incident, there have been no observed or reported interactions between minke whales and MWT gear (Cole, et al. 2013; Henry et al. 2017; Henry et al.

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[3] MMPA LOF; NMFS NEFSC reference documents (marine mammal serious injury and mortality reports): https://nefsc.noaa.gov/publications/crd/.

2015; 2016; Henry et al. 2020; Henry et al. 2019) (Marine Mammal Stock Assessment Reports). In fact, the most recent marine mammal stock assessment report (2012-2016), estimates the annual average minke whale mortality and serious injury from the Northeast MWT fishery to be zero (Hayes, et al. 2019a). Thus, although interactions between MWT gear and minke whales are possible, the interaction risk is low.

Purse Seine. Since 2009, three humpback whales were reported as possibly interacting with purse seine gear in the Gulf of Maine targeting Atlantic herring (i.e., animals were incidentally encircled as purse seine was being closed, but without indication contact with the seine). All interactions, resulted in the animals being released from the nets unharmed (Cole, et al. 2013; Henry, et al. 2017; Henry, et al. 2015; 2016; Henry, et al. 2019) (Marine Mammal Stock Assessment Reports). Thus, although interactions are possible with large whales, purse seines are **not expected to be a source of injury or mortality** to them.

5.3.3.1.2 Small Cetaceans and Pinnipeds

Midwater Trawl Gear. Several species of small cetaceans and pinnipeds are at risk of interacting with midwater trawl gear (Marine Mammal Stock Assessment Reports; MMPA 2015-2020 LOFs). For marine mammals protected under the MMPA, the most recent ten years of observer, stranding, and/or marine mammal serious injury and mortality reports are from 2009-2018; MMPA LOF's issued between 2017 and 2021 consider data over most of this timeframe (i.e., 2009-2017) and were reviewed to provide a list of species (Table 6) that have been observed (incidentally) seriously injured and/or killed between 2008 and 2016 by List of Fisheries Category II MWT fisheries operating in the affected environment of the Atlantic herring fishery.

Table 6. Small cetacean and pinniped species observed seriously injured and/or killed by Category II midwater trawl fisheries in the affected environment of the Atlantic herring fishery.

Fishery	Category	Species Observed or reported Injured/Killed
Mid-Atlantic Midwater Trawl (including Pair Trawl)	II	Harbor seal
		Gray Seal
		Atlantic white-sided dolphin
		Bottlenose dolphin (offshore)
		Risso's dolphin
		Short-beaked common dolphin
		Long-finned pilot whale
Northeast Midwater Trawl (including Pair Trawl)	II	Gray seal
		Harbor seal
		Short-beaked common dolphin
		Atlantic white-sided dolphin
		Long-finned pilot whale
Source: MMPA 2017-2021 LOFs.		

In 2006, based on observed MWT interactions with long-finned pilot whales, short -finned pilot whales, common dolphins, and white sided dolphins, the Atlantic Trawl Gear Take Reduction Team (ATGTRT) was convened to address the incidental mortality and serious injury of these species incidental to bottom and MWT fisheries operating in the New England and Mid-Atlantic regions. Because none of the marine mammal stocks of concern to the ATGTRT are a "strategic stock", nor do they currently interact with a

Category I fishery,[4] it was determined that developing a take reduction plan was unnecessary. In lieu of such plan, the ATGTRT agreed to develop an Atlantic Trawl Gear Take Reduction Strategy (ATGTRS). The ATGTRS identifies informational and research tasks, as well as education and outreach needs to provide the basis for decreasing mortalities and serious injuries of marine mammals to insignificant levels approaching zero. The ATGTRS also identifies several voluntary measures that certain trawl fishing sectors could use to potentially reduce the incidental capture of marine mammals.

Purse Seine. There have been no observed small cetacean interactions with purse seines used to prosecute any Greater Atlantic Region fishery (primarily Gulf of Maine Atlantic herring). As a result, this gear type is not expected to pose an interaction risk with small cetacean species, and therefore, is not expected to be source of serious injury or mortality to any small cetacean.

Purse seines, however, specifically those operating in the Gulf of Maine targeting Atlantic herring, are known to interact with pinniped species. Between 2009 and 2018, pinniped species have been observed in purse seine gear (Table 7); none of these interactions have resulted in mortality or confirmed serious injury to the seal (Hayes, et al. 2019a; Josephson et al. 2019; 2021). As a result, although interactions are possible with seals, we do not expect purse seines to pose a serious injury or mortality risk to these species. This conclusion is further supported by the fact that the List of Fisheries has identified the Gulf of Maine Atlantic herring purse seine fishery as a Category III fishery, that is, a fishery that causes a remote to no likelihood of causing serious injury or mortality to marine mammals.

Table 7. 2009-2018 Observed gray and harbor seal interactions with the Gulf of Maine Atlantic herring purse seine fishery.

Seal Species	Number of Observed Interactions	Released Alive (No Serious Injury or Mortality)
Unknown	12	Yes
Harbor Seal	5	Yes
Gray Seal	12	Yes

5.4 Physical Environment and Essential Fish Habitat

The Atlantic herring fishery occurs in four areas defined as Areas 1A, 1B, 2, and 3 (Map 2). These areas collectively cover the entire Northeast U.S. shelf ecosystem, which has been defined as the Gulf of Maine south to Cape Hatteras, North Carolina, extending from the coast seaward to the edge of the continental shelf, including offshore to the Gulf Stream (Sherman et al. 1996). Roughly, Areas 1A and 1B cover the Gulf of Maine, Area 2 covers southern the New England/Mid-Atlantic region, and Area 3 covers Georges Bank. Amendment 5 to the Atlantic Herring FMP includes a detailed characterization of these areas.

The current EFH designation for Atlantic herring was developed through Omnibus Habitat Amendment 2 (OHA2). The designations for adults and juveniles identify nearly the entire Gulf of Maine as EFH and designate other areas on the southern half of Georges Bank and throughout the Mid-Atlantic Bight. The larval designation includes scattered locations throughout the Gulf of Maine and Georges Bank. The egg designation includes shallower waters of the Gulf of Maine and Georges Bank. Interactive maps of EFH for each species and life stage are on the NOAA EFH Mapper. Details are in OHA2 Volume 2 (designations), Appendix A (designation methods), and Appendix B (supplementary information).

[4] Category I fisheries have frequent incidental mortality and serious injury of marine mammals.

The environment that may be affected by the Proposed Action has been identified as EFH for the benthic life stages of several species (Table 8). More information is in the FMP document that most recently updated each species' EFH designation and the NOAA EFH mapper.

Table 8. Current EFH designation information sources (Note OHA2 = Omnibus Habitat Amendment 2)

Species	Authority	Plan Managed Under	Most recent update
Monkfish	NEFMC, MAFMC	Monkfish	OHA2
Atlantic herring	NEFMC	Atlantic Herring	OHA2
Atlantic salmon	NEFMC	Atlantic salmon	OHA2
Atlantic sea scallop	NEFMC	Atlantic Sea Scallop	OHA2
American plaice	NEFMC	NE Multispecies	OHA2
Atlantic cod	NEFMC	NE Multispecies	OHA2
Atlantic halibut	NEFMC	NE Multispecies	OHA2
Atlantic wolffish	NEFMC	NE Multispecies	OHA2
Haddock	NEFMC	NE Multispecies	OHA2
Ocean pout	NEFMC	NE Multispecies	OHA2
Offshore hake	NEFMC	NE Multispecies	OHA2
Pollock	NEFMC	NE Multispecies	OHA2
Red hake	NEFMC	NE Multispecies	OHA2
Redfish	NEFMC	NE Multispecies	OHA2
Silver hake	NEFMC	NE Multispecies	OHA2
White hake	NEFMC	NE Multispecies	OHA2
Windowpane flounder	NEFMC	NE Multispecies	OHA2
Winter flounder	NEFMC	NE Multispecies	OHA2
Witch flounder	NEFMC	NE Multispecies	OHA2
Yellowtail flounder	NEFMC	NE Multispecies	OHA2
Barndoor skate	NEFMC	NE Skate Complex	OHA2
Clearnose skate	NEFMC	NE Skate Complex	OHA2
Little skate	NEFMC	NE Skate Complex	OHA2
Rosette skate	NEFMC	NE Skate Complex	OHA2
Smooth skate	NEFMC	NE Skate Complex	OHA2
Thorny skate	NEFMC	NE Skate Complex	OHA2
Winter skate	NEFMC	NE Skate Complex	OHA2
Red crab	NEFMC	Red Crab	OHA2
Spiny dogfish	MAFMC/NEFMC	Spiny Dogfish	Original FMP
Atlantic surfclam	MAFMC	Atlantic Surfclam Ocean Quahog	Amendment 12
Ocean quahog	MAFMC	Atlantic Surfclam Ocean Quahog	Amendment 12
Bluefish	MAFMC	Bluefish FMP	Amendment 1
Atlantic mackerel	MAFMC	Squid, Mackerel, Butterfish	Amendment 11
Butterfish	MAFMC	Squid, Mackerel, Butterfish	Amendment 11
Longfin squid	MAFMC	Squid, Mackerel, Butterfish	Amendment 11
Shortfin squid (*Illex*)	MAFMC	Squid, Mackerel, Butterfish	Amendment 11
Black sea bass	MAFMC	Summer Flounder, Scup, and Black Sea Bass	Amendment 12
Scup	MAFMC	Summer Flounder, Scup, and Black Sea Bass	Amendment 12
Summer flounder	MAFMC	Summer Flounder, Scup, and Black Sea Bass	Amendment 12
Golden Tilefish	MAFMC	Tilefish	Amendment 1
Blueline Tilefish	MAFMC	Tilefish	Amendment 6
Chub Mackerel	MAFMC	Atlantic Mackerel, Squid, Butterfish	Amendment 21

5.5 Human Communities

This action evaluates the effect management alternatives may have on the economy, way of life, and traditions of human communities. These social and economic impacts may be driven by changes in fishery flexibility, opportunity, stability, certainty, safety, and/or other factors. While social and economic impacts could be solely experienced by individuals, it is more likely that impacts would be experienced across communities, gear types, and/or vessel size classes.

Summarized here are the fisheries and human communities most likely to be impacted by the Alternatives under Consideration. Social, economic and fishery information herein helps describe the response of the fishery to past management actions and predicting how the alternatives under consideration in this action may affect human communities. Also, this section establishes a descriptive baseline to compare predicted and actual changes resulting from management. Additional information is contained in Amendment 8 (NEFMC 2018b, Volume I, Section 3.6).

MSA Section 402(b), 16 U.S.C. 1881a(b) states that no information gathered in compliance with the Act can be disclosed, unless aggregated to a level that obfuscates the identity of individual submitters. The fishery data in this amendment are thus aggregated to at least three reporting units, to preserve confidentiality. Additional standards are applied to reporting the fishing activity of specific states or fishing communities. To report landings activity to a specific geographic location, the landings have been attributed to at least three fishing permit numbers and the landings must be sold to three dealer numbers. However, the dealers do not necessarily have to be in the same specific geographic location.

5.5.1 Herring Fishery

The U.S. Atlantic herring fishery occurs in the Northwest Atlantic shelf region from Cape Hatteras to Maine, including an active fishery in the inshore Gulf of Maine and seasonally on Georges Bank (Map 2). Atlantic herring is managed as one stock complex, but this stock likely has inshore and offshore components that segregate during spawning. In recognition of the spatial structure of the herring resource, the Atlantic herring Annual Catch Limit (ACL) is divided into sub-ACLs and assigned to four herring management areas. Area 1 is the Gulf of Maine (GOM) divided into an inshore (Area 1A) and offshore section (Area 1B); Area 2 is in the coastal waters between MA and NC (generally referred to as southern New England/Mid-Atlantic), and Area 3 is on Georges Bank (GB).

The Atlantic herring fishery generally occurs south of New England in Area 2 during the winter (January-April), and oftentimes as part of the directed mackerel fishery. There is overlap of the herring and mackerel fisheries in Area 2 and in Area 3 during the winter months, although catches in Area 3 tend to be relatively low. The herring summer fishery (May-August) generally occurs throughout the GOM in Areas 1A, 1B and in Area 3 (GB) as fish are available. Restrictions in Area 1A have pushed the fishery in the inshore GOM to later months (late summer). The midwater trawl (single and paired) fleet is restricted from fishing in Area 1A in the months of January through September because of the Area 1A sub-ACL split (0% January-May) and the purse seine-fixed gear only area (all Area 1A) that is effective June-September.

Autumn and winter fishing (September-December) tends to be more variable and dependent on fish availability; the Area 1A sub-ACL is almost always fully used (except in 2017 and 2018), and the inshore GOM fishery usually closes around November. As the 1A and 1B quotas are taken, larger vessels become increasingly dependent on offshore fishing opportunities (Georges Bank, Area 3) when fish may be available. Atlantic herring is caught in state waters and in the New Brunswick weir fishery.

5.5.1.1 Atlantic Herring Permits and Vessels

Amendment 1 to the Atlantic Herring FMP established a limited access program in the herring fishery with three limited access (A, B, C) and one open access (D) permit categories (Table 9). The vessels that have not been issued a limited access herring permit but have been issued a limited access mackerel permit, are eligible for a Category E permit, a category established through Amendment 5 (implemented March 2014).

Table 9. Atlantic herring permit categories.

	Category	Description
Limited Access	A	Limited access in all management areas.
	B	Limited access in Areas 2 and 3 only.
	C	Limited access in all management areas, with a 25 mt (55,000 lb) Atlantic herring catch limit per trip and one landing per calendar day.
Open Access	D	Open access in all management areas, with a 3 mt (6,600 lb) Atlantic herring catch limit per trip and one landing per calendar day.
	E	Open access in Areas 2 and 3 only, with a 9 mt (20,000 lb) Atlantic herring catch limit per trip and landing per calendar day.

Active Vessels in the Atlantic Herring Fishery

The following describes the vessels recently participating in the Atlantic herring fishery, including nominal revenues for herring trips. Here, an active herring trip is defined liberally as any trip in which at least one pound of Atlantic herring is retained.

Since 2008, the number of vessels with an Atlantic herring permit has generally decreased (Table 10) (NEFMC 2018b, Section 3.6.1.4). This includes a decrease in the limited access directed fishery vessels (Categories A and B), with 39 permitted in 2020. In 2020, 36% of the limited access vessels were active.

Many of the limited access herring vessels (Categories A-C) are also active in the Atlantic mackerel fishery (managed by the MAFMC). For the open access vessels, just 2-4% of the Category D permits have been active since 2008 (Table 10) (NEFMC 2014). The Category E permit was implemented during permit year 2013 (May-April) and about 50-55 E permits have been issued annually since, mostly to vessels with a D permit as well; about 4-10% of the E permits have been active.

Although there has been much fewer total number of active limited access versus open access vessels, the limited access vessels account for about 99% of annual Atlantic herring landings and revenues (Table 11).

Table 10. Fishing vessels with federal Atlantic herring permits, permit years 2011-2020 (May-April).

	Atlantic Herring Permit Year (May-April)										
Permit Category		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Limited Access	A only	42 (60%)	42 (57%)	39 (67%)	40 (63%)	42 (50%)	39 (56%)	39 (56%)	38 (58%)	39 (59%)	39 (54%)
	B and C only	4*	4*	4 (75%)	4*	4*	4*	4*	3*	4*	4*
	C only	47 (23%)	47 (32%)	44 (30%)	42 (24%)	41 (27%)	41 (24%)	41 (34%)	41 (27%)	40 (20%)	43 (19%)
	Total	**93 (41%)**	**93 (44%)**	**87 (48%)**	**86 (43%)**	**87 (39%)**	**84 (41%)**	**84 (46%)**	**82 (43%)**	**83 (39%)**	**86 (36%)**
Open Access	D only	2,147 (3.9%)	2,065 (3.5%)	1,957 (3.3%)	1,838 (3.6%)	1,762 (3.4%)	1,776 (2.9%)	1,759 (3.2%)	1,747 (2.7%)	1,729 (2.0%)	1,696 (2.4%)
	D and E only			6*	52 (9.6%)	54 (5.6%)	53 (5.7%)	54 (7.4%)	49	49*	50*
	E only			0	1*	1*	1*	1*	1*	1*	1*
	Total	**2,147 (3.9%)**	**2,065 (3.5%)**	**1,963 (3.3%)**	**1,891 (3.8%)**	**1,817 (3.5%)**	**1,830 (3%)**	**1,817 (3.4%)**	**1,797 (2.8%)**	**1,779 (2%)**	**1,747 (2.4%)**

Source: GARFO Permit database and DMIS as of July 2021. () = Percent of vessels in the category that were active (retaining ≥ 1 lb. of herring on at least one trip). *Confidential vessel activity data

Table 11. Contribution of herring vessels by permit category to total landings, 2013-2020 (Jan.-Dec.).

Permit Category		Fishing Year (Jan-Dec)							
		2013	2014	2015	2016	2017	2018	2019	2020
Limited Access	A and BC	96.9%	98.0%	99.0%	98.7%	98.3%	98.7%	99.5%	99.5%
	C	2.6%	1.7%	0.9%	1.0%	1.0%	0.6%	0.2%	0.2%
	D, DE, and E	0.1%	0.1%	0.1%	0.2%	0.6%	0.2%	0.2%	0.2%

Source: GARFO Permit database and DMIS as of July 2021.

5.5.1.2 Atlantic Herring Catch

The Atlantic herring stock-wide ACL and management area sub-ACLs are tracked/monitored based on the total catch, – landings and discards, which is provided and required by herring vessels through the vessel monitoring system (VMS) catch reports and vessel trip reports (VTRs) as well as through Federal/state dealer data. Atlantic herring harvesters are required to report discards in addition to landed catch through these independent reporting methods. Note that catch data are from GARFO year-end reports and may be different than in-season quota monitoring values because of database corrections from the reconciliation process. The catch data may also differ from values used in stock assessments which use different data sources.

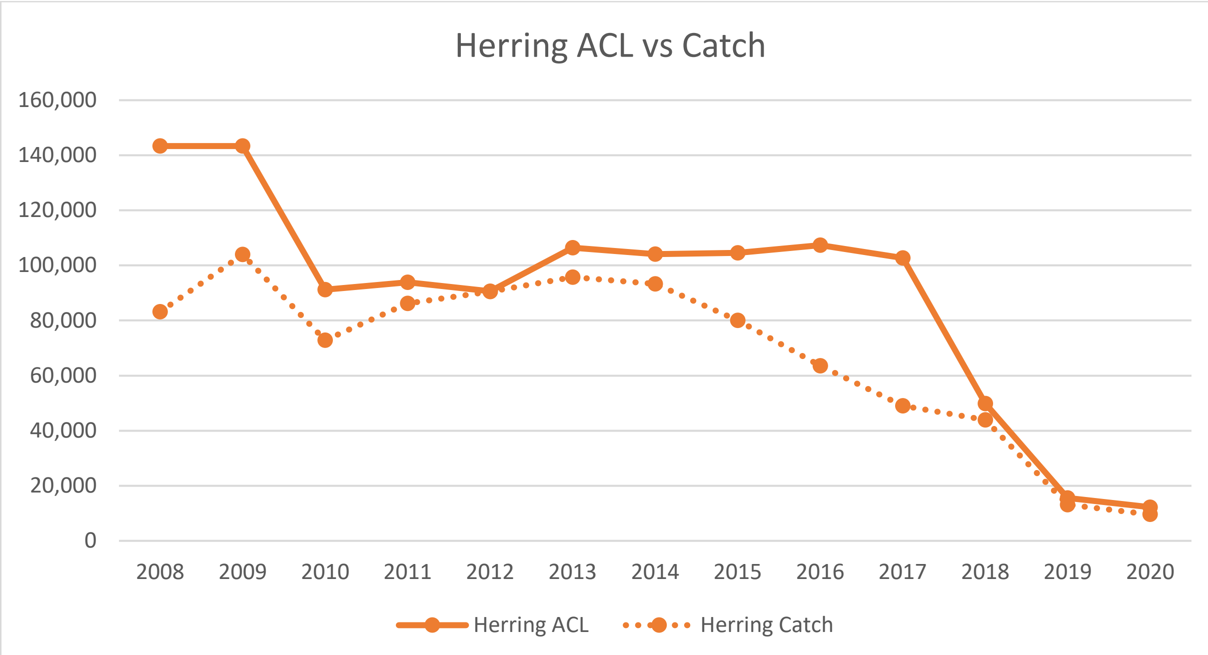
Herring catch limits have declined over time since the FMP was implemented in 1999. The first reduction was in 2006 to about 140,000 mt, followed by another relatively large reduction starting in 2010 with total quotas under 100,000 mt. The total catch limit has remained over 100,000 mt until it was dramatically reduced in 2018 to just under 50,000 mt and again in 2019 to just over 20,000 mt.

Herring catches were relatively high in 2010-2015 (Table 12, Figure 4), and decreased starting in 2016, until ACLs were dramatically reduced starting in 2018. It should be noted that the ACL is divided into four management areas (1A, 1B, 2 and 3), and the utilization does vary by area. In most years Area 1A is completely utilized, as well as Area 1B; however, Areas 2 and 3 are not usually fully utilized. In several years, some management areas have been closed to directed herring fishing (a 2,000 lb possession limit is implemented when 92% of that area's sub-ACL is projected to be caught). The right-hand column in Table 12 highlights the years when in-season herring possession limits have been implemented, or in-season bycatch caps were reached (RH/S and GB haddock), also implementing an in-season herring possession limit, closing an area to directed herring fishing.

Table 12. Summary of Atlantic annual ACL compared to final catch estimates (2008-2020) including relevant in-season actions

FY	Herring ACL	Herring Catch	Usage (%)	Herring possession limits implemented in-season (directed herring fishery closures)
2008	143,350	83,240	58.1%	
2009	143,350	103,943	72.5%	
2010	91,200	72,851	79.9%	
2011	93,905	86,245	91.8%	
2012	90,683	90,561	99.9%	*Herring Area 2, 3 and 1A*
2013	106,375	95,764	90.0%	*Herring Area 2, 1A and 3*
2014	104,088	93,247	89.6%	*Herring 1B, 1A and 3*
2015	104,566	80,011	76.5%	*GB haddock catch cap in-season AM, Herring Area 1A*
2016	107,360	63,581	59.2%	*Herring Area 1B*
2017	102,656	49,072	47.8%	
2018	49,900	43,878	87.9%	*RHS catch cap in-season AM (Mackerel FMP); RHS catch cap in SNE MW and CC MW in-season AM, Herring 1B*
2019	15,613	13,079	83.8%	*RHS catch cap in-season AM (Mackerel FMP); Herring Area 2*
2020	12,225	9,588	78.4%	*Herring Area 3, 1A and 1B*

Figure 4. Comparison of annual Atlantic herring ACL and final catch (2008-2019)



Herring catch by sub-ACL

Action 2 includes alternatives to address overages of sub-ACLs. This section was developed to provide a more detailed summary of catch by herring management area. Table 13 calculates the difference, both percentage and the mt, between the final catch and final sub-ACLs. Rows shown in bold indicate years with sub-ACL overages. Historically, most sub-ACL overages occurred in Area 1B, with a few in Area 1A, a couple in Area 2, and only one in Area 3.

Table 13. Herring initial sub-ACL, final sub-ACL with accountability measure adjustment and catch by year.

Year	Herring Area	Initial sub-ACL	Adjustment	Final sub-ACL (mt)	Catch (mt)	Percentage Difference	MT Difference
2009	**1A**	**45,000**	**-1,350**	**43,650**	**44,088**	**1**	**438**
2009	1B	10,000	-300	9,700	1,799	-81	-7,901
2009	2	30,000	0	30,000	28,032	-7	-1,968
2009	3	60,000	0	60,000	30,024	-50	-29,976
2010	**1A**	**26,546**	**0**	**26,546**	**28,424**	**7**	**1,878**
2010	**1B**	**4,362**	**0**	**4,362**	**6,001**	**38**	**1,639**
2010	2	22,146	0	22,146	20,831	-6	-1,315
2010	3	38,146	0	38,146	17,596	-54	-20,550
2011	**1A**	**26,546**	**2,705**	**29,251**	**30,676**	**5**	**1,425**
2011	1B	4,362	0	4,362	3,530	-19	-832
2011	2	22,146	0	22,146	15,001	-32	-7,145
2011	3	38,146	0	38,146	37,038	-3	-1,108

2012	1A	26,546	1,122	27,668	24,302	-12	-3,366
2012	**1B**	**4,362**	**-1,639**	**2,723**	**4,307**	**58**	**1,584**
2012	**2**	**22,146**	**0**	**22,146**	**22,482**	**2**	**336**
2012	**3**	**38,146**	**0**	**38,146**	**39,471**	**3**	**1,325**
2013	1A	31,200	-1,425	29,775	29,454	-1	-321
2013	1B	4,600	0	4,600	2,459	-47	-2,141
2013	2	30,000	0	30,000	26,562	-11	-3,438
2013	3	42,000	0	42,000	37,290	-11	-4,710
2014	1A	31,200	1,831	33,031	32,898	0	-133
2014	**1B**	**4,600**	**-1,722**	**2,878**	**4,399**	**53**	**1,521**
2014	2	30,000	-1,236	28,764	19,626	-32	-9,138
2014	3	42,000	-2,585	39,415	36,323	-8	-3,092
2015	1A	31,200	-620	30,585	28,861	-6	-1,724
2015	1B	4,600	322	4,922	2,819	-43	-2,103
2015	2	30,000	2,100	32,100	15,114	-53	-16,986
2015	3	42,000	2,910	44,910	33,217	-26	-11,693
2016	1A	30,300	224	30,524	27,831	-9	-2,693
2016	**1B**	**4,500**	**-1,656**	**2,844**	**3,657**	**29**	**813**
2016	2	29,100	2,127	31,227	13,463	-57	-17,764
2016	3	40,900	1,865	42,765	18,631	-56	-24,134
2017	1A	30,300	1,815	32,115	28,682	-11	-3,433
2017	1B	4,500	325	4,825	2,639	-45	-2,186
2017	2	29,100	2,127	31,227	3,617	-88	-27,610
2017	3	40,900	2,973	43,873	14,134	-68	-29,739
2018	1A	30,300	-2,262	28,038	24,861	-11	-3,177
2018	1B	4,500	-1,861	2,639	2,211	-16	-428
2018	2	29,100	-20,900	8,200	7,071	-14	-1,129
2018	3	40,900	-29,582	11,318	9,736	-14	-1,582
2019	1A	4,354	869	5,223	4,916	-6	-307
2019	1B	647	-19	628	159	-75	-469
2019	**2**	**4,188**	**-126**	**4,062**	**4,750**	**17**	**688**
2019	3	5,876	-176	5,700	3,254	-43	-2,446

Note: Bold rows indicate a sub-ACL overage. Percentage difference and metric ton (MT) difference in catch compared to the final sub-ACL.
Source: GARFO year-end catch reports

Figure 5 shows management area catch over time and how that has related to sub-ACLs (initial sub-ACLs in blue and adjusted sub-ACLs in black). There have generally not been drastic changes between initial and final sub-ACLs. In 2018, the large difference between catch and final sub-ACLs in Areas 2 and 3 was due to an in-season adjustment, not accountability measures. Sub-ACLs were relatively stable (i.e., not changing in large quantities from year to year) from 2010-2017 but have been reduced in recent years. Catch across sub-ACLs has also decreased in recent years. Catch in Areas 1A and 1B has tracked sub-ACLs more closely than catch in Areas 2 and 3. There were large catch underages in Areas 2 and 3 between 2015 and 2017.

Figure 5. Catch by herring area, blue points are initial sub-ACLs and black points are final sub-ACLs.

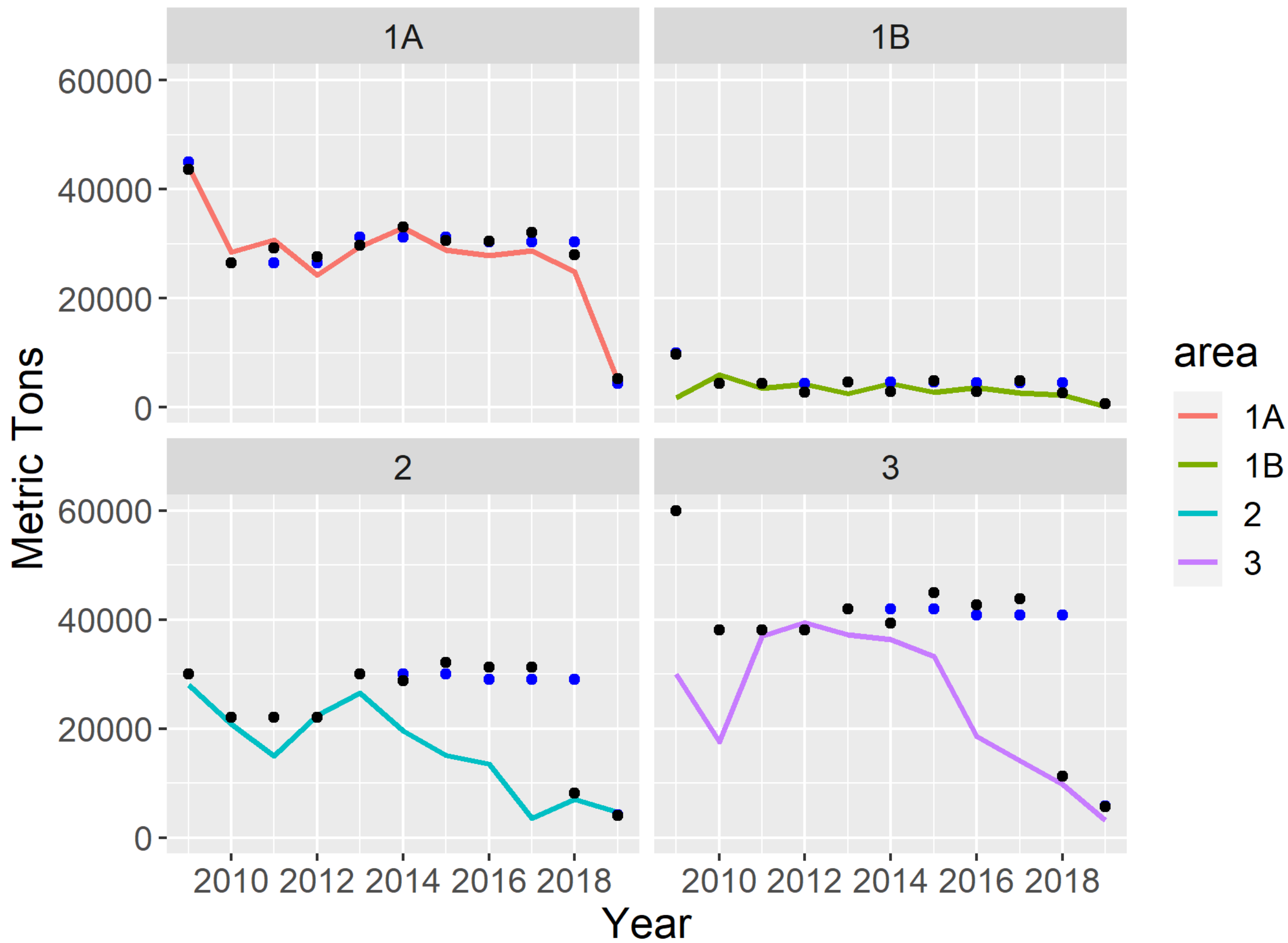


Figure 6 shows the percentage difference between catch and the final sub-ACLs. Catch below the horizontal line indicates an underage and catch above the horizontal line indicates an overage. Overages in Area 1B seem to have larger percentage differences because the sub-ACLs are small. When evaluating overages and underages in units of percentages, there have been large underages in Areas 1B, 2, and 3. Because the percentage difference is not equivalent across areas, it is important to also consider the mt difference between catch and final sub-ACLs (See Figure 7).

Figure 6. Percentage difference between catch and final sub-ACLs.

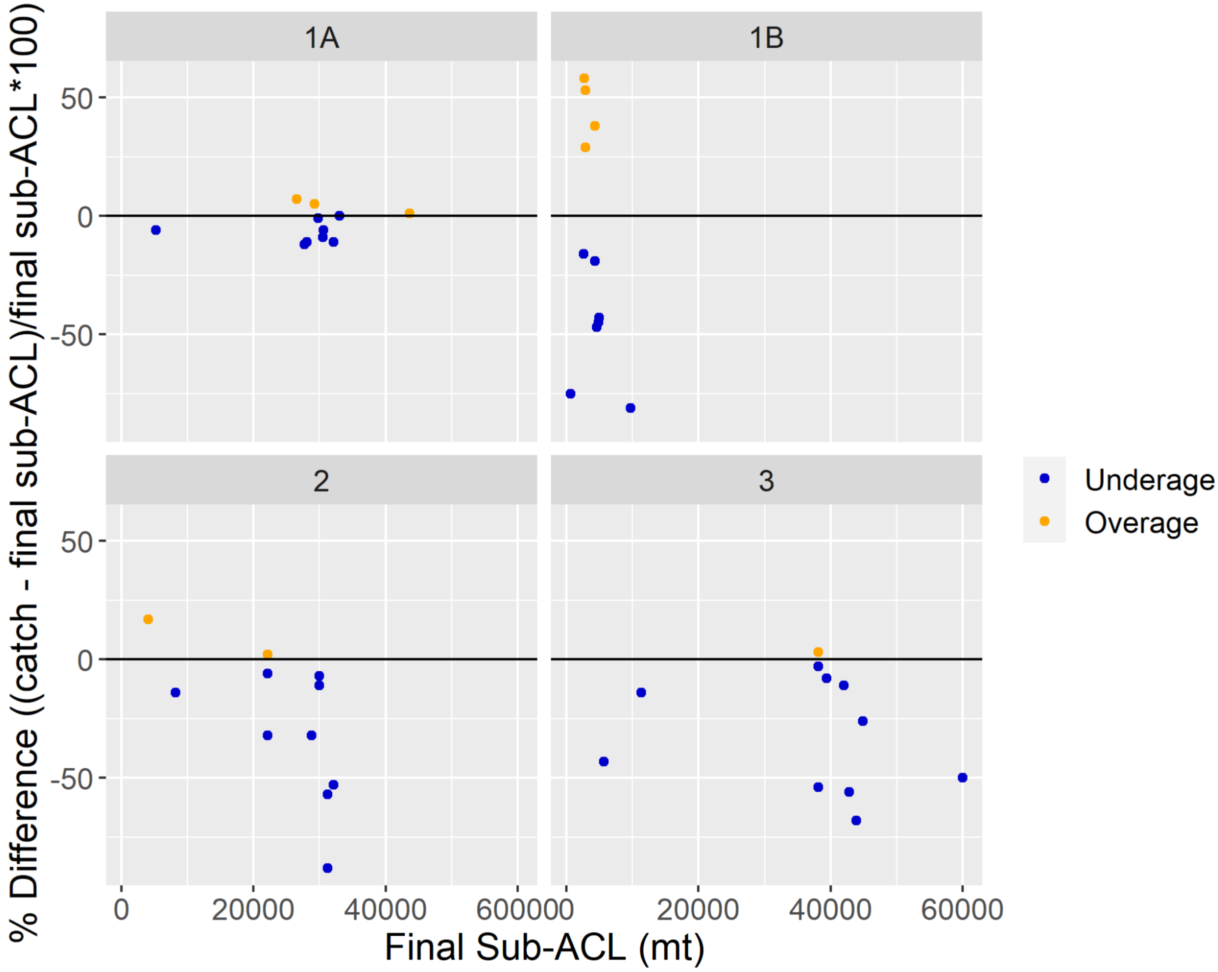


Figure 7 shows the metric ton difference between catch and final sub-ACLs. When evaluating overages and underages in units of metric tons, there have not been large overages, but there have been large underages in Areas 2 and 3. There is not a strong relationship between increasing sub-ACLs and overages.

Figure 7. Difference between catch and final sub-ACLs.

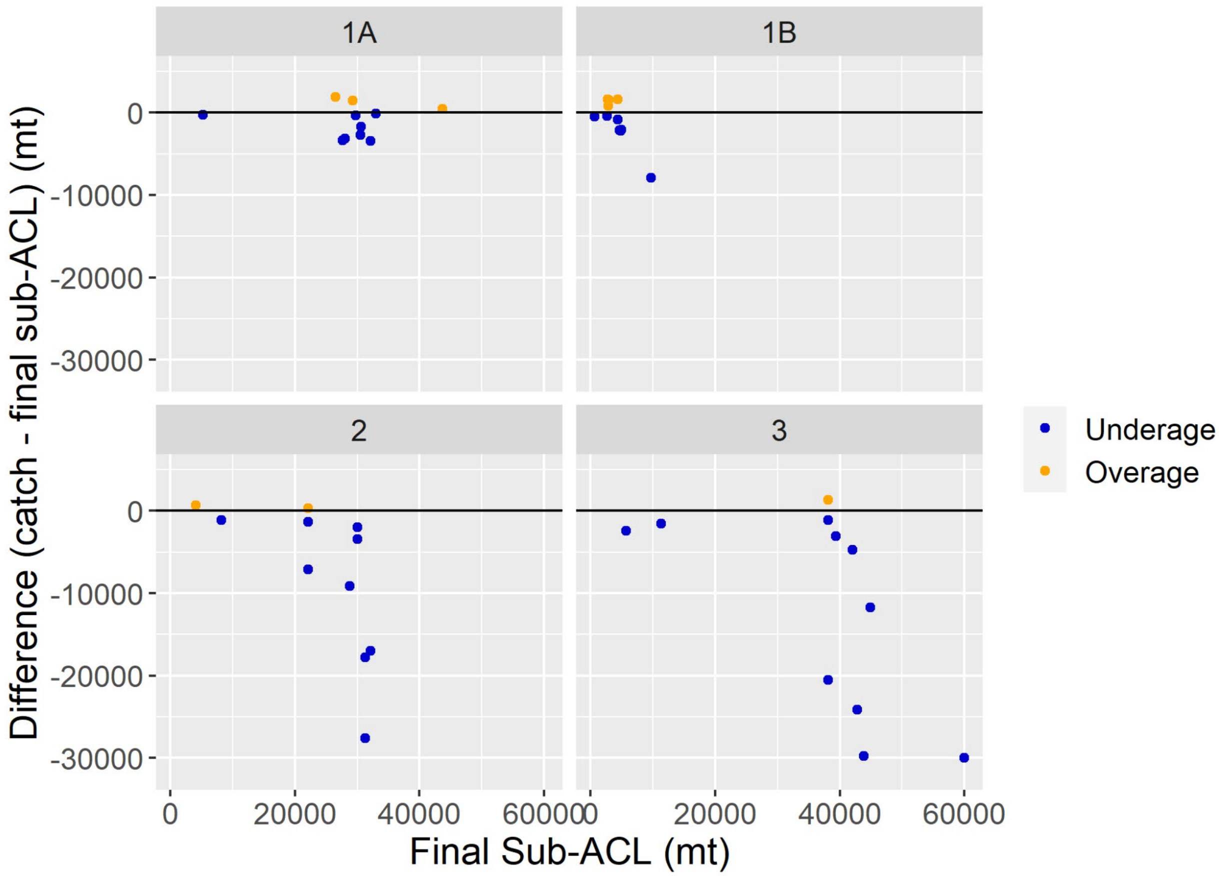
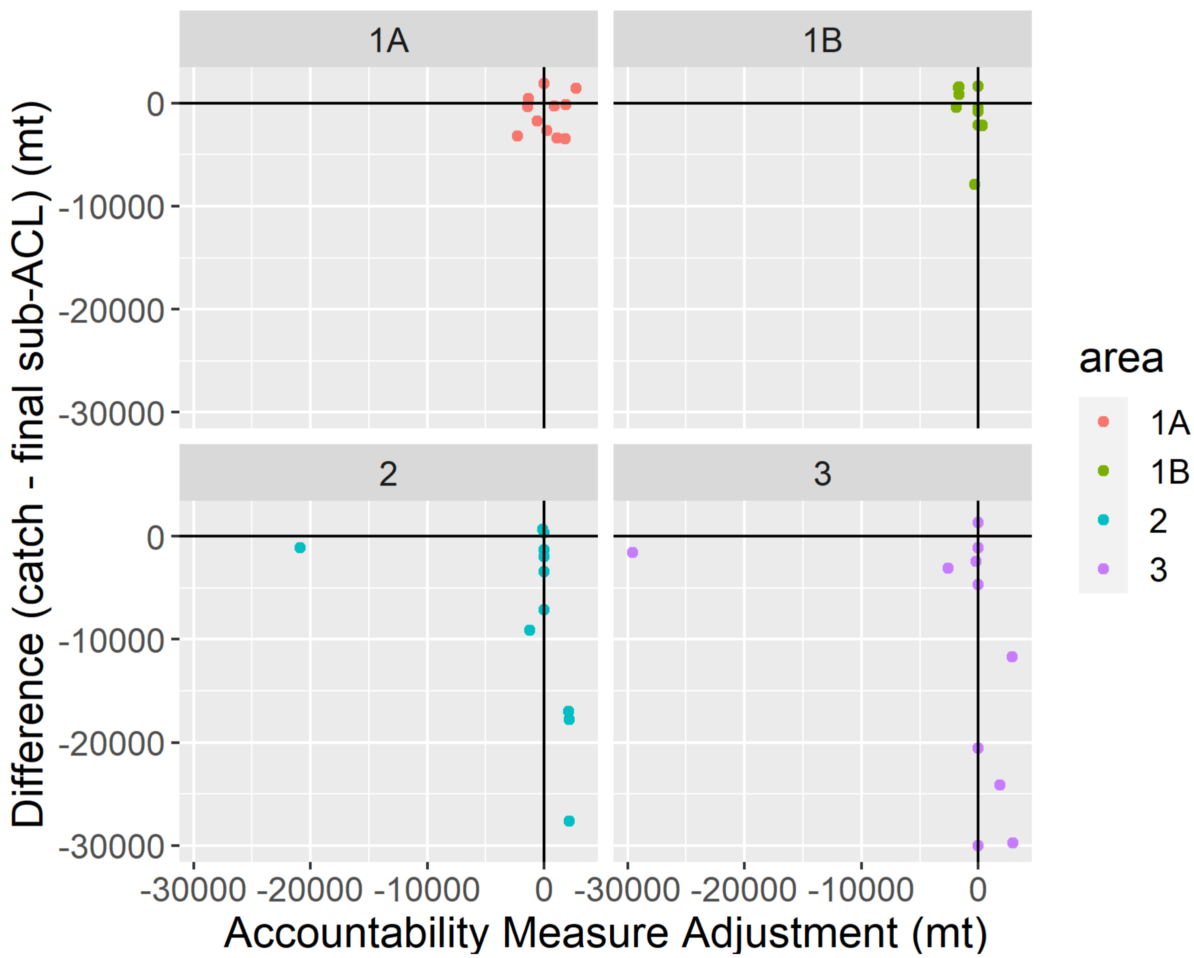


Figure 8 shows the relationship between AMs and overages/underages; a point right of vertical indicates a sub-ACL increase and a point left of vertical indicates a sub-ACL decrease. There is not a strong relationship between AMs (increases to the sub-ACLs) and overages/underages.

