FINAL

Omnibus Essential Fish Habitat Amendment 2

Volume 6: Cumulative effects, compliance with applicable law, and references

Amendment 14 to the Northeast Multispecies FMP
Amendment 14 to the Atlantic Sea Scallop FMP
Amendment 4 to the Monkfish FMP
Amendment 3 to the Atlantic Herring FMP
Amendment 2 to the Red Crab FMP
Amendment 2 to the Skate FMP
Amendment 3 to the Atlantic Salmon FMP

Including a
Final Environmental Impact Statement

Prepared by the
New England Fishery Management Council
In cooperation with the
National Marine Fisheries Service

New England Fishery Management Council
50 Water Street, Mill 2
Newburyport, MA 01950
(978) 465-0492 tel.
(978) 465-3116 fax

National Marine Fisheries Service
55 Great Republic Drive
Gloucester, MA 01930
(978) 281-9315 tel.
(978) 281-9135 fax

Intentionally blank

1 Contents: Volume 6

1.1 Table of contents

1.2 Tables

1.3 Figures

1.4 Maps

2 Cumulative effects analysis

The Council on Environmental Quality requires that Environmental Impact Statements (EISs) contain a cumulative effects assessment. The purpose of this assessment is to describe the combined effects of many actions that may be missed if these actions are analyzed individually. This section describes the potential direct and indirect effects of the alternatives in Omnibus Essential Fish Habitat Amendment 2 together with past, present, and reasonably foreseeable future actions that affect the New England fishery environment.

Cumulative effects are described relative to the Valued Ecosystem Components (VECs) identified in the Affected Environment section of this EIS (Volume 1, Section 4). These VECs are:

- Physical and biological environment, with a focus on seabed habitats in particular
- Managed species – this includes all species managed by the New England Fishery Management Council as well as species managed by other authorities that occur in the New England Region where changes to spatial management measures are under consideration
- Human communities and the fishery – this includes fisheries targeting the above managed species, and the communities associated with those fisheries
- Protected resources – this includes large and small cetaceans, pinnipeds, sea turtles, Atlantic sturgeon, and Atlantic salmon that occur in the New England Region where changes to spatial management measures are under consideration

The cumulative effects analysis describes (1) the baseline status of all VECs, (2) past, present, and foreseeable future actions, and (3) the cumulative effects of No Action, the Council's preferred action, and other alternatives, building upon the baseline status and considering other foreseeable future actions.

The geographic scope of this analysis includes the New England region, as delimited by the New England/Mid-Atlantic inter-council boundary. The region includes U.S. waters in the Gulf of Maine, on Georges Bank, and in Southern New England, together with the continental shelf and slope off Georges Bank and Southern New England to the EEZ boundary. Essential Fish Habitat and Habitat Area of Particular Concern designation alternatives in the amendment do extend south of this boundary, but these designations are administrative in nature and have indirect impacts that are limited to a general influence on fisheries management decisions and the EFH consultation process. All habitat, spawning, and research area management alternatives that would substantively affect fishing operations as well as other VECs are within the New England region.

The temporal scope of this analysis extends backwards in time to the initiation of federal fisheries management, but focuses on the most recent major action in any given fishery management plan, as well as other relatively recent changes in non-fishing activities. The analysis goes forward in time ten years from the planned implementation date of 2016 (i.e. to 2026), although obviously near-term actions are more reliably identified. Given the time it takes many species to recruit to the fishery, any benefits of habitat conservation measures that protect

juvenile fish are expected to be realized as productivity benefits at the stock level sometime around the five year mark. It will take slightly longer to translate increases in productivity into increased landings and economic benefits. Therefore, evaluating cumulative effects up to ten years into the future is consistent with the anticipated conservation and fishery production outcomes of the alternatives in this amendment.

2.1 Past, present, and foreseeable future actions

This section describes past, present, and future foreseeable actions that have effects on the valued ecosystem components evaluated in this amendment.

2.1.1 Fishery management

Federal fishery management plans are developed to optimize yield in U.S. fisheries and to comply with the Magnuson-Stevens Act as reauthorized through 2007. The legislation promotes long-term positive impacts on the environment in the context of fisheries activities, stipulating that management plans must comply with a set of National Standards that collectively serve to optimize the conditions of the human environment. Specific goals of fishery management plans include improving or maintaining the stock structure and abundance of target species, improving economic and social outcomes, and minimizing incidental impacts, for example relative to protected resources and other non-target species. Under this regulatory regime, the cumulative impacts of past, present, and future Federal fishery management actions on the VECs should be expected to result in positive long-term outcomes, although these actions are often associated with offsetting impacts. For example, constraining fishing effort frequently results in negative short-term socio-economic impacts for fishery participants in order to bring about long-term sustainability of a given resource.

In general, the designation of EFH is expected to have indirect, positive impacts on managed resources by guiding the development of conservation-oriented fishery management measures, and through conservation measures recommended for non-fishing projects via the EFH consultation process. Annual catch limits and accountability measures are also expected to have generally positive impacts of managed resources because these measures are designed to limit catches to biologically sustainable levels and to provide both proactive and reactive measures to ensure that these catch limits are not exceeded. Eliminating overfishing and reducing the number of overfished stocks is expected to generate long run benefits to the human community.

This section describes past, present, and future foreseeable fishery management plan actions. Additional information about the fishery management plans that affect the New England region may be found in Volume 1 in the “Managed species and fisheries” section. Future actions for all FMPs may include additional ecosystem considerations, either within the current FMP structure or as part of an overarching ecosystem plan. The New England and Mid-Atlantic Fishery Management Councils and the Atlantic States Marine Fisheries Commission do not currently have ecosystem plans in place, but all three groups are working on expanding their efforts in this sphere, and future management actions will be developed in the context of ongoing environmental change.

In some cases, as was done with this amendment, fishery management plan actions are developed in an omnibus fashion to update many plans at once. These amendments are considered amendments to the individual fishery management plans, and the actions associated with these amendments are described in the table below as needed, by FMP. Examples of this include the 1999 New England Fishery Management Council EFH amendment, which designated EFH across all species managed by the Council at that time. Another example is the Mid-Atlantic Council ACL/AM omnibus amendment, which implemented annual catch limits and accountability measures. The New England Council took a plan-specific approach to implementing ACLs and AMs. Conversely, while New England is taking an omnibus approach to EFH updates, the Mid-Atlantic has been updating their EFH provisions plan by plan, although they are currently in the planning stages of an omnibus review of their designations.

One special case set of omnibus actions are the Standardized Bycatch Reporting Methodology (SBRM) amendments, which cover Federal waters fisheries managed by the New England and/or the Mid-Atlantic Councils. The first SBRM amendment became effective in 2008, and an update to these measures was finalized in June 2015 (80 FR 37182). The updated regulations modify the following elements of the monitoring program: new prioritization process for allocation of observers if agency funding is insufficient to achieve target observer coverage levels; bycatch reporting and monitoring mechanisms; analytical techniques and allocation of at-sea fisheries observers; a precision-based performance standard for discard estimates; a review and reporting process; framework adjustment and annual specifications provisions; and provisions for industry-funded observers and observer set-aside programs.

Separate from the SBRM amendment, NMFS, in collaboration with the New England and Mid-Atlantic Councils, is developing an industry-funded monitoring amendment. The purpose of the amendment is to consider measures that would allow the Councils to develop new industry-funded monitoring programs using a standardized approach. These programs would allow industry funding to be used in conjunction with available Federal funding to pay for additional monitoring to meet fishery management plan-specific coverage targets. This action is needed to allow the Councils to recommend increased monitoring above SBRM coverage levels in specific fisheries and prioritize Federal funding across new industry-funded monitoring programs when funding falls short of Federal cost responsibilities for administering new industry-funded monitoring programs.

The Mid-Atlantic Council is developing a management action related to unmanaged forage species. The action was initiated in December 2014 to “prohibit the development of new, or expansion of existing, directed fisheries on unmanaged forage species until adequate scientific information is available to promote ecosystem sustainability.” Only those species that are not managed by the Mid-Atlantic Council, New England Council, or Atlantic States Marine Fisheries Commission will be addressed. The Mid-Atlantic Council conducted scoping hearings and collected written comments on this action during fall 2015, and reviewed scoping comments in October. At that meeting, the Council voted to initiate an omnibus amendment to add unmanaged forage species as ecosystem component species to the relevant fishery management plans for Council-managed stocks. The Council has not yet determined which forage species will be addressed through this action or which FMPs will be affected. Presumably these actions will

have positive impacts on fishery resources and the communities they support, but it is too early in the development of the amendment to assess what those impacts might be.

The New England Council is developing a deep-sea coral amendment which seeks to protect coral habitats in the New England region from the affects of fishing. The amendment was initially conceived as an add-on set of measures to this action, but due to the complexity of OHA2 the alternatives were split off and are being developed separately. The Council is considering coral management zones in the Gulf of Maine, and also off the southern margin of Georges Bank on the slope, in the canyons, and on the seamounts. The draft management areas are distinct from and do not spatially overlap with habitat management areas proposed in this amendment. Gear restrictions might be similar, i.e. prohibitions on the use of mobile-bottom tending gears, or more expansive, i.e. restrictions on all bottom-tending gears. Although some coral habitats exist beyond the depth range of shallower-waters fishes and invertebrates managed by the Council, many coral areas do overlap with designated EFH for resources managed by the Council. Thus, actions taken in the coral amendment could be expected to have positive impacts on these species.

Table 1 – Past, present, and future foreseeable actions within the fishery management plans in operation in the New England region

Fishery Management Plan	Past actions	Present actions	Future foreseeable actions
Northeast Multispecies FMP	FMP completed in 1986 by NEFMC to reduce fishing mortality and promote rebuilding. Past measures included input controls such as days-at-sea, mesh size, trip, and fish size, and permit limits, and seasonal and year-round management areas. EFH was designated in 1999.	Current management includes annual catch limits by stock and accountability measures for overages. The most recentspecifications were set via Framework 55 (final rule published May 2016). Most fishing conducted within the sector catch-share system. Limits on mesh-size, fish size, and permits are still used, along with area management. Trip limits and days-at-sea are infrequently relied upon.	Amendment 18: caps accumulation limits at an average of 15.5% across all stocks and creates a 5% permit cap. Ongoing specifications actions will allocate annual catch limits in response to updated assessment information. Updates to spawning closures on the multi-year Council priority list. Currently scoping for limited access in small-mesh segment of fishery.

Fishery Management Plan	Past actions	Present actions	Future foreseeable actions
Monkfish FMP	FMP completed in 1999 by NEFMC and MAFMC to address concerns about small fish in landings, gear conflicts, and expanding directed fishery. Measures included permit and day-at-sea limits, trip limits, minimum fish sizes, seasonal spawning restrictions, and gear restrictions, as well as EFH designations. A subsequent action included designation of EFH management areas closed to monkfishing in Lydonia and Oceanographer canyons.	Current management includes annual catch limits by stock and accountability measures for overages. In addition to original FMP measures, current management includes various exemption areas for trawls and gillnets where vessels can use large mesh and are not required to use a Multispecies day-at-sea. Management is closely tied to Northeast Multispecies FMP. Habitat closure areas in two canyons.	Amendment 6: considering modifications to days-at-sea program and catch shares. Ongoing specifications actions will allocate annual catch limits in response to updated assessment information.
Skate Complex FMP	FMP completed in 2003 by NEFMC to protect overfished skates and collect data about the fishery to improve management. Measures included federal permits, reporting requirements, possession limits for wing fishery, and prohibitions on landings of depleted species, as well as EFH designations.	Current management includes annual catch limits and accountability measures for overages. Possession limits now include both wing and bait fisheries.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information.
Atlantic Sea Scallop FMP	FMP completed in 1982 by NEFMC to rebuild stock and reduce interannual fluctuations in abundance. Measures included limits on permits, days-at-sea, crew size, gear restrictions, and meat count restrictions. EFH was designated in 1999 and Amendment 10 (implemented 2004) designated EFH closures, which were updated via Amendment 15 (implemented 2011) updated these areas to be consistent with those in Multispecies Amendment 13	Current management includes annual catch limits and accountability measures for overages. Rotational closure/access area system combined with open area days-at-sea. Seasonal closures and groundfish sub-ACLs to limit fish bycatch, gear restrictions to limit turtle bycatch. No longer have meat count restrictions; 4 inch ring and rotational management used to optimize yield per recruit. Habitat closure areas.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information. Considering adjustments to Northern Gulf of Maine and LAGC management programs, as well as fishing year changes. Future adjustments may be made to rotational management program if additional resource is made available to fishery through lifting of habitat closures.

Fishery Management Plan	Past actions	Present actions	Future foreseeable actions
Atlantic Herring FMP	FMP completed in 1999 by NEFMC. Area-based quota/TAC system. EFH was also designated in 1999.	Current management includes annual catch limits and accountability measures for overages. Enhanced monitoring in groundfish management areas.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information. An ABC control rule update is under development. Coordination with MAFMC and ASFMC on river herring/shad monitoring/bycatch.
Deep-Sea Red Crab FMP	FMP completed in 2003 by NEFMC to address overfishing and the potential for overcapitalization. Measures included permit limits, trips limits, annual TACs, days-at-sea, and limits on gear and processing at sea, as well as the EFH designations.	Current management includes annual catch limits and accountability measures for overages.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information.
Surfclam and Ocean Quahog FMP	FMP completed in 1977 by MAFMC. Initial approaches included limited entry, quarterly quotas, and fishing time restrictions. ITQ system established in 1990.	Fishery is currently managed as an ITQ system, with annual catch limits capping total catch and accountability measures for overages. Fishing is subject to food safety/PSP closures. During 2013 a large PSP closure exemption area was opened to clam dredging on Georges Bank.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information.
Atlantic Bluefish FMP	FMP completed in 1990 to control fishing effort.	Current management includes annual catch limits and accountability measures for overages. Quotas for recreational vs. commercial fisheries.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information.
Atlantic Mackerel, Squid, and Butterfish FMP	Original FMPs in 1978. Consolidated into a single plan in 1983 by MAFMC.	Current management includes annual catch limits and accountability measures for overages.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information. A plan amendment currently in development is considering deep-sea coral management areas in various slope and canyon environments within the mid-Atlantic region. The MAFMC is also developing an umanaged forage amendment and a squid capacity amendment.