Figure 8. Relationship between AM and resulting overage/underage.



5.5.1.3 Effort in the Herring Fishery

Atlantic herring vessels primarily use purse seines or single or paired midwater trawls (MWT, Table 14). Herring and mackerel catches have been summarized in the table below by gear type and area. Total catch from the last five years have been summarized by area and gear type, as well as the total number of unique vessels that reported catch from within a specific herring management area through VTR. In general, the MWT fleet has harvested most landings since 2008 (NEFMC 2018b, Section 3.6.1.5). Some herring vessels use multiple gear types during the fishing year. Single and pair trawl vessels generally fish in all areas (October-December in Area 1A), though Areas 1A and 1B account for less of their total landings in recent years. The purse seine fleet fishes primarily in Area 1A and to a minor extent, Areas 1B and Area 2. Single MWT vessels have been most active in Area 3 and are combined with paired MWT landings in the table below for data confidentiality issues. Small mesh bottom trawl vessels account for a small percentage of herring landings recently; landings by other gear types (e.g., pots, traps, shrimp trawls, hand lines) are minor, but hand gear has been increasing in recent years, especially for mackerel in Area 1A and Area 3.

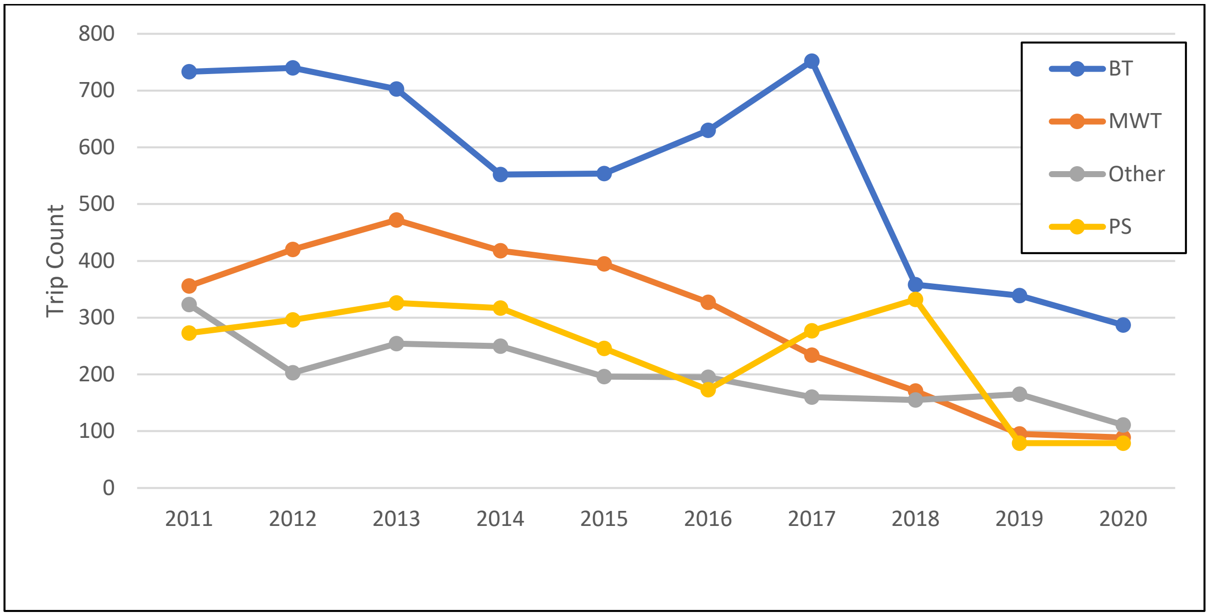
Table 14. Atlantic herring and mackerel commercial landings (mt) by fishing gear type and herring management area (with number of vessels in italics), 2015-2020.

Management Area	Species	Bottom Trawl	Hand Gear	Midwater Trawl	Purse Seine	Other
1A	Herring	818	3	23,352	95,612	29
		27	*17*	*1*	*16*	*8*
	Mackerel	250	2,885	7,148	*	43
		49	*108*	*9*		*31*
1B	Herring	19	*	11,301	150	*
		5		*11*	*3*	
	Mackerel	38	217	293		1
		16	*33*	*3*		*13*
2	Herring	10,496	0	32,367	*	3
		91	*5*	*17*		*18*
	Mackerel	5,155	40	16,687	*	12
		217	*57*	*15*		*129*
3	Herring	204		82,926		
		6		*13*		
	Mackerel	825	1,066	6,022		42
		45	*50*	*13*		*25*

Source: GARFO DMIS and VTR databases as of July 2021.
Notes: Data include all vessels that landed greater than zero pounds of Atlantic herring or Atlantic mackerel. Single and pair midwater trawl data are combined due to data confidentiality restrictions. Herring management areas determined from VTR reported locations. “Bottom trawl” includes trawls of any mesh size. * = confidential

The number of trips landing herring has declined with the decrease in landings in recent years, both fishery-wide and by gear type (Figure 9). The greatest potion of herring trips is by vessels using bottom trawl gear, and trips using this gear type declined by 61% from 2011 to 2020, with 287 trips in 2020. Midwater trawl and purse seine trips declined by 25% and 29%, respectively, with just 89 and 79 trips in 2020.

Figure 9. Number of trips landing herring by gear type, 2011-2020

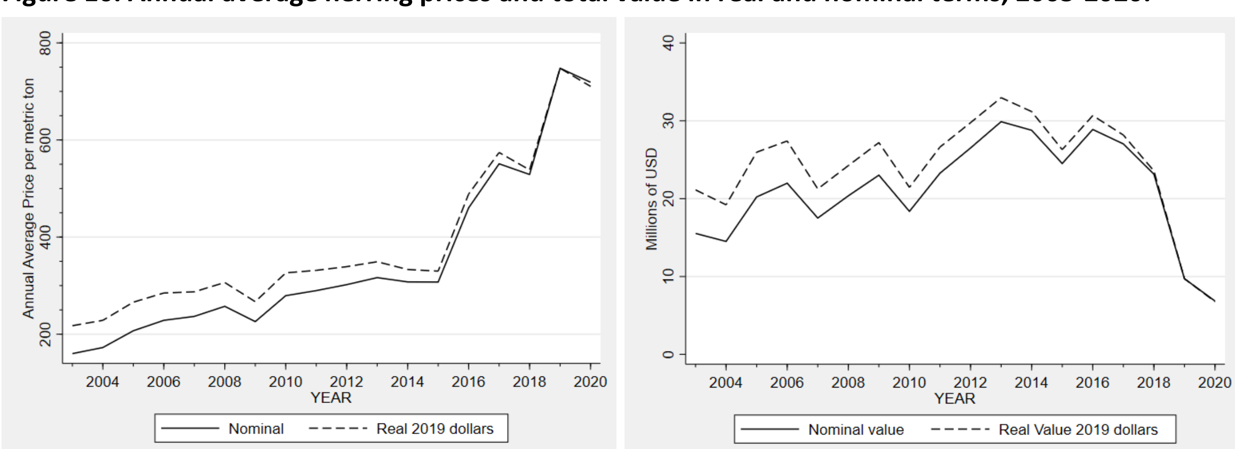


Source: NMFS dealer data as of August 2021.

5.5.1.4 Fishery Economics

Fishery prices and value. From 2004-2015, herring experienced moderate and steady increases in prices (in both real and nominal terms, Figure 10). From 2015 to 2019, prices increased dramatically, as total landings decreased. The price increases offset the decline in landings; however, in 2019, landings and revenue were historically low and even lower in 2020.

Figure 10. Annual average herring prices and total value in real and nominal terms, 2003-2020.



Source: NMFS dealer data as on June 25, 2021.
Note: U.S. GDP Implicit price deflator, 2020=100.

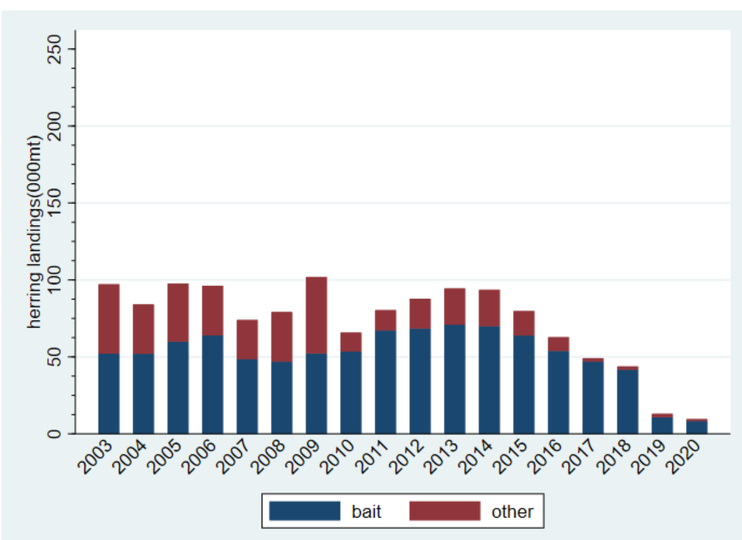
Usage, substitutes, and downstream industries. A large proportion of herring landings are sold as bait, and increasingly so in recent years (Figure 11), for many fisheries, such as lobster, tuna, and recreational fisheries. Historically, Atlantic herring is used for bait by smaller inshore vessels more than larger offshore vessels, because it is typically less expensive; in addition, alternative bait options like skates tend to be preferred for longer soaks in offshore waters and in southern waters. Generally, the herring used for bait goes through a large wholesale dealer to smaller dealers and lobster wharfs along the coast. The wholesale dealers generally have facilities where they sort, barrel, freeze and store bait for redistribution. The locations and processing and selling techniques also vary. Amendments 1, 5 and 8 further describe the ways in which herring is processed and sold.

The annual average price of Atlantic herring increased from about $300 in 2015 to peaking at $750 per metric ton in 2019 (Figure 10, Figure 12). During this time, landings declined (Table 12). Prices are generally highest in the late spring through summer and lowest in the winter. In recent years, landings have been low in late spring/summer often for regulatory reasons.

The lobster industry is the primary consumer of herring bait. Lobster fishing typically occurs in the second half of the year (June/July through November/December). Lobster prices tend to be highest the late spring and early summer (Figure 13). Annual average lobster prices have been about $4/lb, except for 2019 ($5/lb).

The ability of lobstermen to obtain substitute baits for Atlantic herring is constrained by state regulations, storage capacity of bait dealers, and economics. Menhaden is a commonly cited substitute product. The menhaden fishery typically has higher volumes in the second half of the year (June –October/November). Yearly average menhaden prices have been steady around $200/metric ton (Figure 14). As herring landings have declined since 2014, the quantity of menhaden used as bait has increased. The increase in menhaden used as bait has been less than the decrease in herring landings. Use of menhaden for bait has increased in importance relative to its use in fish meal and oil. Since 2013, the proportion of menhaden landings used for bait rose has been increasing (Figure 15). During 2018, ex-vessel menhaden prices averaged $551 per mt in the State of Maine.[5] This was about 4% higher than average *ex-vessel* herring prices that year ($530/mt).

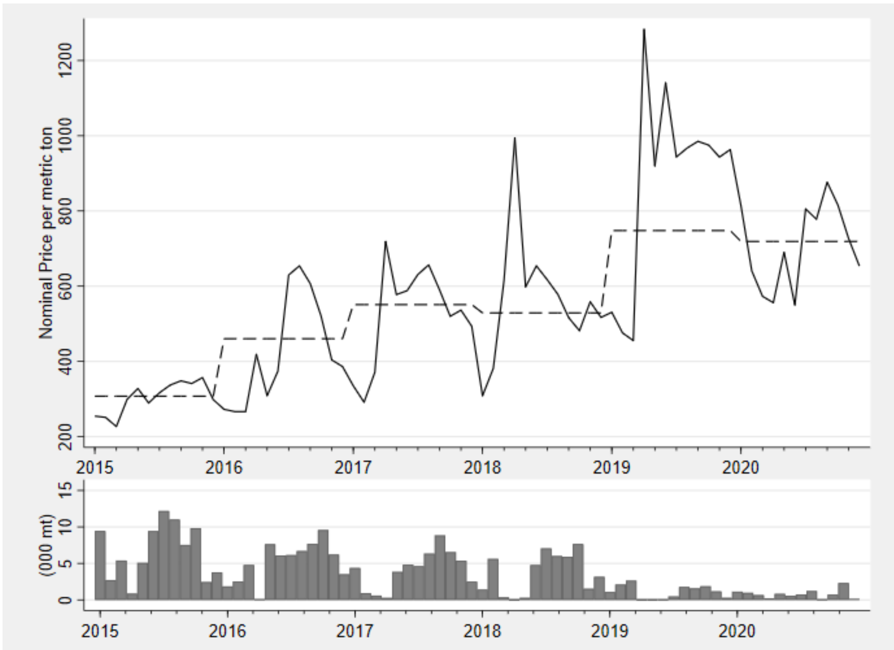
Figure 11. Annual herring sold for bait and non-bait purposes, 2003-2020.



Source: NMFS dealer data as on June 25, 2021.

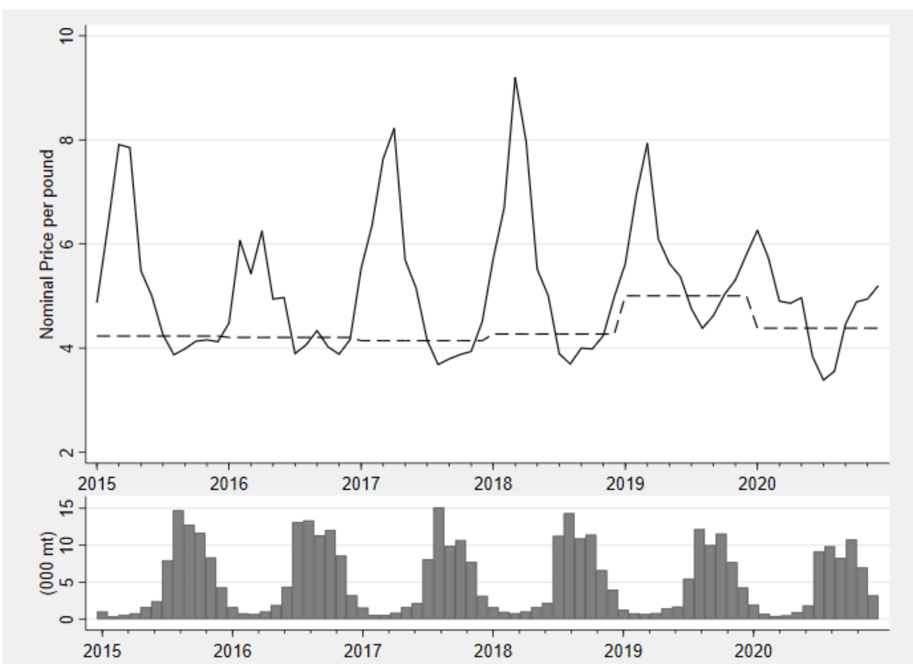
[5] https://www.maine.gov/dmr/commercial-fishing/landings/documents/14-18LandingsBySpecies.Table.pdf

Figure 12. Monthly nominal herring prices (solid); average annual prices (dashed); and monthly landings (bars below), 2015-2020.



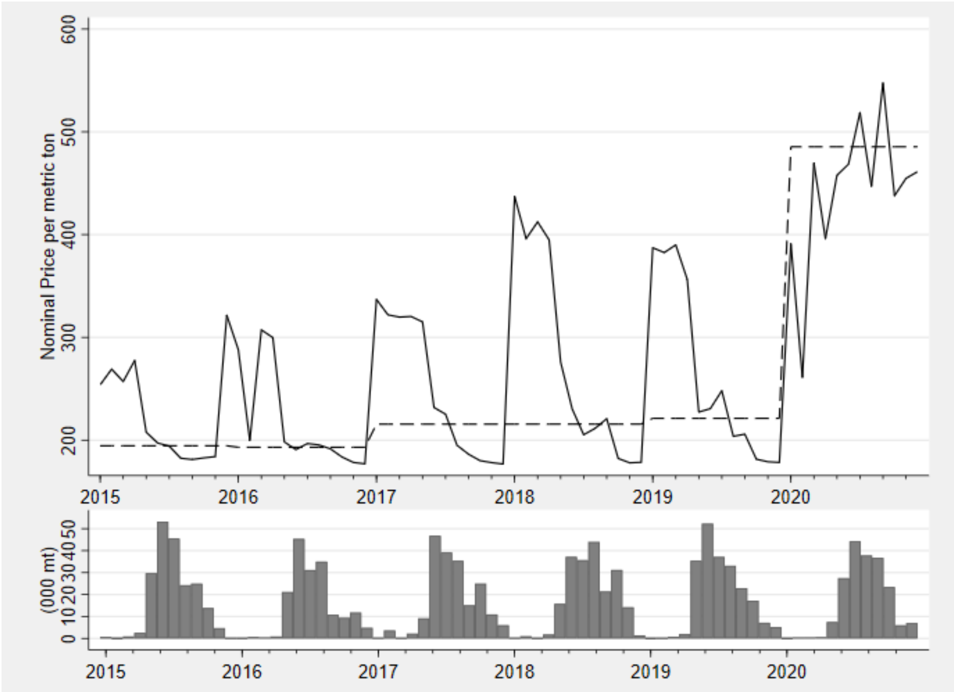
Source: NMFS dealer data as of June 25, 2021.

Figure 13. Monthly nominal lobster prices (solid); average annual prices (dashed); and monthly landings (bars below), 2015-2020.



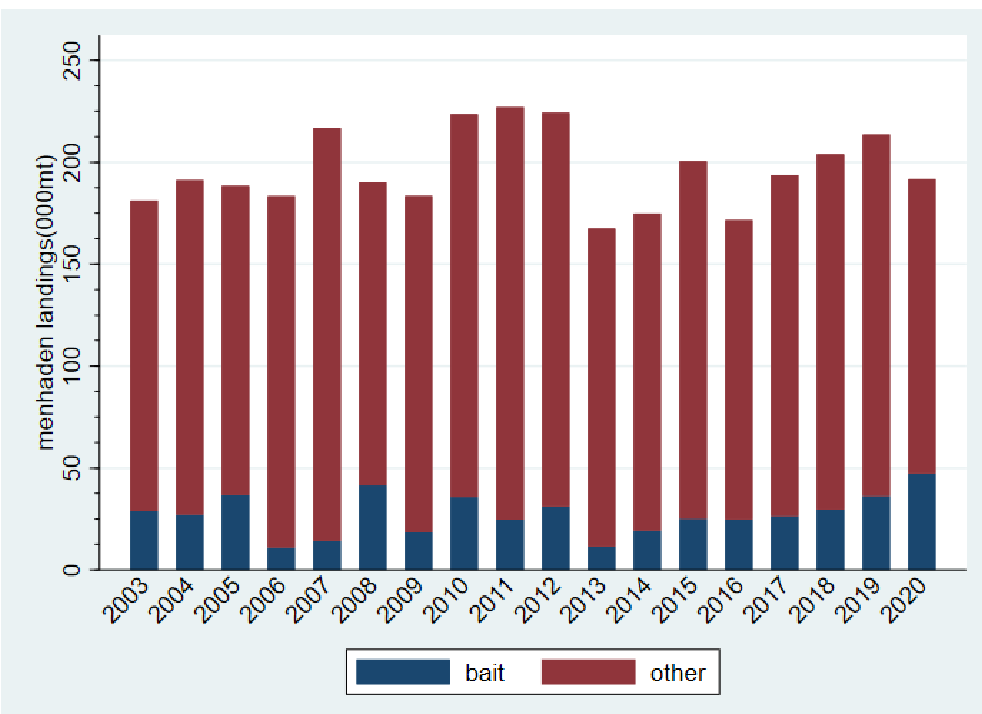
Source: NMFS dealer data as of June 25, 2021.

Figure 14. Monthly menhaden prices (solid); average annual prices (dashed); and monthly landings (bars below), 2015-2020.



Source: NMFS dealer data as of June 25, 2021.

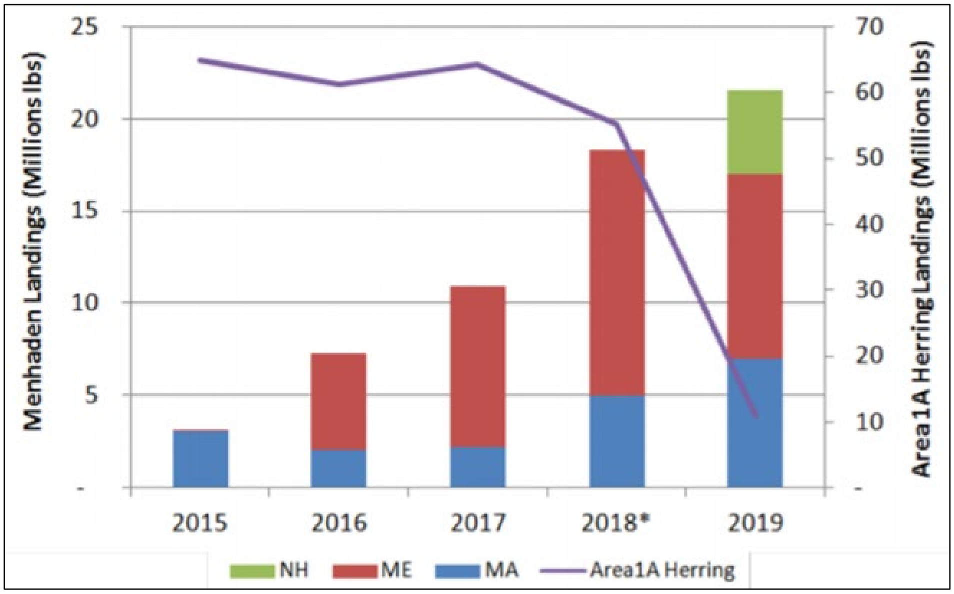
Figure 15. Annual menhaden sold for bait and non-bait purposes, 2003-2020.



Source: NMFS dealer data as of June 25, 2021.

Other sources of bait for the lobster fishery have increased in recent years as herring has become less available in the GOM. The harvest of menhaden in the GOM has increased for Maine, NH, and Massachusetts (Figure 16). This increase has helped supplement the shortage left by the reduced Atlantic herring quota during summer months.

Figure 16. Annual menhaden landings by state and Area 1A herring landings, 2015-2019



Note: 2019 data are preliminary, and values are subject to change. Confidential data is omitted for some 2018 landings data. *Source:* ACCSP Data Warehouse and NOAA VTR Data (From ASMFC 2020b).

Alewife may be another potential substitute. Although volumes of alewife landings are low compared to herring. Landings from Maine sustainable rivers (as outlined by ASMFC) rose from about 588 mt in 2015 to 890 mt. Volumes of alewife landings in 2018 was just 3% of the volume of herring bait sales in 2018. The price of alewife in 2018 was $760/mt, making them a more expensive alternative for use as lobster bait. An ASMFC work group on lobster bait is currently surveying lobstermen and herring dealers to help determine how demand for herring and use of substitute baits may be changing, given recently low herring catch limits.

Dependence on Herring. Herring has been the primary source of revenue for the purse seine vessels, a major source of revenue for midwater trawls, and a minor revenue source for bottom trawls (Table 14) (NEFMC 2021), though herring fishing enables participation in other fisheries. Vessels active in the Atlantic herring midwater trawl fishery generally also have limited access permits in the Atlantic mackerel fishery and permits in a variety of other fisheries but are not necessarily active in all fisheries in which permits are held due to management or logistical constraints. Since 2017, both herring revenue and the percent dependence on herring has declined for vessels landing herring (Table 15).

Table 15. Revenue (in thousands $) by species for vessels that land Atlantic herring, 2017-2020

Year	Vessels	Herring	Mackerel	Squid	Menhaden	Other	Total
2017	74	$26,736 (38%)	$3,176	$24,223	$840	$16,299	**$71,274**
2018	69	$23,060 (31%)	$3,798	$29,362	$1,218	$16,801	**$74,239**
2019	55	$9,583 (22%)	$2,007	$19,265	$152	$12,038	**$43,044**
2020	51	$6,735 (16%)	$4,226	$17,788	$1,298	$12,547	**$42,595**

Source: NMFS VTR data, accessed June 25, 2021.
Note: Percentages in third column are the % of total revenue derived from herring.

5.5.2 Other Managed Resources and Fisheries

In addition to Atlantic herring, many other fisheries could be impacted by the alternatives under consideration. Atlantic mackerel is targeted in combination with Atlantic herring during part of the year, particularly in the southern New England and Mid-Atlantic areas. The lobster fishery is highly dependent on herring as bait. Herring is either a fishery bait source and/or a natural prey item for bluefin tuna, groundfish, and striped bass, which have commercial and recreational fisheries associated with them. Herring is also a prey for whales, other marine mammals, and sea birds, which have ecotourism industries associated with them. Amendment 8 (NEFMC 2018b, Section 3.6.2) contains extensive descriptions of the population status, management and fisheries and ecotourism for these species, and is incorporated herein by reference.

5.5.2.1 Mackerel Fishery

Population status: The Atlantic mackerel stock was most recently assessed in 2021, with 2019 as the terminal year of data (NEFSC 2021). Fishing mortality (F) in 2019 was estimated to be 0.46, so *overfishing* was occurring in 2019. The 2019 spawning stock biomass (SSB) was estimated to be 42,862 mt, or 24% of the SSB_{target} so mackerel continues to be "*overfished*" (below 50% of the target). These findings were like the previous assessment, but the 2021 assessment also found that the MSY value dropped by 17% from 41,334 mt to 34,103 mt. The MAFMC developed a rebuilding program for mackerel with the 2019-2021 specifications but given the new assessment and lack of expected progress, a new rebuilding plan is being considered.

Management: Many vessels that participate in the Atlantic herring fishery are also active in the Atlantic mackerel fishery managed by the Mid-Atlantic Fishery Management Council through the Atlantic Mackerel, Squid, and Butterfish (MSB) Fishery Management Plan. More information about mackerel management is at: http://www.mafmc.org/msb. There is no resource sharing agreement between Canada and the U.S. for Atlantic mackerel, so the U.S. sets an upper limit on total catch, and simply deducts expected Canadian catch from the total catch. This has not caused issues to date but at some potential catches anticipated for the next rebuilding plan, the U.S. may be shut out of the fishery. The MAFMC has requested NMFS take emergency action to limit U.S. catches in 2021-2022 while a revised rebuilding plan is developed.

Fishery: There are three commercial limited access Atlantic mackerel permit categories. When the directed fishery is open, there are no trip limits for Tier 1, Tier 2 has a 135,000 lb trip limit and Tier 3 has a 100,000 lb trip limit (Tier 3 is reduced to 20,000 lb if it catches 7% of the commercial quota). Open access incidental permits have a 20,000 lb trip limit. The directed fishery is primarily composed of Tier 1 vessels. In 2020, there were 31 Tier 1 vessels (Table 16), 24 (77%) of which also had an Atlantic herring Category A permit. The Tier 1 vessels are primarily (71%) over 80 ft in length (NEFMC 2021).

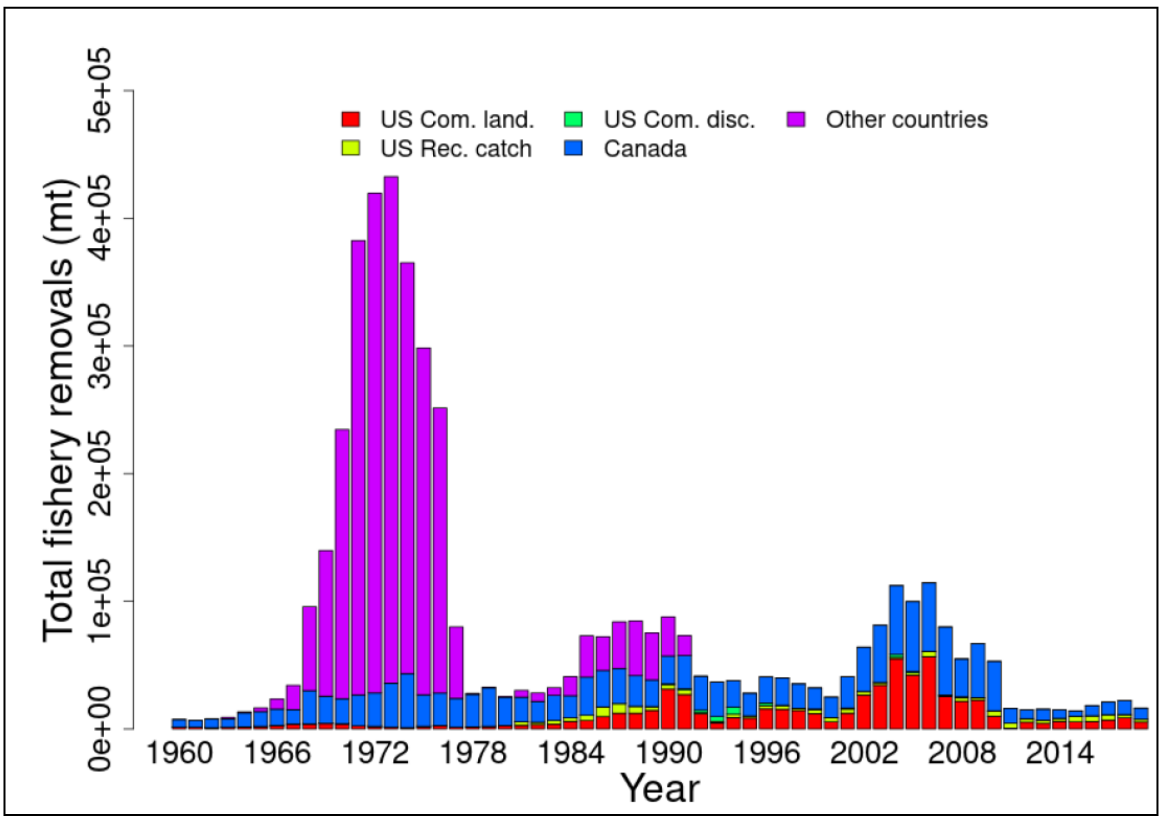
Total landings of Atlantic mackerel (foreign and domestic) peaked over 425,000 mt in 1973 but have been under 100,000 mt per year since 1977. Except for a peak in the early 2000s of about 40,000-55,000 mt, U.S. domestic landings have generally been under 30,000 mt since the 1960s (MAFMC 2015) and under 10,000 mt since 2011 (Figure 17, Figure 18). Revenue from the mackerel fishery has been at or under $5M per year since 2010 (Figure 18). In the early 2000s, most landings shifted from bottom trawl to midwater trawl (NEFSC 2018a), and midwater has remained the predominant gear type for mackerel landings (Figure 19). There is also a recreational fishery for mackerel (including private/rental and party/charter), which until recently contributed a very small portion of catch but with lower commercial catches the portion of catch from recreational fishing has been increasing (changes to MRIP also increased the scale of recreational mackerel catch).

During 2005-2009, when annual domestic mackerel landings were 23,000-58,000 mt, the fishery was primarily focused in the waters of Mid-Atlantic and Southern New England, though there was fishing in the Gulf of Maine and the southern flank of Georges Bank. In more recent years (e.g. 2018 and 2019), with much lower landings, areas of high landings have included shelf areas off Delmarva, the New York bight around Hudson Canyon, just south of Rhode Island, and just east of Cape Cod north to Cape Ann, Massachusetts (MAFMC 2021). Mackerel fishing also varies by season, depending on the mackerel resource condition and distribution, as well as other fisheries. Herring fishing patterns and regulations for example can impact when and where mackerel fishing occurs.

Table 16. Number of vessels with limited Atlantic mackerel permits by Atlantic herring permit category, 2020

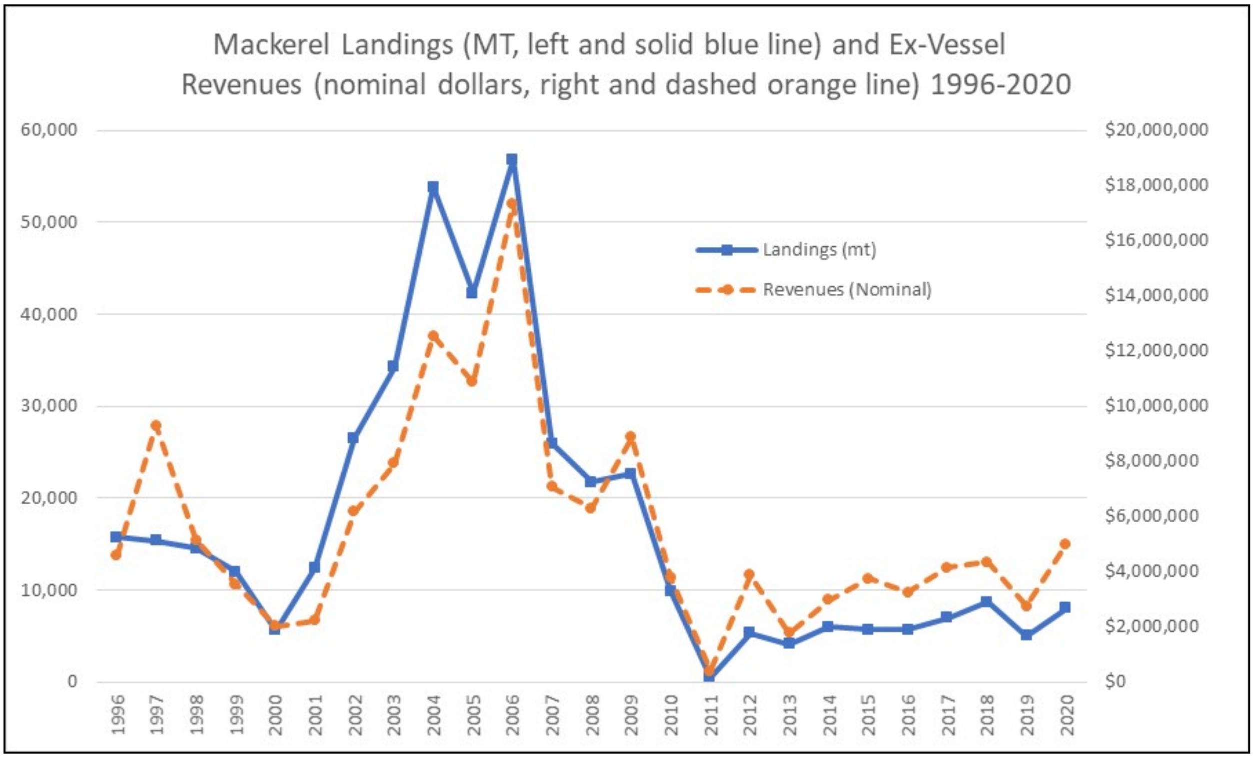
Mackerel Permit Category	Herring permit categories							
	A	B/C	C	D	D/E	E	none	Total
Tier 1	24	0	6	0	1	0	0	**31**
Tier 2	2	1	5	3	13	0	0	**24**
Tier 3	1	1	12	22	31	1	2	**70**
Source: NMFS Permit database. Data as of September 2020.								

Figure 17. Total catch of northwest Atlantic mackerel between 1960 and 2019 by all known sources.



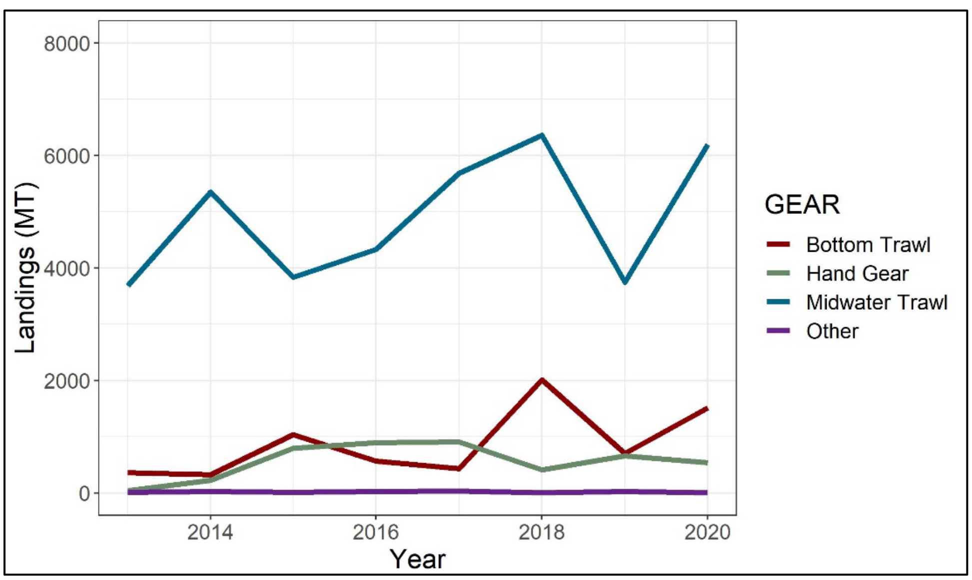
Note: U.S. recreational catch represents recreational landings plus discards, Canada represents Canadian landings (discards are not available), and other countries represents landings by all other countries.

Figure 18. U.S. mackerel landings and nominal mackerel ex-vessel values, 1996-2020.



Source: NMFS unpublished dealer data.

Figure 19. Mackerel landings by gear type, 2013-2017



Source: GARFO DMIS data, as of September 13, 2021

5.5.2.2 Industries Reliant on the Predators of Herring

Analysis of species that feed on herring was conducted in support of Amendment 8 to the Herring FMP, including a quantitative model designed to examine the effects of different herring control rules on outcomes for Bluefin tuna, common and arctic terns, and spiny dogfish. Bluefin tuna models suggested that the major factor in tuna outcomes was determined by individual herring growth rates, a life history trait which is not affected by managers. Tern metrics were sensitive to certain types of control rules (which featured either constant quotas or fixed quotas for three years with a limit on how much they could change). These were not adopted by the NEFMC. Spiny dogfish outcomes were also poor under those types of control rules. As with Bluefin tuna, spiny dogfish outcomes were influenced by herring life-history traits that are not within the control of fishery managers.

Bluefin tuna feeds on herring, and the tuna fishery also uses herring as bait. In 2016, about 7,000 commercial and 21,000 recreational bluefin tuna permits were issued. The bluefin tuna fishery (recreational and commercial combined) landed an average of 862.3 mt from the years 2012 to 2016, with most catch coming from the commercial rod and reel and longline fisheries in the northwest Atlantic (NEFMC 2018b). In 2018, U.S. commercial landings of bluefin tuna were 958 mt with $11.4M in revenue. While landings decreased over 2017 (1,312 mt), revenue increased ($10.1M). Common and arctic terns are protected under the Migratory Bird Treaty Act and managed by the U.S. Fish and Wildlife. There is no directed tourism or recreation activities focusing on these species. Spiny dogfish commercial landings in 2018 were 7,808 mt with $3.5M in revenue (NMFS 2020).

Other fisheries for species that feed on herring include striped bass and groundfish. In 2019, total Atlantic striped bass removals (commercial and recreational, including harvest, commercial discards, and recreational release mortality) were estimated at 5.47M fish, a 5% decrease relative to 2018. The recreational sector accounted for 87% of total removals by number (ASMFC 2020a). Groundfish landings in FY 2018 were 44.3M lb, generating $49.5M. While this is an increase over FY 2017 ($47.0M), overall groundfish landings and revenue have declined (NEFMC 2020).

Ecotourism, in the form of whale watching, also depends on marine life that forages on herring. As of 2017, there were 22 dedicated whale watching companies with 34 vessels from Maine to New Jersey and several in Delaware and Virginia. There are about 30 smaller, charter whale watch operations as well in the Northeast (NEFMC 2018a).

5.5.3 Fishing Communities

Consideration of the socioeconomic impacts on fishing communities of proposed fishery regulations is required by the National Environmental Policy Act of 1969, as Amended (NEPA 1970) and the Magnuson-Stevens Fishery Conservation and Management Act, particularly National Standard 8 (MSA 2007) which defines a "fishing community" as "a community which is substantially dependent on or substantially engaged in the harvesting or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such community" (16 U.S.C. § 1802(17)). Here, "fishing communities" include communities with a substantial involvement in or dependence on the Atlantic herring fishery. For example, herring are widely used as lobster bait, but it is impractical to identify every community with substantial involvement in the lobster fishery (and consequently some dependence on the herring fishery) for assessment in this document.

5.5.3.1 Herring Fishing Communities Identified

There are over 150 communities that have been a homeport or landing port to one or more active Atlantic herring fishing vessels since 1997. These ports mostly occur from Maine to New Jersey. The level of activity in the herring fishery has varied across time. While the involvement of communities in the Atlantic herring fishery is described, it is important to remember that the involvement of vessels therein may vary.

Primary Port Criteria. The herring fishery primary ports are those that are substantially engaged in the fishery, and which are likely to be the most impacted by the alternatives under consideration. The primary ports meet at least one of the following criteria:

1. A ranking of high for engagement in on the Atlantic herring fishery on average in 2015-2019, according to the NOAA Fisheries Community Social Vulnerability Indicators (Table 18).
2. Atlantic herring landings averaging at least 10M lb (4,536 mt) per year from 2011-2020, or anticipated landings above this level based on interviews and documented fishery-related developments (Table 19).

Secondary Port Criteria. The herring fishery secondary ports are those that may not be as dependent or engaged in the fishery as the primary ports but are involved to a lesser extent. They are listed here to provide a broader scope of potential communities impacted by skate management measures. The secondary ports meet at least one of the following criteria:

1. A ranking of at least medium-high for engagement in or reliance on the Atlantic herring fishery on average in 2015-2019, according to the NOAA Fisheries Community Social Vulnerability Indicators (Table 18).
2. Port infrastructure dependent in part or whole on Atlantic herring (e.g., herring dealers, portside sampling stations).

Changes to these criteria since their use in Amendment 8 are: a) updating engagement and reliance indicators from 2011-2015 to 2015-2019, and b) updating average herring landings from 2007-2016 to 2011-2020 and using an average of 10M lb as the threshold rather than requiring 10M lb of landings each year; and 3) creation of secondary port criteria. Also, NOAA Fisheries has changed the indicator of herring engagement to include the number of homeported vessels with herring permits rather than the number of vessels landing herring. Herring landings and revenue and the number of herring dealers remain components of the indicator. The A8 criteria also included port infrastructure dependent on herring; that has become a secondary port criterion. Finally, dependence on herring as bait, geographic isolation and use of herring for value-added production have been dropped. Hundreds of ports depend on herring as bait; geographic isolation is captured in the reliance indicator; and the ports with value-added production meet other criteria.

Herring Primary and Secondary Ports. Based on these updated criteria, there are eight primary ports in the Atlantic herring fishery (Table 17). Of these, the ports with the highest landings are Portland and Rockland, Maine and Gloucester and New Bedford, Massachusetts (Table 19). The primary ports comprised 89% of total fishery landings during 2011-2020. There are 16 secondary ports from Maine to New Jersey, the non-confidential ports of which comprise 8% of herring landings during 2011-2020.

There are 266 other ports that had at herring engagement indicator of at least low on average in 2015-2019, indicating minor participation in the fishery recently. Ports are further described in Amendments 5 and 8. Community profiles are available from the NEFSC Social Sciences Branch website and in Clay et al. (2007).

Table 17. Primary and secondary ports in the Atlantic herring fishery

State	Community	Primary Criteria	Secondary Criteria			Primary/ Secondary
		Herring landings >10M lb	Herring indicator		Port dependent	
			High engagement	Engagement or reliance > med-high		
ME	Machiasport **			√		Secondary
ME	Jonesport *			√	√	Secondary
ME	Gouldsbor/Corea/ Prospect Harbor *			√		Secondary
ME	Tremont **			√		Secondary
ME	Stonington		√	√		Primary
ME	Isle au Haut **			√		Secondary
ME	Rockland	√	√	√	√	Primary
ME	Vinalhaven *			√		Secondary
ME	Matinicus *			√		Secondary
ME	South Bristol *			√		Secondary
ME	Boothbay Harbor **			√		Secondary
ME	Portland	√	√	√	√	Primary
NH	Portsmouth **			√		Secondary
MA	Gloucester	√	√	√	√	Primary
MA	Boston **			√		Secondary
MA	New Bedford	√	√	√	√	Primary
MA	Fall River **				√	Secondary
RI	N. Kingstown *				√	Secondary
RI	Narragansett/Pt. Judith		√	√		Primary
NY	Montauk		√	√		Primary
NY	Wainscott **			√		Secondary
NY	Hampton Bays/ Shinnecock *			√		Secondary
NJ	Barnegat Light *			√		Secondary
NJ	Cape May		√	√	√	Primary

Note: Sebasco, ME and Newport, RI were primary ports in Amendment 8, because of having some herring port infrastructure and lobster dependence. Sebasco no longer has herring port infrastructure and lobster dependence was dropped from the criteria, so these ports are not listed.
* Was a primary port in A8, now a secondary port.
** New secondary port.

Table 18. Atlantic herring fishing community engagement and reliance indicators, 2015-2019 average.

State	Community	Herring Fishing Community Indicator	
		Engagement	Reliance
ME	Machiasport (s)	Low	Med-High
	Jonesport (s)	Medium	High
	Gouldsboro/Corea/Prospect Harbor (s)	Med-High	High
	Tremont (s)	Medium	Med-High
	Stonington (p)	High	High
	Isle au Haut (s)	Low	High
	Rockland (p)	High	High
	Vinalhaven (s)	Low	Med-High
	Matinicus (s)	Low	Med-High
	South Bristol (s)	Medium	High
	Boothbay Harbor (s)	Medium	Med-High
	Portland (p)	High	High
NH	Portsmouth (s)	Med-High	Medium
MA	Gloucester (p)	High	High
	Boston (s)	Med-high	Low
	New Bedford (p)	High	Medium
	Fall River (s)	Medium	Low
RI	N. Kingstown (s)	Medium	Low
	Narragansett/Pt. Judith (p)	High	Med-High
NY	Montauk (p)	High	High
	Wainscott (s)	Low	High
	Hampton Bays/Shinnecock (s)	Med-High	Medium
NJ	Barnegat Light (s)	Medium	High
	Cape May (p)	High	High

Notes: List includes those communities that have a ranking of at least medium-high for herring engagement or reliance or are otherwise designated a primary (p) or secondary (s) port.
Source: NOAA Fisheries Community Social Vulnerability Indicators.

Table 19. Annualized Atlantic herring landings to top ports, 2011-2020

Port, State	2011-2020 Avg. landings (mt)	Rank	Herring permits [a]	Herring dealers [a]
Portland, ME (p)	16,767	1	23	77
Gloucester, MA (p)	12,611	2	27	32
Rockland, ME (p)	10,851	3	14	59
New Bedford, MA (p)	9,035	4	16	45
Narragansett/Pt. Judith, RI (p)	2,686	5	45	24
Stonington, ME (p)	1,348	6	7	26
N. Kingston, RI (s)	1,270	7	5	3
Cape May, NJ (p)	1,225	8	8	4
Jonesport, ME (s)	746	9	10	15
Gouldsboro/Corea/Prospect Harbor, ME (s)	743	10	10	31
Boston, MA (s)	684	11	11	14
Vinalhaven, ME (s)	463	12	3	5
Portsmouth, NH (s)	393	13	4	22
Newport, RI	379	14	5	5
Fall River, MA (s)	227	17	4	24
S. Bristol, ME (s)	222	19	4	5
Montauk, NY (p)	12	>30	45	20
Hampton Bays/Shinnecock, NY (s)	12	>30	32	16
Barnegat Light, NJ (s)	>1	>30	7	3
Other (n=94)	1,722			
Total (n=113)	**61,397**		**242**	**169**

Note: Dark shaded rows are primary ports. Secondary ports not listed are confidential.
Source: Dealer data, accessed July 2021.

5.5.3.2 Social and Gentrification Pressure Vulnerabilities

The NOAA Fisheries Community Social Indicators (see also Jepson & Colburn 2013) are quantitative measures that describe different facets of social and economic well-being that can shape either an individual's or community's ability to adapt to change. The indicators represent different facets of the concepts of social and gentrification pressure vulnerability to provide context for understanding the vulnerabilities of coastal communities engaged in and/or reliant on commercial fishing activities. Provided here are these indicators for the primary and secondary herring ports (Table 20).

The Social Vulnerability Indicators. There are five social vulnerability indicators; the variables for which represent different factors that may contribute to a community's vulnerability. The **Labor force structure** index characterizes the strength/weakness and stability/instability of the labor force. The **Housing characteristics** index measures infrastructure vulnerability and includes factors that indicate housing that may be vulnerable to coastal hazards. The **Personal disruption** index represents factors that disrupt a community member's ability to respond to change because of personal circumstances affecting family life such as unemployment or educational level. The **Poverty** index is a commonly used indicator of vulnerable populations. The **Population composition** index shows the presence of populations who are traditionally considered more vulnerable due to circumstances often associated with low incomes and fewer resources. A high rank in any of these indicates a more vulnerable population.

Most herring port communities exhibited medium-high to high vulnerability in at least one of the five social vulnerability indicators. Across all herring ports, the highest indicator of vulnerability is labor force structure.

Gentrification Pressure Indicators. Gentrification pressure indicators characterize factors that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront, including the displacement of fishing and fishing-related infrastructure. The **Housing Disruption** index represents factors that indicate a fluctuating housing market where some fishing infrastructure displacement may occur due to rising home values and rents. The **Retiree migration** index characterizes areas with a higher concentration of retirees and elderly people in the population. The **Urban sprawl** index describes areas with increasing population and higher costs of living. A high rank in any of these indicates a population more vulnerable to gentrification.

Almost all herring ports scored medium-high to high in at least one of the three gentrification pressure indicators. This suggests that shoreside fishing infrastructure and fishing family homes may face rising property values (and taxes) from an influx of second homes and businesses catering to those new residents, which may displace the working waterfront. Across all herring ports, the highest indicator of vulnerability is housing disruption.

Combined Social and Gentrification Pressure Vulnerabilities. Overall, 15 of the 24 port communities have medium to high levels of vulnerability for four or more of the eight indicators (combined social and gentrification pressure). This indicates high social and gentrification pressure vulnerability overall for both the primary and secondary communities. Stonington, ME and New Bedford and Fall River, MA have six indicators at the medium to high level.

Table 20. Social vulnerability and gentrification pressure in primary and secondary herring ports, 2018.

State	Community	Social vulnerability					Gentrification pressure		
		Labor Force Structure	Housing Characteristics	Environmental Justice indicators			Housing Disruption	Retiree Migration	Urban Sprawl
				Personal Disruption	Poverty	Population Composition			
ME	Machiasport (s)	Med-High	Med-High	Low	Medium	Low	Low	High	Low
	Jonesport (s)	Med-High	Med-High	Medium	Medium	Low	Low	Medium	Low
	Gouldsboro (s)	Med-High	Med-High	Low	Medium	Low	Med-High	Med-High	Low
	Tremont (s)	Low	Medium	Low	Low	Low	Med-High	Low	Low
	Stonington (p)	Medium	Med-High	Med-High	Med-High	Low	High	Medium	Low
	Isle au Haut (s)	Low	n/a*	Low	High	Low	n/a*	Low	Low
	Rockland (p)	Low	Med-High	Low	Medium	Low	Medium	Low	Low
	Vinalhaven (s)	Low	Medium	Low	Low	Low	Med-High	Low	Low
	Matinicus (s)	Medium	n/a*	Med-High	Low	Low	High	Medium	Low
	South Bristol (s)	Medium	Medium	Low	Low	Low	Med-High	Med-High	Low
	Boothbay Harbor (s)	High	Medium	Low	Low	Low	Low	High	Low
	Portland (p)	Low	Medium	Low	Medium	Low	Med-High	Low	Medium
NH	Portsmouth (s)	Low	Low	Low	Low	Low	Med-High	Low	Medium
MA	Gloucester (p)	Low	Low	Low	Low	Low	Medium	Low	Medium
	Boston (s)	Low	Low	Medium	Med-High	Med-High	High	Low	High
	New Bedford (p)	Low	Medium	Med-High	High	Med-High	Medium	Low	Med-High
	Fall River (s)	Medium	Medium	Med-High	Med-High	Medium	Medium	Low	Med-High
RI	N. Kingston (s)	Low	Low	Low	Low	Low	Medium	Low	Low
	Narragansett/Pt. Judith (p)	Medium	Low	Low	Low	Low	Med-High	Medium	Low
NY	Montauk (p)	Medium	Low	Low	Low	Low	High	Med-High	Med-High
	Wainscott (s)	Med-High	Low	Low	Medium	Low	High	Medium	High
	Hampton Bays/Shinnecock (s)	Low	Low	Low	Low	Medium	High	Medium	Med-High
NJ	Barnegat Light	High	Low	Low	Low	Low	High	High	Med-High
	Cape May	Med-High	Low	Low	Low	Low	High	High	Medium

Source: NOAA Fisheries Community Social Indicators.
*n/a indicates ranking is not available due to incomplete data. (p) = herring primary port. (s) = herring secondary port

5.5.3.3 Trends in Fishing Communities

The ports of Portland and Rockland, Maine; Gloucester and New Bedford, Massachusetts and Pt. Judith, Rhode Island have been important landing ports for the herring fishery for some time. With the recent declines in herring landings overall, each of these ports have seen a decline in landings and the number of active dealers, with the largest reductions occurring in the top port of Portland (Figure 20, Figure 22). There has been a gradual decline since 2011 in the number of active herring permits (Table 10) and Portland has had the largest number of herring permits active by port (Figure 21).

Figure 20. Herring landings in selected (non-confidential) primary ports, 2011-2020

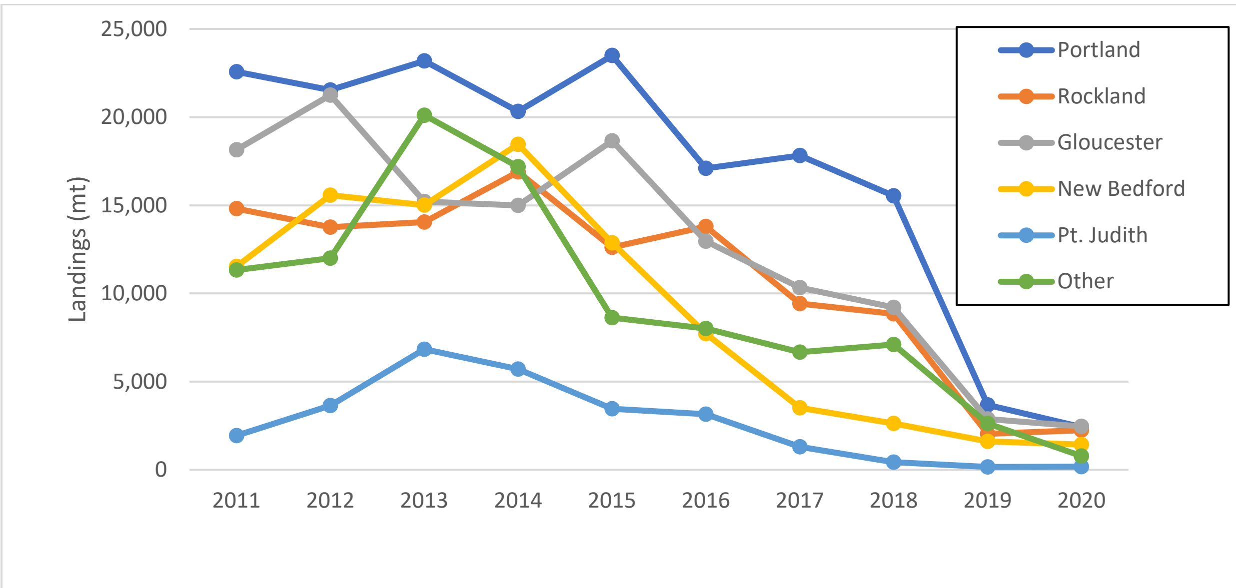


Figure 21. Active herring permits in selected (non-confidential) primary ports, 2011-2020

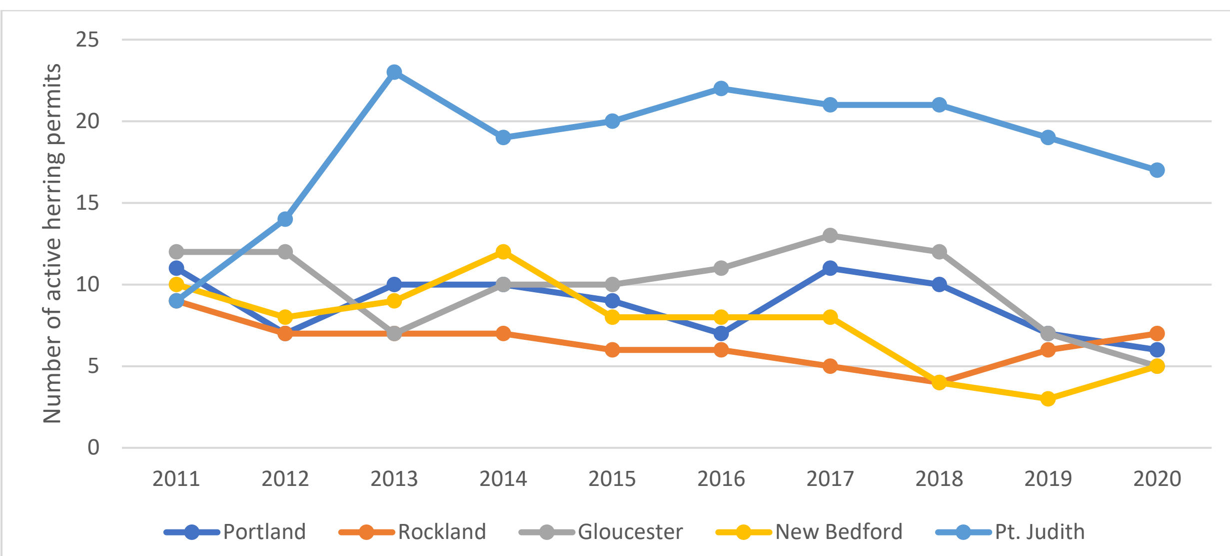
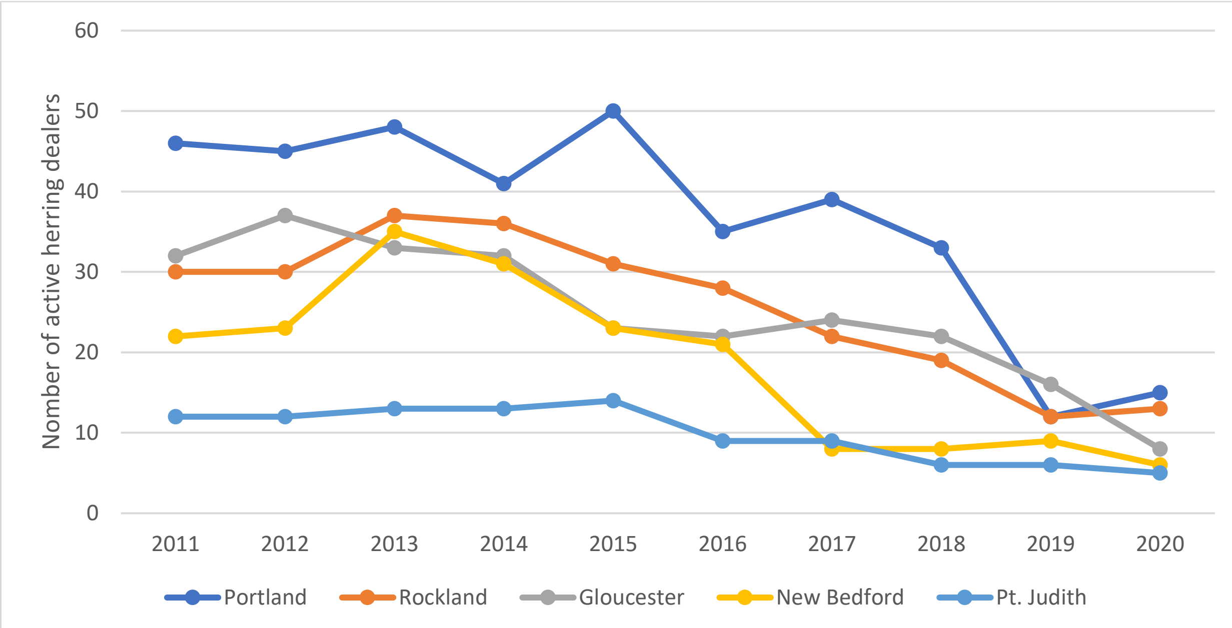


Figure 22. Active herring dealers in selected (non-confidential) primary ports, 2011-2020



Source: Data for Figure 20 to Figure 22 is dealer data, accessed July 2021.

Table 21. Diversity of home port locations for vessels that land herring in top primary herring ports by revenue, 2015-2020.

Landing Port	Time Frame	% same port[1]	% different port[2]		
			Total	Same state	Different state
Rockland, ME	2015-2018	c	c	c	c
	2019-2020	c	c	c	c
Portland, ME	2015-2018	50%	50%	42%	8%
	2019-2020	14%	86%	81%	5%
Gloucester, MA	2015-2018	84%	16%	10%	6%
	2019-2020	76%	24%	15%	9%
New Bedford, MA	2015-2018	56%	44%	14	31%
	2019-2020	c	c	c	c
Point Judith, RI	2015-2018	99%	0%	0%	0%
	2019-2020	100%	0%	0%	0%
Cape May, NJ	2015-2018	17%	83%	0%	83%
	2019-2020	93%	7%	0%	7%

Source: DMIS data, accessed August 2021.
C = confidential
1 Percent of landings in port by vessels that have the same home port.
2 Percent of landings in port by vessels that have a different home port.

The Engagement Index can also be used to determine trends in a fishery over time. Across 2015-2019, the key primary ports of Rockland, Portland, Gloucester, New Bedford, Pt. Judith, Montauk and Cape May have all had high engagement in the herring fishery (Table 22). Engagement has declined in Prospect Harbor, Stonington, Boston, and Fall River across this period and increased in N. Kingston and Hampton Bays.

Table 22. Changes in engagement over time for all primary and secondary herring ports, 2015-2019

State	Community	Engagement Index				
		2015	2016	2017	2018	2019
ME	Machiasport (s)	Low	Medium	Low	Low	Low
	Jonesport (s)	Medium	Medium	Medium	Medium	Low
	Gouldsboro/Corea/ Prospect Harbor (s)	Med-High	High	Med-High	High	Low
	Tremont (s)	Low	Medium	Low	Medium	Low
	Stonington (p)	High	High	High	Med-High	Low
	Isle au Haut (s)	Low	Low	Low	Low	Low
	Rockland (p)	High	High	High	High	High
	Vinalhaven (s)	Low	Medium	Low	Low	Low
	Matinicus (s)	Low	Low	Low	Low	Low
	South Bristol (s)	Medium	Low	Medium	Medium	Medium
	Boothbay Harbor (s)	Medium	Low	Low	Medium	Medium
	Portland (p)	High	High	High	High	High
NH	Portsmouth (s)	High	Low	High	High	Medium
MA	Gloucester (p)	High	High	High	High	High
	Boston (s)	Medium	Med-High	High	Med-High	Medium
	New Bedford (p)	High	High	High	High	High
	Fall River (s)	Medium	Med-High	Low	Medium	Low
RI	N. Kingston (s)	Medium	Medium	Medium	Medium	Med-High
	Narragansett/Pt. Judith (p)	High	High	High	High	High
NY	Montauk (p)	High	High	High	High	High
	Wainscott (s)	Low	Low	Medium	Low	Medium
	Hampton Bays/Shinnecock (s)	Med-High	Med-High	Med-High	Med-High	High
NJ	Barnegat Light (s)	Medium	Medium	Medium	Medium	Medium
	Cape May (p)	High	High	High	High	High
Source: NOAA Fisheries Community Social Vulnerability Indicators.						

5.5.3.4 Herring Fishery by States

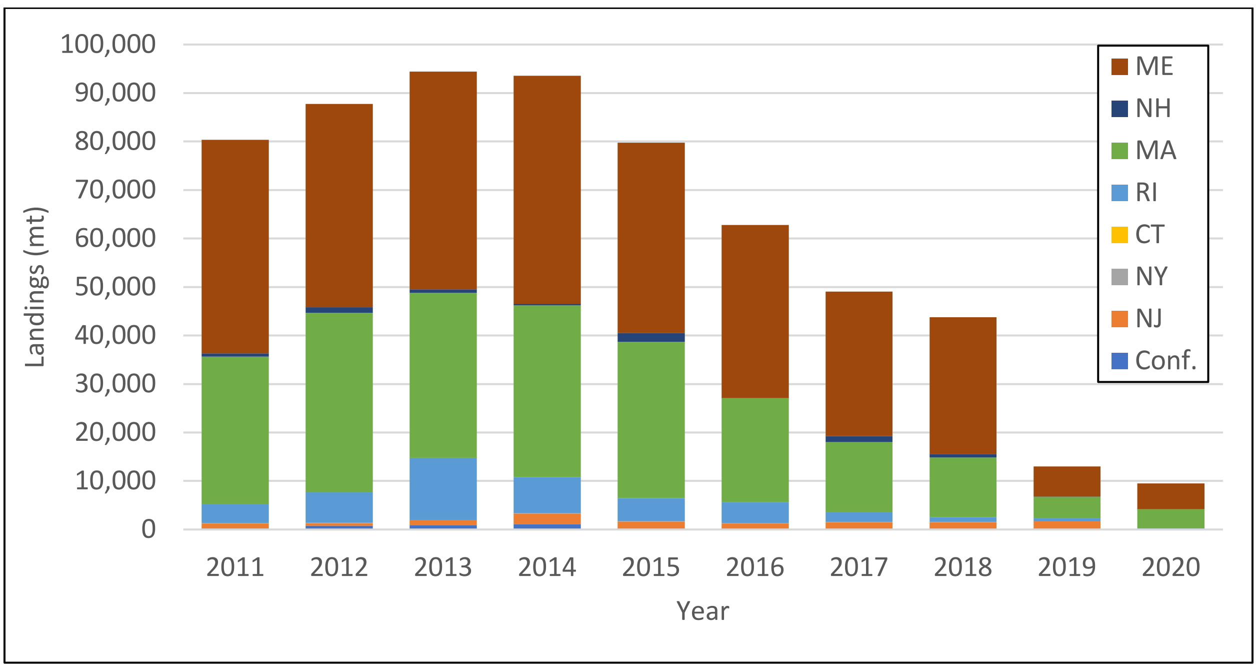
During 2011-2020, herring was landed in seven non-confidential states, mostly in Maine and Massachusetts (Table 23, Figure 23). New York and Rhode Island had the highest number of active herring permits and Maine and Massachusetts had the highest number of active dealers during that time. With the significant reduction in landings since 2014, there is now very little landings activity in states other than Maine and Massachusetts.

Table 23. Annualized Atlantic herring landings to states, 2011-2020

State/Port	2011-2020 Avg. landings (mt)	Herring permits [a]	Herring dealers [a]
Maine	32,225	36	95
New Hampshire	663	20	28
Massachusetts	22,570	47	76
Rhode Island	4,341	50	29
Connecticut	13	14	9
New York	30	75	32
New Jersey	1,259	41	14
Confidential state(s)	296	10	5
Total	**67,397**	**242**	**169**

Note: Some herring primary ports are confidential.
[a] Totals may not equal the sum of the parts, because permits can land in multiple ports and states.
Source: Dealer data, accessed July 2021.

Figure 23. Herring landings by state, 2011-2020.



5.5.3.5 Other Fisheries/Ecotourism

There are several other fisheries, as well as the ecotourism industry, that are potentially impacted by this action. Many ports have coexisting fisheries, including the Atlantic herring fishery. In all, about 140 communities have been identified as potentially impacted by the Atlantic Herring FMP. For example, the mackerel fishery is active primarily in North Kingstown, RI; Gloucester, MA; New Bedford, MA; Portland, ME; Cape May, NJ; Marshfield, MA; Provincetown, MA; and Point Judith, RI. The American lobster fishery is the primary end user of Atlantic herring as bait. American lobster is landed in many port communities on the Atlantic coast. In 2015, 18 of the top 20 ports for lobster landed value were in Maine (primarily midcoast to eastern Maine), and two were in Massachusetts. The communities in Maine to New Jersey important for the bluefin tuna fishery are: Gloucester and New Bedford, MA; Wakefield RI; Montauk, NY; and Brielle, Barnegat Light, and Cape May, NJ. Much more port information is in Amendment 8 (NEFMC 2018b, Section 3.6.3.2.2).

6.0 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

The impacts of the alternatives under consideration are evaluated herein relative to the valued ecosystem components (VECs) described in the Affected Environment (Section 5.0) and to each other. This action evaluates the potential impacts using the criteria in Table 24.

Table 24. General definitions for impacts and qualifiers relative to resource condition (i.e., baseline).

VEC	Resource Condition	Impact of Action		
		Positive (+)	Negative (-)	No Impact (0)
Target and Non-target Species	Overfished status defined by the MSA	Alternatives that would maintain or are projected to result in a stock status above an overfished condition*	Alternatives that would maintain or are projected to result in a stock status below an overfished condition*	Alternatives that do not impact stock / populations
ESA-listed Protected Species (endangered or threatened)	Populations at risk of extinction (endangered) or endangerment (threatened)	Alternatives that contain specific measures to ensure no interactions with protected species (e.g., no take)	Alternatives that result in interactions/take of listed resources, including actions that reduce interactions	Alternatives that do not impact ESA listed species
MMPA Protected Species (not also ESA listed)	Stock health may vary but populations remain impacted	Alternatives that will maintain takes below PBR and approaching the Zero Mortality Rate Goal	Alternatives that result in interactions with/take of marine mammal species that could result in takes above PBR	Alternatives that do not impact MMPA Protected Species
Physical Environment / Habitat / EFH	Many habitats degraded from historical effort (see condition of the resources table for details)	Alternatives that improve the quality or quantity of habitat	Alternatives that degrade the quality, quantity or increase disturbance of habitat	Alternatives that do not impact habitat quality
Human Communities (Socioeconomic)	Highly variable but generally stable in recent years (see condition of the resources table for details)	Alternatives that increase revenue and social well-being of fishermen and/or communities	Alternatives that decrease revenue and social well-being of fishermen and/or communities	Alternatives that do not impact revenue and social well-being of fishermen and/or communities

Impact Qualifiers

A range of impact qualifiers is used to indicate any existing uncertainty	Negligible	To such a small degree to be indistinguishable from no impact
	Slight (sl) as in slight positive or slight negative	To a lesser degree / minor
	Moderately (M) positive or negative	To an average degree (i.e., more than "slight", but not "high")
	High (H), as in high positive or high negative	To a substantial degree (not significant unless stated)
	Significant (in the case of an EIS)	Affecting the resource condition to a great degree, see 40 CFR 1508.27.
	Likely	Some degree of uncertainty associated with the impact

*Actions that will substantially increase or decrease stock size, but do not change a stock status may have different impacts depending on the particular action and stock. Meaningful differences between alternatives may be illustrated by using another resource attribute aside from the MSA status, but this must be justified within the impact analysis.

6.1 IMPACTS ON TARGET SPECIES (ATLANTIC HERRING)

6.1.1 Methods

The potential impacts of the rebuilding plan alternatives under consideration on the Atlantic herring resource are primarily assessed using biological projections. The methods used in the last herring assessment were applied here as well using the base Age Structured Assessment Model (ASAP model; NEFSC 2020a).

However, the projections of spawning stock biomass using the assumption that recruitment is "average" [6] may be overly optimistic in the near-term because recent estimates have been well below average (Figure 2). Therefore, additional sensitivity projections were completed to evaluate the risks associated with recruitment assumptions.

The second set of projections assume herring recruitment is "autocorrelated". When using autocorrelated recruitment (AR, sometimes referred to as autoregressive), annual predicted recruitment values depend on recruitment from the previous year and some random noise or variation in recruitment. The degree of autocorrelation was estimated via linear regression between sequential recruitments, and the regression results were found to be statistically significant. The detailed methods and formulas used for these AR projections are included in Appendix I. The SSC reviewed preliminary analyses prepared to support this rebuilding plan and their final report is included in Appendix II.

The short-term consequence of AR recruitment is that the projected recruitments in the near term will be more like the current levels of recruitment. For example, recruitment is currently low and so the projected recruitments will remain relatively low until the random noise aspect of the process produces improved recruitment. In the long-term, the AR process still reverts to a similar average level of recruitment as the "average recruitment" assumption, but it does so more slowly, 84% of average recruitment in 2023 and close to 90% in later years (Figure 24). In this case, the AR recruitment levels are lower than the average recruitment series because the AR process produces higher highs and lower lows; therefore, the average will be different than just random recruitments. An AR process will not always have a lower average than the random, "average" approach, it just happens to in this case. Furthermore, the AR process is modeled on the log scale and so back transforming the actual recruitments produces a distribution that is non-normal and skewed, which causes differences between the AR and "average" approach (recruitments under the "average" approach would be normally distributed). The main difference between these assumptions is in the first few years, as illustrated in Figure 24.

The 5% and 95% confidence intervals for median recruitment estimated are presented in Table 25. Projection results for recruitment are reported as medians, not averages. Note the confidence intervals around the median for the AR projections are wider than the average recruitment projections because the AR process allows for greater variability than average recruitment. The degree of correlation in the AR process and the amount of random noise were defined using the full time series of estimated herring

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[6] The 2020 management track assessment calculated recruitment the same way it was handled in projections prepared in the 2018 benchmark assessment. Recruitment in each year of the projections was drawn from the empirical cumulative distribution of the estimated recruitments from 1965-2017. The estimates of recruitment from 2018-2019 were excluded because they were imprecisely estimated with CVs equal to 58% and 210%, respectively. In drawing recruitments from the empirical distribution, a uniform random value is drawn between 0-1 each year, and the recruitment associated with that probability from the cumulative distribution is applied. Thus, any recruitment between the minimum and maximum in the estimated time series has an equal probability of selection each year.

recruitments. It was discussed that this approach is likely superior to defining an ad-hoc “below average” recruitment series, or truncated number of years to define recruitment (e.g., the most recent 5 or 10 years).

Figure 24. Median Atlantic herring recruitment values (numbers of fish) for the "average" (in bold) versus autocorrelated (AR) recruitment (dashed line) used in projections (2020-2032).

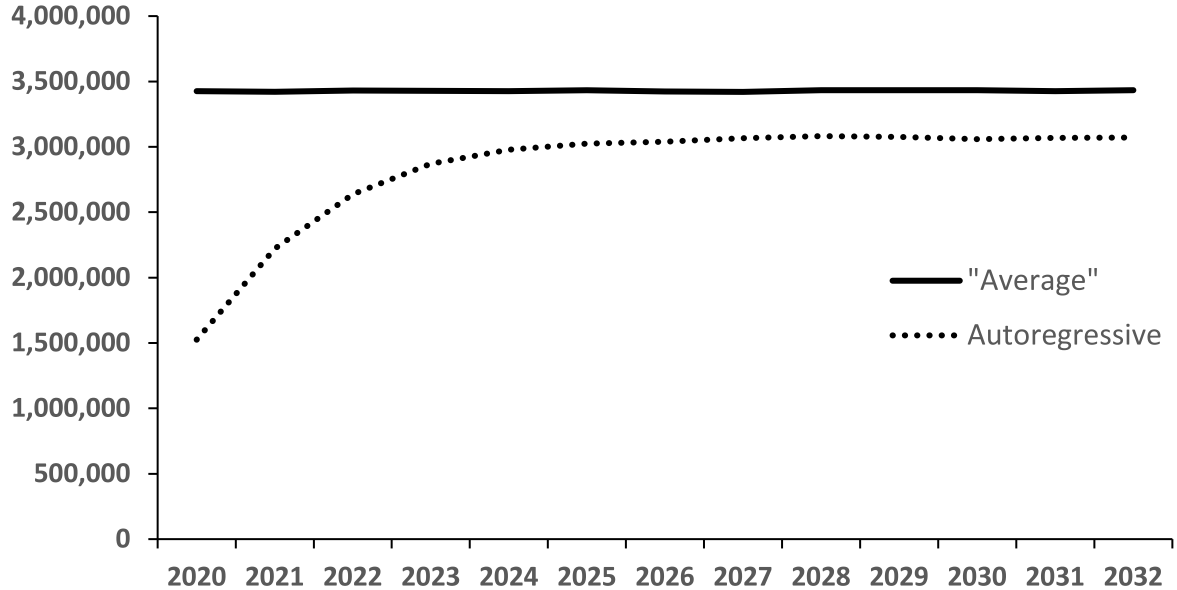


Table 25. Confidence intervals for the “average” and “autocorrelated” recruitment estimates.

	"Average"			Autocorrelated		
	5% CI	Median	95% CI	5% CI	Median	95% CI
2020	913,731	3,426,684	10,155,950	409,357	1,525,166	5,706,166
2021	922,668	3,420,659	10,085,660	525,945	2,221,235	9,467,169
2022	924,183	3,430,797	10,144,480	610,415	2,636,857	11,630,340
2023	909,784	3,429,611	10,121,820	647,364	2,871,534	12,642,840
2024	920,629	3,426,485	10,131,220	675,641	2,978,760	13,140,140
2025	911,010	3,432,964	10,129,350	684,505	3,024,599	13,370,900
2026	912,660	3,423,533	10,132,990	687,635	3,039,450	13,476,070
2027	919,130	3,420,290	10,136,130	691,318	3,066,175	13,480,390
2028	915,434	3,432,648	10,134,300	691,176	3,082,158	13,615,480
2029	914,410	3,432,566	10,126,580	696,582	3,074,937	13,566,900
2030	917,414	3,432,263	10,115,880	699,493	3,059,563	13,632,900
2031	909,597	3,425,736	10,131,430	694,163	3,069,602	13,498,890
2032	928,317	3,432,679	10,131,170	688,754	3,070,659	13,567,230

An additional way to evaluate risk would be to develop additional projections that assume the original ABCs projected under one assumption of recruitment are caught, but later the other assumption of recruitment is realized. For example, if ABCs are calculated assuming average recruitment, but recruitment ends up being more like AR recruitment (lower than average in the near term), than harvesting the original ABC will require higher fishing mortality rates. In this example, realized biomass would be lower than under original projections and if ABC remained the same, fishing mortality would increase higher than projections to attain the original ABC (AVG in AR). In addition, the same approach could be applied in the reverse, realized biomass could be higher than assumed if recruitment ends up being closer to average levels compared to the recent lower levels. In this reverse case, if the same ABC is harvested based on AR projections but biomass is higher than projected, then lower fishing mortality rates would occur, and biomass would rebuild faster than the original AR projections estimate (AR in AVG).

Two additional sets of sensitivity runs to analyze these two cases and help evaluate what could happen if the allocated catch is harvested (the full ABC in this case), but biomass is either higher or lower than anticipated.

For these projections, fishing years 2020 – 2022 are considered bridge years. The fishery specifications in place are assumed to remain in place and the full ABC harvested in each year. Year 1 of this rebuilding plan is FY 2022 because that is the year this rebuilding plan is expected to be implemented. However, this action is expected to be effective mid-year; therefore, the specifications already set for FY 2022 will remain in place and are the same across all projections. Also, once the stock is estimated to rebuild the projections assume the ABC control rule adopted in Amendment 8 will be used in all the remaining years.

6.1.1.1 Projection results

For each alternative (ABC CR and 7year constant) four projections have been developed. The first run is the primary projection that informs the details of the rebuilding plan alternative, and the remaining three runs were prepared as sensitivity analyses to help evaluate the risk and uncertainty associated with future herring recruitment.

1. Assuming future recruitment will be equal to the long-term average (AVG) (median recruitment over the entire time series (1965-2017), excluding the last two years (2018 and 2019), which are very uncertain)
2. Assuming future recruitment will be autocorrelated (AR) and more similar to recent values (annual recruitment depends on recruitment values from the previous year and some variation)
3. Assuming AVG recruitment, when in truth it is AR (AVG in AR)
4. Assuming AR recruitment, when in truth it is AVG (AR in AVG).

Table 26 summarizes the projection results for Alternative 2 (ABC CR). Table 27 includes three separate sensitivity projections for Alternative 2 (ABC CR). Similarly, Table 28 summarizes the projection results for Alternative 3 (7yr constant) and Table 29 includes three separate sensitivity projections for Alternative 3 using different recruitment assumptions. "$P_{rebuild}$" represents the fraction of stochastic realizations for each year, or the probability that projected annual biomass is at or above $SSB_{MSY\ proxy}$, compared to "$P_{overfished}$", which represents the probability that the projected annual biomass is at or above the overfished threshold (1/2 $SSB_{MSY\ proxy}$). "$P_{overfishing}$" represents the probability that projected fishing mortality is at or above the overfishing threshold ($F_{MSY\ proxy}$, currently estimated at 0.54). Finally, "$P_{closure}$" represents the probability projected biomass may fall below 10% of $SSB_{MSY\ proxy}$, under the current ABC control rule if biomass falls below 10% of $SSB_{MSY\ proxy}$ ABC is set to zero, or the fishery is closed, no allocation to the fishery.