Fishery Management Plan	Past actions	Present actions	Future foreseeable actions
Spiny Dogfish FMP	Joint MAFMC-NEFMC FMP implemented in 2000.	Current management includes annual catch limits and accountability measures for overages. Catches controlled by quotas and trip limits.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information.
Summer Flounder, Scup, and Black Sea Bass FMP	Merged into the summer flounder FMP in 1996.	Current management includes annual catch limits and accountability measures for overages. Catch and landings limits are the primary management tool; allocations between recreational and commercial fisheries. Also minimum fish sizes, bag Gear restricted areas to protect scup and black sea bass habitats.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information. MAFMC is developing an amendment to review all aspects of FMP related to summer flounder.
Tilefish FMP	Golden tilefish in the Mid-Atlantic are managed by MAFMC (FMP in 2001). Total allowable landings, rebuilding plan, limited entry, and tiered commercial quota system.	Current management includes annual catch limits and accountability measures for overages. Commercial fishery under ITQ management, with catch limit in incidental fishery. Gear restricted areas to protect sensitive tilefish habitats in the heads of canyons.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information. The MAFMC is considering measures for blueline tilefish, which is a south Atlantic species caught north of Cape Hatteras.
Northern Shrimp FMP	ASMFC plan implemented 1986. Management measures included minimum mesh size, seasonal closures, possession limits, and reporting requirements.	Assessments and specifications process ongoing, although currently the fishery is closed given the status of the stock.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information.
American Lobster FMP	ASFMC plan in state waters, federally managed in Federal waters consistent with ASMFC approach. Area-based management system with trap limits, minimum-maximum size limits, and protections for egg-bearing females.	Area-based management system with trap limits, minimum-maximum size limits, and protections for egg-bearing females. Focus on fishing mortality reduction in Southern New England.	Ongoing specifications actions will allocate annual catch limits in response to updated assessment information.

2.1.2 Protected resources management

Protected resource management focuses on evaluation of stock status, identification of fisheries and other activities that interact with protected resources, and development of measures to minimize interactions and the negative impacts associated with interactions that do occur. Management may also include designation of critical habitats. In some cases protected resource conservation measures include gear modifications and/or restrictions on fishing in specific areas and during particular seasons. These restrictions, which are summarized in Volume 1, Section 4.8.3 are additive to fishing restrictions designed to ensure conservation of managed fish and shellfish stocks. Measures include areas closed seasonally to specific gears, and gear requirements (e.g. pingers, turtle-compliant dredges, sinking groundlines, etc.).

Table 2– Past, present, and future foreseeable actions within the protected resource management plans plans in operation in the New England region

Plan	Past actions	Present actions	Future foreseeable actions
Harbor Porpoise Take Reduction Plan	Spatial and seasonal gear restrictions to minimize interaction, injuries, and mortalities between fishing gear and harbor porpoises, including requirements for pingers. 2013 modifications eliminated consequence closure areas (78 FR 61821, October 4, 2013).	Continue previous actions	Continue previous actions
Atlantic Large Whale Take Reduction Plan	Spatial and seasonal gear restrictions to minimize interaction, injuries, and mortalities between fixed fishing gear (trap/pot and gillnet) and large whale species	Changes to plan were published June 2014 (79 FR 36586); December 2014 (79 FR 73848); and May 2015 (80 FR 30367).	Continue previous actions
Large whale recovery plans	Plans for each species include Humpback Whale (1991), Blue Whale (1998), North Atlantic Right Whale (2005), Fin Whale (2010), Sperm Whale (2010), Sei Whale (2011). Plans describe specific conservation actions and measurable criteria to gauge progress towards recovery.	2016 independent review of recovery plan program. Planning and initial work to update recovery plan program generally, considering peer review recommendations.	Continued work towards plan objectives, update plans as needed. A blue whale plan revision is planned.
Ship strike reduction programs	Reporting systems and speed restrictions to minimize ship strike events; education/outreach activities. Extension of rule to reduce risk of ship strikes (78 FR 73725, December 9, 2013).	Operate under existing reduction program.	Continued updates to measures to reduce ship strikes as technology improves
Sea turtle regulations	Annual fisheries observer coverage requirements for certain fisheries; requirements	Continue previous actions	Continue previous actions

Plan	Past actions	Present actions	Future foreseeable actions
	on handling and resuscitation. Biological opinions have led to gear requirements in sea scallop fishery, summer flounder fishery, NC/VA large mesh gillnet fishery, and VA pound net fishery.		
Sea turtle recovery plans	Plans for each species include Green (1991), Leatherback (1992), Hawksbill (1993), Loggerhead (2009), and Kemp's Ridley (revised 2011). Plans describe specific conservation actions and measurable criteria to gauge progress towards recovery.	2016 independent review of recovery plan program. Planning and initial work to update recovery plan program generally, considering peer review recommendations.	Continued work towards plan objectives, update plans as needed.
Shortnose Sturgeon Recovery Program	Fishing for, catching or keeping shortnose sturgeon illegal; federal agencies that conduct, fund or authorize activities that may adversely affect shortnose sturgeon must consult with NOAA; periodic status reviews; development and implementation of recovery plan (1998)	Continue previous actions	Continue previous actions
Atlantic Sturgeon Recovery Program	Fishing for, catching or keeping Atlantic sturgeon illegal; various restrictions by state; federal agencies that conduct, fund or authorize activities that may adversely affect Atlantic sturgeon must consult with NOAA.	Proposed designation of Critical Habitat (81 FR 41926, June 28, 2016; 81 FR 35701; June 3, 2016; 81 FR 36077, June 3, 2016).	Continue previous actions
Atlantic Salmon Recovery Program and General Conservation Plan	Species listings by distinct population segment; designation of critical habitats; federal agencies that conduct, fund or authorize activities that may adversely affect Atlantic salmon must consult with NOAA; implementation of recovery plan (2005).	General Conservation Plan to promote fish passage and dam removals	Continue previous actions
Proactive Conservation Program for Species of Concern and Candidate Species	Grants to fund research activities, monitoring of status of species of concern/candidate species.	Continue previous actions	Continue previous actions
Stranding and	Network of organizations that	Continue previous actions	Continue previous actions

Plan	Past actions	Present actions	Future foreseeable actions
disentanglement program	rescue and rehabilitate stranded mammals and turtles or disentangle mammals and turtles; purpose is to reduce serious injury and mortalities associated with stranding or fishing gear entanglement.		

2.1.3 Other industrial uses of the marine environment

Non-fishing activities combine with fishery management efforts to affect the VECs considered in this action. Wherever these activities co-occur, they are likely to work additively or synergistically to decrease the quality of the physical and biological environment, and, as such, may indirectly constrain the sustainability of the managed resources, protected resources, and human communities associated with fishing. Appendix G describes the non-fishing activities that affect estuarine/nearshore environments and offshore environments.

Table 3 – Past, present, and future foreseeable non-fishing activities within the New England region

Activity	Past actions	Present actions	Future foreseeable actions
Liquefied natural gas facilities	Three New England import facilities, one land-based just north of Boston, MA, and two offshore of Cape Ann, MA. See http://www.northeastgas.org/about_lng.php.	Existing facilities are not especially active and imports of LNG have been down in New England. See http://www.northeastgas.org/about_lng.php.	The U.S. Department of Energy regulates import and export of natural gas and would approve new import facilities or import to export facility conversions. Given excess capacity at existing New England import terminals, new terminal construction does not appear likely, at least in the short term.

Activity	Past actions	Present actions	Future foreseeable actions
Offshore renewable wind energy	None – emerging use offshore the New England and Mid-Atlantic states	Leases have been sold in the Massachusetts Wind Energy Area (March 2015), Maryland WEA (December 2014), Virginia WEA (September 2013). Rhode Island/Massachusetts WEA (July 2013), the Virginia WEA (September 2013), for the Cape Wind project in Nantucket Sound (October 2010), the Bluewater Wind project off Delaware (November 2012), and the Deepwater Wind and Fishermen's Energy of New Jersey off New Jersey in October and November 2010. None of these wind energy areas overlap the area management alternatives directly, although they do encompass habitats for some of the managed species and protected resources identified above, as well as fishing grounds.	Lease sales in the New Jersey WEA are scheduled for November 2015. Environmental assessment and eventually development activities in current leases; leasing activities in additional wind energy areas, followed by assessment and perhaps development of wind energy installations. For additionla information see http://www.boem.gov/Lease-and-Grant-Information/.
Petroleum exploration	Seismic testing, drilling sediment cores and test wells. Leases sold and test wells drilled in late 1970s and early 1980s; given findings, no additional test well activity after that (see http://www.boem.gov/OCS-Report-MMS-2000-031/) for more information.	Bureau of Ocean Energy Management (BOEM) oversees these activities; currently we are within the 2012-2017 planning period. Currently there are no lease sales proposed in the Atlantic.	BOEM is currently developing the 2017-2022 Oil and Gas Leasing Program (see http://www.boem.gov/Five-Year-Program-2017-2022/) and a public request for information was published early summer 2014. It is not yet clear whether the 2017-2022 program will include potential leasing and exploration in the Atlantic.

Activity	Past actions	Present actions	Future foreseeable actions
Wave and tidal energy	Regulations for the Outer Continental Shelf Renewable Energy Program published in 2009; these include offshore wind energy as well as wave and current (i.e. hydrokinetic) energy projects. BOEM oversees development of these types of projects.	Information about current projects can be found here: http://en.openei.org/wiki/Marine_and_Hydrokinetic_Technology_Database. Various projects in Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut are in the siting/planning, site development, and device testing phases. There are no deployed projects in the New England region.	Future projects could be developed pursuant to the 2009 regulations.
Aquaculture	Existing facilities in New England are in currently in state waters only. There are facilities oriented towards commercial production as well as restoration aquaculture (e.g. oyster reefs, hatcheries).	Currently there are facilities in all coastal New England states, with the largest number of operations in Maine. NH, MA, RI, and CT focus mainly on shellfish, although NH has a steelhead trout facility. Maine raises a diversity of finfish and shellfish species including Atlantic salmon. Salmon is the dominant finfish aquaculture species in New England. Algae and seaweeds are also currently grown.	Expansion of aquaculture appears likely and could include offshore waters in the future. Many factors influence the rate of growth in this sector such as permitting concerns, availability of suitable sites, and regulatory stability. The National Sustainable Offshore Aquaculture Act of 2011 establishes a permitting and programmatic review system for offshore aquaculture sites, although the extensive regulatory requirements of the law could discourage entry into the system (Lapointe, 2013).
Offshore dredging and disposal: activities include mineral mining and vessel disposal		BOEM oversees offshore mineral extraction and has signed agreements with various states to evaluate sand resources for coastal resilience and restoration. Sand mining projects are ongoing in the northeast region. The Environmental Protection Agency approves requests for vessel disposal offshore; at least two vessels have been disposed of in the past few years in the western Gulf of Maine.	BOEM/state collaborative surveys to identify geologic resources suitable for mining, while mapping habitat and cultural resources. Continued disposal of vessels at sea through EPA process (see http://www.epa.gov/region2/water/oceans/wrecks.htm)

2.1.4 Climate change

Globally, conditions in the oceans, atmosphere, and cryosphere (ice cover) are changing. These shifts will affect ecosystem components including fishery resources, their habitats, and the human communities that depend on them, as well as protected resources. Climate science is complex, and synthesis and vetting of models and their conclusions rely on an extensive body of experts working in many different scientific fields. The Intergovernmental Panel on Climate Change or IPCC published their fifth and most recent assessment report in November 2014. Although a detailed description of the underpinnings of climate science and a discussion of the results of climate projection models are beyond the scope of this FEIS, a few conclusions from the fifth assessment synethesis report (IPCC 2014) are highlighted here.

- "Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen.
- In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans. Impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to changing climate.
- Surface temperature is projected to rise over the 21st century under all assessed emission scenarios. It is very likely that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent in many regions. The ocean will continue to warm and acidify, and global mean sea level to rise."

The magnitude and direction of changes in sea surface and bottom temperature and salinity are predicted to vary by region. Saba et al. (2015) explore differences between lower and higher resolution climate models with regards to projections for the northwest Atlantic Ocean in particular. In the northwest Atlantic, colder, fresher waters have a generally southwesten flow via the Labrador Current, while warmer, saltier waters move northeast with the Gulf Stream. The Northeast Channel separates Georges Bank from the Scotian shelf and allows slope (Gulf Stream) and shelf (Labrador Current) waters to mix in the relatively enclosed Gulf of Maine. While acknowledging the increased implementation costs associated with high resolution models, Saba et al. note that NOAA's Geophysical Fluid Dynamics Laboratory's high resolution global climate model CM2.6 can resolve important features of the northeast shelf, including the Northeast Channel, that lower resolution models do not resolve. This high resolution model predicts temperature changes of +3°C in the upper 300 meters of the ocean in response to a doubling of carbon dioxide concentration in the atmosphere, which is a faster (2-3x) rate of increase compare to CM2.6's global average, and twice as fast as a coarser resolution climate model, CM2.1. Saba et al. suggest that the Atlantic Meridional Overturning Circulation, which appears to have a robust and inverse relationship with the position of the Gulf Stream, likely has a substantial influence on temperature patterns in the northwest Atlantic via its influence on the Gulf Stream. They surmise that models that can accurately capture the likely magnitude of weakening of the AMOC should better predict oceanographic changes in the region.