Several key attributes have been summarized across rebuilding plan alternatives assuming average recruitment (Table 30). In addition, summary figures have been developed to help compare the results of Alternative 2 and Alternative 3 (Figure 25 - Figure 30). Finally, two summary figures are included that compare the results for Alternative 2 and 3 as well as the sensitivity runs completed to help assess risk;

Figure 31 is a bar graph comparing the performance of two metrics at once across all runs ($P_{closure}$ and #Years to rebuild), and Figure 32 is a radar graph comparing the tradeoffs between rebuilding and short-term ABC across all runs.

Table 26. Projection results for Alternative 2 (ABC CR), assuming "average" recruitment.

	Reb Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSB_{MSY}	P (rebuild)	P (closure)
2020	*	0.243	56375	0.002	0.999	–	–	0.210	0.000	0.005
2021	*	0.119	48760	0.000	0.918	23424	9483	0.181	0.017	0.066
2022	1*	0.088	45876	0.000	0.893	26283	8722	0.171	0.031	0.115
2023	2	0.077	130736	0.000	0.521	44660	11036	0.486	0.097	0.001
2024	3	0.419	206057	0.290	0.174	69575	56070	0.766	0.274	0.000
2025	4	0.434	250790	0.323	0.060	85649	70950	0.932	0.428	0.000
2026	5	0.434	274581	0.321	0.024	97048	80407	1.021	0.525	0.000
2027	6	0.434	284774	0.321	0.014	105158	87217	1.059	0.569	0.000
2028	7	0.434	289764	0.322	0.010	108837	90302	1.077	0.594	0.000
2029	8	0.434	291899	0.321	0.009	110165	91422	1.085	0.603	0.000
2030	9	0.434	293070	0.321	0.008	110776	91942	1.089	0.605	0.000
2031	10	0.434	293119	0.321	0.008	110964	92089	1.090	0.609	0.000
2032	11	0.434	293798	0.322	0.008	111186	92298	1.092	0.610	0.000

Note: the year with shading indicates the year the stock is projected to rebuild.

* Projections assume the ABCs already allocated under the current specification package for FY 2020-2022 will remain in place (Framework 8). Year 1 of this rebuilding plan is FY 2022 because that is the year this action is expected to be implemented, but the specifications in place will remain until FY 2023 and beyond.

Table 27. Sensitivity runs for Alternative 2 (ABC CR) under different recruitment scenarios: (a) AR; (b) assuming ABC from average recruitment, but AR realized; (c) assuming ABC from AR, but AVG recruitment realized.

Note: the year with shading indicates the year the stock is projected to rebuild, if there is no shading in the table the stock is not expected to rebuild by 2032 under the assumed conditions.

(a) AR

	Reb Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (closure)
2020	*	0.243	56376	0.002	0.999	–	–	0.210	0.000	0.005
2021	*	0.119	48572	0.000	0.918	23348	9483	0.181	0.017	0.067
2022	1*	0.101	44799	0.000	0.890	23339	8722	0.167	0.031	0.157
2023	2	0.072	79407	0.000	0.778	31932	8832	0.295	0.046	0.028
2024	3	0.212	133074	0.071	0.506	47277	22655	0.495	0.138	0.004
2025	4	0.429	174436	0.370	0.338	63871	52662	0.648	0.248	0.001
2026	5	0.434	208073	0.381	0.242	75371	62615	0.774	0.343	0.000
2027	6	0.434	233899	0.388	0.186	85900	71311	0.870	0.412	0.000
2028	7	0.434	251533	0.391	0.151	93962	78019	0.935	0.456	0.000
2029	8	0.434	263024	0.391	0.132	99541	82609	0.978	0.486	0.000
2030	9	0.434	270142	0.390	0.121	103191	85690	1.004	0.503	0.000
2031	10	0.434	275483	0.388	0.114	105627	87708	1.024	0.516	0.000
2032	11	0.434	278533	0.387	0.110	107025	88868	1.035	0.522	0.000

(b) ABC from average recruitment, but AR realized

	Reb Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (closure)
2020	*	0.243	56376	0.002	0.999	–	–	0.210	0.000	0.000
2021	*	0.119	48571	0.000	0.918	23350	9483	0.181	0.017	0.015
2022	1*	0.101	44781	0.000	0.890	23376	8722	0.166	0.031	0.059
2023	2	0.112	77932	0.002	0.778	31931	11036	0.290	0.048	0.004
2024	3	0.673	109547	0.618	0.594	46880	56070	0.407	0.133	0.005
2025	4	0.716	134955	0.625	0.499	55818	70950	0.502	0.235	0.004
2026	5	0.700	158981	0.603	0.447	64141	80407	0.591	0.314	0.002
2027	6	0.669	179306	0.577	0.419	72024	87217	0.667	0.365	0.001
2028	7	0.627	196910	0.551	0.397	78697	90302	0.732	0.399	0.001
2029	8	0.581	213571	0.523	0.379	84631	91422	0.794	0.428	0.000
2030	9	0.542	230032	0.500	0.364	90315	91942	0.855	0.450	0.000
2031	10	0.509	243510	0.479	0.349	95279	92089	0.905	0.469	0.000
2032	11	0.487	254394	0.466	0.338	99132	92298	0.946	0.482	0.000

(c) ABC from AR, but average recruitment realized

	Reb Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (closure)
2020	*	0.243	56377	0.002	0.999	–	–	0.210	0.000	0.000
2021	*	0.119	48761	0.000	0.918	23418	9483	0.181	0.017	0.014
2022	1*	0.088	45819	0.000	0.888	26269	8722	0.170	0.031	0.053
2023	2	0.049	132146	0.000	0.513	44763	8832	0.491	0.113	0.000
2024	3	0.136	232552	0.002	0.146	70398	22655	0.865	0.385	0.000
2025	4	0.272	297541	0.063	0.063	94830	52662	1.106	0.587	0.000
2026	5	0.278	334501	0.071	0.042	110971	62615	1.243	0.681	0.000
2027	6	0.284	351461	0.082	0.037	123597	71311	1.307	0.721	0.000
2028	7	0.296	359372	0.100	0.038	130175	78019	1.336	0.734	0.000
2029	8	0.311	358987	0.122	0.041	132065	82609	1.335	0.729	0.000
2030	9	0.326	355426	0.143	0.045	131738	85690	1.321	0.720	0.000
2031	10	0.338	349522	0.165	0.052	130472	87708	1.299	0.705	0.000
2032	11	0.349	344071	0.185	0.057	128831	88868	1.279	0.692	0.000

** Projections assume the ABCs already allocated under the current specification package for FY 2020-2022 will remain in place (Framework 8). Year 1 of this rebuilding plan is FY 2022 because that is the year this action is expected to be implemented, but the specifications in place will remain until FY 2023 and beyond.*

Table 28. Projection results for Alternative 3(7-year constant F), assuming average recruitment.

Note: the year with shading indicates the year the stock is projected to rebuild.

	Reb Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (closure)
2020	*	0.243	56375	0.002	0.999	–	–	0.21	0	0.005
2021	*	0.119	48760	0	0.918	23424	9483	0.181	0.017	0.066
2022	1*	0.088	45802	0	0.888	26283	8722	0.17	0.031	0.132
2023	2	0.483	112408	0.408	0.634	44736	40766	0.418	0.059	0.009
2024	3	0.483	180082	0.411	0.264	62261	56521	0.669	0.188	0.000
2025	4	0.483	226293	0.406	0.099	78329	71015	0.841	0.328	0.000
2026	5	0.483	252676	0.401	0.043	90163	81753	0.939	0.427	0.000
2027	6	0.483	264874	0.397	0.025	98447	89318	0.985	0.481	0.000
2028	7	0.483	270826	0.397	0.019	102568	93093	1.007	0.508	0.000
2029	8	0.434	284642	0.346	0.09	106849	88646	1.058	0.55	0.000
2030	9	0.434	289141	0.341	0.041	108776	90275	1.075	0.574	0.000
2031	10	0.434	290883	0.336	0.018	109781	91092	1.081	0.594	0.000
2032	11	0.434	292429	0.333	0.011	110370	91608	1.087	0.603	0.000

** Projections assume the ABCs already allocated under the current specification package for FY 2020-2022 will remain in place (Framework 8). Year 1 of this rebuilding plan is FY 2022 because that is the year this action is expected to be implemented, but the specifications in place will remain until FY 2023 and beyond.*

Table 29. Sensitivity runs for Alternative 3 (7-year constant F) under different recruitment scenarios: (a) AR; (b) assuming ABC from average recruitment, but AR realized; (c) assuming ABC from AR, but AVG recruitment realized.

Note: the year with shading indicates the year the stock is projected to rebuild, if there is no shading in the table the stock is not expected to rebuild by 2032 under the assumed conditions.

(a) AR

	Reb Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (closure)
2020	*	0.243	56376	0.002	0.999	–	–	0.21	0	0.005
2021	*	0.119	48572	0	0.918	23348	9483	0.181	0.017	0.067
2022	1*	0.101	44799	0	0.89	23339	8722	0.167	0.031	0.157
2023	2	0.358	69911	0.234	0.825	31932	23508	0.26	0.031	0.100
2024	3	0.358	114824	0.283	0.597	43325	31231	0.427	0.096	0.071
2025	4	0.358	163260	0.295	0.38	57823	41169	0.607	0.221	0.061
2026	5	0.358	208910	0.3	0.243	72546	51328	0.777	0.347	0.058
2027	6	0.358	245113	0.309	0.167	86432	61029	0.911	0.442	0.061
2028	7	0.358	270372	0.314	0.124	97575	68815	1.005	0.503	0.064
2029	8	0.434	286091	0.403	0.204	109588	90936	1.064	0.53	0.030
2030	9	0.434	286383	0.405	0.158	110974	92107	1.065	0.536	0.005
2031	10	0.434	285655	0.405	0.126	110966	92115	1.062	0.538	0.001
2032	11	0.434	283861	0.401	0.111	110337	91604	1.055	0.536	0.000

(b) ABC from average recruitment, but AR realized

	Reb Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (closure)
2020	*	0.243	56376	0.002	0.999	–	–	0.210	0.000	0.000
2021	*	0.119	48571	0.000	0.918	23350	9483	0.181	0.017	0.015
2022	1*	0.101	44781	0.000	0.890	23376	8722	0.166	0.031	0.059
2023	2	0.749	58667	0.681	0.829	31931	40766	0.218	0.039	0.054
2024	3	0.842	85667	0.696	0.671	39400	56521	0.318	0.109	0.028
2025	4	0.845	112618	0.676	0.558	48867	71015	0.419	0.207	0.013
2026	5	0.809	138147	0.646	0.492	57859	81753	0.514	0.286	0.006
2027	6	0.766	159484	0.618	0.456	65966	89318	0.593	0.340	0.003
2028	7	0.711	177652	0.589	0.430	72989	93093	0.660	0.376	0.002
2029	8	0.657	194485	0.561	0.409	79026	94642	0.723	0.405	0.001
2030	9	0.611	211266	0.536	0.391	84731	95359	0.785	0.428	0.000
2031	10	0.570	225169	0.516	0.376	89750	95583	0.837	0.447	0.000
2032	11	0.545	236123	0.501	0.362	93614	95820	0.878	0.460	0.000

(c) ABC from AR, but average recruitment realized

	Reb Year	Mobile Fleet F	SSB	P (overfishing)	P (overfished)	OFL	ABC	SSB/ SSBmsy	P (rebuild)	P (closure)
2020	*	0.243	56377	0.002	0.999	–	–	0.210	0.000	0.000
2021	*	0.119	48761	0.000	0.918	23418	9483	0.181	0.017	0.014
2022	1*	0.088	45819	0.000	0.888	26269	8722	0.170	0.031	0.053
2023	2	0.238	122894	0.043	0.563	44763	23508	0.457	0.100	0.000
2024	3	0.217	213788	0.037	0.205	66774	31231	0.795	0.332	0.000
2025	4	0.218	287239	0.034	0.079	89240	41169	1.068	0.555	0.000
2026	5	0.226	336675	0.034	0.040	108579	51328	1.252	0.687	0.000
2027	6	0.235	363729	0.039	0.028	124494	61029	1.352	0.751	0.000
2028	7	0.248	378433	0.048	0.024	134064	68815	1.407	0.779	0.000
2029	8	0.330	369971	0.135	0.032	138175	90936	1.375	0.756	0.000
2030	9	0.345	357927	0.163	0.043	134772	92107	1.331	0.726	0.000
2031	10	0.356	346834	0.188	0.054	131129	92115	1.289	0.699	0.000
2032	11	0.364	338942	0.208	0.062	128010	91604	1.260	0.679	0.000

** Projections assume the ABCs already allocated under the current specification package for FY 2020-2022 will remain in place (Framework 8). Year 1 of this rebuilding plan is FY 2022 because that is the year this action is expected to be implemented, but the specifications in place will remain until FY 2023 and beyond.*

Table 30 summarizes the projection results for both rebuilding plan alternatives assuming "average" recruitment. The first few years maintain the specifications already in place and assume the full ABC is harvested each year. The main difference between these alternatives is the different fishing mortality allowed under these plans in FY 2023, rows below the dark line in the table below.

Table 30. Summary of projection results for several metrics comparing Rebuilding Plan Alternatives 2 and 3 through 2028.

		Alt. 2 (A8 ABC CR)					Alt. 3 (7yr constant)				
Year	Rebuild Year	F	P (overfishing)	P (overfished)	ABC	P (rebuild)	F	P (overfishing)	P (overfished)	ABC	P (rebuild)
2020	*Bridge*	*0.24*	*0.002*	*0.999*	*0*	*0*	*0.24*	*0.002*	*0.999*	*0*	*0*
2021	*Bridge*	*0.12*	*0*	*0.918*	*9,483*	*0.017*	*0.12*	*0*	*0.918*	*9,483*	*0.017*
2022	*1 (Bridge)*	*0.09*	*0*	*0.893*	*8,722*	*0.031*	*0.09*	*0*	*0.888*	*8,722*	*0.031*
2023	2	0.08	0	0.521	11,036	0.097	0.48	0.408	0.634	40,766	0.059
2024	3	0.42	0.29	0.174	56,070	0.274	0.48	0.411	0.264	56,521	0.188
2025	4	0.43	0.323	0.06	70,950	0.428	0.48	0.406	0.099	71,015	0.328
2026	5	0.43	0.321	0.024	80,407	0.525	0.48	0.401	0.043	81,753	0.427
2027	6	0.43	0.321	0.014	87,217	0.569	0.48	0.397	0.025	89,318	0.481
2028	7	0.43	0.322	0.01	90,302	0.594	0.48	0.397	0.019	93,093	0.508

Figure 25. Projections of Prebuild for Alternative 2 (ABC CR) assuming average recruitment (gray solid line) and AR (gray dotted line) compared to Alternative 3 (F7 or 7yr constant) assuming average recruitment (black solid line) and AR (black dotted line).

Note: Alt 2 reaches Prebuild of 0.5 in year 5 (2026) and alt 3 reaches Prebuild of 0.5 in year 7 (2028).

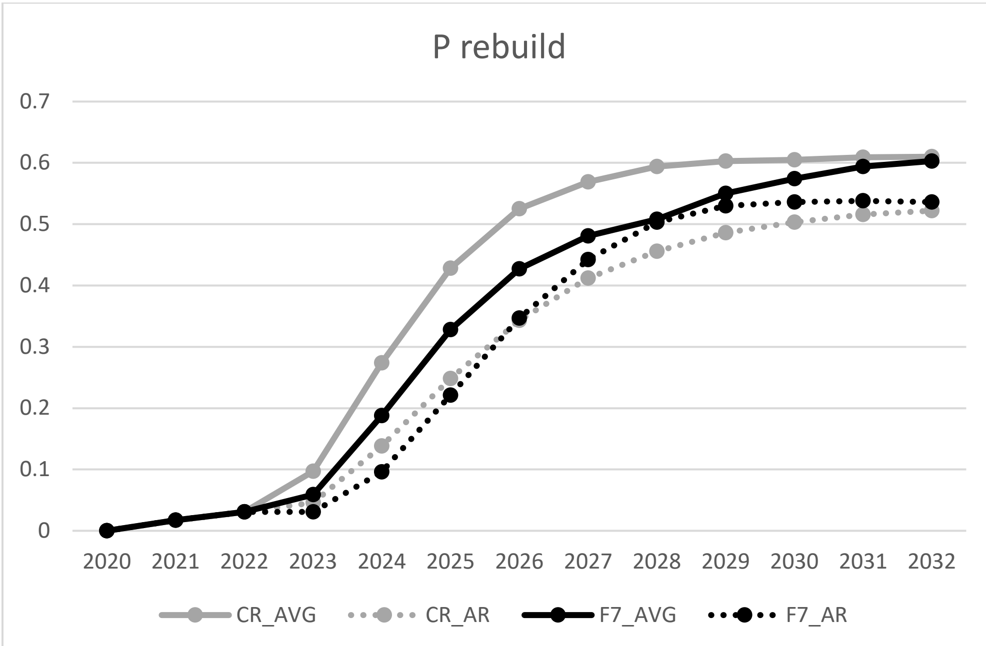


Figure 26. Projections of Poverfished for Alternative 2 (ABC CR) assuming average recruitment (gray solid line) and AR (gray dotted line) compared to Alternative 3 (F7 or 7yr constant) assuming average recruitment (black solid line) and AR (black dotted line).

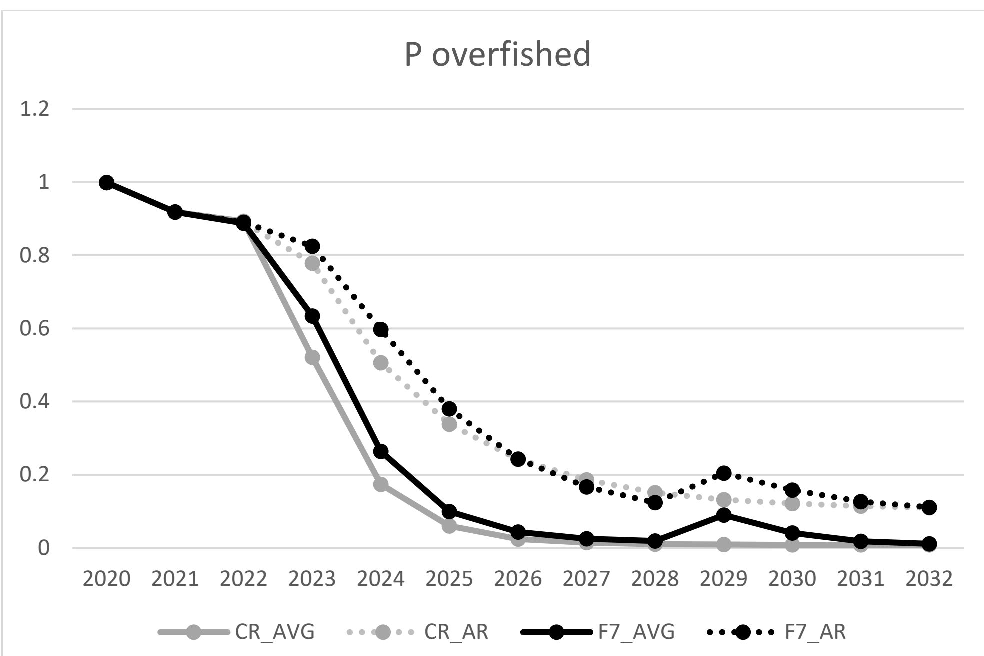


Figure 27. Projections of Poverfishing for Alternative 2 (ABC CR) assuming average recruitment (gray solid line) and AR (gray dotted line) compared to Alternative 3 (F7 or 7yr constant) assuming average recruitment (black solid line) and AR (black dotted line).

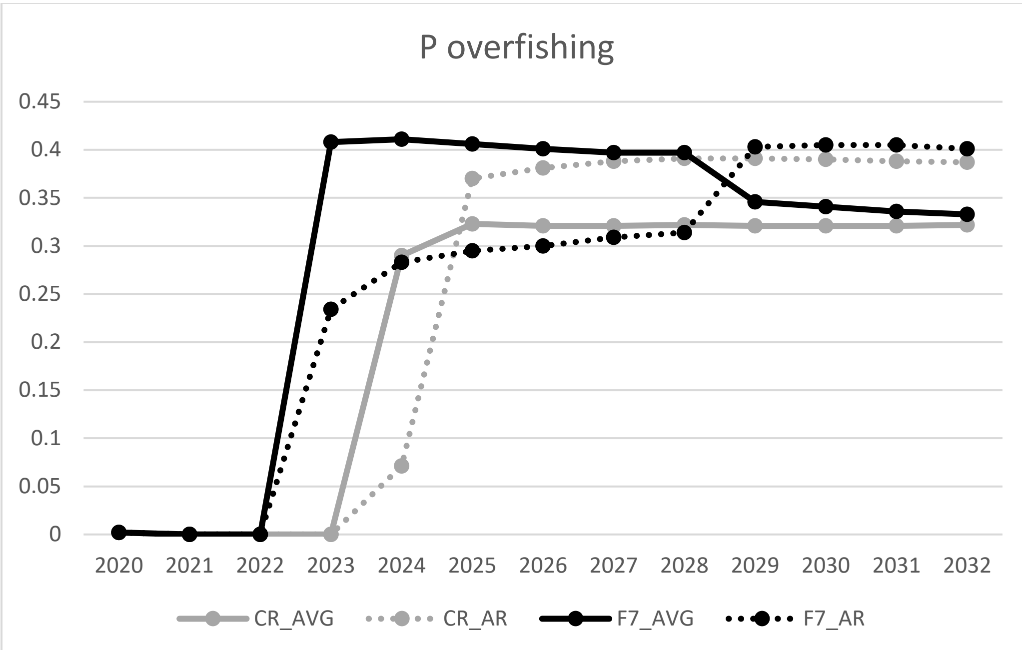


Figure 28. Projected fishing mortality (F) for Alternative 2 (ABC CR) assuming average recruitment (gray solid line) and AR (gray dotted line) compared to Alternative 3 (F7 or 7yr constant) assuming average recruitment (black solid line) and AR (black dotted line).

Note: After the stock is projected to rebuild, F is set to $F_{msy\ proxy}$ (F=0.43) for both alternatives.

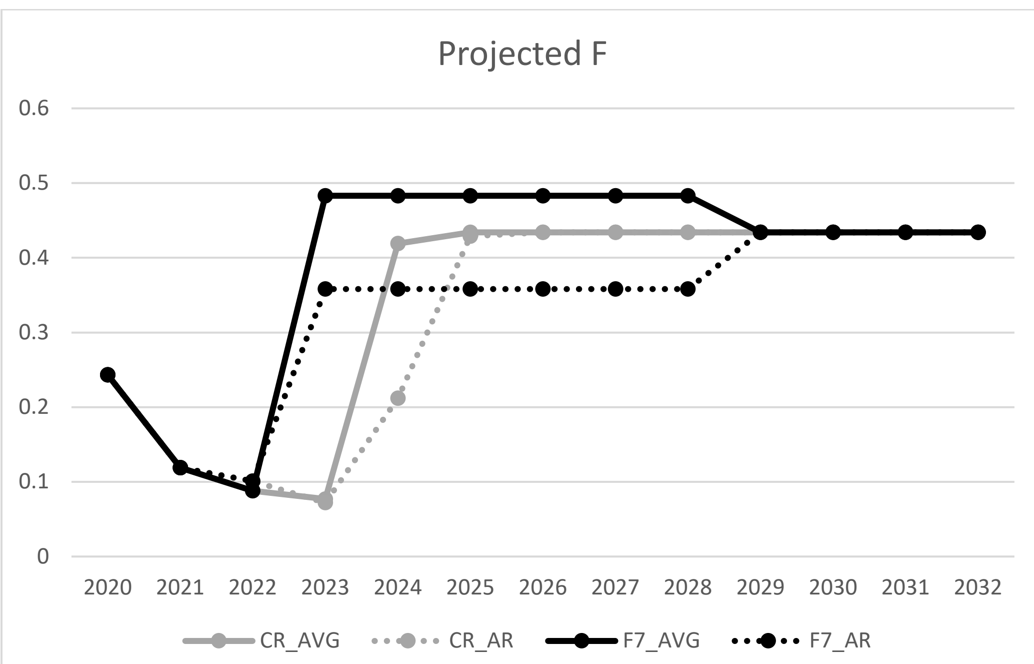


Figure 29. Projected ABC for Alternative 2 (ABC CR) assuming average recruitment (gray solid line) and AR (gray dotted line) compared to Alternative 3 (F7 or 7yr constant) assuming average recruitment (black solid line) and AR (black dotted line).

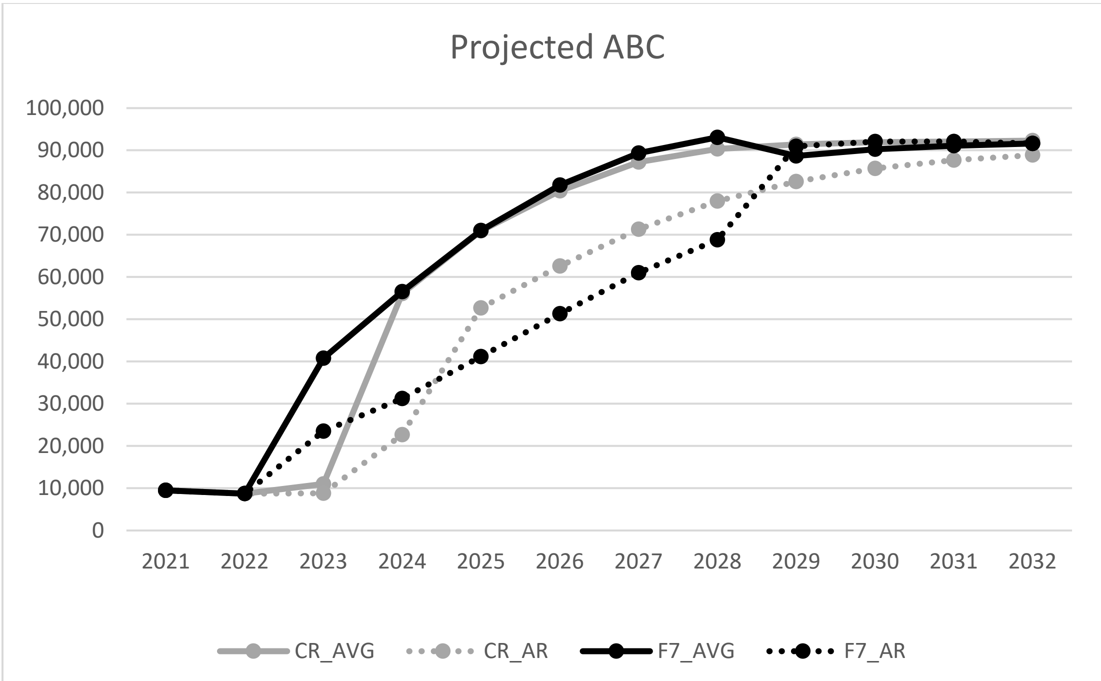


Figure 30. Projected spawning stock biomass (SSB) for Alternative 2 (ABC CR) assuming average recruitment (gray solid line) and AR (gray dotted line) compared to Alternative 3 (F7 or 7yr constant) assuming average recruitment (black solid line) and AR (black dotted line).

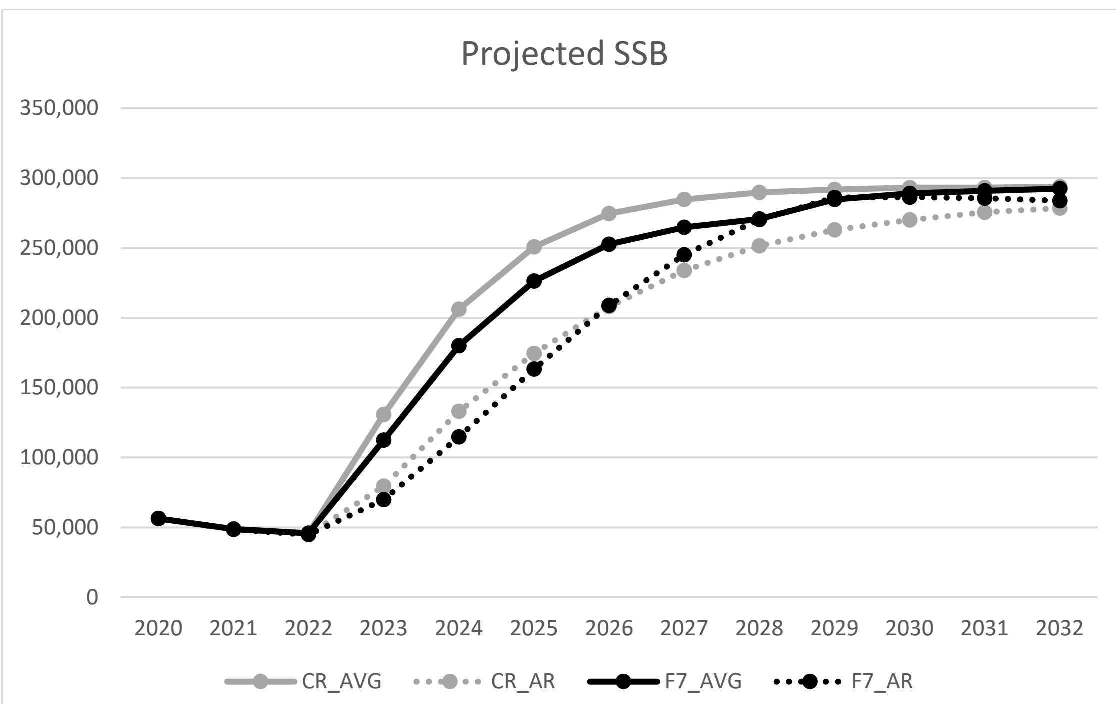


Figure 31 compares probability of a fishery closure (ABC=0) at least once during the next 10 years, and number of years it takes the stock to rebuild. Darker bars are results for scenarios that would implement a rebuilding plan based on average recruitment (AVG), and lighter bars represent the results for the sensitivity runs using other recruitment assumptions. Higher bars indicate "poor" performance and results closer to zero (shorter bars) suggest more desirable performance.

This figure summarizes the two primary risks embedded in these options:

1) a constant fishing mortality rate results in a higher probability of a closure, especially if recruitment is lower (AR), and
2) if management assumes recruitment will be average and it is not (AVG in AR runs) the fishery will take much longer to rebuild under either alternative.

Figure 31. Bar chart comparing performance of rebuilding plan alternatives (ABC CR and 7Y constant) for probability of a fishery closure (top bars) and number of years it takes the resource to rebuild (bottom bars)

Note: The dark bars represent the results for each alternative, and the lighter bars show the results for the sensitivity runs for each alternative under different assumptions about recruitment (AR, AVG in AR and AR in AVG).

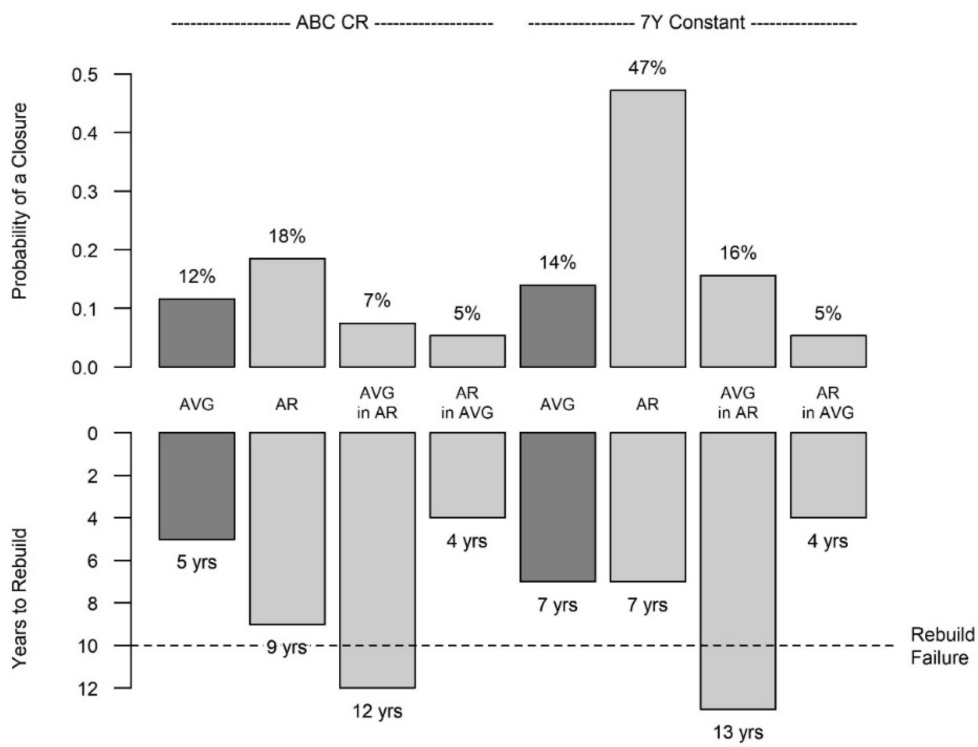
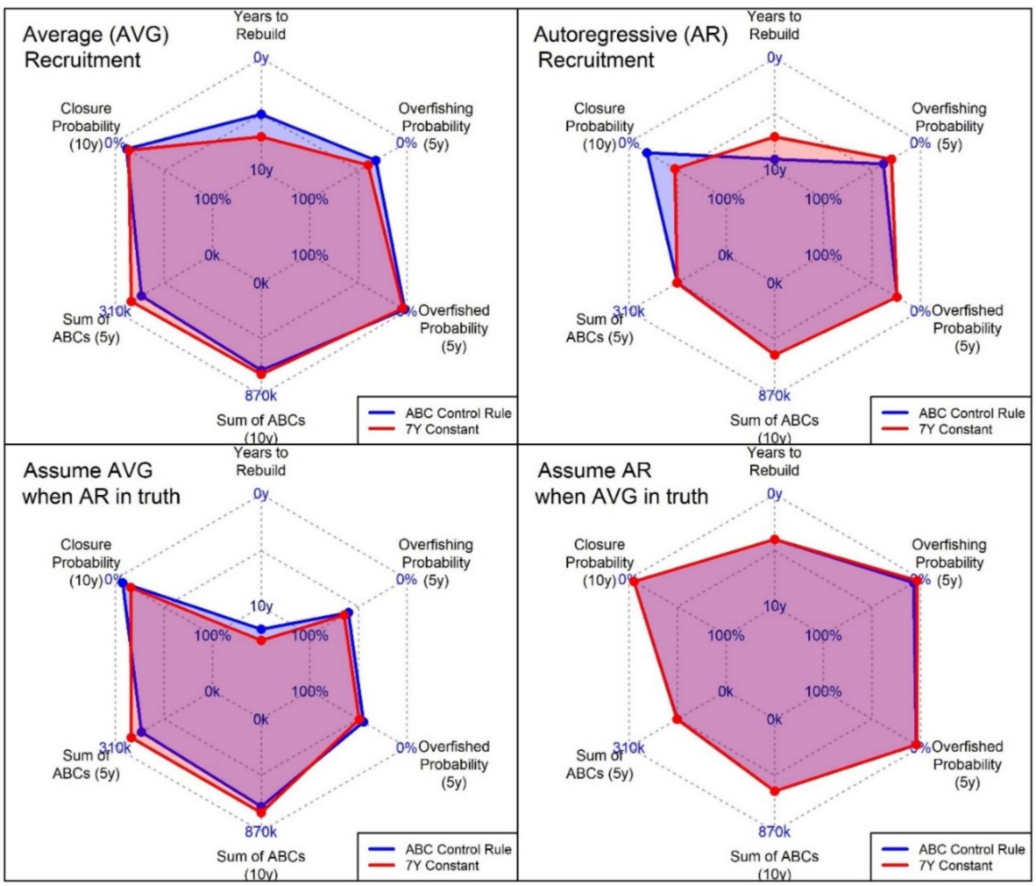


Figure 32 presents the tradeoffs between rebuilding and short-term ABC by displaying results for several metrics at once for both alternatives (ABC CR in blue and 7yr constant in red). For these figures the farther out the results are from the center indicates "good" performance and results closer to the center are less desirable. In summary, these plots show that allocating higher ABCs in the near term has higher risks of a fishery closure (ABC=0), especially under AR recruitment. The fishery may rebuild faster under the ABC CR, but the sum of ABCs over the next five years is slightly lower for the ABC CR (Alt. 2) compared to 7yr constant (Alt. 3). The radar plots also show that both options have similar total catch over the next 10 years as well as $P_{overfished}$.

$P_{closure}$ in Figure 32 represents the probability of the fishery closing *at least* once during the next ten years under each rebuilding plan alternative.[7] This metric shows the risk of a fishery closure (ABC=0) over the next ten years. For example, if there were a 10% chance of closure each year, the fishery would likely close at least once over the next ten years.

Figure 32. Radar plot comparing two rebuilding alternatives (ABC CR in blue and 7yr constant in red) across several metrics (number of years for resource to rebuild, Poverfished in Year5, Poverfishing in Year5, sum of ABCs over the next 10 years, probability of fishery closure ABC=0)



[7] The formula used to calculate $P_{closure}$ over the next ten years is: $pClosure_{y1:y10} = 1 - \prod_y (1 - pClosure_y)$

6.1.2 Action 1 – Rebuilding Plan

6.1.2.1 Rebuilding Plan Alternative 1 (No Action)

Under this alternative, the Council would not recommend implementing a rebuilding plan for Atlantic herring. The Council would continue to set fishery specifications every two years, with default measures for year 3, but there would not be a formal rebuilding plan in place that defines how fishing mortality should be set to achieve rebuilding goals. Because Atlantic herring has recently been declared overfished, the Magnuson-Stevens Act (MSA) requires that a rebuilding plan be implemented to help ensure the measures in place support rebuilding of the resource. Therefore, if a rebuilding plan is not adopted through this action there could be slightly negative impacts on the Atlantic herring resource if fishery specifications do not support rebuilding. An intent of implementing a rebuilding plan is to help track progress. The MSA requires the Secretary of Commerce review rebuilding plans to ensure that adequate progress toward ending overfishing and rebuilding affected fish stocks is being made. Not having a rebuilding plan in place could make it more difficult to track progress.

Because the Council has approved an ABC control rule in the Atlantic herring plan that is the same rule used in Rebuilding Plan Alternative 2, it is likely the same rebuilding F would be used to set future specifications. The projection results for the rebuilding F used in Alternative 2 are expected to have moderately positive impacts on the resources. Therefore, this alternative is expected to have slight negative impacts if there is no rebuilding plan to track progress, and moderate positive benefits if the rebuilding F from the ABC control rule is used and supports rebuilding.

6.1.2.2 Rebuilding Plan Alternative 2 (ABC control rule)

Under this alternative, a rebuilding plan would be established. The policy for setting fishing mortality targets for the rebuilding plan would be consistent with the ABC control rule approved in Amendment 8, which is a biomass-based control rule. $F_{rebuild}$ would vary based on the annual estimate of biomass; the projections prepared for this action suggest that $F_{rebuild}$ would vary between 0.08 and 0.43 (15% - 80% of F_{MSY}).

The Council recommended the ABC control rule in Amendment 8 because it met specific criteria identified by the Council including low variability in yield, low probability of overfished, low probability of closing the herring fishery, and catch at relatively high proportion of MSY. In summary, the control rule was selected because of these characteristics and it explicitly accounts for the role of herring as forage in the ecosystem by limiting fishing mortality at 80% of F_{MSY}, and accounts for uncertainty by limiting the maximum allowable fishing mortality rate at 80%. For these reasons, using the control rule for a rebuilding plan is expected to have moderately positive impacts on the Atlantic herring resource. Because this rebuilding strategy reduces fishing mortality when biomass is low, it is expected to support rebuilding more quickly than a constant fishing mortality strategy that applies the same fishing pressure regardless of biomass. While implementation of a rebuilding plan is expected to inherently have positive impacts on the resource, there is still uncertainty and potential error in the projections, somewhat captured in the sensitivity analyses described above (Section 6.1.1.1). Rebuilding will take time and it could take herring longer to reach higher biomass levels and revert the stock status from overfished.

Alternative 2 is expected to have slight positive impacts on the resource compared to Alternative 1 (No Action) because it would establish an official rebuilding plan that would provide the benefits described above. The fishing mortality targets the Council recommends under Alternative 1 (no rebuilding plan) could be similar or the same as Alternative 2 if the Council maintains use of the ABC CR in future actions. Therefore, the positive impacts on the resource may be similar between these two alternatives. However, a formal rebuilding plan is required by MSA when a stock is declared overfished, and it should provide slight positive benefits to the resource by providing a mechanism for the Secretary to ensure that adequate progress toward ending overfishing and rebuilding affected fish stocks is being made.

Alternative 2 is expected to have slightly positive impacts on the resource compared to Alternative 3 (7year constant). In general, if recruitment returns to average levels, the impacts of these alternatives would not be very different. Alternative 3 allows higher fishing mortality in the short term, but as biomass increases, the fishing mortality allowed under both strategies is relatively similar (0.43 under Alternative 2 and 0.48 under Alternative 3). $P_{overfishing}$ and $P_{overfished}$ are lower for Alternative 2 in the first few years of the rebuilding period, and Prebuild and Projected SSB are higher for Alternative 2 compared to Alternative 3 (Table 30, Figure 25, Figure 26, Figure 27, and Figure 30). These results suggest slightly positive impacts on the resource from Alternative 2 compared to Alternative 3.