The fifth IPCC assessment estimated that the oceans have absorbed approximately 28% of human-generated carbon emissions since 1750 (IPCC 2013). While this absorption helps to

sequester atmospheric carbon in the oceans, it does impact ocean chemistry. Specifically, when carbon dioxide chemically reacts with seawater, carbonic acid is produced, which decreases the pH of seawater. This ocean acidification can have biological effects because lower carbonate ion concentrations lead to lower calcium carbonate saturation levels, which in turn can negatively affect the ability of certain marine organisms to build and maintain bones and shells (Fabry et al. 2008, Feely et al. 2009). Calcium carbonate is present in multiple forms, including aragonite, calcite, high magnesium calcite, and amorphous calcium carbonate (Fabry et al. 2008). These different molecules vary in their chemistry, and are used differently by various marine organisms. While the shells of molluscs are an obvious example of a structure that would be affected by changes in ocean chemistry, some calcified body parts are non-skeletal and perhaps less obviously linked to ocean acidification, for example the statoliths and otoliths which act as gravity sensors in squids and fishes (Fabry et al. 2008). In addition, lowered pH may directly influence other physiological processes of marine animals, by taxing the buffering capacity of their blood, or the ability of their gills to properly bind oxygen (these and other effects are summarized by Fabry et al. 2008). While the impacts of changes in ocean chemistry will be challenging to predict at the population or ecosystem level, they will certainly be negative, and more impactful more quickly for some organisms than others.

2.2 Baseline status of Valued Ecosystem Components

This section summarizes the current status of all VECs, based on past and present actions but not including the proposed action.

2.2.1 Physical and biological environment

The physical and biological environment and its vulnerability to fishing gear impacts are described in Volume 1, Section 4.2. The physical and biological environment relevant to this action includes nearshore and offshore marine habitats in the Gulf of Maine, on Georges Bank, in the Mid-Atlantic Bight, and along the continental slope. The management alternatives focus mostly on benthic (seabed) offshore habitats in the Gulf of Maine and on Georges Bank, including seasonal management areas in the inshore Gulf of Maine as part of the spawning alternatives, and some potential year-round habitat management areas further south near and on Cox Ledge as part of the habitat alternatives (see Volume 3). EFH and HAPC designations extend further south into the Mid-Atlantic Bight and also seaward onto the continental slope and seamounts (see Volume 2).

Fishery management actions have likely had a positive cumulative impact on the status of the physical and biological environment. Fishery management plans are required to evaluate and minimize to the extent practicable adverse effects of fishing on essential fish habitats, and these actions are assumed to have made a positive contribution to habitat condition since the habitat requirements were added to the Magnuson-Stevens Act in 1996. The overall amount of fishing activity also contributes to the condition of the physical and biological environment. In this region, the Swept Area Seabed Impact analysis (see Volume 1) indicates that bottom otter trawls are the primary source of fishery impacts on benthic habitats, and the use of this gear has been on the decline overall, due to declining activity in the large-mesh groundfish fishery. This trend likely contributes positively to the condition of the physical and biological environment.

Protected resource management actions that focus on reducing mortality rates of marine mammals, fish, and turtles may have indirect impacts on the condition of the physical and biological environment. Increases in abundance of protected resources due to conservation measures will influence marine food webs generally, which could ultimately affect the distribution and abundance of benthic fishes and non-target species of fishes and invertebrates that comprise the biological environment.

Other human uses of the marine environment are generally likely to have negative impacts on the physical and biological environment (see Appendix G). However, these activities and their associated impacts tend to be concentrated near shore, and through the essential fish habitat consultation provisions of the Magnuson Stevens Act, the National Marine Fisheries Service is provided the opportunity to request that measures be taken to mitigate negative impacts.

Climate change is altering the physical ocean environment of the New England region, including the pattern and strength of ocean currents; the rate of freshwater inflows; water temperature, acidity, and salinity. The Northeast Fisheries Science Center Ecosystem Assessment Program monitors the state of the northeast shelf regional ecosystem on a routine basis. The spring 2016 status review highlighted the following[1]:

- Sea surface temperatures (SSTs) in the Northeast Shelf Large Marine Ecosystem during 2015 continue to be above average; in some season/area time series, 2015 was the second warmest year on record.
- The fall bloom on the Northeast Shelf was well developed, covering a large area including Georges Bank and much of the Gulf of Maine. There was also a large fall bloom in the Middle Atlantic Bight, which had the earliest start date of the time series.
- Cool water habitats (5-15°C), which form the core thermal habitats of the Northeast Shelf, were reduced in area to their lowest level in the time series during 2015.
- The arrival of the fall thermal transition has gotten progressively later over the past two decades; the 2015 transition in the Middle Atlantic Bight was the latest in the time series.
- The fall distribution of fish and invertebrate species sampled by the NEFSC is portrayed by kernel density plots and the assessments of species distributions using both along-shelf distance and depth. The dominant movement of species has been to the Northeast and into deeper water.
- Summer and winter wind speeds have changed over time, thus impacting the movement of water masses and organisms in the ecosystem.
- The strength of temperature fronts has increased over much of the Northeast Shelf; the 2015 frontal magnitudes for Northeast Shelf ecoregions were the highest in the time series.

Overall, climate change is influencing regional oceanography, including the intensity and timing of physical ocean processes.

[1] See http://www.nefsc.noaa.gov/ecosys/current-conditions/ for more information.

2.2.2 Managed species

The managed species VEC includes the following fishery resources. Section 4.3 of Volume 1 describes in detail the biology, status, and distribution of these resources, as well as the fisheries which prosecute them. The focus here is the status (overfished/overfishing occurring) of the various species, including the status by stock if the species is not managed as a single unit. Although technically a managed species, information about Atlantic salmon is located in the protected resources section, because the fishery management plan prohibits possession of Atlantic salmon and there is no commercial fishery for the stock.

- Northeast multispecies
- Monkfish
- Skates
- Atlantic sea scallop
- Atlantic herring
- Deep-sea red crab
- Surfclam and ocean quahog
- Atlantic bluefish
- Atlantic mackerel, squid, butterfish
- Spiny dogfish
- Summer flounder, scup, and black sea bass
- Golden tilefish
- Northern shrimp
- American lobster

In summary, the majority of stocks that overlap the New England region are not overfished with overfishing not occurring (Table 4 – summary, Table 5 – additional details). A small number of stocks are at low abundance, but with low fishing mortality, or at high abundance, but with high fishing mortality. Cod, some flounders, and thorny skates are overfished with overfishing occurring. In general, past fishery management actions have contributed positively to stock status, but additional action will be necessary to rebuild all stocks in the region. With the exception of thorny skate, all stocks in the overfished/overfishing category are large-mesh groundfish managed under the Northeast Multispecies Fishery Management Plan.

Table 4 – Baseline status of managed species, summary

	Fishing mortality below reference point	***Fishing mortality above reference point***
Stock size above reference point	Not overfished, overfishing not occurring: Acadian redfish, American plaice, Gulf of Maine haddock, Georges Bank haddock, pollock, white hake, southern windowpane flounder, GOM winter flounder (unknown biomass), Southern New England/Mid-Atlantic yellowtail flounder – likely not overfished, northern and southern red hake, northern and southern silver hake, northern and southern monkfish (uncertainty in assessment), smooth skate, barndoor skate, winter skate, little skate, clearnose skate, rosette skate, Atlantic sea scallop, Atlantic herring, surfclam, ocean quahog, bluefish, Atlantic mackerel (uncertainty in assessment), spiny dogfish, scup, black sea bass, golden tilefish	Not overfished, overfishing occurring: summer flounder
Stock size below reference point	Overfished, overfishing not occurring: Atlantic halibut, Atlantic wolffish, ocean pout, thorny skate	Overfished, overfishing occurring: Gulf of Maine and Georges Bank Atlantic cod, Georges Bank winter flounder, northern windowpane flounder, SNE/MA winter flounder, witch flounder, Cape Cod-Gulf of Maine yellowtail flounder, Georges Bank yellowtail flounder

Table 5 – Baseline status of managed species, details. Note that the status of large-mesh groundfish stocks are updated to reflect the 2015 operational assessment.

Northeast multispecies FMP - large mesh species	
Species	**Status and trends**
Acadian redfish	Not overfished, overfishing not occurring. Biomass and recruitment are increasing.
American plaice	Not overfished, overfishing not occurring. Biomass is increasing but recent recruitment has been low.
Atlantic cod	Gulf of Maine Overfished, overfishing occurring. Georges Bank, recent stock assessment uncertain, but managed as if the stock is overfished: For both stocks, recent biomass and recruitment estimates are low.
Atlantic halibut	Recent stock assessment uncertain, but managed as if the stock is overfished. Overfishing is not occurring, and fishing mortality rates are very low.
Atlantic wolffish	Overfished, but overfishing not occurring. Recent recruitment slightly below average, biomass very low.
Haddock	Gulf of Maine: not overfished, overfishing is not occurring. Biomass is over the threshold. Georges Bank: not overfished, overfishing not occurring. Record high recruitment in 2010.
Ocean pout	Overfished, but overfishing is not currently occurring.
Pollock	Not overfished, overfishing not occurring. Recently below average recruitment but above average biomass estimates.
White hake	Not overfished, overfishing not occurring. Recent recruitment and biomass slightly below average.

Windowpane flounder	Northern stock: overfished, but overfishing is not occurring; biomass is approximately 30% of B_{MSY}. Southern stock: not overfished, overfishing not occurring.
Winter flounder	Gulf of Maine: status unclear, but overfishing probably not occurring; spawning stock biomass increased between 2003-2009, but current recruitment is low. Georges Bank: overfished with overfishing occurring; adjusted F and SSB values for 2014 were 0.778 and 2,883 mt, which are above and below the reference points of F=0.536 and SSB_{MSY}=6,700 mt. Southern New England/Mid-Atlantic: overfished, but overfishing not occurring; recent low landings, recruitment, and spawning stock biomass.
Witch flounder	Overfished with overfishing occurring. High recent recruitment with slight increases in spawning stock biomass.
Yellowtail flounder	Cape Cod/Gulf of Maine: overfished with overfishing occurring. Little change in biomass, decreasing recruitment, but decrease in fishing mortality. Southern New England/Mid-Atlantic: overfished and overfishing isoccurring. Georges Bank: status is unknown, but maged as if it is overfished with overfishing occurring. Fishing mortality rates are increasing and biomass is decreasing.
Northeast multispecies FMP – small mesh species	
Species	**Status and trends**
Red hake	Northern and southern stocks: Neither is overfished, and overfishing is not occurring.
Offshore hake	No status determination due to lack of data.
Silver hake	Northern and southern stocks: Neither is overfished, and overfishing is not occurring.
Monkfish FMP	
Species	**Status and trends**
Monkfish	Northern and southern stocks: recent three assessments suggest they are not overfished with overfishing not occurring, but considerable uncertainty in the assessments.
Skates FMP	
Species	**Status and trends**
Smooth skate	Not overfished, overfishing not occurring.
Thorny skate	Overfished with overfishing occurring; biomass appears to be declining.
Barndoor skate	Not overfished, overfishing not occurring.
Little skate	Not overfished, overfishing not occurring.
Winter skate	Not overfished, but overfishing is occurring.
Clearnose skate	Not overfished, overfishing not occurring.
Rosette skate	Not overfished, overfishing not occurring.
Atlantic sea scallop FMP	
Species	**Status and trends**
Atlantic sea scallop	Not overfished, overfishing not occurring, but fishing mortality in 2009 was equal to the threshold value.
Atlantic herring FMP	
Species	**Status and trends**
Atlantic herring	Not overfished, overfishing not occurring.
Deep-sea red crab FMP	
Species	**Status and trends**
Deep-sea red crab	Unknown stock status; data poor stock.
Surfclam and ocean quahog FMP	

Species	**Status and trends**
Surfclam	Not overfished, overfishing not occurring.
Ocean quahog	Not overfished, overfishing not occurring.
Bluefish FMP	
Species	**Status and trends**
Atlantic bluefish	Not overfished, overfishing not occurring.
Atlantic mackerel, squid, and butterfish FMP	
Species	**Status and trends**
Atlantic mackerel	Not overfished, overfishing not occurring; substantial uncertainty in assessment.
Butterfish	Status unknown. Overfishing not likely.
Shortfin squid	Status unknown, but recent catch indices and landings within typical ranges.
Longfin squid	Not overfished, overfishing determination not possible.
Spiny dogfish FMP	
Species	**Status and trends**
Spiny dogfish	Not overfished, overfishing not occurring. Rebuilt biomass as of 2010.
Summer flounder, scup, and black seabass FMP	
Species	**Status and trends**
Summer flounder	Not overfished, overfishing is occurring based on data through 2014. Rebuilt as of 2011, with recent fishing mortality values fluctuating near the reference point.
Scup	Not overfished, overfishing not occurring; biomass approximately double the reference point.
Black sea bass	Not overfished, overfishing not occurring.
Golden tilefish FMP	
Species	**Status and trends**
Golden tilefish	Not overfished, overfishing not occurring. Rebuilt as of 2012.
Northern shrimp FMP	
Species	**Status and trends**
Northern shrimp	Collapsed; biomass has declined since 2007, and recruitment indices are poor.
American lobster FMP	
Species	**Status and trends**
American lobster	Gulf of Maine, Georges Bank, and Southern New England stocks: none are experiencing overfishing, but the Southern New England stock is overfished.

Long term climate shifts combined with decadal oscillations and interannual variability produce the ocean conditions experienced by managed species. The effects of climate change on the physical environment, i.e. changes in temperature, salinity, pH, sea level, and currents, influence habitat suitability. Species vary in terms of their sensitivity to these climate factors. Based on species-specific biological attributes, Hare et al. (2016) estimate the likely effects of climate factors on managed and unmanaged biological resources, combining effects across factors to generate an overall assessment of vulnerability to climate change for each species. These species-level vulnerabilities are described briefly here as background, as they influence the evaluation of the cumulative effects that this amendment and other ongoing present and future forseeable actions will have on the status of managed resource.

Hare et al. summarize the results of their assessment in a matrix, where biological sensitivity and climate exposure are used in combination to categories fish and invertebrate species occupying the Northeast U.S. continental shelf. Based on climate model results, all species living in the region were likely to experience either high or very high climate exposure, with no species expected to experience low or moderate climate exposure. However, species' sensitivity varied from low to very high. The vulnerability categories of greatest concern were those where sensitivity, exposure, or both were estimated to be very high. The matrix is reproduced below for the subset of species considered to be part of the managed resources affected environment in this amendment.

Table 6 – Vulnerability of managed species to climate change, reproduced from Hare et al. 2016. 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).

Biological sensitivity	High	Very high
Very high	**Ocean quahog**	**Atlantic salmon**
High	**Atlantic halibut, Atlantic sea scallop, Thorny skate, Tilefish, Atlantic surfclam, Ocean pout, Atlantic wolffish, Witch flounder, Northern shrimp**	**Winter flounder**
Moderate	*Barndoor skate, Acadian redfish, Smooth skate, American lobster, Atlantic cod,* **White hake, Rosette skate, Pollock**	Black seabass
Low	**Butterfish, Longfin inshore squid, Silver hake, Spiny dogfish, Winter skate, Northern shortfin squid, Bluefish, Deep-sea red crab,** *Red hake ,Offshore hake,* **Little skate, Clearnose skate, Monkfish, Haddock, Atlantic herring,** *Windowpane, Yellowtail flounder, American plaice*	**Summer flounder,** *Atlantic menhaden, Scup*

Climate exposure

Three attributes had the strongest influence on vulnerability, namely growth rate of the population, stock status, and adult mobility. In the red categories, for winter flounder, stock status was an important contributor to the overall sensitivity score, as well as two early life history sensitivity variables. Ocean quahogs have slow individual and population growth rates, virtually no mobility of adults, and being shelled organisms are sensitive to ocean acidification. Atlantic salmon are currently at low abundance, and have specialized habitat requirements particularly related to their reproduction. In the orange categories, Atlantic halibut, thorny skate, ocean pout, Atlantic wolffish, and witch flounder have low stock status and population growth

rate. Wolffish also have complex reproductive habits in that they require specific habitat types and guard their eggs for relatively long periods. Tilefish are not at low abundance but do have low population growth rate. Sea scallops and surfclams are sensitive to ocean acidification and have low adult mobility. Northern shrimp are vulnerable for a number of reasons including stock status, factors related to spawning, and temperature sensitivity. Black seabass have specialized habitat requirements.

Climate-induced changes are already evident among northeast managed species. Nye et al. (2009) examined Northeast Fisheries Science Center trawl survey data through 2007 and found evidence for poleward movement, change in area occupied, change in maximum or minimum latitude, change in mean temperature of occurrence, and/or change in mean depth of occurrence for 24 of 36 stocks examined. Many of these stocks are considered part of the managed species VEC in this action (for some species in the study, fish were grouped as northern and southern but this is not how the stocks are defined for assessment purposes). All of these changes are not necessarily negative, for example, the ability of a stock to undergo range expansion may be a positive adaptation under a changing climate. However, some changes indicate vulnerability to climate shifts, as noted below.

Southern and northern silver hake and red hake, Georges Bank cod, white hake, halibut, southern winter and yellowtail flounders, windowpane flounder, monkfish, and ocean pout showed a poleward shift in their distribution. While evidence or range expansion was present in some stocks, others stocks showed evidence of range contraction, including thorny skate, Georges Bank cod, southern yellowtail flounder, redfish, and wolffish. Movement into deeper waters could indicate that the fish are seeking refuge from warm summer temperatures. Winter skate and Gulf of Maine cod showed shifts in their centers of biomass and moved into deeper waters. Thorny skate, pollock, and wolffish, which are all most abundant in the Gulf of Maine region, did not show shifts in their center of biomass, but were found in increasingly deeper waters over time.

2.2.3 Human communities and the fishery

The various fisheries that are likely to be affected are described in Volume 1, Section 4.3. A summary is provided in Table 7 below. These include fisheries for large and small mesh Northeast multispecies, monkfish, skates, Atlantic sea scallops, Atlantic herring, deep-sea red crab, clams, bluefish, mackerel/squid/butterfish, dogfish, summer flounder/scup/black sea bass, tilefish, shrimp, and lobster. Recent fishery management plan actions should be consulted for detailed assessments of fishery status and communities affected. Fisheries of the United States 2014 (NMFS 2015) summarizes overall fisheries economics of the United States during 2014.

The status of these fisheries is mixed, with most fisheries relatively stable and others on the decline. Declining fishery conditions may be linked to poor stock conditions; this is the case with the Northeast Multispecies large-mesh fishery (some, but not all stocks at low abundance) and the northern shrimp fishery. In the monkfish fishery, landings have been on a downward trend, but monkfish catch limits do not appear to be the limiting factor. A number of other fisheries have stable landings that are below allocations (see below).

A "fishing community" is defined in the Magnuson-Stevens Act, as amended in 1996, 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)). Fishing communities that are likely to be influenced by the alternatives in this amendment are listed Volume 1, Section 4.6 and Table 8 below. The specific communities of interest were identified through the economic analysis of vessel trips most likely to be impacted by the addition of new closed areas (see the economic impacts sections in Volume 4). Specifically these communities represent either the port of landing or city of registration for three or more vessels using mobile bottom-tending gears in 2012.

Depending on the status of their dominant fisheries, the associated communities may be on a positive, stable, or negative trajectory. Obviously many other factors contribute to community status besides fishery conditions; however the community indicator tables provided in Volume 1 provide an indication of which communities are most dependent on commercial and/or recreational fisheries. These communities include Chatham, Chilmark, and Gloucester, Massachusetts; Beals, Boothbay Harbor, Bremen, Bucks Harbor, Cundys Harbor, Friendship, Harpswell, Jonesport, Machiasport, New Harbor, Port Clyde, South Bristol, Stonington, Tenants Harbor, Vinalhaven, and Winter Harbor, Maine; Hobucken, Oriental, and Wanchese, North Carolina; Barnegat/Barnegat Light and Cape May, New Jersey; and Montauk, New York. Of these, Gloucester, MA is noteworthy because it is the only one of these communities where large-mesh groundfish was the primary species or species group by percentage of revenue in 2012.

Fishery management actions and stock status are assumed to be the major contributors to fishery status and associated community impacts, with protected resources management and non-fishing uses of the marine environment contributing incidentally to fishery and community baseline status. Some protected resource conservation measures negatively impact fishing operations, restricting the use of particular gear types during specific seasons and in specific areas. In some cases these regulations restrict use of a gear entirely, but in other instances there are gear modifications required only, such as vessel speed restrictions, pinger requirements for gillnets, or use of turtle excluder dredges in the scallop fishery.

Changes in the abundance and distribution of these biological resources affect the communities that prosecute fisheries for these resources. For example, if the target species important to a particular port community declines in abundance or its distribution shifts north or south due to environmental factors, there may be negative economic impacts locally, although there could be positive impacts due to increases in abundance of other species. It is impossible to pinpoint the degree to which these types of environmental changes are influencing the baseline status of the VECs analyzed in this action, but certainly regional-scale changes in climate combine with fishing and non-fishing human activities to shape the baseline status.

Table 7 – Baseline status of fisheries

Fishery	Status and trends

Fishery	Status and trends
Northeast multispecies large mesh fishery	Murphy et al. 2015 provides a summary of the economic performance of the Northeast multispecies fishery through the end of fishing year 2013 (April 2014). Total Annual Catch Entitlement declined 13% from the prior fishing year, owing to ACL declines in 12 of 17 allocated stocks. Losses in revenue from groundfish ($28 million) were not offset by the small increases in revenues for non-groundfish species, and prices fell in 2013 to four-year lows. The active fleet declined between 2010-2013 to 735 vessels, and fewer, but longer, trips were taken in FY 2013. Revenues are unequally distributed and concentrated at the vessel affiliation or ownership level. The value of lease market transfers is declining, and about one-third of all leasing occurs within ownership groups.
Northeast multispecies small-mesh	The small mesh/whiting specifications were recently updated through fishing year 2017. A detailed update of the fishery trends was prepared for Amendment 19 to the Northeast Multispecies FMP (2012). Between 2002 and 2010, silver hake landings fluctuated between 5,000-8,000 mt, with landings around 8,000 mt ($11 million revenue) in 2010. About 25% of 2010 landings were from the northern area and the remaining landings were from the southern area. Offshore hake landings are very minor. Red hake are less commercially important, with between 400-900 mt landings over the same time period, and generally under $500,000 in revenue annually.
Monkfish	Landings in both the northern and southern areas combined have declined each year since FY2005, with the peak fishing year in FY2003, and were at the lowest level since the inception of the FMP in 1999. Monkfish landings increased between FY2002 and FY2003, principally due to the increase trip limits in the SMA but declined in FY2004 as trip limits and DAS allocations were reduced in that area. In FY2005 total landings increased by 1,272 mt, or about 7% due to an increase in SMA landings as a result of increased trip limits and DAS allocations, and in spite of a decline of 20% in NMA landings from the previous year. NMA landings have declined each year since FY2001, although trip limits were only established in FY2007, and in FY2008 were about 24% of what they were at the peak. The NMA is below the target TAL for FY2011 (63%) and FY2012 (67%); the SMA is also below the target TAL for FY2011 (65%) and FY2012 (58%).
Skate	The status of the skate fishery is summarized in Framework Adjustment 2 to the Northeast Skate Complex FMP (2014). The skate fishery caught 56% of the overall ACL in FY 2012; this was a decrease on FY 2011 landings. No AMs were triggered in FY 2012 as there was no overage. The wing fishery caught 70.5% of the wing TAL; the bait fishery caught 76.2% of the bait TAL. State landings in FY 2012 were 1,407 mt. Total discards in FY 2012 were 11,179 mt. Due to the relative absence of recreational skate fisheries, virtually all skate landings are derived from regional commercial fisheries. Commercial fishery landings never exceeded several hundred metric tons until the advent of distant-water fleets during the 1960s. Total skate landings have fluctuated between two levels between FY 2009 and 2012. The fluctuations in landings are largely attributable to the wing fishery as landings in the bait fishery have remained relatively stable. It is not clear what is driving the trend in wing landings as quota is not thought to be limiting to the fishery. One potential explanation is the decrease in winter skate survey index that suggests fewer winter skate were available to the fishery.

Fishery	Status and trends
Atlantic sea scallop	Framework 26 to the Atlantic Sea Scallop FMP (2015) summarizes current trends in the fishery. Total fleet revenues peaked in 2011 (at around $600 million) and have declined somewhat since then to over $450 million in 2013. The substantial increase in total fleet revenue since the early 1990s was mainly due to the increase in scallop landings and the increase in the number of active limited access vessels during the same period. In the fishing years 2003-2012, the landings from the northeast sea scallop fishery stayed above 50 million pounds, surpassing the levels observed historically, with lower landings of 40 million pounds in the 2013 fishing year. The landings by general category vessels (including limited access general category landings by LA vessels, and vessels with incidental and NGOM permits), declined after 2009 when limited access and quotas were implemented for the GC fleet, which receives 5.5% of the total ACL. Substantial recent recruitment events may lead to record high landings in the coming years, if most of the small animals survive and recruit to the fishery.
Atlantic herring	The current status of the herring fishery is summarized in the specifications package submitted in 2013. Herring catches have been fairly consistent over the last ten years, increasing between 2011 and 2012 to 93,130 mt, down from a ten year high of 103,943 mt in 2009. The Council's preferred specifications for the next three fishing years (2016-2018) are similar to the current specifications, with a slightly lower ACL of 104,800 mt down from the current ACL of 107,800 mt.
Deep-sea red crab	The current status of the red crab fishery is summarized in the specifications package submitted in 2014. 2010-2012 landings were lower than the TAL, and appeared to be consistent with average landings since 2002. Landings were grouped by three fishing regions based on VTR-reported statistical area fished, and landings by region indicated that the fishery has been operating nearly equally in all regions in recent years. LPUE appeared stable between 2010 and 2012 and showed an increasing trend since 2007.
Surfclam and ocean quahog	The Mid-Atlantic Fishery Management Council surfclam and ocean quahog AP information documents (2014) summarize the current status of the clam fisheries. The number of vessels fishing for surfclams and quahogs has been fairly stable over the last 15 years, with a ten year high of 49 vessels in 2012. Prices for surfclams increased slightly in 2013, and the ex-vessel value of the federal surfclam harvest was approximately $31.0 million. Activity is increasing on Georges Bank and further expansion of the fishery on Georges Bank is likely in the near term. The number of vessels targeting quahogs both in the mid-Atlantic/southern New England and off the Maine coast has declined somewhat in recent years. In 2013, prices were essentially flat as compared to 2012, but overall ex-vessel value of non-Maine landings increased about 10% to $22.9 million in 2013. The Maine fishery ex-vessel value was reported at $1.48 million in 2013 according to data from dealers, a 15% decrease from 2012. Price per bushel in Maine has declined, as has the total harvest.
Bluefish	The Mid-Atlantic Fishery Management Council Bluefish AP Information Document (2013) summarizes the current status of the fishery. Recreational landings peaked at 21 million pounds in 2007, and have declined recently to 11 million pounds in 2012, well below allocations. Commercial landings, which were also well below allocations in 2012, have been relatively stable and are less than half the recreational landings in recent years.
Atlantic mackerel, squid, and butterfish	The Mid-Atlantic Fishery Management Council's AP information documents (2013) summarize the current status of these fisheries. Mackerel landings have declined since the mid-2000s, and were under 10,000 mt in 2012 (valued about $4 million). Ex-vessel prices have increased. Twenty percent or less of the quota has been landed since 2008. Illex squid landings have generally been increasing since the mid-2000s, and were just over 10,000 mt in 2012, however price and ex-vessel value declined between 2011 and 2012. Longfin squid landings have shown a general downward trend since the early 1990s, but have increased in the past few years to between 10-15 million pounds in 2012. Price has increased over time. Butterfish landings have been fairly flat since the early 2000s, below 1000 mt annually. CPI-adjusted price has generally fallen since the late 1980s. Butterfish landings were well below the quota in 2012.