However, if recruitment does not improve Alternative 3 (7yr constant) has higher risks of closing the fishery; ABC is set to zero if biomass falls below 10% SSB_{MSY} under the current ABC CR. The probability of fishery closure ($P_{closure}$) over the next ten years for Alternative 2 increases from 12% assuming average recruitment to 18% assuming AR recruitment, compared to Alternative 3 that changes from 14% under average recruitment to 47% under AR recruitment. This suggests that the risk of biomass falling to very low levels under a constant F strategy of 0.48 is greater than a rebuilding strategy that reduces F when biomass is at lower levels (

Figure 31).

In addition, there is fairly strong evidence that several herring populations are subject to Allee effects; the productivity (per-capita recruitment) of the populations becomes reduced at low stock size. Several papers suggest that a goal of management should be to avoid very low stock sizes to help maintain overall productivity of the resource. (Frank & Brickman 2000; Pera¨la¨ & Kuparinen 2017; Saha et al. 2013; Sau et al. 2020). If the Atlantic herring spawning stock remains low for several years, there is a risk that recruitment will worsen and cause further depletion, an outcome not included in the current projections and sensitivity runs.

By design, the Amendment 8 biomass-based control rule uses a relatively risk-averse fishing mortality rate when stock size is low and increases fishing mortality up to 80% of F_{MSY} when biomass is relatively high (>50% $SSB_{MSY\ proxy}$). A biomass-based control rule is intended to be robust to all resource conditions (high or low recruitment). Therefore, even if herring recruitment does not return to levels used in the projections, if biomass remains low in future years, the fishing mortality levels allowed under the Amendment 8 biomass-based control rule would also remain low until biomass increases.

When considering the impacts of a rebuilding plan for Atlantic herring, it is also important to consider species that rely on herring for forage. Because herring is an important prey species in the region, ecosystem considerations should be taken into account when selecting a rebuilding plan. Taking all these issues into account, moderately positive impacts are expected from Alternative 2 compared to Alternative 3.

It is important to note for both alternatives (ABC CR and 7year constant), when ABC is defined assuming average recruitment, but AR recruitment is realized (AVG in AR runs), the stock will not rebuild within ten years (Table 27 and Table 29). It is important to recognize that even if fishing mortality is kept very low, the stock may not rebuild as scheduled unless recruitment improves.

6.1.2.3 Rebuilding Plan Alternative 3 (7year constant)

Under this alternative, a rebuilding plan would be established. The fishing mortality target of the rebuilding plan would be constant, $F_{rebuild}$ would be set at F=0.48, about 89% of F_{MSY} during the rebuilding timeframe.

Alternative 3 is expected to have slight positive to slight negative impacts on the resource compared to Alternative 1 (No Action). There may be slight positive impacts because it would establish an official rebuilding plan compared to not have a rebuilding plan under Alternative 1. However, in the absence of a rebuilding plan, the Council may continue to recommend fishing mortality targets consistent with the ABC CR in place, which are lower than the $F_{rebuild}$ under this alternative. Therefore, if that is the case there may be slight negative impacts on the resource if it takes longer to rebuild under this alternative compared to applying the ABC control rule in place. On its own, the alternative is expected to have slight positive impacts on the resource because it is expected to help rebuild the resource in a relatively timely way (in 7 years assuming average recruitment). This is less than ten years, but if recruitment is below average, it may take longer.

Alternative 3 is expected to have slightly negative impacts on the resource compared to Alternative 2 (ABC CR). In general, if recruitment returns to average levels, these alternatives are not very different. This alternative allows higher fishing mortality in the short term, but as biomass increases the fishing mortality allowed under both strategies is relatively similar (0.43 under Alternative 2 and 0.48 under Alternative 3). $P_{overfishing}$ and $P_{overfished}$ are higher for this alternative under the first few years of the rebuilding period, and Prebuild and Projected SSB are lower compared to Alternative 2 (See Table 30, Figure 25, Figure 26, Figure 27, and Figure 30).

However, if recruitment does not improve Alternative 3 (7yr constant) has higher risks of closing the fishery. The risk of biomass falling to lower levels and closing the fishery are higher under Alternative 3; therefore, slightly negative impacts are expected on the resource compared to Alternative 2, especially if recruitment does not improve (

Figure 31). The projections with lower estimates of recruitment (AR) are where these alternatives differ the most. Alternative 2 may be more robust to uncertainty compared to Alternative 3 because $P_{closure}$ is lower for Alternative 2 compared to Alternative 3 in the runs with AR recruitment (

Figure 31). Similarly, the number of years it could take for herring to rebuild if recruitment is lower than average is longer for Alternative 3 compared to Alternative 2.

Figure 32 summarizes the tradeoffs between rebuilding and short-term ABCs for Alternative 2 compared to Alternative 3. For the most part the results are very similar. It is expected to take longer to rebuild the resource under Alternative 3 compared to Alternative 2 assuming average recruitment, 7 years compared to 5 years. Similarly, the probability of overfishing is slightly higher for Alternative 3 compared to Alternative 2 under the first 5 years of the rebuilding plan. Therefore, there may be moderately negative impacts on the resource under Alternative 3 compared to Alternative 2, but in the longer term these rebuilding plan alternatives are expected to have more similar impacts. Both are expected to rebuild the resource under ten years, provided recruitment improves.

6.1.3 Action 2 – Adjust Herring Accountability Measures (AMs)

6.1.3.1 Overage AM Alternative 1 (No Action)

Under this alternative, there would be no changes to the proactive, in-season or reactive AMs in place to minimize overages of Atlantic herring catch limits. These include in-season reduced possession limits that limit the directed herring fishery (e.g., when a sub-ACL reaches 90%, possession reduced to 40,000 lb, 2,000 lb at 98%, closed at 100%) as well as reactive pound for pound AMs to address any overages. These measures would remain in place and are expected to have moderately positive impacts on the resource by preventing overfishing and keeping the fishery accountable for any overages above catch limits. A version of these measures have been in place since the FMP was first created and brought into compliance with new ACL and AM requirements since 2011 under Amendment 4. To date there have been relatively limited cases when sub-ACLs have been exceeded in one management area or another, and the total ACL has never been exceeded (Figure 4 to Figure 7).

6.1.3.2 Overage AM Alternative 2

Under this alternative, catch from a management area that exceeds the sub-ACL by less than 10% of the sub-ACL is not deducted from the ACL and respective sub-ACL in a subsequent year unless total catch also exceeds the total ACL. Alternative 2 is expected to have slight negative impact on the resource if one area is consistently fished above target levels. However, this alternative only allows an up to 10% overage in a particular area and herring stocks are known to mix during the year; therefore, any potential slight negative impacts are limited. Because Alternative 2 maintains that the total ACL cannot be exceeded there are minimal risks in terms of overfishing overall; therefore, more negligible impacts are expected. Thus, compared to Alternative 1, No Action, there could be slight negative impacts since No Action prevents overages in all herring management areas. Overages would also be prevented under Alternative 2 from the in-season AMs (i.e., possession limit reductions when a sub-ACL is neared) that would remain in place, as well as the ability to close an area when a sub-ACL is reached.

Compared to Alternative 3, Alternative 2 may have slight positive impacts on the resource because overages are limited to 10% per management area, compared to unlimited overages per sub-ACL, so long as the total ACL is not exceeded.

6.1.3.3 Overage AM Alternative 3

Under this alternative catch from a management area that exceeds the sub-ACL would be deducted from the ACL and respective sub-ACL in a subsequent year, only if total catch also exceeded the total ACL. Catch can exceed a sub-ACL by any amount so long as the total ACL is not exceeded.

Alternative 3 is expected to have moderate negative to no impacts on the resource. There may be moderate negative impacts on a sub-component of the stock if one area is consistently fished above target levels. However, because this alternative maintains that the total ACL cannot be exceeded there are minimal risks in terms of overfishing the resource overall; therefore, there may be no impacts on the overall stock, but moderately negative impacts on portions of the stock. Compared to Alternative 1, No Action, there could be moderate negative impacts since No Action prevents overages in all herring management areas. Overages would also be prevented under Alternative 3 from the in-season AMs (i.e., possession limit reductions when a sub-ACL is neared) that would remain in place, as well as the ability to close an area when a sub-ACL is reached. Compared to Alternative 2, this alternative may have slight negative impacts on the resource because this alternative does not have overage limits per area. The four herring management areas have different allocations per area: Area 1A – 28.9%, Area 1B – 4.3%, Area 2 – 27.8% and Area 3 – 39%). Therefore, without overage limits there is a greater risk that one sub-area could be fished higher than another. This measure would still help prevent overfishing overall because the total ACL cannot be exceeded. However, there may be a greater risk of overfishing one stock component under this alternative compared to Alternative 2 and Alternative 1.

6.2 Impacts on Non-target Species (Bycatch)

Non-target species refers to species other than Atlantic herring which are caught/landed by federally permitted vessels while fishing for herring. Most catch by herring vessels on directed trips is Atlantic herring, with extremely low percentages of bycatch (discards). Atlantic mackerel is targeted in combination with Atlantic herring during part of the year in the southern New England and Mid-Atlantic areas and is therefore not considered a non-target species. The primary non-target species in the directed Atlantic herring fishery are groundfish (particularly haddock) and the river herring/shad (RH/S) species.

There are accountability measures in place for both haddock and river herring/shad if area and gear specific catch cap is exceeded. Dogfish, squid, butterfish, and Atlantic mackerel are also common species encountered in the directed Atlantic herring fishery. However, in some cases (especially Atlantic mackerel), while herring is often the target species, mackerel is also landed, and some trips are quite mixed in terms of mackerel and herring landings. Therefore, Atlantic mackerel is not considered a non-target species since there can be substantial landings of that species for various segments of the fishery during certain seasons and in certain areas, Section 5.2 has more information about non-target species in the herring fishery.

6.2.1 Methods

Different gear types and seasonal fishing activity have different potential impacts on non-target species. This section focuses on the biological impacts on species caught incidentally in the herring fishery; these analyses are largely qualitative and based on whether alternatives under consideration are expected to shift effort to areas that may have increased interactions or change gear types that can have differential impacts on bycatch rates. River herring and haddock are the two primary species caught as bycatch in the Atlantic herring fishery. The potential impacts on non-target species or bycatch are primarily qualitative. In general, if more fishing time is expected due to an action, there could be potential negative impacts on non-target species or bycatch, particularly if fishing effort is expected to shift to an area or season with higher bycatch rates.

6.2.2 Action 1 – Rebuilding Plan

This action would establish a rebuilding program for Atlantic herring. Under Alternative 1 (No Action), the Council would not recommend implementing a rebuilding plan. While future specifications for the fishery will be set outside a rebuilding plan, they will use the Council's existing ABC control rule, implemented via Amendment 8. This control rule adjusts the fishing mortality rate and thus the ACL depending on estimated herring biomass relative to MSY, with lower F at lower biomass values. Under Alternatives 2 and 3, a rebuilding plan would be established. The fishing mortality target for the Alternative 2 rebuilding plan would be consistent with the ABC control rule approved in Amendment 8. Because Alternatives 1 and 2 use the same ABC control rule, fishing mortality rates and the associated ACLs will be the same for Alternatives 1 and 2. ACLs and fishing effort should increase over time under these alternatives as the stock rebuilds. Under Alternative 3, the fishing mortality target for the rebuilding plan, $F_{rebuild}$, would be set at a constant value F=0.48, about 89% of F_{MSY}. While F will be held constant under Alternative 3, the resulting ABC and ACL is expected to increase over time as biomass increases.

It is important to note that rebuilding trajectories are often uncertain, and depend on factors beyond fishing mortality, including recruitment rates, which are discussed in detail in the target species impacts section. Thus, even though the rebuilding plans specify fishing mortality rates, it is difficult to predict how biomass, annual catch limits, and thus fishing activity will change over time for each alternative. In estimating impacts on non-target species, it is assumed that differences in ACLs will translate to differences in fishing effort. In this fishery, ACLs and effort are likely to track closely, given that quota utilization is high, especially under lower biomass values.

The expected trajectories of F, biomass, and catch limits is different under Alternative 3 as compared to Alternatives 1 and 2, with higher catches and effort in the short term under Alternative 3. However total ABC across the entire ten-year rebuilding period is very similar, whether the A8 control rule or a constant $F_{rebuild}$ approach is selected. Therefore, impacts on non-target species are expected to be similar across the three alternatives considering the entire rebuilding period in aggregate. While similar aggregate impacts are expected to be similar across alternatives, lower catch limits and fishing effort in a given year will be associated with potentially lower impacts on non-target species, but the differences are small.

Overall, despite possible variations in fishing effort between these options, and because this action maintains the use of catch caps for both haddock and river herring/shad to control impacts on bycatch, these alternatives are all expected to have slight positive to slight negative impacts on non-target species. Continued slight positive impacts on haddock are expected to reflect the current stock status, which is not overfished and not experiencing overfishing. Continued slight negative impacts on river herring/shad are expected to reflect the current stock status, which are essentially depleted according to the most recent stock assessments that were unable to define reference points due to lack of data.

6.2.3 Action 2 – Adjust Herring Accountability Measures (AMs)

These alternatives could adjust the reactive AMs used in the herring fishery to account for overages. All alternatives would maintain the current pro-active AMs. Alternative 1 (No Action) would also maintain the current reactive AM, which requires a pound for pound reduction in future ACLs if there are overages in any of the four herring management areas. Alternatives 2 and 3 change when pound for pound payback would be required. Under Alternative 2, if a sub-ACL is exceeded by less than 10%, and the overall ACL is not exceeded, then the overage is not deducted from future allocations. Under Alternative 3, if the sub-ACL is exceeded by any amount, but the overall ACL is not exceeded, then the overage is not deducted from future allocations. Under other conditions, overages are deducted.

In general, reactive AMs do not have a large effect on the amount of effort in the fishery over time. The in-season measures serve to reduce fishing effort as the catch limits are approached, such that quota overages are generally small relative to overall effort. In addition, the nature of reactive AMs means that harvest occurs in one year, but then effort is reduced in subsequent years, meaning that while effort may be temporally redistributed, the amount of fishing activity over several years will be similar, whether AMs were implemented or not. Alternatives 2 and 3, which include some scenarios where payback is not required, could lead to a slight net increase in effort relative to Alternative 1, but the total ACL cannot be exceeded under any of the alternatives. Therefore, any potential increase in effort is still within the total ACL level considered. Despite possible variations in fishing effort between these options, and because this action maintains the use of catch caps for both haddock and river herring/shad to control impacts on bycatch, these alternatives are all expected to have slight positive to slight negative impacts on non-target species. Continued slight positive impacts on haddock are expected to reflect the current stock status, which is not overfished and not experiencing overfishing. Continued slight negative impacts on river herring/shad are expected to reflect the current stock status, which are essentially depleted according to the most recent stock assessments that were unable to define reference points due to lack of data.

6.3 Impacts on Protected Species

Protected species are those afforded protections under the Endangered Species Act (ESA; species listed as threatened or endangered under the ESA) and/or the Marine Mammal Protection Act (MMPA). Section 5.3.2 lists protected species that occur in the affected environment of the Atlantic herring FMP and have the potential to be impacted by the fishery, specifically via interactions with fishing gear predominantly used in the Atlantic herring fishery (i.e., midwater trawl and purse seine gear) and/or via removal of forage (i.e., Atlantic herring).

As provided in Section 5.3.1, ESA listed species and designated critical habitat are not expected to be impacted, via interactions with fishing gear, by the herring fishery. Specifically, NMFS determined that the Atlantic Herring FMP is extremely unlikely to interact with ESA listed species of marine mammals, sea turtles, or fish, and will not destroy or adversely modify designated critical habitat (NMFS 2010). However, as the forage base of ESA listed species of fin and sei whales includes small schooling fish, such as Atlantic herring, the operation of the Atlantic herring fishery has the potential to impact these species by affecting a component of their forage base. All ESA-listed species are in poor condition and therefore, any action that could adversely impact forage can negatively impact that species' recovery.

As provided in Section 5.3, MMPA (non-ESA listed) protected species of large whales (e.g., humpback and minke whales), species of small cetaceans, and pinnipeds have the potential to be impacted by the Atlantic herring fishery, via foraging and/or interactions with fishing gear predominantly used in the fishery (i.e., purse seine and mid-water trawls). To evaluate the impacts of gear interactions on MMPA (non-ESA listed) protected species of large whales (i.e., humpback whales), species of small cetaceans, and pinnipeds, it is important to note that the predominant gear types used in the herring fishery are purse seines and midwater trawls, and that most landings is by the midwater trawl fishery, but most activity in terms of trips and permits is to purse seine vessels (Section 5.5.1). As some MMPA protected species forage on Atlantic herring, the potential foraging impacts to these marine mammal species will also be evaluated.

In addition, evaluating the impacts of each alternative on MMPA protected species takes into account the species or stocks (resource) condition (Section 5.3, Table 5). Specifically, the evaluation of impacts takes into consideration whether the MMPA protected species is in good condition (i.e., marine mammal stocks whose PBR level have not been exceeded) or in poor condition (i.e., marine mammal stocks that have exceeded or are near exceeding their PBR level). For marine mammal stocks that have their PBR level reached or exceeded, some level of negative impacts would be expected from alternatives that result in the potential for interactions between fisheries and those stocks. For species that are at more sustainable levels (i.e., PBR levels have not been exceeded), alternatives not expected to change fishing behavior or effort may have some level of positive impacts by maintaining takes below the PBR level and approaching the zero-mortality rate goal (Table 5).

With respect to this action, there will not be major changes in the amount or areas that herring vessels fish from most of the alternatives under consideration. The alternatives under consideration that may impact herring fishing patterns directly are identified, and potential impacts are described. Discussions regarding potential interactions with protected species (i.e., non-ESA-listed marine mammal species) as well as impacts on prey availability are largely qualitative. The alternatives under consideration are evaluated below in terms of whether they are expected to greatly impact the availability of herring as prey, as well as whether they will impact fishing effort in time and space, such that, relative to current operating conditions, interaction risks to protected species identified in Section 5.3 are affected.

6.3.1 Action 1 – Rebuilding Plan

Action 1 would establish a rebuilding program for Atlantic herring. Under Alternative 1 (No Action), the Council would not recommend implementing a rebuilding plan. While future specifications for the fishery will be set outside a rebuilding plan, they will use the Council's existing ABC control rule, implemented via Amendment 8. This control rule adjusts the fishing mortality rate and thus the ACL depending on estimated herring biomass relative to MSY, with lower F at lower biomass values. Under Alternatives 2 and 3, a rebuilding plan would be established. The fishing mortality target for the Alternative 2 rebuilding plan would be consistent with the ABC control rule approved in Amendment 8. Because Alternatives 1 and 2 use the same ABC control rule, fishing mortality rates and the associated ACLs will be the same for Alternatives 1 and 2. ACLs and fishing effort should increase over time under these alternatives as the stock rebuilds. Under Alternative 3, the fishing mortality target for the rebuilding plan, $F_{rebuild}$, would be set at a constant value F=0.48, about 89% of F_{MSY}. While F will be held constant under Alternative 3, the resulting ABC and ACL is expected to increase over time as biomass increases.

As provided in Section 5.3, interactions between ESA-listed species and gear used in the Atlantic herring fishery have never been observed or documented. However, MMPA (non-ESA listed) protected species of marine mammals, specifically minke and humpback whales, as well as species of small cetaceans and pinnipeds, have the potential to interact with fishing gear used in the herring fishery. Interaction risks with protected species are strongly associated with the amount of gear in the water, gear soak or tow time, as well as the area of overlap, either in space or time, of the gear and a protected species (with risk of an interaction increasing with increases in of any or all these factors). None of the rebuilding plan alternatives are expected to result in elevated effort (e.g., longer tow times, more trawl gear placed in the water and towed); therefore, increased interaction risks with MMPA (non-ESA listed) protected species of marine mammals are not expected. Given this information, under Alternative 1 and Alternative 2, depending on resource condition (strategic versus non-strategic stocks; Table 5), impacts to MMPA (non-ESA listed) protected species of marine mammals are expected to be slight negative (strategic and non-strategic stocks).

Under Alternative 3, given that effort is expected to increase marginally in the first few years compared to Alternative 1 and 2, interaction risks have the potential to slightly increase compared to fishing levels projected under Alternative 1 and 2. Any potential increases in effort under Alternative 3 is not expected to affect gear type, quantity, soak or tow duration, or degree of overlap between gear and protected species compared to typical levels observed in this fishery. While marginal increases in effort under Alternative 3 compared to Alternatives 1 and 2 may provide some additional risk to MMPA (non-ESA listed) protected species, depending on resource condition (strategic versus non-strategic stocks; see Table 5), impacts to MMPA (non-ESA listed) protected species of marine mammals are still expected to be slight negative (strategic and non-strategic stocks). Regarding ESA-listed species, impacts, as it relates to interaction risks, are expected to be negligible. Relative to Alternatives 1 and 2, Alternative 3 is expected to result in slight negative impacts to protected species (ESA-listed and/or MMPA protected).

Regarding foraging, under all three alternatives above, herring will continue to be removed from the ecosystem at their present rate. Therefore, impacts to protected species (ESA-listed and/or MMPA protected) are expected to remain negligible (i.e., for those protected species of marine mammals that don’t forage on herring) to slight negative impacts (i.e., for protected species that do forage on herring, See Table 5). Under Alternative 3, a slight increase in fishery removals would potentially provide less herring in the ecosystem compared to more status quo levels under Alternatives 1 and 2. As a result, there may be somewhat less forage available for protected species of marine mammals (ESA-listed and/or MMPA protected) that prey on herring (Section 5.3). Given this, the foraging impacts to ESA-listed and/or MMPA protected species from Alternative 3, relative to Alternative 1 and 2,are expected to be negligible (i.e., for protected species that don’t forage on herring) to slight negative (i.e., for protected species that do forage on herring).

6.3.2 Action 2 – Adjust Herring Accountability Measures (AMs)

Action 2 could adjust the AMs used in the herring fishery. All alternatives would maintain the current pro-active AMs. Alternative 1 (No Action) would also maintain the current reactive AM, which requires a pound for pound reduction in future ACLs if there are overages in any of the four herring management areas. Alternatives 2 and 3 change when pound for pound payback would be required. Under Alternative 2, if a sub-ACL is exceeded by less than 10%, and the overall ACL is not exceeded, then the overage is not deducted from future allocations. Under Alternative 3, if the sub-ACL is exceeded by any amount, but the overall ACL is not exceeded, then the overage is not deducted from future allocations. Under other conditions, overages are deducted.

In general, reactive AMs do not have a large effect on the amount of effort in the fishery over time. The in-season measures serve to reduce fishing effort as the catch limits are approached, such that quota overages are generally small relative to overall effort. In addition, the nature of reactive AMs means that harvest occurs in one year, but then effort is reduced in subsequent years, meaning that while effort may be temporally redistributed, the amount of fishing activity will be similar, whether AMs were implemented or not. Alternatives 2 and 3, which include some scenarios where payback is not required, could lead to a slight net increase in effort relative to Alternative 1.

Overall, despite possible spatial variations in fishing effort (one area being fished above target levels) if sub-ACLs are exceeded (under Alternative 2 or 3), changes in total fishing effort are not expected to greatly differ from current operating conditions in the fishery. Interaction risks with protected species are strongly associated with the amount of gear in the water, gear soak or tow time, as well as the area of overlap, either in space or time, of the gear and a protected species (with risk of an interaction increasing with increases in of any or all these factors). Since none of the alternatives allow fishing to exceed above the total ACL, increased interaction risks with protected species are not expected. While effort may be higher than target levels in a particular area under Alternative 2 and 3, effort will also be lower in a different area unless the fishery reaches the total ACL and closes for the remainder of the year. NMFS will still monitor catch in-season, and if an area approaches a sub-ACL reduced possession limits will still be implemented reducing fishing effort. These overage measures are primarily designed to address overages as the fishery approaches a sub-ACL before an area is closed. The in-season trigger of reduced possession limits will still control effort limits in the fishery.

Given this information, and the information provided in Section 5.3 and Table 5, as it relates to interactions, the impacts of all three alternatives in this section are expected to result in slight negative impacts to MMPA (non-ESA listed) protected species of marine mammals, and negligible impacts to ESA listed species.

In terms of foraging impacts, none of the alternatives have the potential to result in herring catch to exceed the total ACL. Therefore, none of the alternatives will result in the fishery removing herring at levels that go above and beyond current conditions, large changes in the forage availability for those protected species of marine mammals that prey upon Atlantic herring is not expected. Based on this, the impacts of Alternative 1, 2, or 3 on protected species (ESA-listed and MMPA protected), in terms of forage, are expected to be as those provided in Section 5.3 (i.e., ESA listed and/or MMPA protected species: negligible (i.e., for protected species that don't forage on herring) to slight negative (i.e., for protected species that do forage on herring). However, as Alternative 2 would limit overages at 10% of a sub-ACL compared to no limit under Alternative 3, there may be slightly more herring left in a particular herring management area under Alternative 2 compared to Alternative 3. But the total removal fishery wide would still be limited to the total ACL under all three alternatives, and herring management areas are still closed in-season when the fishery is estimated to catch a set percentage of the sub-ACL for that area. Given this, Alternative 1 or 2 may afford negligible (i.e., for protected species that do forage on herring) to slightly more positive impacts (i.e., for protected species that do forage on herring) compared to Alternative 3 if sub-ACLs help limit herring removals within a herring management area where ESA-listed and/or MMPA species forage on herring.

6.4 Impacts on Physical Environment and Essential Fish Habitat

Since 1996, the MSA has included a requirement to evaluate the potential adverse effects of fisheries, including the Atlantic herring fishery, on the essential fish habitat (EFH) of Atlantic herring and other species. A general description of the physical environment and EFH is in the Affected Environment (Section 6.4). The EFH regulations specify that measures to minimize impacts should be enacted when adverse effects that are "more than minimal" and "not temporary in nature" are anticipated.

The magnitude of adverse effects resulting from fishing operations is generally related to (1) the location of fishing effort, because habitat vulnerability is spatially heterogeneous, and (2) the amount of fishing effort, specifically the amount of seabed area swept or bottom time. To the extent that adoption of a management alternative would shift fishing to more vulnerable habitats, and/or increase seabed area swept, adoption would be expected to cause an increase in habitat impacts as compared to no action. If adoption of an alternative is expected to reduce seabed area swept or cause fishing effort to shift away from more vulnerable into less vulnerable habitats, a decrease in habitat impacts would be expected. The magnitude of an increase or decrease in adverse effects relates to the proportion of total fishing effort affected by an alternative.

Bearing in mind that both the direction and magnitude of changes are difficult to predict, because changes in fishing behavior in response to management actions can be difficult to predict, potential shifts in adverse effects are described for each alternative under consideration. However, changes in the magnitude of fishing effort resulting from individual measures should be viewed in the context of the overall impacts that the herring fishery is estimated to have on seabed habitats. Specifically, previous analyses (described below) have concluded that adverse effect to EFH that result from operation of the herring fishery do not exceed the more than minimal or temporary thresholds.

An assessment of the potential effects of the directed Atlantic herring commercial fishery on EFH for Atlantic herring and other federally managed species in the Northeastern U.S. was conducted as part of an EIS that evaluated impacts of the Atlantic herring fishery on EFH (NMFS 2005). This analysis was included in Appendix VI, Volume II of the FEIS for Amendment 1 to the Atlantic Herring FMP. It found that midwater trawls and purse seines do occasionally contact the seafloor and may adversely impact benthic habitats used by federally managed species, including EFH for Atlantic herring eggs. However, after reviewing all the available information, the conclusion was reached that if the quality of EFH is reduced due to this contact, the impacts are minimal and/or temporary and, pursuant to MSA, do not need to be minimized, i.e., that there was no need to take specific action at that time to minimize the adverse effects of the herring fishery on benthic EFH. This conclusion also applied to pelagic EFH for Atlantic herring larvae, juveniles, and adults, and to pelagic EFH for any other federally managed species in the region.

Atlantic herring vessels primarily use purse seines, single midwater trawls or midwater pair trawls, and bottom trawls to direct on herring, with the MWT fleet harvesting most landings since 2008. Bottom trawls are the only gear in this fishery that has adverse impacts on EFH, and those vessels only represented about 4% of total herring landings between 2017 and 2019 and are primarily concentrated in SNE/Area 2 (Table 27 in Framework 8). There are also smaller scale operations that land herring with bottom trawls under a Category C permit, mostly in the GOM.

6.4.1 Methods

As noted above, fishery effects on EFH are related to the amount and location of fishing activity and the gear types employed. In general herring fishery impacts on EFH are estimated to be minimal. A qualitative approach is used to estimate the potential impacts on the physical environment and EFH across the range of alternatives considered in this action. In general, if more fishing time is expected, there could be potential negative impacts on physical habitats relative to other alternatives considered.

6.4.2 Action 1 – Rebuilding Plan

This action would establish a rebuilding program for Atlantic herring. Under Alternative 1 (No Action), the Council would not recommend implementing a rebuilding plan. While future specifications for the fishery will be set outside a rebuilding plan, they will use the Council’s existing ABC control rule, implemented via Amendment 8. This control rule adjusts the fishing mortality rate and thus the ACL depending on estimated herring biomass relative to MSY, with lower F at lower biomass values. Under Alternatives 2 and 3, a rebuilding plan would be established. The fishing mortality target for the Alternative 2 rebuilding plan would be consistent with the ABC control rule approved in Amendment 8. Because Alternatives 1 and 2 use the same ABC control rule, fishing mortality rates and the associated

ACLs will be the same for Alternatives 1 and 2. ACLs and fishing effort should increase over time under these alternatives as the stock rebuilds. Under Alternative 3, the fishing mortality target for the rebuilding plan, $F_{rebuild}$, would be set at a constant value F=0.48, about 89% of F_{MSY}. While F will be held constant under Alternative 3, the resulting ABC and ACL is expected to increase over time as biomass increases.

It is important to note that rebuilding trajectories are often uncertain, and depend on factors beyond fishing mortality, including recruitment rates, which are discussed in detail in the target species impacts section. Thus, even though the rebuilding plans specify fishing mortality rates, it is difficult to predict how biomass, annual catch limits, and thus fishing activity will change over time for each alternative. For estimating habitat impacts, it is assumed that differences in ACLs will translate to differences in fishing effort. In this fishery, ACLs and effort are likely to track closely, given that quota utilization is high, especially under lower biomass values.

The expected trajectories of F, biomass, and catch limits is different under Alternative 3 as compared to Alternatives 1 and 2, with higher catches and effort in the short term under Alternative 3. However total ABC across the entire ten-year rebuilding period is very similar, whether the A8 control rule or a constant $F_{rebuild}$ approach is selected. Therefore, habitat impacts are expected to be negligible and similar across the three alternatives considering the entire rebuilding period in aggregate. While similar aggregate impacts are expected to be similar across alternatives, lower catch limits and fishing effort in a given year will be associated with lower habitat impacts.

Overall, despite possible variations in fishing effort between these options, given the minimal and temporary nature of adverse effects on EFH in the Atlantic herring fishery, these alternatives are expected to have negligible impacts relative to one another and negligible impacts on the physical environment and EFH.

6.4.3 Action 2 – Adjust Herring Accountability Measures (AMs)

These alternatives could adjust the AMs used in the herring fishery. All alternatives would maintain the current pro-active AMs. Alternative 1 (No Action) would also maintain the current reactive AM, which requires a pound for pound reduction in future ACLs if there are overages in any of the four herring management areas. Alternatives 2 and 3 change when pound for pound payback would be required. Under Alternative 2, if a sub-ACL is exceeded by less than 10%, and the overall ACL is not exceeded, then the overage is not deducted from future allocations. Under Alternative 3, if the sub-ACL is exceeded by any amount, but the overall ACL is not exceeded, then the overage is not deducted from future allocations. Under other conditions, overages are deducted.

In general, reactive AMs do not have a large effect on the amount of effort in the fishery over time. The in-season measures serve to reduce fishing effort as the catch limits are approached, such that quota overages are generally small relative to overall effort. In addition, the nature of reactive AMs means that harvest occurs in one year, but then effort is reduced in subsequent years, meaning that while effort may be temporally redistributed, the amount of fishing activity will be similar, whether AMs were implemented or not. Alternatives 2 and 3, which include some scenarios where payback is not required, could lead to a slight net increase in effort relative to Alternative 1.

Overall, despite possible variations in fishing effort between these options, given the minimal and temporary nature of adverse effects on EFH in the Atlantic herring fishery, these alternatives are expected to have negligible impacts relative to one another and negligible impacts on the physical environment and EFH.

6.5 IMPACTS ON HUMAN COMMUNITIES

The analysis of impacts on human communities characterizes the magnitude and extent of the economic and social impacts likely to result from the alternatives considered, individually and in relation to each other. Management regulations influence the direction and magnitude of economic and social change, but attribution is difficult, because communities are constantly evolving in response to many external factors (e.g., market conditions, technology, alternate uses of waterfront) that contribute to community vulnerability and adaptability to changing regulations. For this analysis, the comparison of alternatives is usually progressive (e.g., the analysis of Alternative 1 includes no comparisons, Alternative 2 is compared to Alternative 1, and finally Alternative 3 is compared to Alternatives 1 and 2).

Economic impacts. The economic effects of regulations can be categorized by changes in costs (including transactions costs such as search, information, bargaining, and enforcement costs) or revenues (by changing market prices or by changing the quantities supplied). These economic effects may be felt by the directly regulated entities as well as related industries. For the herring fishery, this would include participants in the mackerel and lobster fisheries.

Social impacts. The social effects of regulations relate to changes factors such as demographics, employment fishery dependence, safety, attitudes towards management, equity, cultural values, and the well-being of persons, families, and fishing communities (e.g., Burdge 1998; NMFS 2007).

It is important to consider impacts on the following: the fishing fleet (vessels grouped by fishery, primary gear type, and/or size); vessel owners and employees (captains and crew); dealers and processors; consumers; community cooperatives; fishing industry associations; cultural components of the community; and fishing families. While some management measures may have a short-term negative impact on some communities, this should be weighed against potential long-term benefits to all communities which can be derived from a sustainable fishery. Amendment 8 further describes approaches to the analysis of impacts on human communities.

6.5.1 Action 1 – Rebuilding Plan

General impacts of an Atlantic herring rebuilding plan on human communities

Human communities would be impacted by an Atlantic herring rebuilding plan as it sets harvest levels for the fishery. A rebuilding plan is likely to have long-term economic and social benefits to the herring fishery by helping to prevent overfishing and optimize yield on a continuous basis. In the long term, ensuring continued, sustainable harvest of fishery resources benefits all fisheries and their communities. However, if catch limits need to be lowered to achieve rebuilding, increasing the ABC (and associated catch limits) would likely have positive short-term impacts on fishing communities. Likewise, lowering allowable harvests could result in short-term revenue reductions, which may, in turn, have negative impacts on employment and the size of the herring fishery within fishing communities. Additionally, declines in fishing earnings may decrease job satisfaction among fishermen (e.g., Pollnac & Poggie 2008; Pollnac et al. 2015), which may reduce the well-being of fishermen, their families, and their communities (e.g., Pollnac, et al. 2015; Smith & Clay 2010).

The impacts on predator fisheries and ecotourism of having an Atlantic herring rebuilding plan would likely be indirect and moderate positive in the long term. Predator fisheries and ecotourism fare better under positive Atlantic herring resource conditions, and slight to moderate positive impacts on Atlantic herring are expected under the action alternatives, with Alternative 2 more positive than Alternative 3 (Section 6.1.2). It is difficult to monetize the benefits for the predator fisheries and ecotourism stakeholders of a rebuilding plan.

The specific communities that may be impacted by this action are identified in Section 5.5.3. This includes eight primary (e.g., Gloucester, Portland, New Bedford, Rockland) and 16 secondary ports in the Atlantic herring fishery. The communities more involved in the Atlantic herring fishery are likely to experience more direct impacts of this action, though indirect impacts may be experienced across all the identified communities. As this action largely affects stock-wide harvest levels, impacts would likely occur across the communities that participate in the Atlantic herring and other potentially affected fisheries, proportional to their degree of participation in the fisheries.

Economic analysis specific to the alternatives

The rebuilding plans are projected to produce flow of gross revenues in each year out to ten years in the future. The timing of these is benefits likely to vary across the different rebuilding plans. Because a benefit that occurs sooner is more valuable than a benefit far in the future, it is necessary to discount projected revenues. The Office of Management and Budget mandates that, in such cases, the analysis must discount revenues by 7% and 3% (OMB Circular A-4).Thus, the general approach used in this analysis is to describe the discounted projected revenues under the different rebuilding alternatives and recruitment assumptions. To do this:

1. Landings are assumed to be equal to the projected ABCs described in Section 6.1.[8]
2. Predict prices corresponding to that level of landings using the results of a simple price model.
3. Multiply price by landings to construct revenue.
4. Discount by 7% or 3% per year as mandated by OMB Circular A-4.
5. Sum up the discounted yearly revenue.

Prices

Annual herring landings and price data from 2003-2020 were used to estimate a relationship between prices and landings. Prices are normalized to 2019 real US dollars using the GDP implicit price deflator. Prices per metric ton and landings are expressed in thousands of metric tons. The first column of Table 10 contains the model of prices that is used to predict future prices.[9] Based on the econometric model of prices, predicted prices and revenues are calculated according to:

$$\text{Predicted Price} = 815 - 5.893 * \text{landings} \tag{1}$$

$$\text{Predicted Revenue} = (815 - 5.893 * \text{landings}) * \text{landings} \tag{2}$$

The landings coefficient implies that, on average, an increase in landings of 1,000 mt will reduce prices by $5.89 per metric ton. The predicted revenue is quadratic relative to landings (Figure 10). According to this model of prices, the maximum revenue is about $28M, which occurs at landings of about 69,000 mt. Increasing landings beyond this point will decrease gross revenues.

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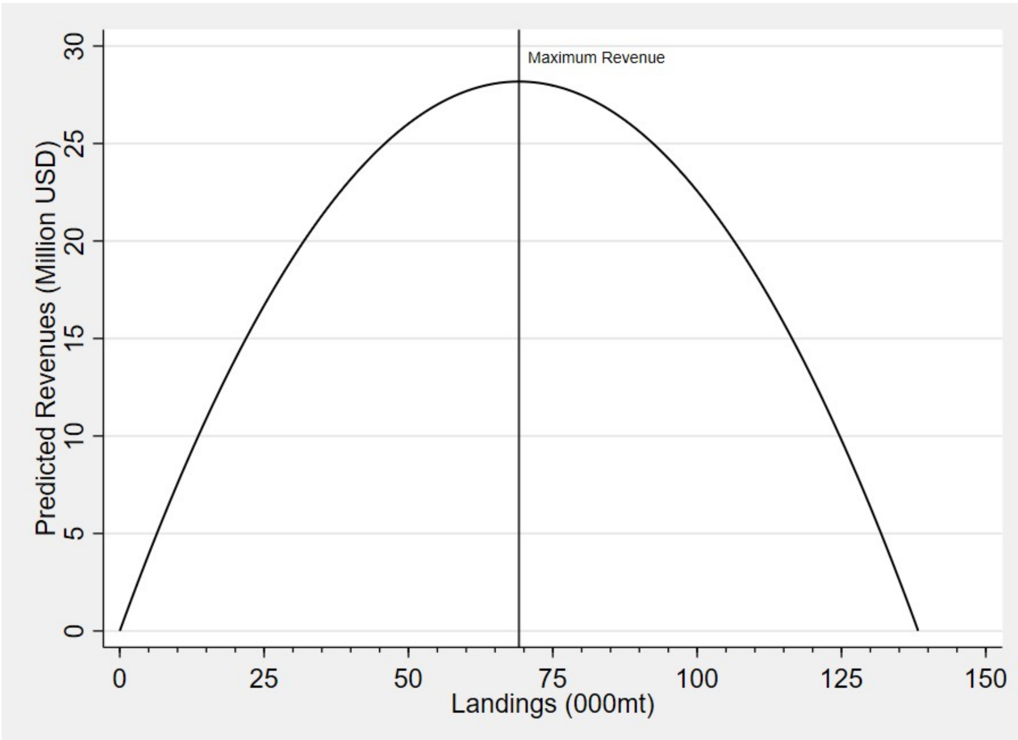
[8] Due to the uncertainty buffer, the actual annual catch limit is always less than the ABC. Therefore, the analysis produces revenues that are likely higher than actual.

[9] A least-squares regression will produce biased estimates if prices and quantities are simultaneously determined. An Instrumental Variables (IV) estimator, where the previous year's landings is used as an instrument can overcome this problem. A pair of log-transformed models are also estimated. The first column is the preferred specification and used for predictions. The other three columns are presented as robustness checks. The log-landings coefficient from the IV model is an elasticity and implies that an increase in landings of 1% will reduce prices by 0.44%.

Figure 33. Relationship between landings and predicted revenue.



The methods used to model prices are slightly different that those used in Deroba et al (2019), in which an autoregressive distributed lag model was used. The authors found that an increase in landings of 1,000 mt will reduce prices by $1.19 per metric ton. Alternatively, an increase in landings of 1% will reduce prices by 0.395%. Note that the elasticity[10] estimates in Deroba et al (2019) are comparable to elasticities in Table 31.

In Amendment 8, an elasticity of -0.50 was assumed. By coincidence, this assumption turned out to be fairly close to both the estimates in Deroba et al (2019) and the elasticities in this analysis (columns 3 and 4 of Table 31).