Fishery	Status and trends
Spiny dogfish	The Mid-Atlantic Fishery Management Council Spiny Dogfish AP Information Document (2013) summarizes the current status of the dogfish fishery. Toward the end of the federal rebuilding schedule that ended in 2010, substantial increases in stock biomass allowed for an increase in the federal quota in 2009 to 12 M lb while still maintaining the rebuilding fishing mortality rate. US landings increased annually between 2003 and 2011, and value has increased over the same period to a high of approximately $4.5 million in 2011.
Summer flounder, scup, and black seabass	The Mid-Atlantic Fishery Management Council's Advisory Panel information documents (2013, 2015) summarize the current status of these fisheries. All three have significant recreational and commercial components. Both commercial and recreational summer flounder landings have been fairly flat over the past 10 years, totaling 13.31 million pounds and 6.29 million pounds, respectively, in 2012, with commercial catch declining in 2014 to 10.91 million pounds, and recreational landings increasing to 7.12 million pounds. Prices and ex-vessel revenues in the commercial fishery have increased recently. For scup, recreational landings have been relatively flat in recent years, but commercial landings have increased to about 15.93 million pounds in 2014 (2014 recreational landings were approximately 4.12 million pounds). Black sea bass landings are similar across the recreational and commercial fisheries, and have fluctuated between 3 and 8 million pounds over the past 30+ years. Commercial landings have increased since 2009 and were 2.38 million pounds in 2014. Prices have been increasing since the mid-1990s and thus ex-vessel values have increased since 2009 along with landings. Recreational landings decreased in 2011 but increased in 2014 to 3.78 million pounds.
Golden tilefish	The Mid-Atlantic Fishery Management Council Golden Tilefish AP Information Document (January 2013) summarizes the current status of the tilefish fishery. Since 2001, golden tilefish landings have ranged from 1.6 (2007) to 2.7 (2004) million pounds. With the exception of FY 2003, 2004, and 2010 commercial tilefish landings have been below the commercial quota specified each year since the Tilefish FMP was first implemented. Commercial tilefish ex-vessel revenues have ranged from $2.5 to $5.6 million for the 1999 through 2011 period, generally rising during this time period.
Northern shrimp	The northern shrimp fishery is seasonal, targeting female shrimp when they come inshore to spawn. When the annual total allowable catch has been harvested, the fishery closes. Both the 2009/2010 and 2010/2011 seasons were relatively short (156 days and 90 days, respectively). Delays in reporting landings resulted in short notice of the early closures during these seasons, and the total allowable catches were exceeded in both years. As a result, Amendment 2 implemented trip limits, trap limits, and days out of the fishery, in an effort to slow down catch rates and extend the season. Despite these changes, the 2011/2012 season was also brief, opening on January 2, 2012 for trawls and February 1 for traps, and closing on February 17. The most recent assessment indicates collapse of the stock, and future prospects look bleak. In December 2013, the Commission's Northern Shrimp Section approved a moratorium for the 2014 northern shrimp fishing season.
American lobster	Landed revenues for American lobster increased between 2009 and 2011 from $310 million to $423 million dollars. Landings were approximately 100-125 million pounds over that same period.

Table 8 – Fishing communities potentially affected by this amendment. Blank cells at the community level indicate data omitted due to confidentiality requirements.

State	2012 Landings		
Community	Value	Lbs	Top species/species groups landed
Connecticut	**$ 21,432,347**	**8,381,236**	
New London	$ 7,138,598	3,578,601	Scallops; mackerel, squid, butterfish; small mesh groundfish; monkfish

State	2012 Landings		
Community	**Value**	**Lbs**	**Top species/species groups landed**
Stonington	$ 12,126,105	3,674,200	Scallops; summer flounder, scup, black sea bass; mackerel, squid, butterfish
Massachusetts	**$ 613,057,787**	**275,652,568**	
Barnstable	$ 8,647,609	1,426,395	Other; lobster; scallops; summer flounder, scup, black sea bass
Boston	$ 18,726,770	11,520,973	Large mesh groundfish; lobster; other
Chatham	$ 16,648,927	10,726,709	Other; scallops; lobster; large mesh groundfish
Chilmark	$ 1,267,709	251,199	Other; lobster; summer flounder, scup, black sea bass; large mesh groundfish
Fairhaven	$ 25,065,515	7,096,357	Scallops; other; lobster
Falmouth	$ 1,489,220	312,974	Other; summer flounder, scup, black sea bass; bluefish
Gloucester	$ 56,758,715	77,398,771	Large mesh groundfish; lobster; herring; scallops
Harwichport	$ 3,423,954	955,996	Other; lobster; scallops
Hyannis	-	-	-
Marshfield	$ 2,681,211	2,502,469	Lobster; large mesh groundfish; scallops
Mattapoisset	$ 319,379	195,054	Summer flounder, scup, black sea bass; other; ; large mesh groundfish
Nantucket	$ 2,712,606	449,624	Other; summer flounder, scup, black sea bass; lobster
New Bedford	$ 407,366,943	133,902,861	Scallops; large mesh groundfish; surfclam, ocean quahog; lobster
Newburyport	$ 924,924	288,756	Lobster; other; large mesh groundfish
Plymouth	$ 4,031,312	1,821,381	Lobster; other; mackerel, squid, butterfish
Provincetown	$ 6,108,947	1,890,793	Scallops; lobster; other; large mesh groundfish
Rockport	$ 796,794	230,669	Lobster; other
Sandwich	-	-	-
Salisbury	$ 5,524,274	2,791,940	Lobster; other; scallops; large mesh groundfish
Scituate	$ 4,519,702	3,253,876	Lobster; large mesh groundfish; dogfish; scallops
Woods Hole	$ 2,771,733	1,352,844	Mackerel, squid, butterfish; summer flounder, scup, black sea bass; other; large mesh groundfish
Maine	**$ 529,559,487**	**288,302,577**	
Beals	$ 11,463,226	5,035,395	Lobster; other; scallops
Boothbay Harbor	$ 4,663,088	1,710,569	Lobster; other; large mesh groundfish
Cundys Harbor	-	-	-
Friendship	$ 14,179,324	5,816,154	Lobster; other
Harpswell	$ 17,986,181	6,710,242	Lobster; other; large mesh groundfish
Jonesport	$ 12,696,660	17,800,984	Lobster; other; surfclam, ocean quahog
New Harbor	$ 3,727,306	1,794,881	Lobster
Port Clyde	$ 9,625,855	6,075,059	Lobster; other; large mesh groundfish
Portland	$ 33,565,377	58,643,014	Lobster; other; herring; large mesh groundfish
Rockland	$ 14,754,927	35,154,608	Herring
Saco	$ 436,456	378,490	Lobster; large mesh groundfish; other
South Bristol	$ 6,204,061	3,290,724	Lobster; other; herring
Stonington	$ 47,217,453	22,232,499	Lobster; other; herring; scallops
Vinalhaven	$ 28,291,930	13,446,137	Lobster; other
Wells	-	-	-
North Carolina	**$ 30,845,218**	**20,597,665**	
Beaufort	$ 4,809,443	2,352,085	Other; summer flounder, scup, black sea bass

State	2012 Landings		
Community	**Value**	**Lbs**	**Top species/species groups landed**
New Hampshire	**$ 23,261,842**	**11,414,633**	
Portsmouth	$ 5,674,278	2,753,325	Lobster; large mesh groundfish; other
Rye	$ 2,084,685	1,834,168	Large mesh groundfish; lobster; other
Seabrook	$ 2,346,150	1,879,911	Large mesh groundfish
New Jersey	**$ 192,128,847**	**240,210,579**	
Barnegat/Barneg at Light	$ 30,010,778	6,443,562	Scallops; other; monkfish
Cape May	$ 74,866,105	74,271,810	Scallops; mackerel, squid, butterfish; other; summer flounder, scup, black sea bass
Point Pleasant	$ 28,675,177	25,066,710	Scallops; surfclam, ocean quahog; summer flounder, scup, black sea bass; lobster
New York	**$ 43,800,906**	**28,231,715**	
Montauk	$ 23,105,671	14,426,314	Mackerel, squid, butterfish; summer flounder, scup, black sea bass; tilefish; other
Rhode Island	**$ 78,513,456**	**81,241,913**	
Newport	$ 10,561,749	8,582,400	Lobster; scallops; other; skates
Point Judith/ Narragansett	$ 42,701,304	43,912,198	Mackerel, squid, butterfish; scallops; other; herring
Virginia	**$ 176,793,054**	**453,871,518**	
Chincoteague	$ 9,143,896	4,479,025	Other; summer flounder, scup, black sea bass
Hampton	$ 14,072,645	5,591,189	Summer flounder, scup, black sea bass; other; bluefish
Newport News	$ 31,083,344	5,527,009	Scallops; summer flounder, scup, black sea bass; other
Seaford	$ 19,457,920	2,025,932	-

2.2.4 Protected resources

Various protected resources overlap the New England region. The distribution and status of these species is described in detail in Volume 1, Section 4.8. In general, the various large whales and sea turtles that overlap the region are considered endangered under the Endangered Species Act. Some fish stocks including shortnose sturgeon, Atlantic sturgeon, and Atlantic salmon are also listed as endangered. Various small whale, dolphin, and pinniped species are protected by the Marine Mammal Protection Act but are not listed under ESA.

In general, the status of protected resources is on a positive trajectory, with some exceptions. Nest count data for turtles suggest improvements in the status of these species since 2004 (see discussion in Volume 1, section 4.8.2.4, and TEWG 2009). Large whale assessments indicate general increases in the population sizes for these species (again, see Volume 1, section 4.8.2.1, and Waring et al. 2015). Small cetacean and pinniped populations appear to generally be fairly stable or increasing in their abundance (see Volume 1, section 4.8.2.2 and Waring et al. 2013). The Atlantic sturgeon was only recently listed under the Endangered Species Act and assessments of the status of various distinct population segments are ongoing (see Volume 1, section 4.8.2.5). As noted in Volume 1 section 4.8.2.6, the trend in abundance of Atlantic salmon in the Gulf of Maine DPS has been low and either stable or declining over the past several decades.

Table 9 – Baseline status of protected resource species

Sea Turtles		
Species	**Status**	**Potentially affected by this action**
Leatherback sea turtle	Endangered	Yes; seasonal occurrence in SNE/MAB.
Kemp's ridley sea turtle	Endangered	Yes; seasonal occurrence in SNE/MAB.
Green sea turtle, North Atlantic DPS	Threatened[a]	Yes; seasonal occurrence in SNE/MAB.
Loggerhead sea turtle, *Northwest Atlantic Ocean DPS*	Threatened	Yes; seasonal occurrence in SNE/MAB.
Hawksbill sea turtle	Endangered	No
Cetaceans		
Species	**Status**	**Potentially affected by this action**
North Atlantic right whale	Endangered	Yes
Humpback whale	Protected[b]	Yes
Fin whale	Endangered	Yes
Sei whale	Endangered	Yes
Blue whale	Endangered	No
Sperm whale	Endangered	No
Minke whale	Protected	Yes
Long-finned pilot whale	Protected	Yes
Short-finned pilot whale	Protected	Yes
Risso's dolphin	Protected	Yes; mostly along shelf edge/slope
Atlantic white-sided dolphin	Protected	Yes
Short Beaked common dolphin	Protected	Yes
Spotted dolphin	Protected	No
Bottlenose dolphin[c]	Protected	Yes
Harbor porpoise	Protected	Yes
Pygmy sperm whale	Protected	No
Dwarf sperm whale	Protected	No
Striped dolphin	Protected	No
Beaked whales	Protected	No
Pinnipeds		
Species	**Status**	**Potentially affected by this action**
Harbor seal	Protected	Yes
Gray seal	Protected	Yes
Harp seal	Protected	Yes; but less common
Hooded seal	Protected	Yes; but less common
Fish		
Species	**Status**	**Potentially affected by this action**
Shortnose sturgeon	Endangered	No
Atlantic salmon	Endangered	Yes
Atlantic sturgeon		
Gulf of Maine DPS	Threatened	Yes
New York Bight DPS, Chesapeake Bay DPS, Carolina DPS & South Atlantic DPS	Endangered	Yes
Cusk	Candidate	Yes
Thorny skate	Candidate	Yes

[a] On April 6, 2016, a final rule was issued removing the current range-wide listing of green sea turtles and, in its place, listing eight green sea turtle DPSs as threatened and three DPSs as endangered (81 FR 20057). The green sea

turtle DPS located in the Northwest Atlantic is the North Atlantic DPS of green sea turtles; this DPS is considered threatened under the ESA.

[b] On September 8, 2016, a final rule was issued revising the ESA listing status of humpback whales (81 FR 62259). Fourteen DPSs were designated: one as threatened, four as endangered, and nine as not warranting listing. The DPS found in U.S. Atlantic waters, the West Indies DPS, is delisted under the ESA; however, this DPS is still protected under the MMPA.

[c] Depending on stock, some bottlenose dolphins are considered MMPA strategic stocks (see section 4.8.2.2, Volume I, for details).

2.3 Combined direct impacts of the proposed EFH and HAPC designations and other combinations of alternatives

The Essential Fish Habitat and Habitat Area of Particular Concern designation alternatives (alternatives and impacts in Volume 2), which are generally are administrative in nature. From the Council's perspective, one purpose of the EFH and the HAPC designations is to provide a focus for the analysis of fishing impacts, and to highlight locations where restrictions on methods of fishing might be employed to meet objectives relative to specific species, including particular life stages. Another purpose of these designations is that they serve as a tool that can be used by NMFS, and to a lesser extent, by the Council, when they engage in the EFH consultation process. While they do serve an important information and consultation purpose, the EFH and HAPC designations themselves are not associated with any restrictions on the timing or methods of fishing. Thus, the primary impacts of the designations relate to the applicability of the designations to the consultation process. More narrowly-defined designations are more easily relied upon when conducting EFH consultations as areas that should be the target of conservation actions.

2.3.1 No Action alternatives

The No Action EFH designation alternatives are generally based on relative abundance data from the NEFSC trawl surveys, typically at the 75^{th} and 90^{th} percentile levels of catch, with some inshore data from state surveys and from the estuarine living marine resource program. A few of the existing designations are not based on relative abundance, but rather are more accurately species range or presence/absence designations. Some of the egg and larval designations are based on egg or larval data, and may use other lifestages as a proxy. When combined with other past, present, and future foreseeable actions intended to conserve fishery resouces, the existing EFH designations are expected to have indirect, positive impacts on managed resources and their habitats through improvements to fisheries management, and also through conservation actions recommended via the EFH consultation process. Indirect, positive impacts to human communities are also expected. No discernable impacts on protected resources are anticipated, as the designations were not developed with protected resource considerations in mind.

The No Action HAPC designations include an HAPC for Atlantic salmon in select rivers along the coast of Maine, and an HAPC for juvenile cod on the northern edge of Georges Bank. When combined with other conservation measures specific to Atlantic salmon, such as dam removals, the Atlantic salmon HAPC is expected to have positive impacts. The HAPC on the northern edge of Georges Bank has in the past and will continue to focus conservation efforts related to the development of fishery management measures, which is expected to have indirect, positive

impacts on fishery resources and habitats. No additional cumulative impacts on the protected resources VEC beyond the baseline are expected to result from the HAPCs.

2.3.2 Preferred alternatives

Similar to No Action, many of the preferred alternative EFH designations are based on relative abundance data from NEFSC trawl surveys at the 75th and 90th percentile levels of catch, in addition to state survey data inshore. Compared to the No Action designations, the preferred alternative designations were generated based on more data from state surveys, which is expected to result in inshore designations that more accurately reflect the species' distributions. Because many federal projects are conducted in nearshore habitats, more realistic depictions of fish habitats inshore facilitate NMFS EFH consultation work in these areas. In addition, in offshore areas the preferred designations incorporate depth and temperature information into the maps. Compared to No Action maps which rely on relative abundance data alone, the additions of depth and temperature data result in more realistic delineation of habitats for each species. Although the EFH map representations are still somewhat generalized depictions of the areas important to each species and lifestage, the updated maps are more meaningful depections of fish habitats that should be more useful in both fishing and non-fishing contexts. The EFH text descriptions were also updated for the preferred alternatives, made more specific when possible and better linked to the map representations. Collectively, while both the No Action and preferred alternative EFH designations are expected to have positive impacts on managed resources and the fisheries they support, the preferred alternatives are expected to generate a greater magnitude of positive impacts. Future updates to the designations can build on these changes to make the designations even more informative. Similar to the No Action designations, the preferred alternatives are not expected to have any impacts, positive or negative, on protected resources.

The No Action HAPC designations include an HAPC for Atlantic salmon in select rivers along the coast of Maine, and an HAPC for juvenile cod on the northern edge of Georges Bank. Collectively, the preferred alternatives maintain these HAPCs, and designate additional HAPCs, including areas overlapping Cashes and Jeffreys Ledges and Stellwagen Bank in the offshore Gulf of Maine, as well as inshore areas along the Massachusetts, New Hampshire, and Maine coasts for juvenile cod. The HAPC designations also include various deep-water canyon and slope areas off Georges Bank and in the Mid-Atlantic region, as well as the shallow portions of two New England seamounts. Even prior to formal adoption of these deep-water HAPCs via this amendment, these designations provided a foundation for future deep-water conservation activities undertaken by both the New England and Mid-Atlantic Fishery Management Councils. Amendments under development by both Councils aim to improve conservation of habitats that support deep-sea corals and other associated species, and the canyon and seamount HAPCs were a precursor to various management areas under consideration for coral protection. Overall, these preferred alternative HAPC designations are expected to have indirect positive impacts on the consultation and fishery management process relative to the No Action designations alone with respect to biological habitats, managed species, and human communities. In general, no additional cumulative impacts on the protected resources VEC beyond the baseline are expected to result from the HAPCs. The Atlantic salmon HAPC, when combined with other conservation measures specific to Atlantic salmon, should continue to have positive cumulative impacts.

2.3.3 Other alternatives considered

Both the No Action and preferred alternative EFH designations are typically based on relative abundance data at the 75th and 90th percentile levels of catch. The 25th and 50th percentile catches were also analyzed and map representations were developed for each. Compared to the 75th and 90th percentile maps, the non-preferred 25th and 50th percentile maps cover a smaller area where the highest survey catches occurred (the 25th percentile maps have the smallest areal coverage and the 90th percentile maps the largest). This may be viewed as a positive relative to either the No Action or the preferred designations, because it would focus management and conservation efforts on a smaller subset of habitats where the highest catches of each species have been observed historically. However, these narrower designations may miss important areas of occurrence for some species, which could have a negative impact if it limits the scope of conservation recommendations provided on a given project. Considering these two factors together, increased specificity but the chance of missing important areas, the 25th and 50th percentile modified abundance based and abundance plus habitat considerations maps probably have slightly fewer positive impacts than the preferred alternative designations. Because they include additional state survey information and more recent survey data as compared to the No Action designations, these alternatives are likely neutral relative to No Action. For a given catch percentile, the alternatives that include habitat considerations have more positive impacts relative to the alternatives based on abundance only, because they limit the designations to appropriate depths and temperatures, and are therefore less likely to have EFH map coverages in locations not suitable for a particular species.

The species range designation alternatives are more general in nature and broadly cover any areas where the species was caught in the NEFSC trawl surveys, as well as inshore areas where the species was caught in more than 10% of tows, or estuarine areas where the species was identified as common or abundant. Because these designations are non-specific, they are less useful for helping to target recommended conservation measures. However, habitats used by a particular species and lifestage are unlikely to be missed by the species range alternatives. On balance, the species range designations probably provide fewer positive benefits relative to No Action, and especially relative to the preferred alternative designations.

2.4 Combined direct impacts of the proposed spatial management measures and other combinations of alternatives

This section summarizes the direct impacts of five groups of spatial management alternatives: (1) the No Action alternatives, (2) the preferred alternatives, (3) no year-round habitat management areas combined with seasonal spawning areas, (4) smaller/fewer year-round habitat management areas combined with seasonal spawning areas, (5) more/larger year-round habitat management areas combined with year-round and seasonal spawning areas and DHRAs.

In contrast with the EFH and HAPC designation alternatives, the spatial management alternatives (alternatives in Volume 3, impacts in Volumes 4 and 5) affect the types of fishing activities that are authorized in specific management areas. The impacts analyses in Volumes 4 and 5 are summarized in tables in this section using the symbols and color coding shown below, including a range of impacts when appropriate. The magnitude qualifiers ‘highly’, ‘moderately’, and ‘slightly’ correspond with the qualifiers used throughout the analysis volumes.

In terms of economic impacts on the human community, a particular magnitude of potentially displaced revenues may constitute a slight impact in the context of one fishery and a moderate or high level of impact in another. In addition, impacts may be locally substantial, but only slightly positive or negative when considering the fishery as a whole. Overall short-term and long-term human community impacts conclusions are net determinations across all potentially affected fisheries combined. Note that the economic analysis provided in this FEIS measures potential revenue displacement in new closures, or likely revenue gains from existing closures, and focuses on impacts to those entities most directly affected, i.e. the commercial or recreational fishermen that harvest marine resources. The economic impacts of amendment alternatives thus represent a partial analysis using proxies for the true benefits and costs expected to accrue solely to fishermen. This naturally abstracts away from the broader societal benefits one would calculate under optimal circumstances. More information can be found in the introduction to human community impacts in Volume 4.

Symbol	Meaning
+++	Highly positive
++	Moderately positive
+	Slightly positive
0	Neutral
-	Slightly negative
--	Moderately negative
---	Highly negative
Negl	Negligible
Unk	Unknown or uncertain

2.4.1 No Action alternatives

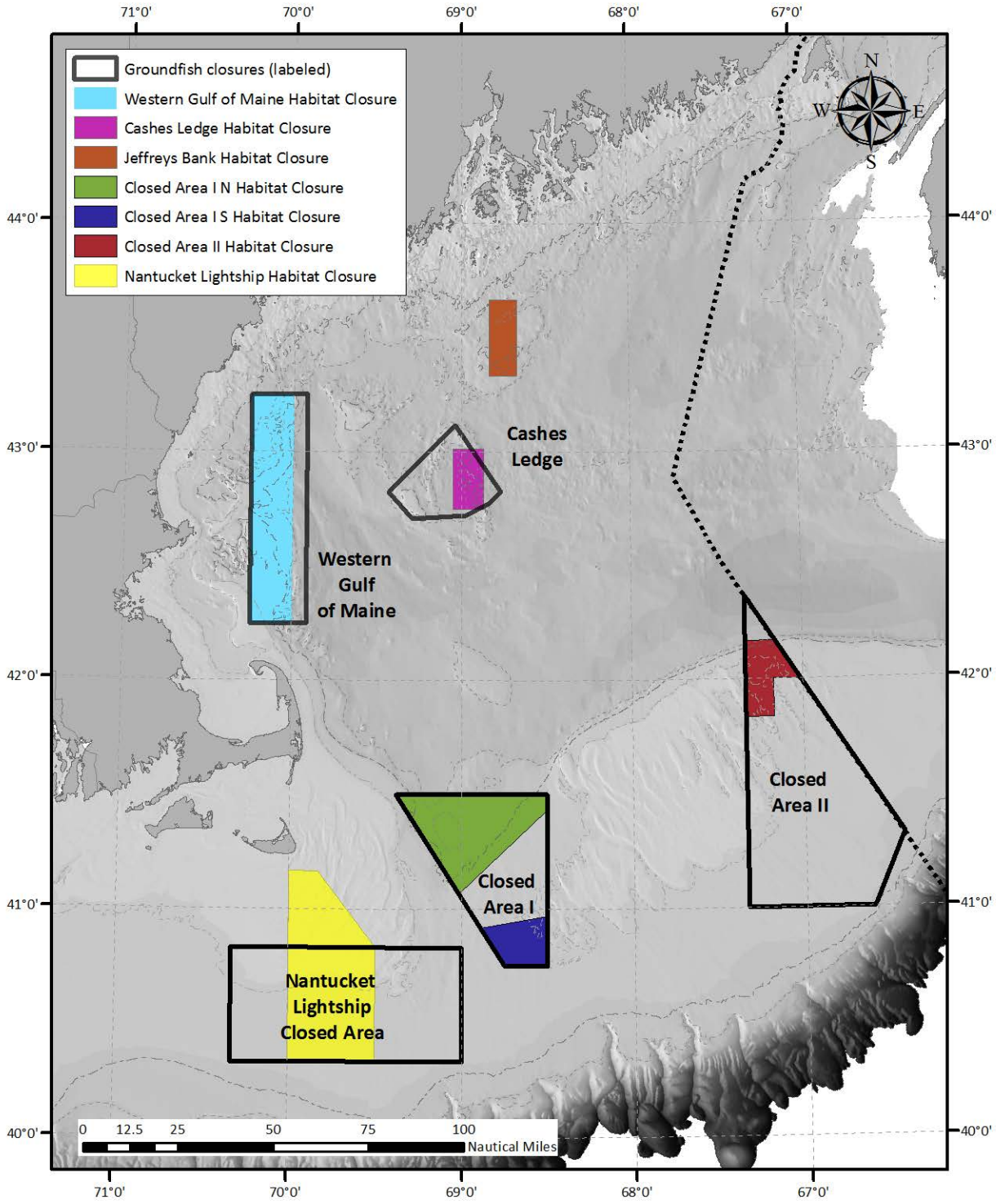
The No Action spatial management alternatives include existing year-round habitat and groundfish closed areas, as well as rolling closures and seasonal closures, including the Gulf of Maine Cod Spawning Protection Area (Table 10, Map 1, Map 2). These management areas and the fishing restriction measures associated with each are described in detail in Volume 3, Section 2. Note that No Action is always Alternative 1 in any particular sub-regional or regional section of the document. The fishing restrictions in the groundfish closures are noted as ‘gears capable of catching groundfish’ in the table below, but this is something of an oversimplification, as the measures vary slightly for each area (see details in Volume 3). The year-round groundfish closures were analyzed as part of the no action alternatives for both habitat and spawning protection, as these management areas provide both types of benefits, to varying degrees. However, these areas were not originally designated with either purpose as the major focus, and instead were mainly intended for mortality reduction. Impacts associated with the No Action alternatives are summarized in Table 11 (habitat and biological resources), Table 12 (fishing communities), and Table 13 (protected resources).