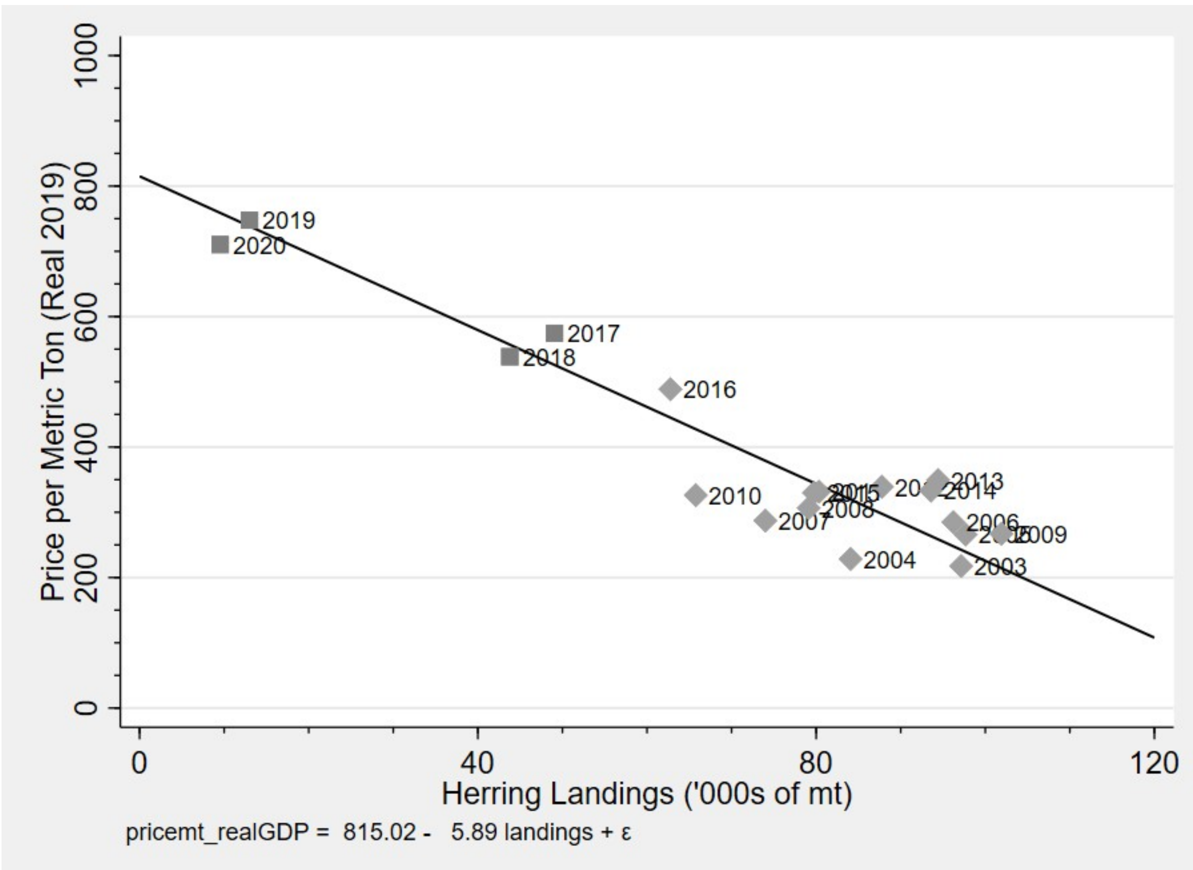
Table 31. Regression results of IV model (shaded) and sensitivity analyses

	IV	Sensitivity Analyses		
		OLS	Log-Log IV	Log-Log
Landings (000 mt)	-5.893*** (0.628)	-5.356*** (0.500)		
Log landings			-0.442*** (0.0706)	-0.465*** (0.0695)
Constant	815.0*** (46.92)	774.6*** (38.79)	7.734*** (0.294)	7.813*** (0.292)
Observations	17	18	17	18
R^2	0.861	0.878	0.751	0.737
Notes: Standard errors in parentheses. * p < 0.05, ** p < 0.001, *** p < 0.001				

[10] Elasticity here is how price changes in response to changes in landings.

Figure 34 is a scatterplot of real herring prices and landings from 2003-2020, in 1000s of metric tons. A line representing equation 1, which is derived from the first columns of Table 31, is added. Data available after the Amendment 8 analysis are marked with triangles.

Figure 34. Annual herring prices and landings



Results Overview

Table 32 and Table 33 give the discounted gross revenue for Alternative 2 (ABC Control Rule) and Alternative 3 (Constant F). Under baseline recruitment and discounting (upper left cell of both tables), discounted gross revenues are about $16M less for Alternative 2 relative to Alternative 3. Changing the discount rate to 7% reduces the difference to approximately $13M (bottom left cells).

Under autocorrelated recruitment, discounted gross revenues are about $5M less under Alternative 2 relative to Alternative 3. Changing the discount rate to 7%, the difference between the two is still about $5M.

The ABC CR AR in AVG sensitivity analysis uses the same ABCs as derived from the ABC CR AR, so revenues in columns 2 and 3 of Table 32 are the same. The ABC CR AVG in AR sensitivity analysis uses the same ABCs as derived from the ABC CR, so revenues in columns 1 and 4 of Table 32 are the same. The same is true for Table 33.

Table 32. Projected discounted revenues ($M USD) over 2021-2032 using 3% and 7% discount rates for Alternative 2 ABC control rule (shaded) and sensitivity analyses

Discounted Revenue	ABC CR	Sensitivity Analyses		
		ABC CR AR	ABC CR AR in AVG	ABC CR AVG in AR
3%	$213.68	$207.87	$212.61	$213.68
7%	$170.26	$163.93	$169.32	$170.26

Table 33. Projected discounted revenues ($M USD) over 2021-2032 using 3% and 7% discount rates for Alternative 3 Constant F (shaded) and sensitivity analyses

Discounted Revenue	Constant F	Sensitivity Analyses		
		Constant F AR	Constant F AR in AVG	Constant F AVG in AR
3%	$228.06	$212.61	$212.61	$223.89
7%	$183.49	$169.32	$169.32	$180.57

6.5.1.1 Rebuilding Plan Alternative 1 (No Action)

Under Alternative 1, the Council would not recommend implementing a rebuilding plan for Atlantic herring.

The impacts of Alternative 1 on human communities would likely be indirect and slight negative. The Council would likely continue to use the ABC control rule set through Amendment 8, but there would be no formal rebuilding plan in place. If fishery specifications do not support rebuilding, there could be continued negative impacts on the herring resource and the industry could not benefit from a rebuilt stock. Since a rebuilding plan is a MSA requirement, due to the overfished status of herring, Alternative 1 may result in distrust in the management process if stakeholders feel that managers are not meeting rebuilding requirements.

A realistic projection of ABCs under Alterative 1 is difficult; it would require projecting how fisheries managers would set ABC without a rebuilding plan. As described in Section 4.1.1, This analysis assumes that the Council would continue to use the ABC control rule to set fishery specifications two years at a time, producing the same set of ABCs as Alternative 2.

Alternative 1 is likely to result in discounted gross revenues of $213.68 M over 2021-2032 (Table 32). Sensitivity analysis regarding the type of recruitment in Figure 35 shows the time series trajectory of (non-discounted) revenues corresponding to the ABC CR. This provides some insight into the yearly projected fishing revenues. The first year in which the Rebuilding F starts (2022) is marked with a vertical dashed line. In all four plots, revenue decreases towards the end of the rebuilding period. This occurs because the ABCs are above the 69,000 mt critical point described in Section 6.5.1. Table 34 summarizes average revenue, by year, for Alternatives 1 and 2 along with the sensitivity analysis.

Alternative 1 would continue the period of substantially reduced catch limits implemented in 2019. The social and economic impacts on herring fishery-related businesses and communities would likely continue to be negative, as the period of reduced revenue would continue. With no change in the ABC from what was already implemented, there would be a degree of constancy and predictability for fishing industry operations and a steady supply to the market. It is possible that the size and demographic characteristics of the fishery-related workforce would remain unchanged, as would the dependence on and participation in the fishery – relative to the conditions currently expected.

Figure 35. Projected revenue at mean ABCs for the four ABC Control Rule scenarios

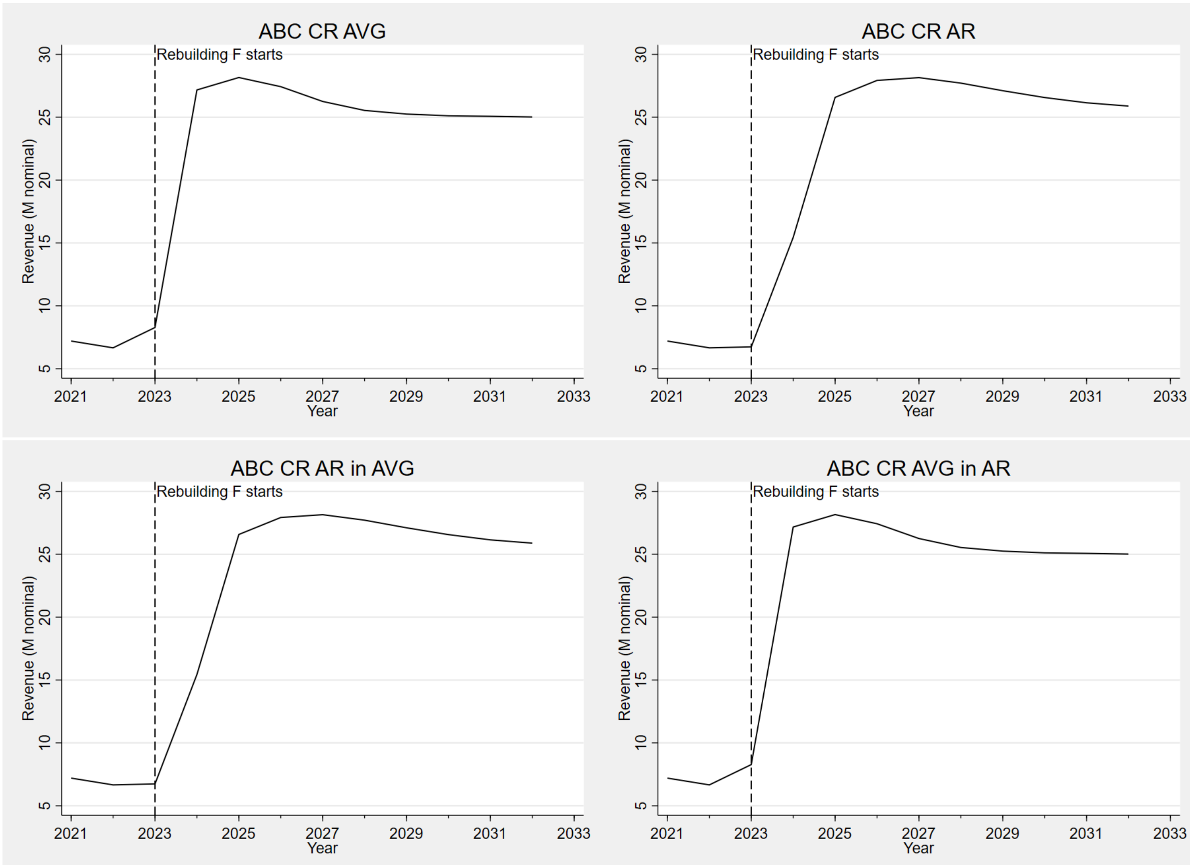


Table 34. Projected annual revenue ($M USD) for Alternatives 1 and 2 under different assumptions

	ABC CR AVG	ABC CR AR	ABC CR AR in AVG	ABC CR AVG in AR
2021	7.20	7.20	7.20	7.20
2022	6.66	6.66	6.66	6.66
2023	8.28	6.74	6.74	8.28
2024	27.17	15.44	15.44	27.17
2025	28.16	26.58	26.58	28.16
2026	27.43	27.93	27.93	27.43
2027	26.25	28.15	28.15	26.25
2028	25.54	27.71	27.71	25.54
2029	25.25	27.11	27.11	25.25
2030	25.12	26.56	26.56	25.12
2031	25.08	26.15	26.15	25.08
2032	25.02	25.89	25.89	25.02

6.5.1.2 Rebuilding Plan Alternative 2 (ABC control rule)

Under Alternative 2, a rebuilding plan would be established. The fishing mortality target for the rebuilding plan would be consistent with the ABC control rule approved in Amendment 8.

The impacts of Alternative 2 on human communities would likely be indirect and slight negative but slight positive relative to Alternative 1. The Council would continue to use the ABC control rule set through Amendment 8, and it would become the formal rebuilding plan.

However, having a formal rebuilding plan in place is required by MSA when a stock is declared overfished, and it should provide slight positive benefits to the resource by providing a mechanism for the Secretary to ensure that adequate progress toward ending overfishing and rebuilding affected fish stocks is being made. Alternative 2 may result in more trust in the management process if stakeholders feel that managers are meeting rebuilding requirements. Having a rebuilding plan may better ensure that fishery specifications support rebuilding; there could be more positive impacts on the herring resource, and the industry could benefit from a rebuilt stock.

As with Alternative 1, Alternative 2 is likely to result in discounted gross revenues of about $213.68 M over 2021-2032 (Table 33). In all four plots, revenue decreases towards the end of the rebuilding period. This occurs because the ABC are above the 69,000 mt critical point described in Section 6.5.1.1. Table 34 summarizes average revenue, by year, for Alternatives 1 and 2 along with the sensitivity analysis.

Alternative 2 would continue the period of substantially reduced catch limits implemented in 2019. The social and economic impacts on herring fishery-related businesses and communities would likely continue to be negative, as the period of reduced revenue would continue. However, the probability of a fishery closure is low ($P_{closure}$ = 0.000 after 2023, Table 26). With no change in the ABC from what was already implemented, there would be a degree of constancy and predictability for fishing industry operations and a steady supply to the market. It is possible that the size and demographic characteristics of the fishery-related workforce would remain unchanged, as would the dependence on and participation in the fishery – relative to the conditions currently expected.

6.5.1.3 Rebuilding Plan Alternative 3 (7-year constant)

Under Alternative 3, a rebuilding plan would be established. The fishing mortality target of the rebuilding plan would be constant, $F_{rebuild}$ would be set at F=0.48, about 89% of F_{MSY}.

The impacts of Alternative 3 on human communities would likely be indirect and slight negative but slight positive relative to Alternatives 1 and 2. Having a formal rebuilding plan in place is required by MSA when a stock is declared overfished. Alternative 3 may result in more trust in the management process relative to No Action if stakeholders feel that managers are meeting rebuilding requirements. Having a rebuilding plan may better ensure that fishery specifications support rebuilding; there could be more positive impacts on the herring resource, and the industry could benefit from a rebuilt stock. As the $F_{rebuild}$ under Alternative 3 is higher than under the ABC CR in place (under Alternatives 1 and 2), there may be more positive impacts to the herring fishery as catch limits would be set higher, at least in the near term. However, the overfishing probability is slightly higher under Alternative 3, and it could take longer to rebuild relative to applying the ABC control rule (Figure 26), so any long-term gains to the fishery of this approach may be tempered if rebuilding is hindered.

Alternative 3 is likely to result in discounted gross revenues of about $228M over 2020-2032; this is $15M higher than under Alternatives 1 and 2. The timing of revenues under Alternative 3 is different than Alternatives 1 and 2; ABC, and therefore revenues, are higher earlier in the rebuilding plan. In particular, gross revenues in 2023 are projected to be $23M, which is about $15M higher than gross revenues under Alternatives 1 and 2 in the same year.

Figure 36 shows the time series trajectory of (non-discounted) revenues corresponding to the 7-year constant F rebuilding plan. This provides some insight into the yearly projected fishing revenues and uncertainty about those projections. The first year the rebuilding plan (2022) is marked with a vertical dashed line. In all four plots, revenue decreases towards the end of the rebuilding period. This occurs because the ABC are above the 69,000 mt critical point described in Section 6.5.1.1. Table 35 summarizes average revenue, by year, for Alternative 3 along with the sensitivity analysis.

As with Alternative 2, Alternative 3 would continue the period of substantially reduced catch limits implemented in 2019 (though slightly higher than under Alternative 2). The social and economic impacts on herring fishery-related businesses and communities would likely continue to be negative, as the period of reduced revenue would continue. The probability of a fishery closure is low, slightly higher than under Alternative 2 in the early years of rebuilding, but $P_{closure}$ is 0.000 after 2023 (Table 28) like Alternative 2. With little change in the ABC from what may be implemented under No Action or Alternative 2, there would be a degree of constancy and predictability for fishing industry operations and a steady supply to the market. It is possible that the size and demographic characteristics of the fishery-related workforce would remain unchanged, as would the dependence on and participation in the fishery – relative to the conditions currently expected.

Figure 36. Projected revenue at mean ABCs for the constant catch scenarios

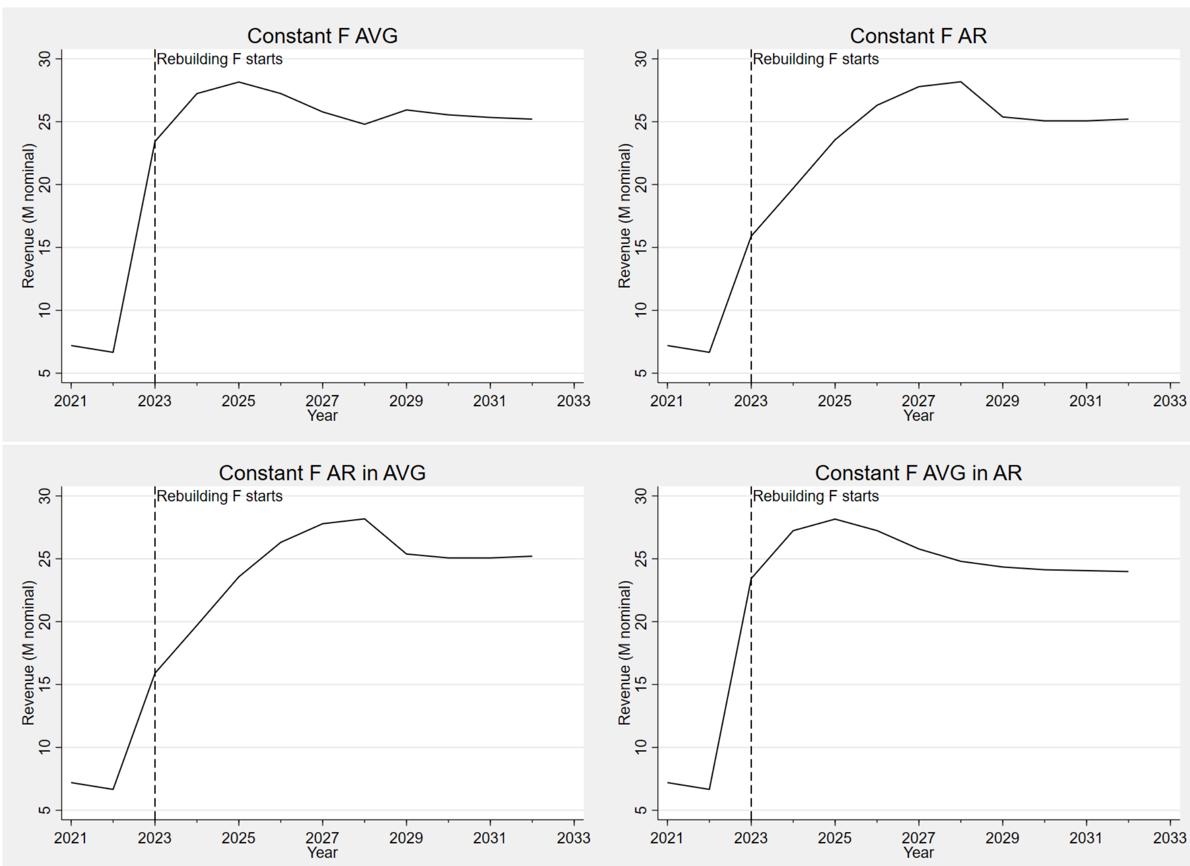


Table 35. Projected annual revenue ($M USD) for Alternative 3 under different assumptions

	Constant F AVG	Constant F AR	Constant F AR in AVG	Constant F AVG in AR
2021	7.20	7.20	7.20	7.20
2022	6.66	6.66	6.66	6.66
2023	23.43	15.90	15.90	23.43
2024	27.24	19.71	19.71	27.24
2025	28.16	23.56	23.56	28.16
2026	27.24	26.31	26.31	27.24
2027	25.78	27.79	27.79	25.78
2028	24.80	28.18	28.18	24.80
2029	25.94	25.38	25.38	24.35
2030	25.55	25.07	25.07	24.13
2031	25.34	25.07	25.07	24.06
2032	25.20	25.21	25.21	23.98

6.5.2 Action 2 – Adjust Herring Accountability Measures (AMs)

Since 2009, there have been 11 overages of a sub-ACL, although only three have occurred in the last five years (Table 36). Improvements to the quota monitoring system over time are making overages less likely. In these years, the total ACL was never exceeded. Current low sub-ACLs for all areas (relative to the fleet's daily ability to catch herring) make in-season quota management that is designed to achieve, but not exceed a sub-ACL, logistically difficult and more difficult to predict which, if any, sub-ACLs might be exceeded.

Table 36. Sub-ACL overages since 2009

Year	Area	sub-ACL (mt)	Catch (mt)	Overage (%)
2009	1A	43,650	44,088	1%
2010	1A	26,546	28,424	7%
	1B	4,362	6,001	38%
2011	1A	29,251	30,676	5%
2012	1B	2,723	4,307	58%
	2	22,146	22,482	2%
	3	38,146	39,471	3%
2014	1B	2,878	4,399	53%
2016	1B	2,844	3,657	29%
2019	2	4,061	4,758	17%
2020	1A	4,244	4,353	3%
	1B	483	831	72%

The general approach to examining the economic impacts of these alternatives is to compute the change in revenues that would have been caused by the overage deductions over the last five years. In 2020, herring prices were about $710/mt (real 2019 USD); this is used to compute revenue. For the three overages that occurred from 2016-2020, the total overages were 1,858 mt.

Under the *status quo*, the 1,858 mt of overages are deducted from a future catch limit. Therefore, the overages reduce fishery revenue by $1.3M. Because overages do not occur every year, annual foregone revenues of about $264,000 per year are expected. This is the baseline against which the alternatives are measured against. Note that future losses described in the alternatives would be somewhat offset by any gain in the year of an overages, a value that is assumed to be equivalent across the alternatives, so not quantified further here.

6.5.2.1 Overage AM Alternative 1 (No Action)

Under No Action, there would be no changes to the proactive (in-season) or reactive AMs in place to minimize overages of Atlantic herring catch limits. These include in-season reduced possession limits (e.g., when a sub-ACL reaches 90%, possession reduced to 40,000 lb, 2,000 lb at 98%, closed at 100%) that limit the directed herring fishery as well as reactive pound for pound AMs to address any overages. This action is not considering modifications to the in-season proactive AMs; therefore, the focus of these analyses is on the reactive, pound for pound payback AM to address overages.

In the short term, the impacts of the No Action reactive AM would likely be negligible to slight negative. The expected annual foregone revenues are $264,000 per year. The reactive AMs (for sub-ACL or ACL overages) are enforced in the year after the final catch is tallied, typically resulting in a one-year delay of consequences, given the timing of the fishery. Participants in the fishery during a year in which a sub-ACL/the ACLs is exceeded will benefit from those higher levels of catch. When the AM is implemented in a future year, active participants will experience a reduction in potential herring landings and therefore may suffer negative impacts. However, impacts would be nullified over the three-year process for vessels fishing in all years. The delay could cause an economic consequence for any fishery participants who are new or were not fishing during the year of the overage, resulting in slight negative impacts on the attitudes and beliefs among these participants if management is perceived to be unfair. However, due to the limited access nature of the fishery, the number of potential new participants is small. Because Alternative 1 would reduce a future ACL even if the ACL was not exceeded, the fishery is prevented from achieving optimum yield on a continual basis, resulting in negative impacts to the fishery.

In the long term, impacts would be slight positive. The AMs are designed to keep harvests within catch limits, which will help secure the long-term sustainability of the resources and the fishery and other user groups that depend on herring. Ensuring continued, sustainable harvest of fishery resources benefits all fisheries and their communities.

6.5.2.2 Overage AM Alternative 2

Under Alternative 2, catch from a management area that exceeds its sub-ACL by less than or equal to 10% would not be deducted from the ACL and respective sub-ACL in a subsequent year unless total catch also exceeds the total ACL.

The social and economic impacts of Alternative 2 on herring fishery-related businesses and communities would likely be slight positive and more positive than No Action. If Alternative 2 had been in place over 2016-2020, the three overages would have resulted in reduction of 1,120 mt to future catch limits. This would have reduced fishery revenue by $0.8M or $160,000 per year. Therefore, under Alternative 2, the foregone revenue is $160,000 per year. Relative to the *status quo*, about $104,000 in additional revenue per year to accrue to the fishery under Alternative 2 relative to Alternative 1.

The short-term impacts of Alternative 2 would likely be slight positive and more positive than No Action. The fishery could exceed a sub-ACL in a herring management area (by <10%) without having a reduction in potential herring landings in a future year (unless the ACL was exceeded). This flexibility could be particularly used in Area 1B where sub-ACLs are often quite small relative to the capacity of vessels to catch herring. Positive impacts that are likely to accrue to those users of areas that have gone over the ACLs. If a sub-ACL overage is <10%, there would not be economic consequences for any fishery participants who are new or were not fishing during the year of the overage, so management could be perceived to be fairer relative to No Action. Because Alternative 2 would not automatically reduce a future ACL unless the ACL was exceeded, optimum yield would more likely be achieved on a continual basis relative to No Action, resulting in more positive impacts to the fishery. Catch monitoring and in-season closures to the directed fishery would still be in place (e.g., possession limit reductions when a sub-ACL is neared, closure at 100%); this should limit the magnitude of any sub-ACL overages. In the long term, impacts would likely be slight positive but slightly less positive than No Action. The AMs are designed to keep harvests within overall catch limits, which will help secure the long-term sustainability of the resources and the fishery and other user groups that depend on herring. This alternative could allow one sub-area to be fished harder than the target catch limit for that sub-component; however, the potential for causing negative harm to any sub-component of the herring resource is small since overages are limited to 10%. Ensuring continued, sustainable harvest of fishery resources benefits all fisheries and their communities.

6.5.2.3 Overage AM Alternative 3

Under Alternative 3, catch from a management area that exceeds its sub-ACL would be deducted from the ACL and respective sub-ACL in a subsequent year, only if total catch also exceeded the total ACL. Catch can exceed a sub-ACL by any amount so long as the total ACL is not exceeded.

The social and economic impacts of Alternative 3 on herring-related fisheries and communities would likely be slight positive and more positive than No Action and Alternative 2.

If Alternative 3 had been in place over 2016-2020, the three overages would have resulted in no reductions to future catch limits. Therefore, under Alternative 3, the foregone revenue is \$0 per year. Relative to the status quo, about \$264,000 in additional revenue per year, is likely to accrue to the fishery under Alternative 3. Note that catch monitoring and in-season closures to the directed fishery would still be in place; this limits the magnitude of any overages of sub-ACLs

The short-term impacts would likely be slight positive and more positive than No Action and Alternative 2. The fishery could exceed a sub-ACL in a herring management area (by any amount) without having a reduction in potential herring landings in a future year (unless the ACL was exceeded). This could be particularly used in Area 1B where sub-ACLs are often quite small relative to the capacity of vessels to catch herring. As with Alternative 2, positive impacts that are likely to accrue to users of areas that have gone over the ACLs. No matter the sub-ACL overage, there would not be economic consequences for any fishery participants who are new or were not fishing during the year of the overage, so management could be perceived to be fairer relative to No Action and Alternative 2. Because Alternative 3 would not automatically reduce a future ACL unless the ACL was exceeded (like Alternative 2), optimum yield would more likely be achieved on a continual basis relative to No Action, resulting in more positive impacts to the fishery.

While catch monitoring and in-season closures to the directed fishery would still be in place (e.g., possession limit reductions when a sub-ACL is neared, closure at 100%) should limit the magnitude of any sub-ACL overages, Alternative 3 provides less incentive for the fishery to prevent sub-ACL overages than Alternative 2 (or No Action). Thus, there may be higher risk of negative distributional impacts within the fishery if fishing in an area is less restrained early in the year, leading to an area or fishery-wide closure earlier in the year, precluding fishing by other participants that tend to fish later or in other areas. For example, small-mesh bottom trawl vessels tend to fish in Area 2 late in the year. An early closure from fishing by other vessels may preclude their access to the area. Under low total quotas, these risks may be higher than under larger quotas. Thus, the more positive impacts to the fishery of Alternative 3 than Alternative 2 are tempered by the higher risk of negative distributional impacts.

In the long term, impacts would likely be less certain and potentially slight negative relative to No Action and Alternative 2. The AMs are designed to keep harvests within overall catch limits, which will help secure the long-term sustainability of the resources and the fishery and other user groups that depend on herring. However, there is greater potential for causing negative harm to a sub-component of the herring resource relative to the other alternatives if the sub-ACL in a management area is consistently exceeded by a substantial amount. Doing so may jeopardize the continued, sustainable harvest of fishery resources and benefits accrued to fisheries and their communities.

6.6 CUMULATIVE EFFECTS ANALYSIS

6.6.1 Introduction

The purpose of the cumulative effects analysis (CEA) is to consider the combined effects of many actions on the human environment over time that would be missed if each action were evaluated separately. It is not practical to analyze the cumulative effects of an action from every conceivable perspective. Rather, the intent is to focus on those effects that are truly meaningful. The following remarks address the significance of the expected cumulative impacts as they relate to the federally managed Atlantic herring fishery.

A cumulative effects assessment makes effect determinations based on a combination of: 1) impacts from past, present, and reasonably foreseeable future actions; 2) the baseline conditions of the VECs (the combined effects from past, present, and reasonably foreseeable future actions plus the present condition of the VEC); and 3) impacts of the alternatives under consideration for this action.

6.6.1.1 Consideration of the Valued Ecosystem Components (VECs)

The valued ecosystem components for the Atlantic herring fishery are generally the "place" where the impacts of management actions occur and are identified in Section 5.0.

- *Target Species (Atlantic herring)*
- *Non-target species*
- *Protected species*
- *Physical environment / Essential Fish Habitat*
- *Human communities*

The CEA identifies and characterizes the impacts on the VECs by the alternatives under consideration when analyzed in the context of other past, present, and reasonably foreseeable future actions.

6.6.1.2 Geographic Boundaries

The geographic scope of the impacts to species is the range each in the Western Atlantic Ocean, as described in the Affected Environment (Section 5.0). The physical environment, including habitat and EFH, is bounded by the range of the herring fishery, from the GOM through the Mid-Atlantic Bight, and includes adjacent upland areas (from which non-fishing impacts may originate). For protected species, the geographic range is the Northwest Atlantic Ocean. The geographic range for human communities focuses on the Northeast U.S.

6.6.1.3 Temporal Boundaries

Overall, while the effects of the historical Atlantic herring fishery are important and considered in the analysis, the temporal scope of past and present actions for Atlantic herring, non-target species and other fisheries, the physical environment and EFH, and human communities is primarily focused on actions that occurred after FMP implementation (2001). An assessment using this timeframe demonstrates the changes to resources and the human environment that have resulted through management under the Council process and through U.S. prosecution of the fishery. For protected species, the scope of past and present actions is focused on the 1980s and 1990s (when NMFS began generating stock assessments for marine mammals and sea turtles that inhabit waters of the U.S. EEZ) through the present.

The temporal scope of future actions for all VECs extends about five years (2027) into the future beyond the implementation of this action. The dynamic nature of resource management for these species and lack of information on projects that may occur in the future make it difficult to predict impacts beyond this timeframe with any certainty. The impacts discussed in this section are focused on the cumulative effects of the proposed action (i.e., the suite of preferred alternatives) in combination with the relevant past, present, and reasonably foreseeable future actions over these time scales.

6.6.2 Relevant Actions Other Than Those Proposed in this Document

This section summarizes the past, present, and reasonably foreseeable future actions and effects that are relevant for this cumulative effects assessment. Some past actions are still relevant to the present and/or future actions.

6.6.2.1 Fishery Management Actions

6.6.2.1.1 Atlantic herring FMP Actions

Past, present, and reasonably foreseeable future actions for Atlantic herring management include the establishment of the original FMP, all subsequent amendments and frameworks, and the setting of annual catch limits and measures to constrain catch and harvest. The past, present, and reasonably foreseeable future actions for each VEC are described in more detail in Section 4.9.3.1 of Amendment 8 to the Council's Herring FMP. In summary, there have been numerous actions taken in the past, and likely in the near future that have a range of impacts on the Atlantic herring resource, other biological aspects of the ecosystem, as well as human communities that rely on herring directly or on species that consume herring as prey. Key actions are described below.

Target species fishery related actions:

Herring management measures were developed in two related, but separate FMPs – one by the Council and one by the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC plan was adopted in 1999 and has been updated several times through various Addendums and Amendments. The primary measures in place are related to management of the Area 1A quota and spawning protection measures in the Gulf of Maine. Overall, the actions taken by ASMFC are expected to have positive impacts on the resource and fishery by preventing overfishing and considering fishery access issues in herring management Area 1A.

The NEFMC Atlantic herring FMP was implemented in 2001. A limited entry program was established in 2007 under Amendment 1 and Amendment 4 to the FMP primarily brought the plan into compliance with new MSA requirements for ACLs and AMs. Numerous frameworks and fishery specifications actions have followed setting catch limits and adjusting other aspects of the plan. Herring specifications are generally set for 2-3 years at a time and the overall impacts on the biological and human environments are expected to be positive since catch limits are set in a sustainable way.

Amendment 5 to the Atlantic Herring FMP was implemented in 2014 included measures for catch reporting, vessel requirements for catch sampling by observers, and slippage restrictions to ensure catch is available for sampling by an observer. This action had low positive impacts on the herring resource, non-target species and protected resources by improving catch reporting and catch sampling. Also, Amendment 7 implemented an Industry Funded Monitoring Amendment in the herring fishery in 2020. Effectiveness of this action has been delayed due to Covid 19 and other issues, but now that it is fully implemented (July 2021), herring vessels are required to have observers on 50% of trips, with some exceptions. Vessels can opt to use electronic monitoring with dockside sampling to replace at-sea human observers. This action should have further beneficial impacts on target and non-target species from improved monitoring.

Finally, Amendment 8 to the plan implemented a harvest control rule as well as an inshore area that is closed to midwater trawl gear. These measures are expected to prevent overfishing and minimize potential user conflicts between the MWT fishery and other users that focus on predators of herring in inshore areas. In summary, all the actions developed by the Council are expected to have positive impacts on the herring resource and fishery by ensuring the fishery is sustainably managed using catch limits and accountability measures to prevent overfishing and minimize impacts on the environment.

Non-target species:

Catch caps are in place for the two stocks that are primarily caught as bycatch in this fishery – GB haddock and river herring/shad. The RH/S catch caps were adopted in Framework 3 to the Atlantic herring FMP and have been in place since 2014, and the haddock catch cap was first adopted in 2006 under Framework 43 to the Multispecies FMP. Several adjustments have been made to these caps in subsequent actions. Overall, these catch caps are expected to continue to control and minimize impacts on bycatch. Monitoring in both the herring (through Herring Amendment 5 and the Omnibus Industry Funded Amendment) and potentially the groundfish fishery (through development and approval of Amendment 23 to the Groundfish FMP) are expected to improve the reliability and accountability of catch reporting. Catch caps and improved monitoring overall generally have positive impacts on non-target species.

Physical habitat/EFH:

The EFH Omnibus Amendment 2 (April 2018) reviewed and updated EFH designations, identified Habitat Areas of Particular Concern, and updated the status of current knowledge of gear impacts. It also implemented new management measures for minimizing the adverse impact of fishing on EFH that affect all species managed by the NEFMC. This action overall generally has positive impacts on the physical habitat and EFH in the region. The Council also approved an omnibus clam dredge framework that identifies areas within the Habitat Management Area that are currently fished or contain high energy sand and gravel that could be suitable for a hydraulic clam dredging exemption. The Council also recently developed a deep-sea coral amendment to protect deep-sea coral habitats throughout New England from the negative impacts of fishing gears. The new deep-sea protection zone will be a closure to all bottom-tending gears, with an exemption for the red crab pot fishery. The clam framework or coral amendment are unlikely to have direct impacts on the Atlantic herring resource or fishery.

Protected resources:

The herring plan does not have any specific gear or time and area closures specific to measures to reduce threats to protected species. Interactions with protected species and herring fishing gear are relatively rare events. Section 5.3 describes the potential risks of interaction in more detail. There is an Atlantic Large Whale Take Reduction team that has developed spatial and seasonal gear restrictions implemented by NMFS since 1999 to minimize interaction, injuries, and mortalities between vertical lines and large whale species. Although the herring fishery rarely interacts with large whales, these management measures could have an impact on where and when vessels in affected fisheries are allowed to fish, which could overlap with the herring fishery, although those impacts are uncertain. Improvements in monitoring through Amendment 5 and IFM could have indirect beneficial impacts on protected species from improved monitoring of the herring fishery. Overall, the actions taken to date have potentially had slight positive impacts on protected resources, but the herring fishery likely still has slight negative impacts from interaction risks with fishing gear.

Human communities:

All actions taken under the Atlantic herring FMP have had effects on human communities. Some actions have included specific measures designed to improve flexibility and increase efficiency of the herring fishery. For example, Framework 8 adjusted how in-season AMs are triggered that close the directed herring fishery when sub-ACLs are approached. More flexibility was added for some herring management areas to potentially extend fishing seasons by implementing a two-step possession limit. In addition, this action (Framework 9) includes a measure that would further optimize yield by adjusting current overage provisions. If adopted, the fishery could exceed a sub-ACL by 10% and not face future deductions from that sub-ACL overage, if the total ACL is not exceeded. These are a few examples of measures that have been developed over time to improve economic efficiency in the fishery with potential beneficial impacts on human communities. There are also actions in more recent years that have reduced fishing quotas, with short-term negative economic impacts and longer-term positive economic impacts when herring biomass increases.

6.6.2.1.2 Other Fishery Management Actions

In addition to the Atlantic herring FMP, there are many other FMPs and associated fishery management actions for other species that impacted these VECs over the temporal scale described in Section 6.6.1.3. These include FMPs managed by the Mid-Atlantic Fishery Management Council, New England Fishery Management Council, Atlantic States Marine Fisheries Commission, and to a lesser extent the South Atlantic Fishery Management Council. Omnibus amendments are also frequently developed to amend multiple FMPs at once. Actions associated with other FMPs and omnibus amendments have included measures to regulate fishing effort for other species, measures to protect habitat and forage species, and fishery monitoring and reporting requirements.

Other FMPs

As mentioned above, the ASMFC also has an Atlantic Herring Plan that has been adjusted several times over the years. This plan has direct impacts on the Atlantic herring resource and fishery, especially in Area 1A. The Squid Mackerel Butterfish FMP developed by the Mid-Atlantic Fishery Management Council has indirect impacts on the Atlantic herring resource and fishery because many of the vessels hold permits under both plans.

Omnibus actions

The primary omnibus actions that have had impacts on the Atlantic herring fishery and resource are the Omnibus Habitat Amendment and the Industry Funded Monitoring Amendment. Both actions are described in more detail above – See Section 6.6.2.1.

6.6.2.1.3 Fishery Management Action Summary

The Council has taken many actions to manage the Atlantic herring fishery. The MSA is the statutory basis for federal fisheries management. The cumulative impacts on the VECs of past, present, and reasonably foreseeable future federal fishery management actions under the MSA should generally be associated with positive long-term outcomes because they constrain fishing effort and manage stocks at sustainable levels. Constraining fishing effort through regulatory actions can have negative short-term socioeconomic impacts. These impacts are sometimes necessary to bring about long-term sustainability of a resource, and as such should promote positive effects on human communities in the long-term.

In general, the actions taken by NMFS and ASMFC (which also has an FMP for herring) are designed to prevent overfishing and optimize yield. Amendment 8 to the federal FMP is expected to further those goals by implementing a long-term harvest control rule and implement gear prohibitions in near shore areas to address potential impacts of localized depletion from concentrated removals of herring from mid-water trawl gear.

Similarly, the plan overall minimizes the impacts of this fishery on protected resources and EFH to the extent practicable. Finally, herring catches have been reduced dramatically in recent years, which has had negative impacts on human communities that rely on the herring fishery. However, these reductions are an effort to help rebuild the biomass so the stock can recover to higher levels more quickly to again supply herring to numerous fishing communities in this region. Section 5.0 of this document summarizes the current state of the Atlantic herring resource and fishery, and provides additional information about habitat, protected resources, and non-target species that may be affected by the alternatives under consideration. The impacts of non-fishing activities are also considered.

6.6.2.2 Non-Fishing Impacts

6.6.2.2.1 Other Human Activities

Non-fishing activities that occur in the marine nearshore and offshore environments and connected watersheds can cause the loss or degradation of habitat and/or affect the fish and protected species that utilize those areas. The impacts of most nearshore, human-induced, non-fishing activities tend to be localized in the areas where they occur, although effects on species could be felt throughout their populations since many marine organisms are highly mobile. For offshore projects, some impacts may be localized while others may have regional influence, especially for larger projects. The following discussion of impacts is based on past assessments of activities and assumes these activities will continue as projects are proposed.

Examples of non-fishing activities include point source and non-point source pollution, shipping, dredging/deepening, wind energy development, oil and gas development, construction, and other activities. Specific examples include at-sea disposal areas, oil and mineral resource exploration, aquaculture, construction of offshore wind farms, and bulk transportation of petrochemicals. Episodic storm events and the restoration activities that follow can also cause impacts. The impacts from these activities primarily stem from habitat loss due to human interaction and alteration or natural disturbances. These activities are widespread and can have localized impacts on habitat related to accretion of sediments, pollutants, habitat conversion, and shifting currents and thermoclines. For protected species, primary concerns associated with non-fishing activities include vessel strikes, dredge interactions (especially for sea turtles and sturgeon), and underwater noise. These activities have both direct and indirect impacts on protected species. Wherever these activities co-occur, they are likely to work additively or synergistically to decrease habitat quality and as such may indirectly constrain the productivity of managed species, non-target species, and protected species. Decreased habitat suitability tends to reduce the tolerance of these VECs to the impacts of fishing effort. Non-fishing activities can cause target, non-target, and protected species to shift their distributions away from preferred areas and may also lead to decreased reproductive ability and success (from current changes, spawning disruptions, and behavior changes), disrupted or modified food web interactions, and increased disease. While localized impacts may be more severe, the overall impact on the affected species and their habitats on a population level is unknown, but likely to have impacts that mostly range from no impact to slight negative, depending on the species and activity.

Non-fishing activities permitted by other Federal agencies (e.g., beach nourishment, offshore wind facilities) require examinations of potential impacts on the VECs. The MSA imposes an obligation on other Federal agencies to consult with the Secretary of Commerce on actions that may adversely affect EFH (50 CFR 600.930). NMFS and the eight regional fishery management councils engage in this review process by making comments and recommendations on federal or state actions that may affect habitat for their managed species. Agencies need to respond to, but do not necessarily need to adopt these recommendations. Habitat conservation measures serve to potentially minimize the extent and magnitude of indirect negative impacts federally-permitted activities could have on resources under NMFS' jurisdiction. In addition to guidelines mandated by the MSA, NMFS evaluates non-fishing effects during the review processes required by Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act for certain activities that are regulated by Federal, state, and local authorities. Non-fishing activities must also meet the mandates under the ESA, specifically Section 7(a)(2)[11], which ensures that agency actions do not jeopardize the continued existence of endangered species and their critical habitat.

In recent years, offshore wind energy and oil and gas exploration have become more relevant activities in the Greater Atlantic region. They are expected to impact all VECs, as described below.

Impacts of offshore wind energy development on Biological Resources (Target species, Non-target species, Protected Species) and the Physical Environment

Construction activities may have both direct and indirect impacts on marine resources, ranging from temporary changes in distribution to injury and mortality. Impacts could occur from changes to habitat in the areas of wind turbines and cable corridors and increased vessel traffic to and from these areas. Species that reside in affected wind farms year-round may experience different impacts than species that seasonally reside in or migrate through these areas. Species that typically reside in areas where wind turbines are installed may return to the area and adapt to habitat changes after construction is complete. Inter-array and electricity export cables will generate electromagnetic fields, which can affect patterns of movement, spawning, and recruitment success for various species. Effects will depend on cable type, transmission capacity, burial depth, and proximity to other cables. Substantial structural changes in habitats associated with cables are not expected unless cables are left unburied (see below). However, the cable burial process may alter sediment composition along the corridor, thereby affecting infauna and emergent biota. Taormina et al. (2018) provide a recent review of various cable impacts, and Hutchinson et al. (2020) and Taormina et al. (2020) examine the effects of electromagnetic fields in particular.

The full build out of offshore wind farms will result in broad habitat alteration. The wind turbines will alter hydrodynamics of the area, which may affect primary productivity and physically change the distribution of prey and larvae. It is not clear how these changes will affect the reproductive success of marine resources. Scour and sedimentation could have negative effects on egg masses that attach to the bottom. Benthic habitat will be altered due to the placement of scour protection at wind turbine foundations, and over cables that are not buried to target depth in the sediment, converting soft substrates into hard substrates. This could alter species composition and predator/prey relationships by increasing favorable habitat for some species and decreasing habitat for others. The placement of wind turbines will also establish new vertical structure in the water column, which could serve as reefs for bottom species, fish aggregating devices for pelagic species, and substrate for the colonization of other species, e.g. mussels. Various authors have studied these types of effects (e.g., Bergström et al. 2013; Dannheim et al. 2019; Degraer et al. 2019; Langhamer 2012; Methratta & Dardick 2019; Stenberg et al. 2015).

11 "Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency (hereinafter in this section referred to as an "agency action") is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat."

Elevated levels of sound produced during site assessment activities, construction, and operation of offshore wind facilities will impact the soundscape.[12] Temporary, acute, noise impacts from construction activity could impact reproductive behavior and migration patterns; the long-term impact of operational noise from turbines may also affect behavior of fish and prey species, through both vibrations in the immediate area surrounding them in the water column, and through the foundation into the substrate. Depending on the sound frequency and source level, noise impacts to species may be direct or indirect (Finneran 2015; 2016; Madsen et al. 2006; Nowacek et al. 2007; NRC 2000; 2003; 2005; Piniak 2012; Popper et al. 2014; Richardson et al. 1995; Thomsen et al. 2006). Exposure to underwater noise can directly affect species via behavioral modification (avoidance, startle, spawning) or injury (sound exposure resulting in internal damage to hearing structures or internal organs; Bailey et al. 2014; Bailey et al. 2010; Bergström et al. 2014; Ellison et al. 2011; Ellison et al. 2018; Forney et al. 2017; Madsen, et al. 2006; Nowacek, et al. 2007; NRC 2003; 2005; Richardson, et al. 1995; Romano et al. 2004; Slabbekoorn et al. 2010; Thomsen, et al. 2006; Wright et al. 2007). Indirect effects are likely to result from changes to the acoustic environment of the species, which may affect the completion of essential life functions (e.g., migrating, breeding, communicating, resting, foraging; Forney, et al. 2017; Richardson, et al. 1995; Slabbekoorn, et al. 2010; Thomsen, et al. 2006).[13]

Wind farm survey and construction activities and turbine/cable placement will substantially affect NMFS scientific research surveys, including stock assessment surveys for fisheries and protected species[14] and ecological monitoring surveys. Disruption of such scientific surveys could increase scientific uncertainty in survey results and may significantly affect NMFS' ability to monitor the health, status, and behavior of marine resources and protected species and their habitat use within this region. Based on existing regional Fishery Management Councils' acceptable biological catch control rule processes and risk policies (e.g., 50 CFR §§ 648.20 and 21), increased assessment uncertainty could result in lower commercial quotas and recreational harvest limits that may reduce the likelihood of overharvesting and mitigate associated biological impacts on fish stocks. However, this would also result in lower associated fishing revenue and reduced recreational fishing opportunities, which could result in indirect negative impacts on fishing communities.

Impacts of Offshore Wind Energy Development on Socioeconomic Resources

One offshore wind pilot project off Virginia installed two turbines in 2020**.** Several potential offshore wind energy sites have been leased or identified for future wind energy development in federal waters from Massachusetts to North Carolina (Map 3). According to BOEM, about 22 gigawatts (close to 2,000 wind turbines based on current technology) of Atlantic offshore wind development via 17 projects are reasonably foreseeable along the east coast (BOEM 2020b). BOEM has recently begun a planning process for the Gulf of Maine via a regional intergovernmental renewable energy task force (https://www.boem.gov/Gulf-of-Maine). It is unclear at this time where development might occur in the Gulf of Maine. Given the water depth in the region, floating turbines will likely be the primary type of wind turbine foundations to be deployed in the area. As the number of wind farms increases, so too would the level and scope of impacts to affected habitats, marine resources, and human communities.

Offshore wind energy development is being considered in parts of the outer continental shelf that overlap with the Atlantic herring resource, specifically in SNE, which is only part of the overall herring fishery compared to the potential offshore wind energy sites currently under consideration (Map 3). The herring fishery has been active in the SNE area in certain seasons and is expected to for the near future as herring rebuilds. The social and economic impacts of offshore wind energy on the fishery could be generally

12 See NMFS Ocean Noise Strategy Roadmap: https://cetsound.noaa.gov/Assets/cetsound/documents/Roadmap/ONS_Roadmap_Final_Complete.pdf

13 See NMFS Ocean Noise Strategy Roadmap (footnote #2)

14 Changes in required flight altitudes due to proposed turbine height would affect aerial survey design and protocols (BOEM 2020a).

negative due to the overlap of wind energy areas with productive herring fishing grounds. Impacts may vary by year based on the temporal and spatial variation in herring fishing activity.

There could also be social and economic benefits in the form of jobs associated with construction and maintenance, and replacement of some electricity generated using fossil fuels with renewable sources (AWEA 2020).

It remains unclear how fishing or transiting to and from fishing grounds (whether those grounds are within a wind farm) might be affected by the presence of a wind farm. While no offshore wind developers have expressed an intent to exclude fishing vessels from wind turbine arrays once construction is complete, it could be difficult for operators to tow bottom-tending mobile gear or transit amongst the wind turbines, depending on the spacing and orientation of the array and weather conditions (The U.S. Coast Guard has considered transit and safety issues related to the Massachusetts and Rhode Island lease areas in a recent port access route study, and has recommended uniform 1 mile spacing in east-west and north-south directions between turbines to facilitate access for fishing, transit, and search and rescue operations. Future studies in other regions could result in different spacing recommendations (USGC 2020)). If vessel operators choose to avoid fishing or transiting within wind farms, effort displacement and additional steaming time could result in negative socioeconomic impacts to affected communities, including increased user conflicts, decreased catch and associated revenue, safety concerns, and increased fuel costs. If vessels elect to fish within wind farms, effects could be negative due to reduced catch and associated revenue, user conflicts, gear damage/loss, and increased risk of allision or collision.

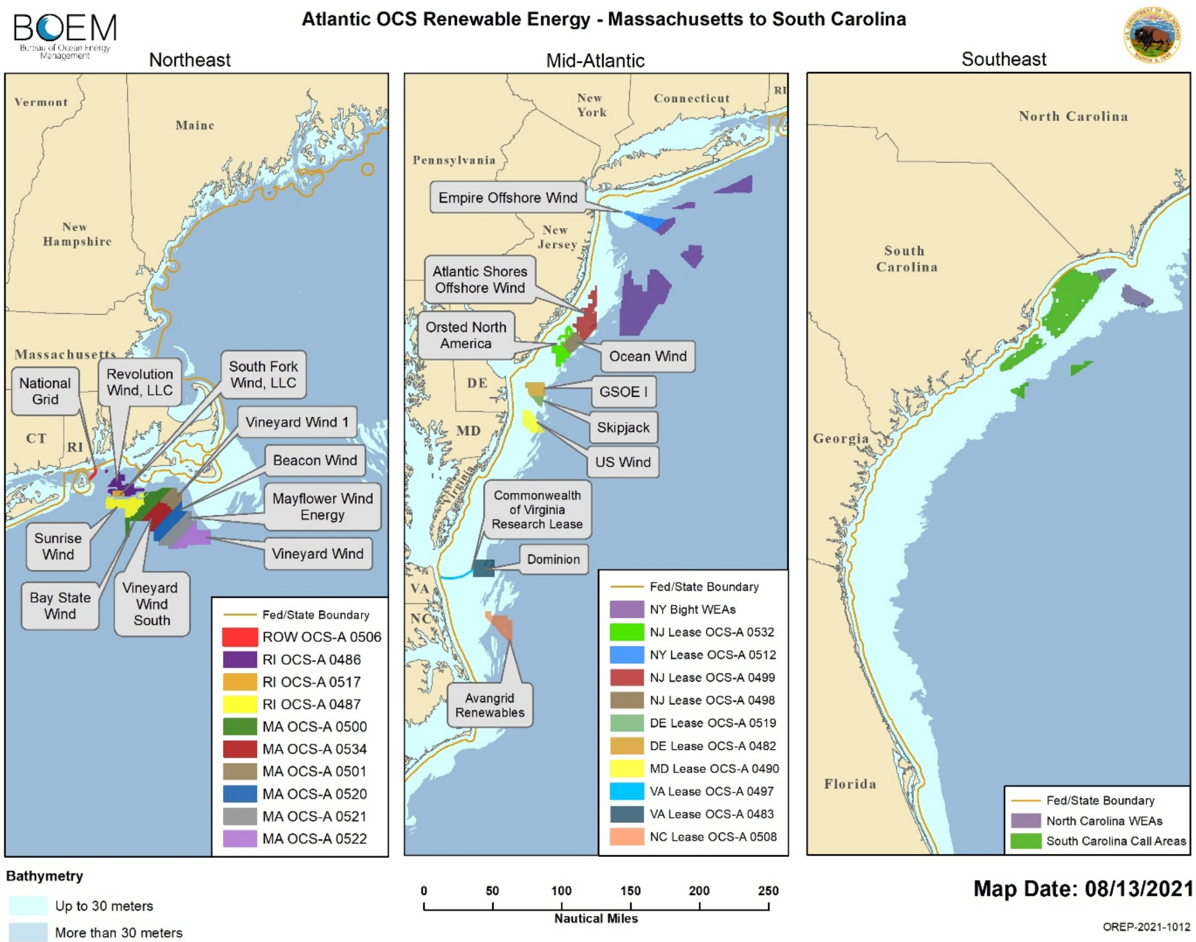
Impacts of Oil and Gas Development on Biological and Socioeconomic Resources

For oil and gas, this timeframe could include leasing and possible surveys, depending on the direction of BOEM's 5-year planning process in the North and Mid-Atlantic regions (Note that there are fewer oil and gas development activities in the region than offshore wind; therefore, the non-fishing impacts focus more heavily on offshore wind). Seismic surveys to detect and quantify mineral resources in the seabed impact marine species and the acoustic environment within which marine species live. These surveys have uncertain impacts on fish behaviors that could cumulatively lead to negative population level impacts. For protected species (sea turtle, fish, small cetacean, pinniped, large whale), the severity of these behavioral or physiological impacts is based on the species' hearing threshold , the overlap of this threshold with the frequencies emitted by the survey, as well as the duration of time the surveys would operate, as these factors influence exposure rate (Ellison, et al. 2011; Ellison, et al. 2018; Finneran 2015; 2016; Madsen, et al. 2006; Nelms et al. 2016; Nowacek et al. 2015; Nowacek, et al. 2007; NRC 2000; 2003; 2005; Piniak 2012; Popper, et al. 2014; Richardson, et al. 1995; Thomsen, et al. 2006; Weilgart 2013). If fishery resources are affected by seismic surveys, then so in turn the fishermen targeting these resources would be affected. However, such surveys could increase jobs, which may provide some positive effects on human communities (BOEM 2020a). It is important to understand that seismic surveys for mineral resources are different from surveys used to characterize submarine geology for offshore wind installations, and thus these two types of activities are expected to have different impacts on marine species.

Offshore Energy Summary

The overall impact of offshore wind energy and oil and gas exploration on the affected species and their habitats at a population level is unknown, but likely to range from no impact to moderate negative, depending on the number and locations of projects that occur. The individual project phases (site assessment, construction, operation, and decommissioning) as well as different aspects of the technology (foundations, cables/pipelines, turbines) will have varying impacts on resources. Mitigation efforts, such as habitat conservation measures, time of year construction restrictions, layout modifications, and fishery compensation funds could lessen the magnitude of negative impacts as well. The overall impact on socioeconomic resources is likely slight positive to moderate negative; potentially positive due to a potential increase in jobs and recreational fishing opportunities, but negative due to displacement and disruption of commercial fishing effort.

Map 3. Map of BOEM Wind Planning areas, Wind Energy Areas, and Wind Leasing Areas on the Atlantic Outer Continental Shelf.



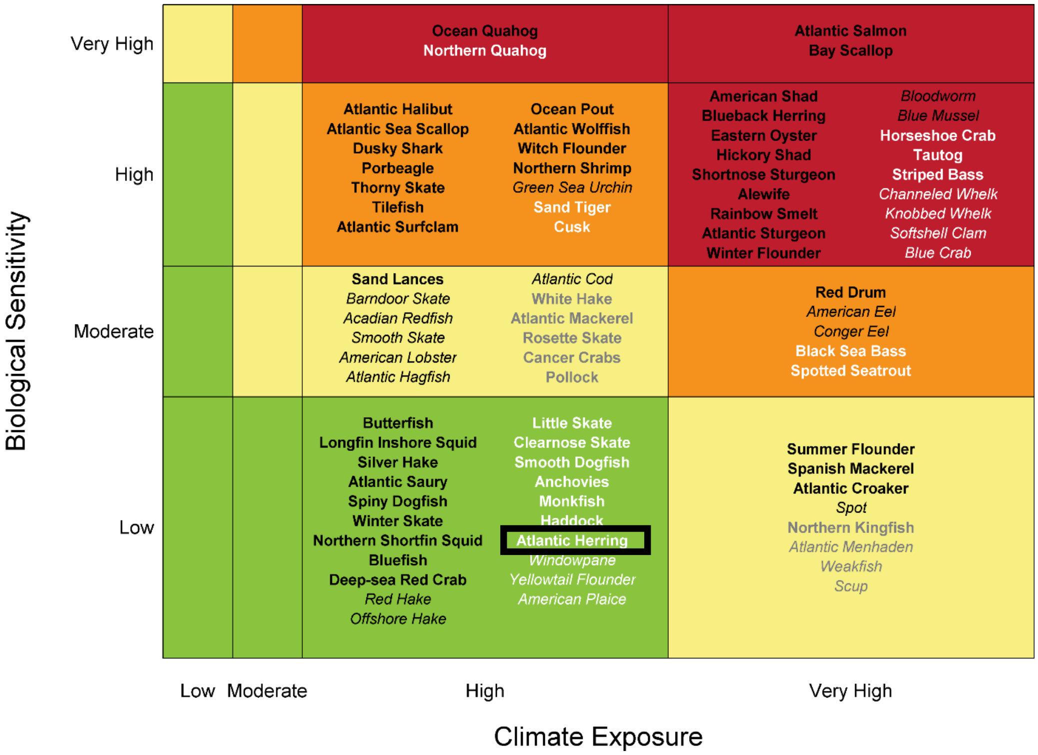
Source: https://www.boem.gov/sites/default/files/images/Map-of-Atlantic-OCS-renewable-energy-areas_8_13_2021.jpg

6.6.2.2.2 Global Climate Change

Global climate change affects all components of marine ecosystems, including human communities. Physical changes that are occurring and will continue to occur to these systems include sea-level rise, changes in sediment deposition; changes in ocean circulation; increased frequency, intensity and duration of extreme climate events; changing ocean chemistry; and warming ocean temperatures. The rates of physical and chemical changes in marine ecosystems have been most rapid in recent decades (Johnson et al. 2019). Emerging evidence demonstrates that these physical changes are resulting in direct and indirect ecological responses within marine ecosystems, which may alter the fundamental production characteristics of marine systems (Stenseth et al. 2002). The general trend of changes can be explained by warming causing increased ocean stratification, which reduces primary production, lowering energy supply for higher trophic levels and changing metabolic rates. Different responses to warming can lead to altered food-web structures and ecosystem-level changes. Shifts in spatial distribution are generally to higher latitudes (i.e., poleward) and to deeper waters as species seek cooler waters within their normal temperature preferences. Climate change will also potentially exacerbate the stresses imposed by fishing and other non-fishing human activities and stressors. Survival of marine resources under a changing climate depends on their ability to adapt to change, but also how and to what degree those other human activities influence their natural adaptive capacity.

The Northeast Fisheries Climate Vulnerability Assessment indicates that Atlantic herring has “high” climate exposure, but is “low” for biological sensitivity to climate change effects (Hare, et al. 2016). Atlantic herring is a highly migratory species with multiple spawning locations throughout the Gulf of Maine and Georges Bank. Vulnerability results for other Greater Atlantic species, including most of the non-target species identified in this action, are shown in Figure 37 (Hare, et al. 2016). While the effects of climate change may benefit some habitats and the populations of species through increased availability of food and nutrients, reduced energetic costs, or decreased competition and predation, a shift in environmental conditions outside the normal range can result in negative impacts for those habitats and species unable to adapt. This, in turn, may lead to higher mortality, reduced growth, smaller size, and reduced reproduction or populations. Thus, already stressed populations are expected to be less resilient and more vulnerable to climate impacts. Climate change is expected to have impacts that range from positive to negative depending on the species. However, future mitigation and adaptation strategies to climate change may mitigate some of these impacts. The science of predicting, evaluating, monitoring, and categorizing these changes continues to evolve. The social and economic impacts of climate change will depend on stakeholder and community dependence on fisheries, and their capacity to adapt to change. Commercial and recreational fisheries may adapt in different ways, and methods of adaptation will differ among regions. In addition to added scientific uncertainty, climate change will introduce implementation uncertainty and other challenges to effective conservation and management.

Figure 37. Overall climate vulnerability score for Greater Atlantic species, with Atlantic herring highlighted with black box.



Note: Overall climate vulnerability is denoted by color: low (green), moderate (yellow), high (orange), and very high (red). Certainty in score is denoted by text font and text color: very high certainty (>95%, black, bold font), high certainty (90–95%, black, italic font), moderate certainty (66–90%, white or gray, bold font), low certainty (<66%, white or gray, italic font).
Source: Hare et al. (2016).

6.6.3 Magnitude and Significance of Cumulative Effects

In determining the magnitude and significance of the cumulative impacts of the preferred alternatives, the incremental impacts of the direct and indirect impacts should be considered, on a VEC-by-VEC basis, in addition to the effects of all actions (those identified and discussed relative to the past, present, and reasonably foreseeable future actions of both fishing and non-fishing actions). Table 37 provides a summary of likely impacts found in the various groups of management alternatives contained in this action. The CEA baseline that, as described above in Section 6.6.2, represents the sum of past, present, and reasonably foreseeable future actions and conditions of each VEC. When an alternative has a positive impact on the VEC, for example, reduced fishing mortality on a managed species, it has a positive cumulative effect on the stock size of the species when combined with "other" actions that were also designed to increase stock size. In contrast, when an alternative has negative effects on a VEC, such as increased mortality, the cumulative effect on the VEC would be negative and tend to reduce the positive effects of the other actions. The resultant positive and negative cumulative effects are described below for each VEC. As in Section 6.6.2.2, non-fishing impacts on the VECs generally range from no impact to slight negative.

6.6.3.1 Magnitude and Significance of Cumulative Effects on Target Species

Past fishery management actions taken through the Atlantic herring FMP and the annual specifications process such as catch limits, commercial quotas, for the target species ensure that the stock is managed sustainably and that measures are consistent with the objectives of the FMP under the guidance of the MSA. The impacts of annual specification of management measures are largely dependent on how effective those measures are in meeting the objectives of preventing overfishing and achieving optimum yield, and on the extent to which mitigating measures are effective; however, these actions have generally had a positive cumulative effect on Atlantic herring. A rebuilding plan in particular, as proposed in this action, is expected to have positive short-term and long-term impacts on the herring resource by increasing overall biomass. It is anticipated that the future management actions described in Section 6.6.2.1 will have additional indirect positive effects on the target species through actions which reduce and monitor bycatch, protect habitat, and protect the ecosystem services on which the productivity of the target species depends.

As noted previously in Section 6.1, none of the preferred alternatives are expected to result in significantly increased levels of fishing effort or changes to the character of that effort relative to current conditions. Therefore, impacts of the fishery on herring are not expected to change relative to current conditions under the preferred alternatives (i.e., generally positive for herring). The proposed actions described in this document would positively reinforce the past and anticipated positive cumulative effects on herring by achieving the objectives specified in the FMP.

When the direct and indirect effects of these Framework 9 alternatives are considered in combination with all other actions (i.e., past, present, and reasonably foreseeable future actions), *the cumulative effects are expected to yield non-significant positive impacts on Atlantic herring.*

6.6.3.2 Magnitude and Significance of Cumulative Effects on Non-target Species

The combined impacts of past federal fishery management actions on non-target species have been mixed, as decreased effort and reduced catch of non-target species continue, though some stocks are in poor status. Current regulations continue to manage for sustainable stocks, thus controlling effort on direct and discard/bycatch species. As noted in Section 6.6.2.1, the actions proposed by Framework 9 would likely continue this trend. Future actions are anticipated to continue rebuilding non-target species stocks and limit the take of incidental/bycatch in the Atlantic herring fishery, particularly through mitigation measures such as sub-ACLs and catch caps with AMs. The other measures proposed in this action would likely have primarily no impact on non-target species. Continued management of directed stocks will also control catch of non-target species.

As noted previously in Section 6.2, none of the preferred alternatives are expected to result in significantly increased levels of fishing effort or changes to the character of that effort relative to current conditions. Therefore, impacts of the fishery on non-target species are not expected to change relative to the current condition under the preferred alternatives (i.e., slight positive for non-target species). The proposed actions in this document would positively reinforce past and anticipated cumulative effects on non-target species by achieving the objectives in the FMP.

When the direct and indirect effects of Framework 9 alternatives are considered in combination with all other actions (i.e., past, present, and reasonably foreseeable future actions), *the cumulative effects are expected to yield non-significant slight positive to negligible impacts on non-target species.*

6.6.3.3 Magnitude and Significance of Cumulative Effects on Protected Species

Given their life history dynamics, large changes in protected species abundance over long time periods, and the multiple and wide-ranging fisheries management actions that have occurred, the cumulative impacts on protected species were evaluated over a long-time frame (i.e., from the early 1970s when the Marine Mammal Protection Act and Endangered Species Act were implemented through the present).

Numerous protected species (ESA listed and/or MMPA protected) occur in the Northwest Atlantic. The distribution and status of those species in the region are described in Section 5.3. Depending on species and status, the population trends for these protected resources are variable, and as follows:

Sea Turtles

Nest counts inform population trends for sea turtle species. In the affected environment (Section 5.3), four sea turtle species were identified in the region: Northwest Atlantic Ocean DPS of loggerhead, Kemp's ridley, North Atlantic DPS of green, and leatherback sea turtles. For the Northwest Atlantic Ocean DPS of loggerhead sea turtles, there are five unique recovery units that comprise the DPS. Nesting trends for each of these recovery units are variable; however, recent data from Florida index nesting beaches, which comprise most of the nesting in the DPS, indicate a 19% increase in nesting from 1989 to 2018 (https://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/). For Kemp's ridley sea turtles, from 1980 through 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15% annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival of immature and adult sea turtles, and updated population modeling, this rate is not expected to continue and the overall trend is unclear (Caillouet et al. 2018; NMFS & USFWS 2015). The North Atlantic DPS of green sea turtle is showing a positive trend in nesting (Seminoff et al. 2015). Leatherback turtle nesting in the Northwest Atlantic is showing an overall negative trend, with the most notable decrease occurring during the most recent time frame of 2008 to 2017 (Northwest Atlantic Leatherback Working Group 2018).

Large Whales

Large whale assessments indicate that for some species there is decreasing (i.e., North Atlantic right whales) trend in the population, while for other species, as a trend analysis has not been conducted, it is unknown what the population trajectory is.[15]

Small cetaceans and Pinnipeds

For most small cetaceans and pinniped populations, it is unknown what the population trajectory is as a trend analysis has not been conducted for these populations.[16] However, in the most recent stock assessment reports, population trends were provided for common bottlenose dolphin stocks and gray seals; the analysis indicated a declining trend in population size for all common bottlenose dolphin stocks and an increasing trend for the gray seal population (Hayes et al. 2018b; 2019b).

Atlantic Sturgeon

Population trends for Atlantic sturgeon are difficult to discern; however, the most recent stock assessment report concludes that Atlantic sturgeon, at both coastwide and DPS level, are depleted relative to historical levels (ASMFC 2017a; ASSRT 2007).

Atlantic Salmon

There is no population growth rate available for Gulf of Maine DPS Atlantic salmon; however, the consensus is that the DPS exhibits a continuing declining trend (NOAA 2016; USFWS 2018).

Summary

Taking into consideration the above information, past fishery management actions taken through the respective FMPs and annual specifications process have had slight indirect positive cumulative effects on

15 https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region

16 https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region

protected species. The actions have constrained fishing effort both at a large scale and locally, and have implemented, pursuant to the ESA, MMPA, or MSA, gear modifications, requirements, and management areas. These measures and/or actions have served to reduce interactions between protected species and fishing gear. It is anticipated that future management actions, described in Section 6.6.2.1 will result in additional indirect positive effects on protected species. These impacts could be broad in scope.

The preferred alternatives would not substantially modify current levels of fishing effort in terms of the overall amount of effort, timing, and location. They would allow existing fishing effort to continue. As described in Section 6.3, the proposed action is expected to have impacts on protected species that range from slight negative to negligible, depending on the species.

When the direct and indirect effects of the Framework 9 alternatives are considered in combination with all other actions (i.e., past, present, and reasonably foreseeable future actions), *the cumulative effects are expected to yield non-significant slight negative to slight positive impacts to protected resources.*

6.6.3.4 Magnitude and Significance of Cumulative Effects on Physical Environment

Past fishery management actions taken through this FMP and annual specifications process have had positive cumulative effects on habitat. The actions have constrained fishing effort both at a large scale and locally and have implemented gear requirements which may reduce impacts on habitat. As required under this FMP, EFH and Habitat Areas of Particular Concern were designated for the managed resources. It is anticipated that the future management actions described in Section 6.6.2.1 will result in additional direct or indirect positive effects on habitat through actions which protect EFH and protect ecosystem services on which these species' productivity depends.

Many additional non-fishing activities, as described in Section 6.6.2.2, are concentrated near-shore and likely work either additively or synergistically to decrease habitat quality. The effects of these actions, combined with impacts resulting from years of commercial fishing activity, have negatively affected habitat. These impacts could be broad in scope. All the VECs are interrelated; therefore, the linkages among habitat quality, managed resources and non-target species productivity, and associated fishery yields should be considered. Some actions, such as coastal population growth and climate change may indirectly impact habitat and ecosystem productivity; however, these actions are beyond the scope of NMFS and Council management. Reductions in overall fishing effort and protection of sensitive habitats have mitigated some negative effects.

As noted previously in Section 6.4, the proposed action is unlikely to significantly increase levels of fishing effort or changes to the character of that effort relative to current conditions. Although the impacted areas have been fished for many years with many different gear types and therefore will not likely be further impacted by these measures, continued fishing effort will continue to impact habitats. Therefore, the impacts of the fishery on the physical environment are not expected to change relative to the current condition under the preferred alternatives (i.e., slight negative for physical environment).

When the direct and indirect effects of the Framework 9 alternatives are considered in combination with all other actions (i.e., past, present, and reasonably foreseeable future actions), *the cumulative effects are expected to yield non-significant negligible to slight negative impacts on the physical environment and EFH.*

6.6.3.5 Magnitude and Significance of Cumulative Effects on Human Communities

Past fishery management actions taken through the respective FMPs and annual specifications process such as catch limits and commercial quotas have had both positive and negative cumulative effects on human communities. They have benefitted domestic fisheries through sustainable fishery management but can also reduce participation in fisheries. The impacts from annual specification of management measures are largely dependent on how effective those measures are in meeting their intended objectives and the extent to which mitigating measures are effective. Quota overages may alter the timing of commercial fishery revenues such that revenues can be realized a year earlier. Fishermen may be impacted by reduced revenues in years which the overages are deducted.

It is anticipated that the future management actions described in Section 6.6.2.1 will result in positive effects for human communities due to rebuilding and sustainable management practices, although additional indirect negative effects on some human communities could occur if management actions result in reduced revenues in the short term. Overall, the past, present, and reasonably foreseeable future actions that are truly meaningful to human communities have had overall positive cumulative effects. Despite the potential for negative short-term effects on human communities due to reduced revenue, positive long-term effects are expected due to the long-term sustainability of the managed stocks.

By providing revenue and contributing to the overall functioning of and employment in coastal communities, the Atlantic herring fishery has both direct and indirect positive social impacts. As described in Section 6.6, the preferred alternatives are unlikely to result in substantial changes to levels of fishing effort or the character of that effort relative to current conditions, catches will remain relatively low while the resource rebuilds, and then return to more typical levels when biomass increases. The proposed overage measure that increases flexibility should have low positive impacts on the fishery as well. Through implementation of this action, the Council seeks to achieve the primary objective of the MSA, which is to prevent overfishing and achieve OY from the managed fisheries.

When the direct and indirect effects of the Framework 9 alternatives are considered in combination with all other actions (i.e., past, present, and reasonably foreseeable future actions), *the cumulative effects are expected to yield non-significant slight positive impacts.*

6.6.4 Proposed Action on all the VECs

The Council's preferred alternatives (i.e., the proposed action) are described in Section 4.0. The direct and indirect impacts of the proposed action on the VECs are described in Sections 6.1 to 6.6 and are summarized in the Executive Summary (Section 1.0). The magnitude and significance of the cumulative effects, including additive and synergistic effects of the proposed actions, as well as past, present, and future actions, have been taken into account (Section 6.6.3).

When considered in conjunction with all other pressures placed on the fisheries by past, present, and reasonably foreseeable future actions, the preferred alternatives are not expected to result in any significant impacts, positive or negative. This action would implement a rebuilding plan for Atlantic herring and adjust how overages of sub-ACL are accounted for. Overall, these measures should have positive impacts on the biological and human ecosystems by rebuilding the herring resource and supporting optimum yield in the herring fishery (Table 37).

The preferred alternatives are consistent with other management measures that have been implemented in the past for the fishery which are part of a broader management scheme for the Atlantic herring fishery. This management scheme has, for the most part, helped to rebuild stocks and ensure long-term sustainability, while minimizing environmental impacts.

The regulatory atmosphere within which federal fishery management operates requires that management actions be taken in a manner that will optimize the conditions of managed species, habitat, and human communities. Consistent with NEPA, the MSA requires that management actions be taken only after consideration of impacts to the biological, physical, economic, and social dimensions of the human environment. Given this regulatory environment, and because fishery management actions must strive to create and maintain sustainable resources, impacts on all VECs from past, present and reasonably foreseeable future actions have generally been positive and are expected to continue in that manner for the foreseeable future. This is not to say that some aspects of the VECs are not experiencing negative impacts, but rather that when considered as a whole and as a result of the management measure implemented in these fisheries, the overall long-term trend is positive.

There are no significant cumulative effects associated with the preferred alternatives based on the information and analyses presented in this document and in past FMP documents (Table 37). Cumulatively, through 2027, it is anticipated that the preferred alternatives will result in *non-significant impacts on all VECs, with generally positive impacts on the herring resource and human communities and slight negative to negligible impacts on EFH and protected resources.*

Table 37. Summary of Cumulative Effects of the Preferred Alternatives.

	Target Species	Non-Target Species	Habitat	Protected Resources	Human Communities
Direct/Indirect Impacts of Preferred Alternative	Moderate positive (rebuilding) to Slight negative (AM)	Slight positive to slight negative	Negligible	Slight negative to negligible	Slight positive to negative on herring fishery; moderate positive on other predator industries (rebuilding) Slight positive (AMs)
Combined Cumulative Effects Assessment Baseline Conditions	Positive	Positive	Slight negative to negligible	Slight positive to slight negative	Positive to negative (in the short-term) and positive (in the long-term) on herring fishery; moderate positive on other predator industries
Cumulative Effects	Positive	Slight positive to negligible	Slight negative to negligible	Slight negative to slight positive	Slight Positive

7.0 APPLICABLE LAWS/EXECUTIVE ORDERS

7.1 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

7.1.1 National Standards

Section 301 of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires that regulations implementing any fishery management plan or amendment be consistent with ten national standards. Below is a summary of how this action is consistent with the National Standards and other required provisions of the MSA.

The Council continues to meet the obligations of National Standard 1 by adopting and implementing conservation and management measures that will continue to prevent overfishing, while achieving optimum yield for managed species and the U.S. fishing industry on a continuing basis. The primary goal of managing the Atlantic herring fishery is to maintain long-term sustainable catch levels and the first objective of the Atlantic herring FMP is to prevent overfishing. The Atlantic herring FMP established a fishery specifications process that ensures a consistent review of the stock status, fishery performance, and other factors to manage by annual catch limits (ACLs) and prevent overfishing. The measures implemented through this action should further achieve the goals/objectives and reduce the possibility of overfishing. The Atlantic herring resource was recently declared overfished, but overfishing is not occurring (Section 5.1). Action 1 of this framework is proposing a rebuilding plan to address the recent change in stock status. Action 2 of this framework is expected to help optimize yield by providing more flexibility for the fishery. Limited overages of a sub-ACL in one management area would be allowed up to 10% without future deductions if the total ACL is not exceeded. This flexibility would better enable the fishery to catch more of the total ACL while preventing excessive fishing in one area.

The Council has complied with National Standard 2 by using fisheries-independent data from several surveys, commercial fishery landings data, stock assessments, and other scientific data sources. The rebuilding plan alternatives are supported by the best available scientific information, using fishery projections developed by the Herring PDT and reviewed by the Council's SSC. The supporting science and analyses, upon which the proposed action is based, are summarized and described in Sections 5.0 and 6.0 of this document.

The Council manages Atlantic herring throughout its range (National Standard 3). While most are landed in Maine, Massachusetts, and New Jersey, herring landings have been reported in many other states from Maine through Virginia. While the Atlantic herring FMP manages the coastal stock complex as a single unit, it also considers impacts of fishing mortality on individual spawning components. To address that portion of the resource that is caught in State waters, the Atlantic herring FMP and related actions were developed in coordination with the Atlantic States Marine Fisheries Commission (ASMFC). The coastal stock complex includes herring that are caught in the Canadian fixed gear fishery in New Brunswick and in Canadian waters on Georges Bank. Furthermore, the management measures proposed in this action do not discriminate among residents of different states (National Standard 4); the measures are intended to be applied equally to all permit holders of the same category, regardless of homeport or location.

The proposed action is intended to maximize opportunities for the fishery while minimizing the potential for overfishing. The measures proposed in this document should promote efficiency in the use of fishery resources through appropriate measures intended to provide access to the fishery for both current and historical participants while minimizing the race to fish in any of the herring management areas, and they do not have economic allocation as their sole purpose (National Standard 5). Specifically, Action 2 is intended to improve efficient use of the herring ACL by providing more flexibility to the fishery related to overages of sub-ACLs.

The proposed action accounts for variations in the fishery (National Standard 6). The 2018 benchmark stock assessment for Atlantic herring noted marked declines in stocks and in recruitment from previous assessments, and these trends continued in the 2020 stock assessment. There are several factors which could introduce variations into the herring fishery, and there is some uncertainty in the estimate of current stock size and in recruitment. Furthermore, market fluctuations, environmental factors, and predator-prey interactions constantly introduce additional variations among, and contingencies in, the herring resource, the fishery, and the available catch. The proposed rebuilding plan policy will likely represent substantial reductions in allowable catch from previous years. However, this catch policy intends to balance the needs of the herring fishery, predators of herring, and related industries that depend on herring, while accounting for the documented decrease in herring stocks and recruitment.

As always, the Council considered the costs and benefits associated with the proposed action. Any costs incurred from the proposed action are necessary to achieve the goals and objectives of the Atlantic herring FMP and outweigh the benefits of taking the management action. Consistent with National Standard 7, the management measures proposed in this document are not duplicative and were developed in close coordination with NMFS, the ASMFC, the MAFMC, and other interested entities and agencies to minimize duplicity.

The proposed action considers the importance of fishery resources to fishing communities (National Standard 8). A complete description of the fishing communities participating in and dependent on the Atlantic herring fishery is in Section 5.5.3. Relative to the No Action alternatives, the proposed action is likely to have negative (short-term) to slight positive impacts on communities that engage in and depend on the Atlantic herring fishery. Given the depleted state of the resource and the uncertainty in recruitment, a precautionary approach is required to ensure long-term sustainability of Atlantic herring. Thus, in the long-term, communities depending on the Atlantic herring resource are expected to be sustained by this action by managing the resource in a precautionary manner to ensure long-term sustainable catch. And Action 2 (modifications to the overage AMs) is expected to have positive impacts on the herring fishery from increased revenue potential.

National Standard 9 is focused on non-target species and Section 5.2 of this document has comprehensive information related to bycatch in the Atlantic herring fishery. The primary non-target species caught in this fishery are GB haddock and river herring/shad, which both have catch caps. The proposed action does not change the catch caps in place intended to promote the concept of reducing bycatch to the extent practicable by providing an incentive to avoid incidental catch of RH/S and/or haddock while still allowing an opportunity to achieve OY. When a cap trigger is reached, it implements a very low herring possession limit (essentially closing the area to directed herring fishing) for the rest of that fishing year.

Finally, this action is consistent with National Standard 10 to promote the safety of human life at sea. Nothing in the proposed action increases any operational restrictions on fishing regulated under the FMP that might negatively impact safety at sea.

7.1.2 Other MSA Requirements

This action is also consistent with the fourteen additional required provisions for FMPs. Section 303 (a) of the MSA contains required provisions for FMPs.

1. *Contain the conservation and management measures, applicable to foreign fishing …*

   Foreign fishing for the Atlantic herring resource is considered during the fishery specifications process when OY is determined, and the management area sub-ACLs are established for a fishing year. None of the measures proposed in this action apply to foreign fishing vessels; the domestic herring fleet has been shown to have the capacity to fully use the available catch.

2. *Contain a description of the fishery …*

   All the information required by this provision can be found in the Final EIS for Amendment 8 to the Atlantic herring FMP submitted in May 2019 and Section 5.5 of this action.

3. *Assess and specify the present and probable future condition of, and the maximum sustainable yield and optimum yield from the fishery …*

   The present and probable future condition of the Atlantic herring resource and estimates of MSY were updated through the most recent 2018 benchmark stock assessment as well as the 2020 management track assessment in June 2020 (NEFSC 2020a). Information related to the Atlantic herring stock assessment and updated biological reference points are summarized in Section 5.1 of this document.