Table 10 – No Action spatial management alternatives

Alt. type	Sub-region or region	#	Areas included	Fishing restriction options
Habitat	Eastern Gulf of Maine	1	None	None
Habitat	Central Gulf of Maine	1	Jeffreys Bank Habitat Closure Area, Cashes Ledge Habitat Closure Area, Cashes Ledge Closure Area	Current measures: no mobile bottom-tending gears in habitat closures, restrictions on gears capable of catching groundfish in CL Closure Area
Habitat	Western Gulf of Maine	1	Western Gulf of Maine Habitat Closure Area, Western Gulf of Maine Closure Area	Current measures: no mobile bottom-tending gears in habitat closure, restrictions on gears capable of catching groundfish in WGOM Closure Area
Habitat	Georges Bank	1	Closed Areas I and II Habitat Closure Areas, Closed Areas I and II	Current measures: no mobile bottom-tending gears in habitat closures, restrictions on gears capable of catching groundfish in CAI and CAII
Habitat	Great South Channel/Southern New England	1	Nantucket Lightship Habitat Closure Area, Nantucket Lightship Closed Area	Current measures: no mobile bottom-tending gears in habitat closure, restrictions on gears capable of catching groundfish in NL Closed Area
Spawning	Gulf of Maine	1A[1]	Western Gulf of Maine Closure Area, Cashes Ledge Closure Area, Cod Protection Closures, Gulf of Maine Cod Spawning Protection Area	Current measures; generally restrictions on gears capable of catching groundfish, with more stringent measures in the GOM Cod Spawning Protection Area
Spawning	Georges Bank/Southern New England	1	Closed Areas I and II, Nantucket Lightship Closed Area, Georges Bank May Seasonal Closure Area	Current measures; generally restrictions on gears capable of catching groundfish
Research	All	1	No DHRAs designated	None

[1] Note that the baseline no action (1B) is also analyzed in the FEIS and includes the long term rolling closures recently changed via Framework 53 (May 2015)

Map 1 – No Action spatial management alternatives – year round areas only



Map 2 – No Action spatial management alternatives – seasonal areas only

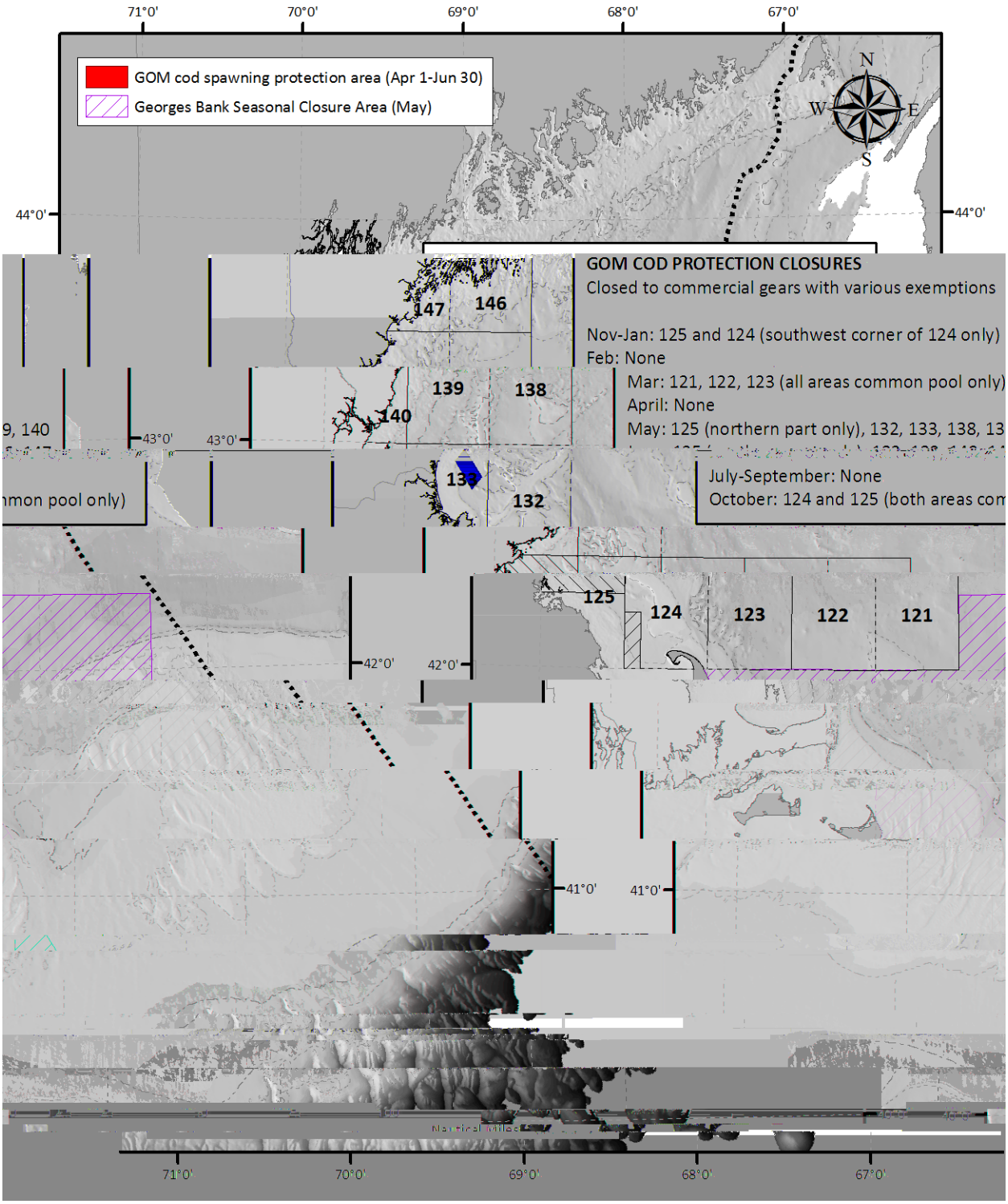


Table 11 – Habitat and managed resource impacts of the No Action alternatives.

Type	Sub-region or region	Alternative	Habitat	Large mesh mults groundfish resource	Small mesh mults groundfish resource	Monkfish resource	Skate resource	Sea scallop resource	Herring resource	Deep-sea red crab resource	Surfclam and ocean quahog resources	Bluefish resource	Mackerel, squid, and butterfish resources	Dogfish resource	Summer flounder, scup, and black sea bass resources	Golden tilefish resource	Northern shrimp resource	Lobster resource
Habitat	EGOM	Alt. 1 (No action)	-	- to 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	CGOM	Alt. 1 (No action)	+++	+ to ++	0	0	+	0	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 1 (No action)	++ to +++	++	- to 0	0	+ to ++	0	+	0	0	0	0	0	0 to +	0	0	0
Habitat	WGOM	Alt. 7A (preferred)	0 to +	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	GB	Alt. 1 (No action)	++	+++	0	0	0 to +	0	+	0	0	0	0	0	0 to +	0	0	+
Habitat	GSC-SNE	Alt. 1 (No action)	0	+	0	0	0 to +	0	+	0	0	0	0	0	0 to +	0	0	0
Spawning	GOM	Alt. 1A (Reg. No Action, pref.)	-	++	Unk	0	0 to ++	0	+	0	0	0	0	0	0 to +	0	0	0
Spawning	GOM	Alt. 1B (Baseline No Action)	-	++	Unk	0	0 to ++	0	+	0	0	0	0	0	0 to +	0	0	0
Spawning	GB-SNE	Alt. 1 (No Action)	- to 0	++	Unk	0	0 to ++	0	+	0	0	0	0	0	0 to +	0	0	+
Research	n/a	Alt. 1 (No Action)	--	-	0	0	0	0	0	0	0	0	0	0	- to 0	0	0	0

Table 12 – Human community impacts of the No Action alternatives.

Type	Sub-region or region	Alternative	Economic short-term	Economic long-term	Large mesh mults fishery	Small mesh mults fishery	Monkfish fishery	Skate fishery	Sea scallop fishery	Herring fishery	Red crab fishery	Clam fishery	Bluefish fishery	Mackerel, squid, butterfish fishery	Dogfish fishery	Summer flounder,scup, black sea bass fishery	Golden tilefish fishery	Shrimp fishery	Lobster fishery
Habitat	EGOM	Alt. 1 (No action)	0	-- to 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	CGOM	Alt. 1 (No action)	+	+	+	0	0	- to 0	0	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 1 (No action)	++	++	++	0	-	0	0	0	0	-	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 7A (preferred)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	GB	Alt. 1 (No action)	---	---	+ to ++	0	-	- to 0	--	0	0	0	0	0	0	- to 0	0	0	0
Habitat	GSC-SNE	Alt. 1 (No action)	-- to -	-- to -	0	0	0	- to 0	-	0	0	-	0	0	0	- to 0	0	0	0
Spawning	GOM	Alt. 1A (Reg. No Action, pref.)	++	++	0 - +	0	-	- to 0	- to 0	-	0	0	0	0	0	0	0	0	0
Spawning	GOM	Alt. 1B (Baseline No Action)	++	++	0 - +	0	-	- to 0	- to 0	-	0	0	0	0	0	0	0	0	0
Spawning	GB-SNE	Alt. 1 (No Action)	+ to ++	+ to ++	+ to ++	0	-	- to 0	0	-	0	0	0	0	0	- to 0	0	0	0
Research	n/a	Alt. 1 (No Action)	- to 0	- to 0	0	0	0 - +	0	-	0	0	0 - +	0	0	0	0	0	0	0

Table 13 – Protected resource impacts of the No Action alternatives.

Alt. type	Sub-region or region	Alternative	Marine mammals	Sea turtles	Sturgeon	Salmon
Habitat	EGOM	Alt. 1 (No action)	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	CGOM	Alt. 1 (No action)	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	WGOM	Alt. 1 (No action)	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	WGOM	Alt. 7A	Neutral	Neutral	Neutral	Neutral
Habitat	GB	Alt. 1 (No action)	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	GSC-SNE	Alt. 1 (No action)	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Spawning	GOM	Alt. 1A (Regulatory No Action)	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Spawning	GOM	Alt. 1B (Baseline No Action)	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Spawning	GB-SNE	Alt. 1 (No Action)	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Research	n/a	Alt. 1 (No Action)	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive

The combined direct impacts of the No Action alternatives on habitat and biological resources generally range from slightly negative to highly positive. The sole exception is that moderately negative impacts to habitat are expected if no action is selected in the research area section of the document, and no dedicated habitat areas are designated in this amendment, due to opportunity costs associated with this choice.

The largest positive magnitudes of impacts are in the habitat and large mesh multispecies groundfish categories. Across these two VECs, positive to highly positive impacts are anticipated to continue in the central and western Gulf of Maine sub-regions via continuation of No Action. Habitat and groundfish impacts in the eastern Gulf of Maine and Great South Channel/Southern New England sub-regions are expected to be slight. In eastern Maine, slight impacts are due to limited fishing activity requiring adverse effects minimization, and fewer groundfish that would benefit from conservation measures. In the case of the No Action measures for the Great South Channel/Southern New England sub-region, the current closures do not have a particularly strong association with either vulnerable habitats or juvenile groundfish, hence the minimal impacts expected. The current spawning areas, which are in many cases seasonal, are not expected to have a substantial impact on habitat, but do have a positive impact on large mesh groundfish. Overall, across these two VECs, No Action management is generally having a positive impact.

Impacts on other managed resources are generally expected to be neutral. Some slightly to moderately positive effects are expected on skates, herring, summer flounder/scup/black seabass, and lobster. These are due to spatial overlaps between these resources and particular management areas, and the benefits associated with gear restrictions currently in effect. In particular, the Western Gulf of Maine Closure Area is expected to have slightly to moderately positive impacts on skate, and Closed Area II is expected to have slight positive impacts on lobster. Various existing management areas overlap spatially and temporally with herring egg beds, which may have a slight positive impact on the herring resource. Summer flounder, scup and black seabass have slight overlaps with some of the No Action management areas, and are expected to derive some benefits from current gear restrictions. Impacts on a number of other resources are expected to be neutral, given limited overlaps with the management areas (e.g. tilefish or red crab), or a very general distribution that does not overlap with the management areas (e.g. monkfish).

In contrast to impacts on managed resources and habitat, human community impacts associated with No Action skew more towards the negative for certain fisheries. Effects on many other fisheries are expected to be neutral across the board, either due to the fishery working through exemptions, special access programs, or other access programs, within and around the current management measures, or due to limited spatial overlaps. For example, the small mesh multispecies fishery operates under a series of exemptions from large mesh fishery regulations, and many of the exemption areas fished for whiting are outside the current year-round and seasonal closures, so the fishery is not negatively or positively affected by existing management areas. Fisheries such as red crab, tilefish, squid, and shrimp do not particularly overlap No Action management areas, and therefore have neutral impacts. Fisheries for monkfish, skates, clams, and summer flounder/scup/black seabass may be experiencing some negative effects of effort displacement under existing management, but these effects are likely small in magnitude.

The large mesh groundfish fishery appears to be deriving the most positive benefits from current management, in particular in the habitat and spawning areas that overlap the western Gulf of Maine and Georges Bank. The fishery is likely experiencing some negative impacts associated with effort displacement due to year-round closures, but these are not outweighed by expected conservation benefits. The scallop fishery, however, is experiencing moderately negative impacts associated with existing habitat management areas on Georges Bank, and to a lesser extent, in Southern New England. Unlike with groundfish, the existing closures are not currently considered to be generating positive impacts on the scallop resource that balance these costs. Given the high overall value of this fishery, these reduced fishing opportunities contribute to highly negative (Georges Bank) or moderately to slightly negative (Great South Channel) impacts, in both the short and long-term, across all fisheries. Put another way, the scallop fishery is highly valuable and the resource condition is good, meaning the negative effects of current area management are too substantial to be outweighed by potential gains for other fisheries due to proposed management measures. In contrast to Georges Bank and the Great South Channel, long-term economic impacts in the Gulf of Maine are more positive. Negative impacts in eastern Maine relate to the opportunity costs associated with not designating management areas that may generate long-term resource and fishery benefits, but outcomes from existing seasonal and year-round closures in the Gulf of Maine are generally positive.

The combined direct impacts of the No Action measures on protected resources are expected to be slight. In general the effort shifts associated with spatial management areas are expected to have some indirect effects on fishery interactions with protected resources, but these interactions are also managed directly via gear-based measures and seasonal restrictions.

2.4.2 Preferred alternatives

The preferred spatial management alternatives are described in Table 14 and shown in Map 3 (year-round areas) and Map 4 (seasonal areas). Collectively, the preferred alternatives maintain some management areas and modify others. Some existing areas are eliminated entirely, and in other locations new areas are added for habitat, spawning, and research. In particular, a new habitat management area was added in eastern Maine, where previously there were no year-round or seasonal restrictions on fishing. In the central and western regions of the Gulf of Maine, some of the habitat and year-round closures were modified, but the system of management areas was kept largely intact. While a new research area was added overlapping the southern part of the Western Gulf of Maine Habitat Closure Area, a new spawning area was added in Massachusetts Bay, and a new mobile bottom-tending gear closure was added on Fippennies Ledge, these three areas generally overlap with current management areas. Therefore, in general in the central and western portions of the Gulf of Maine, limited impacts on fishery resources, habitats, and fishing communities are expected relative to No Action.

Adjustments on Georges Bank and in southern New England represent a more substantial departure from No Action management. The three year-round groundfish closures will be modified substantially, with removal of the Nantucket Lightship Closure Area and conversion of the northern part of Closed Area I and all of Closed Area II from year-round to seasonal closures. Habitat management areas in this part of New England are shifted to focus more on hard-bottom habitats, with new areas on Nantucket Shoals/west of the Great South Channel, on Georges

Shoal, and on Cox Ledge and 19 Fathom Bank off Rhode Island. Areas along the northern edge of Georges Bank abutting the Exclusive Economic Zone will still be managed for habitat conservation purposes, but the footprint of habitat management on the northern edge will increase, while fishing restricition measures will change. A dedicated habitat research area is also proposed in the southern part of what is now Closed Area I.

Impacts associated with the preferred alternatives are summarized in Table 15 (habitat and biological resources), Table 16 (fishing communities), and Table 17 (protected resources).