4. *Assess and specify-- (A) the capacity and the extent to which fishing vessels of the United States, on an annual basis, will harvest the optimum yield specified under paragraph (3); etc.*

   This MSA provision relates directly to the Atlantic herring fishery specification process and is addressed when the Council develops the specifications for the herring fishery, including OY, Domestic Annual Processing (DAP), and Domestic Annual Harvesting (DAH). This action is focused on a rebuilding plan policy, not the specific catch limits associated with fishery specifications. This action does include a measure expected to improve flexibility for the fishery to optimize yield by modifying overage provisions related to sub-ACLs.

5. *Specify the pertinent data which shall be submitted to the Secretary with respect to commercial, recreational, and charter fishing in the fishery …*

   Data regarding the type and quantity of fishing gear used, catch by species, areas fished, season, sea sampling hauls, and domestic harvesting/processing capacity are updated in the Affected Environment (Section 5.5) of this document.

6. *Consider and provide for temporary adjustments, after consultation with the Coast Guard and persons utilizing the fishery, regarding access to the fishery for vessels otherwise prevented from harvesting because of weather or other ocean conditions …*

   The Proposed Action does not alter any adjustments made in the Atlantic herring FMP that address opportunities for vessels that would otherwise be prevented from harvesting because of weather or other ocean conditions affecting safety aboard fishing vessels. Therefore, consultation with the U.S. Coast Guard was not required relative to this issue. The safety of fishing vessels and life at-sea is a high priority issue for the Council and was considered throughout the development of the management measures proposed in Amendment 8 to this FMP (May 2019).

7. *Describe and identify essential fish habitat for the fishery …*

   Essential fish habitat has been identified for Atlantic herring in the Atlantic herring FMP and has been addressed through all subsequent related management actions in a manner consistent with the MSA. Amendment 8 updated the description of the physical environment and EFH (NEFMC 2019) and evaluated the impacts on EFH of the proposed action and other alternatives (NEFMC, 2019). Nothing in this action changes those descriptions and evaluations.

8. *In the case of a fishery management plan that, after January 1, 1991, is submitted to the Secretary for review under section 304(a) assess and specify the nature and extent of scientific data which is needed for effective implementation of the plan;*

   Amendment 8 provides an updated list of data and research needs with respect to the Atlantic herring fishery and its management program and the Council reviews research priorities across all FMPs on an annual basis. The SSC has reviewed the most recent benchmark and management track assessments, the most updated scientific data available for regarding the status of the Atlantic herring resource. No new data is required for the implementation of this action.

9. *Include a fishery impact statement for the plan or amendment*

   Any additional impacts from measures proposed in this action are evaluated in Section 6.0 of this document.

10. *Specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished …*

    The status determination criteria for Atlantic herring were established in the Atlantic herring FMP and were revised through Amendment 4. This action proposes an update to the overfishing and overfished definitions incorporating results from the most recent stock assessment. The most recent management track assessment concluded that the stock is overfished and overfishing is not occurring (See Section 5.1) and the proposed overfishing/overfished definition is summarized in Section 5.1 and Table 3.

11. *Establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery …*

    In 2015, NMFS approved a Standardized Bycatch Reporting Methodology (SBRM) amendment submitted by the Councils. NMFS led the development of an omnibus amendment to establish provisions for industry-funded monitoring across all New England and Mid-Atlantic Council-managed FMPs (Amendment 7 to the Atlantic herring FMP). The amendment's final measures were published in April 2018 and became fully effective in 2021.

12. *Assess the type and amount of fish caught and released alive during recreational fishing under catch and release fishery management programs and the mortality of such fish …*

    The Atlantic herring FMP does not include a catch and release recreational fishery management program because there is no recreational fishery for herring although sometimes recreational fishermen catch herring to use as bait.

13. *Include a description of the commercial, recreational, and charter fishing sectors which participate in the fishery …*

    Aside from the importance of Atlantic herring as a forage species in the Northeast U.S. and the use of Atlantic herring as bait in recreational fisheries, there is no specific recreational interest in the fishery (Amendment 8, Section 3.6 and Section 5.6 of this action describes the commercial sector).

14. *To the extent that rebuilding plans or other conservation and management measures which reduce the overall harvest in a fishery are necessary, allocate any harvest restrictions or recovery benefits fairly and equitably among the commercial, recreational, and charter fishing sectors in the fishery.*

    The Atlantic herring FMP does not allocate catch among the commercial, recreational and charter fisheries. The proposed action does include implementation of a rebuilding plan but it does not directly implement harvest reductions and only recommends reductions in the overall harvest in future action if there is risk of overfishing until herring biomass improves.

15. *Establish a mechanism for specifying annual catch limits in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability.*

    The Atlantic herring FMP includes a multi-year specifications process for the herring fishery that complies with the ACL/AM provisions of the MSA. Future Council actions for this FMP will continue to specify ACLs to prevent overfishing and measures to ensure accountability in the fishery.

7.2 NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) provides a mechanism for identifying and evaluating the full spectrum of environmental issues associated with federal actions and for considering a reasonable range of alternatives to avoid or minimize adverse environmental impacts. The Council on Environmental Quality has issued regulations specifying the requirements for NEPA documents (40 CFR 1500 – 1508), as has NOAA in its policy and procedures for NEPA (NAO 216-6A). This EA is being prepared using the 2020 CEQ NEPA Regulations. The effective date of the 2020 CEQ NEPA Regulations was September 14, 2020, and reviews begun after this date are required to apply the 2020 regulations unless there is a clear and fundamental conflict with an applicable statute. 85 Fed. Reg. at 43372-73 (§§ 1506.13, 1507.3(a)). This EA began in December 2020 [DATE] and accordingly proceeds under the 2020 regulations.

All NEPA requirements are addressed in this action, as described below.

7.2.1 Environmental Assessment

The required elements of an Environmental Assessment (EA) are specified in 40 CFR 1501.5(c). They are included in this document as follows:

- The need for this action is in Section 3.2;
- The alternatives that were considered are in Section 4.0;
- The environmental impacts of the proposed action are in Section 6.0
- A determination of significance has been prepared separately by NMFS (FONSI statement); and,
- The agencies and persons consulted on this action are in Sections 7.2.3.

While not required for the preparation of an EA, this document includes the following additional sections that are based on requirements for an Environmental Impact Statement (EIS).

- An executive summary is in Section 1.0;
- A table of contents is in Section 2.0;
- Background and purpose are in Section 3.0;
- A summary of the document is in the executive summary in Section 1.0;
- A brief description of the affected environment is in Section 5.0;
- Cumulative impacts of the proposed action are in Section 6.6;
- A list of preparers is in Section 7.2.4.

7.2.2 Point of Contact

Questions concerning this document may be addressed to:

Mr. Thomas A. Nies, Executive Director
New England Fishery Management Council
50 Water Street, Mill 2
Newburyport, MA 01950 (978) 465-0492

7.2.3 Agencies Consulted

The following agencies, listed alphabetically, were consulted in preparing this document:

- Atlantic States Marine Fisheries Commission and Atlantic Herring Section

- Mid-Atlantic Fishery Management Council
- New England Fishery Management Council, including representatives from:
    - Connecticut Department of Environmental Protection
    - Maine Department of Marine Resources
    - Massachusetts Division of Marine Fisheries
    - New Hampshire Fish and Game
    - Rhode Island Department of Environmental Management
- National Marine Fisheries Service, NOAA, Department of Commerce
- United States Coast Guard, Department of Homeland Security
- United States Fish and Wildlife Service, Department of Interior

7.2.4 List of Preparers

The following personnel participated in preparing this document:

- ***New England Fishery Management Council***. Deirdre Boelke (Herring Plan Coordinator), Michelle Bachman, Woneta Cloutier, Dr. Rachel Feeney, Chris Kellogg, Thomas Nies
- ***National Marine Fisheries Service.*** Dr. Jonathan Deroba, Marianne Ferguson, Dr. Min-Yang Lee, Maria Fenton, Carrie Nordeen, Danielle Palmer, Ashley Weston, Sara Weeks
- ***State agencies.*** Matthew Cieri (Maine DMR), Micah Dean (MADMF), Renee Zobel (NHFG)
- Mid-Atlantic Fishery Management Council. Jason Didden

7.2.5 Opportunity for Public Comment

This action was developed from December 2020 – September 2021, and there were 16 public meetings related to this action (Table 38). Opportunities for public comment occurred at Advisory Panel, Committee, and Council meetings. There were more limited opportunities to comment at PDT meetings. Meeting discussion documents and summaries are available at www.nefmc.org.

Table 38. Public meetings related to Framework 9.

Date	Meeting Type	Location
December 1, 2020	Council	Webinar
December 9, 2020	Advisory Panel	Webinar
December 11, 2020	Committee	Webinar
January 20, 2021	PDT	Webinar
February 23, 2021	Advisory Panel	Webinar
February 25, 2021	Committee	Webinar
March 12, 2021	PDT	Webinar
March 26, 2021	SSC	Webinar
April 14, 2021	Council	Webinar
May 19, 2021	PDT	Webinar
June 2, 2021	Advisory Panel	Webinar
June 4, 2021	Committee	Webinar
July 28, 2021	PDT	Webinar

September 13, 2021	Advisory Panel	Webinar
September 15, 2021	Committee	Webinar
September 28, 2021	Council	Webinar

7.3 Marine Mammal Protection Act

Section 6.3 contains an assessment of the impacts of the proposed action on marine mammals. The New England Fishery Management Council has reviewed the impacts of the proposed action on marine mammals and has concluded that the management actions proposed are consistent with the provisions of the MMPA. Although they are likely to affect marine mammals inhabiting the management unit, the specifications will not alter the effectiveness of existing MMPA measures to protect those species, such as take reduction plans, based on the overall reductions in fishing effort and the effectiveness of other management measures that have been implemented through the Atlantic herring FMP.

7.4 Endangered Species Act

This action does not represent any irreversible or irretrievable commitment of resources with respect to the FMP that would affect the development or implementation of reasonable and prudent measures during the consultation period. NMFS has discretion to amend its MSA and Endangered Species Act (ESA) regulations and may do so at any time subject to the Administrative Procedure Act and other applicable laws. Thus, the Council has preliminarily determined that fishing activities conducted pursuant to this action will not affect endangered and threatened species or critical habitat in any manner beyond what has been considered in prior consultations on this fishery.

Section 7 of the ESA requires Federal agencies conducting, authorizing, or funding activities that affect threatened or endangered species to ensure that those effects do not jeopardize the continued existence of listed species. The batched fisheries Biological Opinion finalized December 16, 2013, concluded that the actions considered would not jeopardize the continued existence of any listed species. On October 17, 2017, NMFS reinitiated consultation on the batched Biological Opinion due to updated information on the decline of Atlantic right whale abundance.

Section 7(d) of the ESA prohibits Federal agencies from making any irreversible or irretrievable commitment of resources with respect to the agency action that would effectively foreclose the formulation or implementation of any reasonable and prudent alternatives during the consultation period. This prohibition is in force until the requirements of section 7(a)(2) have been satisfied. Section 7(d) does not prohibit all aspects of an agency action from proceeding during consultation; non-jeopardizing activities may proceed if their implementation would not violate section 7(d). Per the October 17, 2017, memo, it was concluded that allowing those fisheries specified in the batched Biological Opinion to continue during the reinitiation period will not increase the likelihood of interactions with ESA-listed species above the amount that would otherwise occur if consultation had not been reinitiated. Based on this, the memo concluded that the continuation of these fisheries during the reinitiation period would be unlikely to jeopardize the continued existence of any ESA-listed species. Taking this and the impacts of the proposed action into consideration, the proposed action, along with other activities, is not expected to jeopardize to any ESA-listed species.

Formal consultation on the Atlantic herring fishery was last completed on October 29, 2010. The October 29, 2010, Biological Opinion concluded that the operation of the herring fishery fishery is unlikely to jeopardize the continued existence of listed species. An ESA Section 7 consultation for this action was completed on [date]. The consultation concluded that the proposed specification measures do not constitute a modification to the operations of the herring fisheries under the FMP that would cause an effect to ESA-listed species or critical habitat not considered in the [date] Biological Opinion.

7.5 Administrative Procedure Act

Sections 551-553 of the Administrative Procedure Act established procedural requirements applicable to informal rulemaking by federal agencies. The purpose is to ensure public access to the federal rulemaking process, and to give public notice and opportunity for comment. The Council did not request relief from notice and comment rule making for this action and expects that NOAA Fisheries will publish proposed and final rule making for this action.

7.6 Paperwork Reduction Act

The purpose of the Paperwork Reduction Act is to minimize paperwork burden for individuals, small businesses, nonprofit institutions, and other persons resulting from the collection of information by or for the Federal Government. It also ensures that the Government is not overly burdening the public with information requests. This action does not include any revisions to the current PRA collection requirements; therefore, no review under the Paperwork Reduction Act is necessary.

7.7 Coastal Zone Management Act

Section 307 of the Coastal Zone Management Act (CZMA) is known as the federal consistency provision. Federal Consistency review requires that "federal actions, occurring inside or outside of a state's coastal zone, that have a reasonable potential to affect the coastal resources or uses of that state's coastal zone, to be consistent with that state's enforceable coastal policies, to the maximum extent practicable." The Council previously made determinations that the FMP was consistent with each state's coastal zone management plan and policies, and each coastal state concurred in these consistency determinations (in the Atlantic herring FMP). Since the proposed action does not propose any substantive changes from the FMP, the Council has determined that this action is consistent with the coastal zone management plan and policies of the coastal states in this region. Once the Council has adopted final measures and submitted Framework 9 to NMFS, NMFS will request consistency reviews by CZM state agencies directly.

7.8 Information Quality Act

Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554, also known as the Data Quality Act or Information Quality Act) directed the Office of Management and Budget (OMB) to issue government-wide guidelines that "provide policy and procedural guidance to federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by federal agencies." OMB directed each federal agency to issue its own guidelines, establish administrative mechanisms allowing affected persons to seek and obtain correction of information that does not comply with the OMB guidelines, and report periodically to OMB on the number and nature of complaints. The NOAA Section 515 Information Quality Guidelines require a series of actions for each new information product subject to the Data Quality Act. Information must meet standards of utility, integrity and objectivity. This section provides information required to address these requirements.

Utility of Information Product

Framework 9 includes: a description of the management issues to be addressed, statement of goals and objectives, a description of the proposed action and other alternatives/options considered, analyses of the impacts of the proposed measures and other alternatives/options on the affected environment, and the reasons for selecting the preferred alternatives. These proposed modifications implement the FMP's conservation and management goals consistent with the Magnuson-Stevens Fishery Conservation and Management Act as well as all other existing applicable laws.

Utility means that disseminated information is useful to its intended users. "Useful" means that the content of the information is helpful, beneficial, or serviceable to its intended users, or that the information supports the usefulness of other disseminated information by making it more accessible or easier to read, see, understand, obtain or use. The information presented in this document is helpful to the intended users (the affected public) by presenting a clear description of the purpose and need of the proposed action, the measures proposed, and the impacts of those measures. A discussion of the reasons for selecting the proposed action is included so that intended users may have a full understanding of the proposed action and its implications. The intended users of the information contained in this document are participants in the herring fishery and other interested parties and members of the general public. The information contained in this document may be useful to owners of vessels holding an Atlantic herring permit as well as Atlantic herring dealers and processors since it serves to notify these individuals of any potential changes to management measures for the fishery. This information will enable these individuals to adjust their fishing practices and make appropriate business decisions based on the new management measures and corresponding regulations.

The information being provided in this action concerning the status of the herring fishery is updated based on landings and effort information through the 2020 fishing year. Information presented in this document is intended to support Framework 9 and the proposed measures, which have been developed through a multi-stage process involving all interested members of the public. Consequently, the information pertaining to management measures contained in this document has been improved based on comments from the public, fishing industry, members of the Council, and NOAA Fisheries.

Until a proposed rule is prepared and published, this document is the principal means by which the information herein is publicly available. The information provided in this document is based on the most recent available information from the relevant data sources, including detailed and relatively recent information on the herring resource and, therefore, represents an improvement over previously available information. This document will be subject to public comment through proposed rulemaking, as required under the Administrative Procedure Act and, therefore, may be improved based on comments received.

This document is available in several formats, including printed publication, and online through the NEFMC's web page (www.nefmc.org). The *Federal Register* notice that announces the proposed rule and the final rule and implementing regulations will be made available in printed publication, on the website for the Greater Atlantic Regional Fisheries Office (www.greateratlantic.fisheries.noaa.gov), and through the Regulations.gov website. The *Federal Register* documents will provide metric conversions for all measurements.

Integrity of Information Product

Integrity refers to security – the protection of information from unauthorized access or revision, to ensure that the information is not compromised through corruption or falsification. Prior to dissemination, information associated with this action, independent of the specific intended distribution mechanism, is safeguarded from improper access, modification, or destruction, to a degree commensurate with the risk and magnitude of harm that could result from the loss, misuse, or unauthorized access to or modification of such information. All electronic information disseminated by NMFS adheres to the standards set out in Appendix III, "Security of Automated Information Resources," of OMB Circular A-130; the Computer Security Act; and the Government Information Security Act. All confidential information (e.g. dealer purchase reports) is safeguarded pursuant to the Privacy Act; Titles 13, 15, and 22 of the U.S. Code (confidentiality of census, business, and financial information); the Confidentiality of Statistics provisions of the Magnuson-Stevens Act; and NOAA Administrative Order 216-100, Protection of Confidential Fisheries Statistics.

Objectivity of Information Product

Objective information is presented in an accurate, clear, complete, and unbiased manner, and in proper context. The substance of the information is accurate, reliable, and unbiased; in the scientific, financial, or statistical context, original and supporting data are generated and the analytical results are developed using sound, commonly accepted scientific and research methods. “Accurate” means that information is within an acceptable degree of imprecision or error appropriate to the *kind* of information at issue and otherwise meets commonly accepted scientific, financial, and statistical standards.

For purposes of the Pre-Dissemination Review, this document is a “Natural Resource Plan.” Accordingly, the document adheres to the published standards of the MSA; the Operational Guidelines, Fishery Management Plan Process; the Essential Fish Habitat Guidelines; the National Standard Guidelines; and NOAA Administrative Order 216-6A, Environmental Review Procedures for Implementing NEPA. This information product uses information of known quality from sources acceptable to the relevant scientific and technical communities. Several data sources were used in the development of this action, including, but not limited to, historical and current landings data from the Commercial Dealer database, vessel trip report (VTR) data, and fisheries independent data collected through the NMFS bottom trawl surveys. The analyses herein were prepared using data from accepted sources and have been reviewed by members of the Atlantic Herring Plan Development Team and by the SSC where appropriate.

Despite current data limitations, the conservation and management measures considered for this action were selected based upon the best scientific information available. The analyses important to this decision used information from the most recent complete calendar years, generally through 2020. The data used in the analyses provide the best available information on the number of permits, both active and inactive, in the fishery, the catch (including landings and discards) by those vessels, the landings per unit of effort (LPUE), and the revenue produced by the sale of those landings to dealers, as well as data about catch, bycatch, gear, and fishing effort from a subset of trips sampled at sea by government observers.

Specialists (including professional members of PDTs, technical teams, committees, and Council staff) who worked with these data are familiar with the most current analytical techniques and with the available data and information relevant to the small-mesh multispecies fishery. The proposed action is supported by the best available scientific information. The policy choice is clearly articulated in Section 4.0, the management alternatives considered in this action.

The supporting science and analyses, upon which the policy choice was based, are summarized and described in the SAFE Report for Fishing Years 2021-2023 (Framework 8), Section 6.0 of this document, and in the Amendment 8 FEIS. All supporting materials, information, data, and analyses within this document have been, to the maximum extent practicable, properly referenced according to commonly accepted standards for scientific literature to ensure transparency. The review process used in preparation of this document involves the responsible Council, the NEFSC, GARFO, and NOAA Fisheries Service Headquarters. The NEFSC’s technical review is conducted by senior-level scientists specializing in population dynamics, stock assessment, population biology, and social science.

The Council review process involves public meetings at which affected stakeholders have opportunity to comment on the document. Review by staff at GARFO is conducted by those with expertise in fisheries management and policy, habitat conservation, protected species, and compliance with the applicable law. The Council also uses its SSC to review the background science and assessment to approve the Overfishing Limits (OFLs) and Allocable Biological Catch (ABCs), including the effects those limits would have on other specifications in this document. The SSC is the primary scientific and technical advisory body to the Council and is made up of scientists that are independent of the Council.

A list of current committee members can be found at https://www.nefmc.org/committees/scientific-and-statistical-committee.

Final approval of the action proposed in this document and clearance of any rules prepared to implement resulting regulations is conducted by staff at NOAA Fisheries Service Headquarters, the Department of Commerce, and the U.S. Office of Management and Budget. In preparing this action for the Herring FMP, NMFS, the Administrative Procedure Act, the Paperwork Reduction Act, the Coastal Zone Management Act, the Endangered Species Act, the Marine Mammal Protection Act, the Information Quality Act, and Executive Orders 12630 (Property Rights), 12866 (Regulatory Planning), 13132 (Federalism), and 13158 (Marine Protected Areas). The Council has determined that the proposed action is consistent with the National Standards of the MSA and all other applicable laws.

7.9 Executive Order 13158 (Marine Protected Areas)

Executive Order (EO) 13158 on Marine Protected Areas (MPAs) requires each federal agency whose actions affect the natural or cultural resources that are protected by an MPA to identify such actions, and, to the extent permitted by law and to the maximum extent practicable, in taking such actions, avoid harm to the natural and cultural resources that are protected by an MPA. The EO directs federal agencies to refer to the MPAs identified in a list of MPAs that meet the definition of MPA for the purposes of the EO. The EO requires that the Departments of Commerce and the Interior jointly publish and maintain such a list of MPAs. A list of MPA sites has been developed and is available at: http://marineprotectedareas.noaa.gov/nationalsystem/nationalsystemlist/. No further guidance related to this EO is available at this time.

In the Northeast U.S., the only MPAs are the Stellwagen Bank National Marine Sanctuary (SBNMS), the Tilefish Gear Restricted Areas in the canyons of Georges Bank, and the National Estuarine Research Reserves and other coastal sites. The only MPA that overlaps the herring fishery footprint is the SBNMS, and that is expected to decline after implementation of the inshore MWT gear prohibition implemented under Amendment 8.

This action is not expected to more than minimally affect the biological/habitat resources of the Stellwagen MPA, which was comprehensively analyzed in the Omnibus Habitat Amendment 2 (NEFMC 2016). Fishing gears regulated by the Atlantic herring FMP are unlikely to damage shipwrecks and other cultural artifacts because fishing vessel operators avoid contact with cultural resources on the seafloor to minimize costly gear losses and interruptions to fishing.

7.10 Executive Order 13132 (Federalism)

Executive Order 131321 on federalism established nine fundamental federalism principles for Federal agencies to follow when developing and implementing actions with federalism implications. However, no federalism issues or implications have been identified relative to the measures proposed in this action, thus preparation of an assessment under EO 13132 is unwarranted. The affected states have been closely involved in the development of the proposed action through their representation on the Council. All affected states are represented as voting members of at least one Regional Fishery Management Council. No comments were received from any state officials relative to any federalism implications that may be associated with this action.

7.11 Executive Order 12898 (Environmental Justice)

Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations provides guidelines to ensure that potential impacts on these populations are identified and mitigated, and that these populations can participate effectively in the NEPA process (EO 12898 1994). NOAA guidance NAO 216-6A, Companion Manual, Section 10(A) requires the consideration of EO 12898 in NEPA documents. Agencies should also encourage public participation, especially by affected communities, during scoping, as part of a broader strategy to address environmental justice issues. Minority and low-income individuals or populations must not be excluded from participation in, denied the benefits of, or subjected to discrimination because of their race, color, or national origin.

Environmental justice is measured at the community level. Here, community is defined as a fishing community. Indicators of vulnerability for purposes of environmental justice can include but are not limited to income, race/ethnicity, household structure, education levels, and age. The NOAA Fisheries Community Social Indicators, especially the poverty, population composition, and personal disruption indices (Table 20) can help identify the communities where environmental justice may be of concern. Herring ports that ranked medium-high to high for at least one of these indices are: Stonington, Isle au Haut and Matinicus, Maine and Boston, New Bedford and Fall River, Massachusetts. These communities may be more vulnerable to changes in federal actions, due to factors described above as important indicators for environmental justice, noting that Boston has low reliance on the herring fishery due to the size of the city (Table 18), so any impacts in Boston may be less pronounced than in other communities.

Although the impacts of the Proposed Action may affect communities with environmental justice concerns, the proposed action should not have disproportionately high effects on low income or minority populations. The proposed action would apply to all participants in the affected area, regardless of minority status or income level. There is insufficient demographic data on participants in the Atlantic herring fishery (i.e., vessel owners, crew, dealers, processors, employees of supporting industries) to quantify the income and minority status of potentially affected fishery participants. However, it is qualitatively known that people of racial or ethnic minorities constitute a substantial portion of the employees in the seafood processing sector, particularly in communities such as New Bedford. For the herring fishery, evidence suggests that minority participation is focused within the processing sector. For a New Bedford-based herring processor, 90-95% of its employees are of Central American descent (Section 4.5.1.5.4, Amendment 5 DEIS). For a New Jersey-based processor, its minority employees are Hispanic (Lund's, personal communication, 2012).

Without more data, it is difficult to fully determine how this action may impact various population segments. The public comment process is an opportunity to identify issues that may be related to environmental justice, but none have been raised relative to this action. The public has never requested translations of documents pertinent to the Atlantic herring fishery.

Regarding subsistence consumption of fish and wildlife, federal agencies are required to collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence. GARFO tracks these issues, but there are no federally recognized tribal agreements for subsistence fishing in New England federal waters.

7.12 Regulatory Flexibility Act (RFA)

The purpose of the Regulatory Flexibility Act (RFA) is to reduce the impacts of burdensome regulations and recordkeeping requirements on small businesses. To achieve this goal, the RFA requires Federal agencies to describe and analyze the effects of proposed regulations, and possible alternatives, onsmall business entities. To this end, this document contains an Initial Regulatory Flexibility Analysis (IRFA), found below, which includes an assessment of the effects that the Proposed Action and other alternatives are expected to have on small entities.

Under section 603(b) of the RFA, an IRFA must describe the impact of the proposed rule on small entities and contain the following information:

A description of the reasons why the action by the agency is being considered.

1. A succinct statement of the objectives of, and legal basis for, the proposed rule.
2. A description—and, where feasible, an estimate of the number—of small entities towhich the proposed rule will apply.
3. A description of the projected reporting, recordkeeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities thatwill be subject to the requirement and the types of professional skills necessary for preparation of the report or record.
4. An identification, to the extent practicable, of all relevant federal rules that may duplicate, overlap, or conflict with the proposed rule.

7.12.1 Reasons for Considering the Action

The purpose and need for this action are presented in Section 3.2 of this document.

7.12.2 Objectives and Legal Basis for the Action

The objectives for this action are presented in Section 3.2 of this document, and the legal basis is in Section 7.0.

7.12.3 Description and Estimate of Small Entities to Which the RuleApplies

For RFA purposes only, NMFS has established a small business size standard for businesses, including their affiliates, whose primary industry is commercial fishing (50 CFR § 200.2). A business primarily engaged in commercial fishing (NAICS code 11411) is classified as a small business if it is independently owned and operated, is not dominant in its field of operation (including its affiliates) and has combined annual receipts not in excess of $11 million for all its affiliated operations worldwide.

For the purposes of this analysis, entities (firms) are defined as collections of fishing vessels with identical ownership personnel. For example, if five permits have the same seven people listed as co-owners on their application paperwork, those seven people form one ownership entity, covering those five permits. If any of the individual people own additional vessels, either by themselves, with new co-owners, or with a subset of the seven, those vessels are separate entities for the purpose of this analysis.

7.12.4 Regulated Commercial Harvesting Entities

7.12.4.1 Tier 1 All Directly Regulated Fishing Firms

This rule would affect all vessels with permits to fish in the herring fisheries; therefore, the direct regulated entity is a firm that controls at least one herring permit. Table 39 describes the small and large directly regulated fishing entities. A firm is included if it owned at least one category A, B, C, D, or E Herring Permit on July 1, 2021. Average revenue for each firm over the past three years (2018-2020) is summarized and used to make a size determination. There are nine large entities and 1,213 small entities.

The nine large entities earned a combined $189M in fishing revenue (an average of about $21M per firm) over the trailing three years. About $2M (an average of about $225,000) of that revenue was derived from herring. The 1,213 small entities earned a combined $655M in fishing revenue (an average of about $540,000 per firm). About $11M (an average of about $9,000) of that revenue was derived from herring.

7.12.4.2 Tier 2 Directly Regulated Firms with a Limited Access Herring Permit

Many of the firms described in Table 39 hold only an (open access) category D herring permit and no other herring permit. Impacts of the proposed regulation are likely to be largest for the participants in the directed fishery (holding at least one A, B, C, or E category permit). Table 40 describes the directly regulated entities that hold at least one of these permits. There are six large entities and 97 small entities that meet these criteria.

The six large entities earned a combined $129M in fishing revenue (an average of about $21.5M per firm) over the trailing three years. About $2M (an average of about $333,000) of that revenue was derived from herring. The 97 small entities earned a combined $131M in fishing revenue (an average of about $1.4M per firm). About $11M (an average of about $111,000 per firm) of that revenue was derived from herring.

7.12.4.3 Tier 3 Active Directly Regulated Firms with a Limited Access Herring Permit

Some of the firms described in the previous section are not active in the herring fishery, despite controlling a Limited Access herring permit. The "active, Limited Access" fishery, where active is defined as deriving any revenue from herring in 2020, is described in Table 41. There are two large and 29 small entities that meet this criterion. Because there are only two large entities, revenue statistics for this class are not presented. The 29 active small entities earned a combined $31.99M in fishing revenue (an average of about $1.18M per firm). About $0.65M (an average of about $394,000 per firm) of that revenue was derived from herring.

Table 39. Directly Regulated Fishing Firms (Tier 1).

	Large	Small
Firms	9	1,213
Total Vessels	130	1,630
Total Receipts	$188.77	$655.34
Herring Receipts	$2.03	$11.09
Mackerel Receipts	$0.88	$2.96
Menhaden Receipts	$0.01	$4.58
Squid Receipts	$10.76	$48.32
Other Receipts	$175.09	$588.40
Note: Revenue figures represent aggregate revenue for the small and large classes of firms, averaged over 2018-2020 and are in millions of nominal US Dollars.		

Table 40. Directly regulated fishing firms with a Limited Access Herring permit (Tier 2).

	Large	Small
Firms	6	97
Total Vessels	85	165
Total Receipts	$129.08	$131.28
Herring Receipts	$2.03	$10.86
Mackerel Receipts	$0.88	$2.58
Menhaden Receipts	$0.00	$2.76
Squid Receipts	$10.75	$33.61

Other Receipts	$115.41	$81.48
Note: Revenue figures represent aggregate revenue for the small and large classes of firms, averaged over 2018-2020 and are in millions of nominal US dollars.		

Table 41. Active, directly regulated fishing firms with a Limited Access Herring permit (Tier 3).

	Small
Firms	29
Total Vessels	39
Total Receipts	$31.99
Herring Receipts	$10.65
Mackerel Receipts	$2.10
Menhaden Receipts	$0.22
Squid Receipts	$10.87
Other Receipts	$8.15
Note: These firms hold at least one A,B, C, or E category permit and had revenue from herring in 2020. Revenue figures represent aggregate revenue for the small classes of firms, averaged over 2018-2020 and are in millions of nominal US Dollars. There were fewer than three large firms that derived revenue from herring in 2020, so these data are not presented.	

7.12.5 Record Keeping and Reporting Requirements

There are no additional record keeping or reporting requirements associated with this action.

7.12.6 Duplication, Overlap, or Conflict with Other Federal Rules

No relevant Federal rules have been identified that would duplicate or overlap the proposed action.

7.12.7 Impacts of the Proposed Rule on Small Entities

The proposed action would establish a rebuilding plan for herring, adopting the ABC control rule from Amendment 8 as the rebuilding plan. Under the status quo, the fishery would be managed with the ABC control rule from Amendment 8. Therefore, the rebuilding plan component of the proposed regulation would have no direct economic impacts on the small entities.

The proposed action would also change the accountability measures in the herring fishery; so up to 10% overage of a sub-ACL before payback provisions reduce future sub- ACLs, provided the total ACL is not exceeded. This is expected to increase fishery revenue by $160,000 per year relative to the status quo.

To examine the effects of the proposed rule on small entities, the additional expected revenue to fishing firms is allocated in proportion to their share of the herring fishery over the trailing three years. The change in gross receipts, in both dollar and percentage terms, for each of the firms is then constructed. This analysis assumes that fishing in the future in the "other fisheries" is like the 2018-2020 average and that proportional expansions or decreases at the firm level would occur relative to the 2018-2020 average. So, if a firm "exited" prior to 2018, it will not have any revenue if even if conditions improve.

Table 42 illustrates the expected changes in receipts. Most of the additional revenue accrues to small firms; however, the increase in gross receipts from fishing is quite small in magnitude[17].

Table 42. Expected changes in gross receipts (millions of nominal USD)

	Large	Small
Firms	9	1,213
Baseline Gross Receipts	$188.767	$655.343
Gross Receipts (Preferred Alt)	$188.793	$655.477
Baseline Herring Receipts	$2.032	$11.093
Herring Receipts (Preferred Alt)	$2.058	$11.227
Change in Herring Receipts	$0.026	$0.134

7.12.7.1 Tier 1 All Directly Regulated Fishing Firms

Figure 38 is a histogram of the change in gross receipts for small firms in the fishery. Figure 39 is a histogram of the change in gross receipts for small firms in the fishery in percentage terms.

Figure 38. Changes in gross receipts for small directly regulated firms with any herring permit (Tier 1)

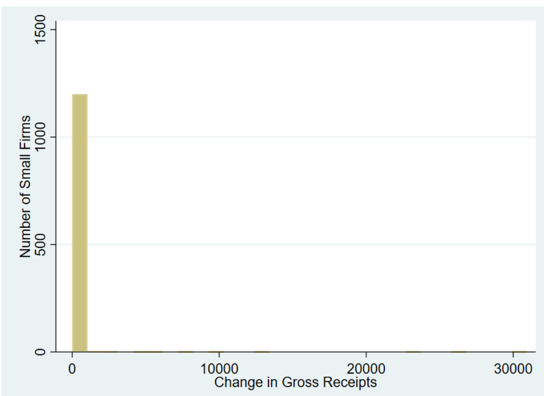
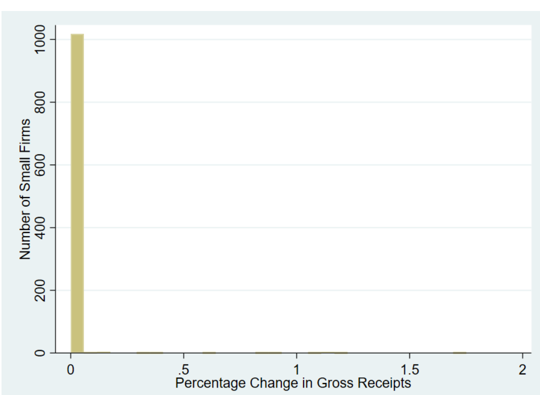


Figure 39. Changes in gross receipts for small directly regulated firms with any herring permit (Tier 1) expressed in percentage terms



[17] Because of the way additional revenue is allocated to the firms, the gross receipts of the inactive firms cannot increase.

7.12.7.2 Tier 2 Directly Regulated Firms with a Limited Access Herring Permit

Figure 40 is a histogram of the change in gross receipts for small firms in the fishery. Figure 41 is a histogram of the change in gross receipts for small firms in the fishery in percentage terms.

Figure 40. Changes in Gross Receipts for Directly Regulated Firms with a Limited Access Herring Permit (Tier 2)

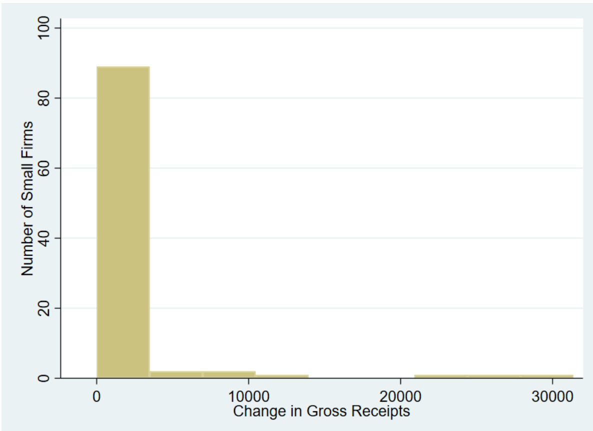
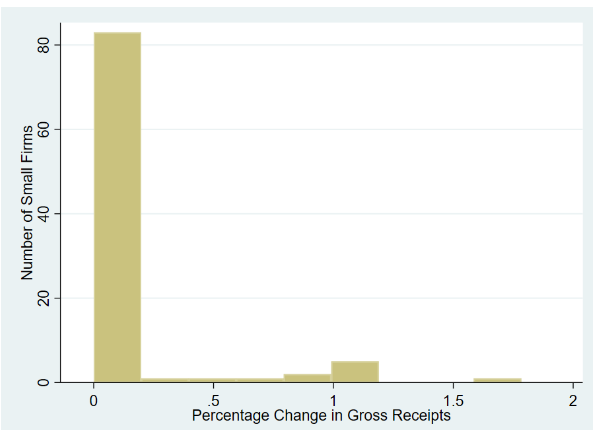


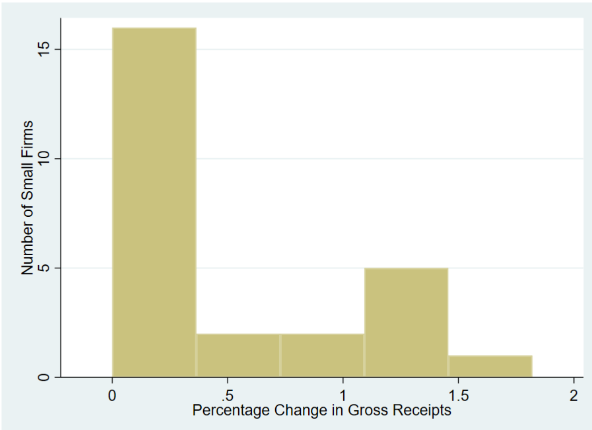
Figure 41. Changes in Gross Receipts for Directly Regulated Firms with a Limited Access Herring Permit (Tier 2) expressed in percentage terms



7.12.7.3 Tier 3 Active Directly Regulated Firms with a Limited Access Herring Permit

Figure 42 is a histogram of the change in gross receipts for small firms in the fishery in percentage terms; because there are relatively few firms, histogram of the change in gross receipts (analogous to Figure 38 and Figure 40) is not reported.

Figure 42. Changes in gross receipts for directly regulated firms with a limited access herring permit (Tier 2)



7.13 Executive Order 12866 (Regulatory Planning and Review)

The purpose of E.O 12866 is to enhance planning and coordination with respect to new and existing regulations. This E.O. requires the Office of Management and Budget (OMB) to review regulatory programs that are considered to be "significant." E.O. 12866 requires areview of proposed regulations to determine whether or not the expected effects would be significant, where a significant action is any regulatory action that may:

- Have an annual effect on the economy of $100 million or more, or adversely affect in a material way the economy, a sector of the economy, productivity, jobs, the environment,public health or safety, or State, local, or tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities,of the principles set forth in the Executive Order.

In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, include the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider.

7.13.1 Statement of the Problem/Goals and Objectives

Problem, goals, and objectives are explained in Section 3.2.

7.13.2 Management Alternatives and Rationale

The alternatives under consideration in this Framework are explained in Section 4.0.

7.13.3 Description of the Fishery

A description of the fishery is available in Section 5.5.

7.13.4 Summary of Impacts

The expected economics effects (benefits/costs) of the preferred alternative for Action 1 and 2, relative to the no action baseline for the herring fishery, are discussed throughout Section 6.5 of this document. Action 1 has no economic impacts on the directed herring fishery; the ABC control rule selected for rebuilding is identical to the ABC control rule currently in place.

The Atlantic herring fishery is overfished; however, overfishing is not occurring. A rebuilding plan must be developed and implemented within two years (by October, 2022). If the proposed regulations are not implemented by then, the herring fishery management plan would not be in compliance with the MSFCMA as of that date. This is likely to result in costly litigation; the remedy of the deficiency would be to consider and develop a rebuilding plan. Action 2 would likely lead to slightly higher catches; an increase in revenue of about $160,000 per year is expected to accrue to the participants in the herring fishery. Due to slightly higher catches, *de minimus* negative effects on the herring stock are expected. The preferred alternative for Action 2 would not increase catch above ACLs and is not expected to have an impact on future stock status.

7.13.5 Determination of Significance

Based on the analyses provided in this document, the proposed regulation is not expected to constitute a "significant regulatory action." This action is not expected to have an impact of $100M or more on the economy, or adversely affect in a material way the economy, a sector of the economy, productivity, jobs, the environment, public health or safety, or state, local, or tribal governments or communities. They are not expected to raise novel legal and policy issues. The proposed action also does not interfere with an action taken or planned by another agency. It does not materially alter the budgetary impact of entitlements, grants, user fees, or loan programs, or the rights and obligations of recipients.

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