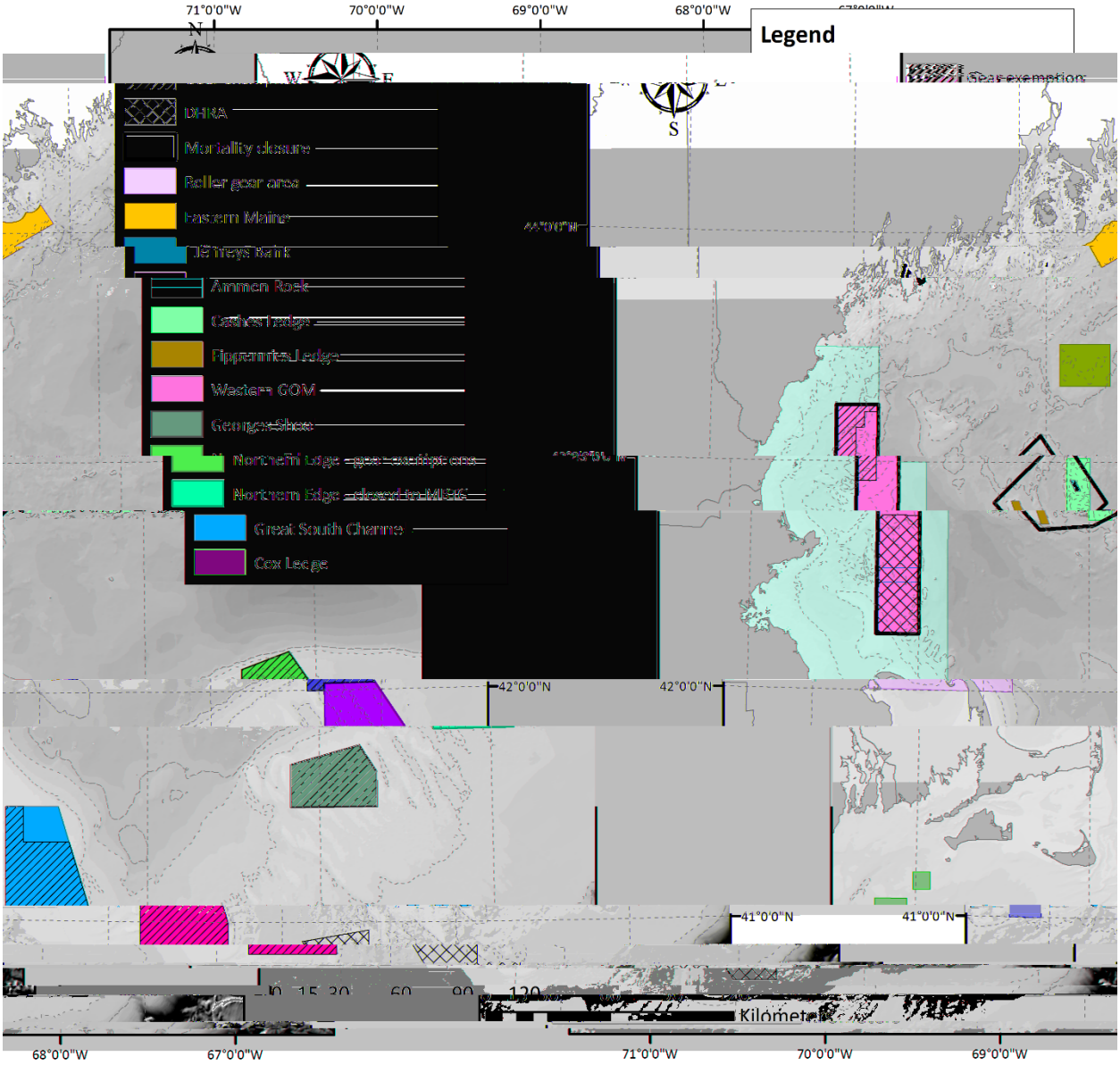
Table 14 – Preferred spatial management alternatives

Alt. type	Sub-region or region	#	Areas included	Fishing restriction options
Habitat	Eastern Gulf of Maine	3	Small Eastern Maine HMA	No mobile bottom-tending gear
Habitat	Central Gulf of Maine	1	Cashes Ledge Closure Area	Restrictions on gears capable of catching groundfish
Habitat	Central Gulf of Maine	3	Modified Jeffreys Bank EFH HMA, Modified Cashes Ledge EFH HMA, Ammen Rock HMA, Fippenies Ledge HMA	No mobile bottom-tending gear, Ammen Rock closed to all fishing except lobster traps
Habitat	Western Gulf of Maine	1	Western Gulf of Maine Habitat Closure Area, Western Gulf of Maine Closed Area with modified boundary	Current measures: no mobile bottom-tending gears in habitat closure, restrictions on gears capable of catching groundfish in WGOM Closure Area
Habitat	Western Gulf of Maine	7A	Inshore Roller Gear Restricted Area	Trawl roller gear limited to 12 inches in diameter. Maintains current area but expands restriction to all trawl gears.
Habitat	Western Gulf of Maine	8	WGOM Shrimp Trawl Exemption Area	Shrimp trawls exempted from northwestern corner of WGOM mobile bottom-tending gear closure
Habitat	Georges Bank	10	Northern Edge – MBTG HMA, Northern Edge Reduced Impact HMA, Georges Shoal 2 MBTG HMA	Georges Shoal – no mobile bottom-tending gears; one year exemption for clam dredges. Northern Edge MBTG – no mobile bottom-tending gears. Northern Edge Reduced Impact – scallop dredge access fishing only, groundfish trawls under SAP rules west of 67° 20’ only, no hydraulic clam dredges
Habitat	Great South Channel	4	Great South Channel HMA and Cox Ledge HMA	GSC – no mobile bottom-tending gears, one-year hydraulic clam dredge exemption in most of area except NE corner. Cox Ledge – no hydraulic dredges, no ground cables on trawls.
Spawning	Gulf of Maine	1A	Western Gulf of Maine Closure Area with modified boundary, Cashes Ledge Closure Area, Cod Protection Closures (seasonal), GOM Cod Spawning Protection Area (Apr-June)	Restrictions on gears capable of catching groundfish. WGOM Closure Area and habitat closure area boundaries the same.
Spawning	Gulf of Maine	3	Masschusetts Bay Cod Spawning Protection Area (Nov-Jan)	Restrictions on gears capable of catching groundfish. Overlaps with some of the Cod Protection Closures implemented May 2015.
Spawning	Gulf of Maine	4	Block 125 during April	Restrictions on gears capable of catching groundfish

Alt. type	Sub-region or region	#	Areas included	Fishing restriction options
Spawning	Georges Bank/Southern New England	3B 3C	Closed Areas I North and Closed Area II	Closed to various gears capable of catching groundfish, including recreational gears (Option B), with an exemption for scallop dredges (Option C)
Research	Western Gulf of Maine	3C	Stellwagen DHRA without reference area	No mobile bottom-tending gear, no gears capable of catching groundfish (recreational gears allowed)
Research	Georges Bank	4	Georges Bank DHRA	No mobile bottom-tending gear
Research	All	5	Applies to any DHRAs designated	DHRA sunsets after 3 years if not being used

Map 3 – Preferred spatial management alternatives, year-round areas only

-- Gear exemption areas hatched. In western Gulf of Maine, shrimp trawls exempt. In Great South Channel and Georges Shoal, clam dredges exempt for one year. On Northern Edge (red area), scallop access fishing exempt, bottom trawling for groundfish exempt west of 67° 20′ W.
-- Dedicated Habitat Research Areas are cross-hatched. Stellwagen DHRA (north), Georges Bank DHRA (south)
-- Mortality closures shown with heavy black outline. Current gear restrictions.
-- Largest shaded area is the roller gear restricted area.
-- Other shaded/colored areas are mobile bottom-tending gear closures, with gear exemptions as noted above.
-- Cox Ledge closed to clam dredges, and trawls cannot use ground cables.
-- Ammen Rock closed to all gears except lobster traps.



Map 4 – Preferred spatial management alternatives, seasonal spawning areas

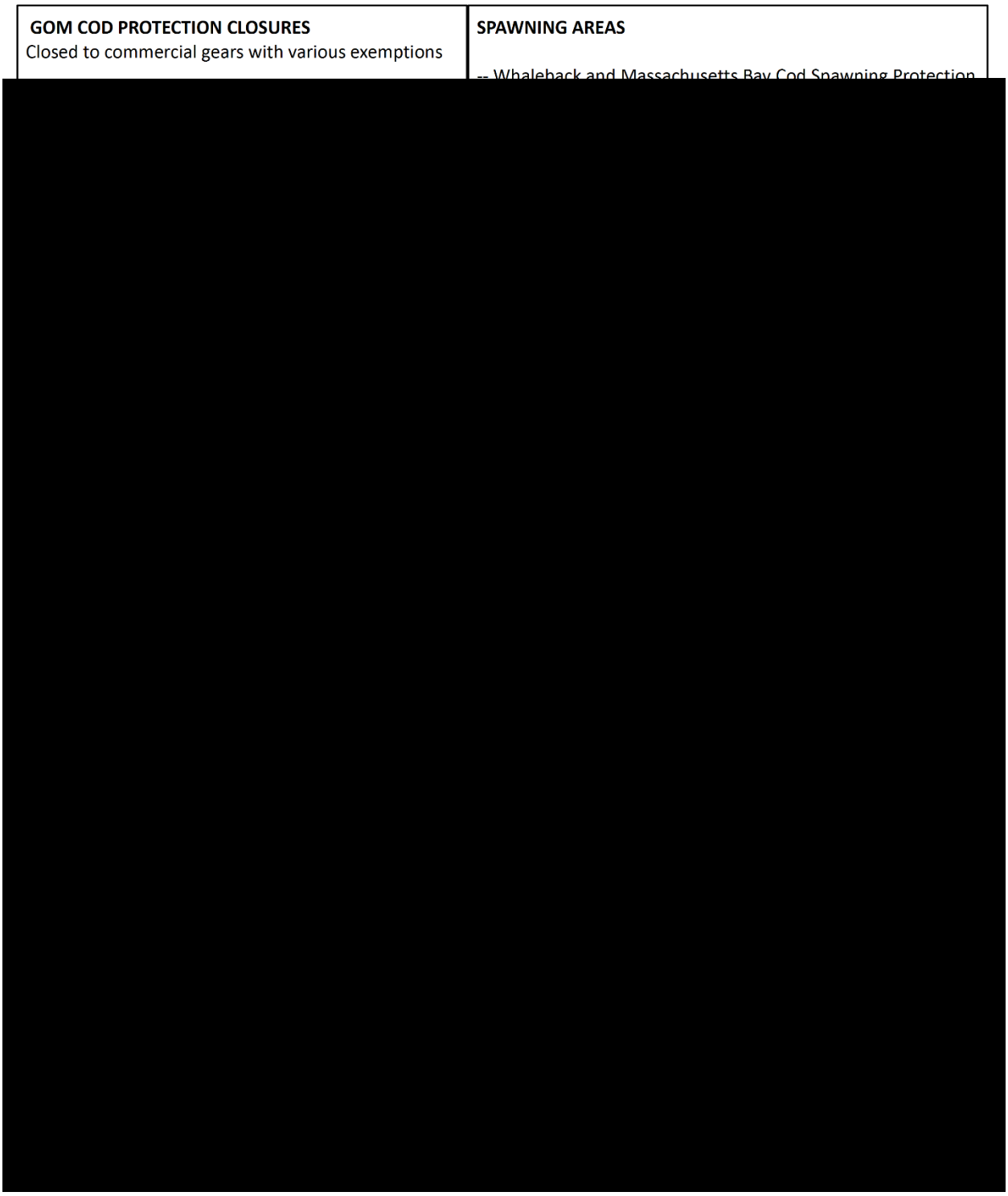


Table 15 – Habitat and managed species impacts of the preferred alternatives.

Type	Sub-region or region	Alternative	Habitat	Large mesh mults groundfish resource	Small mesh mults groundfish resource	Monkfish resource	Skate resource	Sea scallop resource	Herring resource	Deep-sea red crab resource	Surfclam and ocean quahog resources	Bluefish resource	Mackerel, squid, and butterfish resources	Dogfish resource	Summer flounder, scup, and black sea bass resources	Golden tilefish resource	Northern shrimp resource	Lobster resource
Habitat	EGOM	Sm. Eastern Maine (preferred)	+	+	0 to +	0	0 to +	0	0	0	0	0	0	0	0	0	0	+
Habitat	CGOM	CL GF, CL HMA, JB HMA, FL HMA, AR HMA (preferred)	+++	+ to ++	0	0	0 to +	0	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 1 with modified boundary (preferred)	++	++	- to 0	0	+ to ++	0	+	0	0	0	0	0	0 to +	0	0	0
Habitat	WGOM	Alt. 7A (preferred)	0 to +	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 8 (preferred)	0	+	0	0	- to 0	0	0	0	0	0	0	0	0	0	0	0
Habitat	GB	Alt. 10 (preferred)	++	++	0	0	- to 0	0	+	0	0	0	0	0	0 to +	0	0	+
Habitat	GSC-SNE	Alt. 4 with temporary clam dredge exemption (preferred)	+ to ++	+	0	0	- to 0	0	+	0	0	0	0	0	0 to +	0	0	+
Spawning	GOM	Alt. 1A (Reg. No Action, pref.)	-	++	Unk	0	0 to ++	0	+	0	0	0	0	0	0 to +	0	0	0
Spawning	GOM	Alt. 3 (preferred)	-	++	Unk	0	0 to +	0	-	0	0	0	0	0	0	0	0	0
Spawning	GOM	Alt. 4 (preferred)	-	++	Unk	0	0 to +	0	0	0	0	0	0	0	0	0	0	0
Spawning	GB-SNE	Alt. 3B (preferred)	0 to +	+	Unk	0	- to 0	+	-	0	0	0	0	0	- to 0	0	0	-
Spawning	GB-SNE	Alt. 3C (preferred)	0 to +	-	Unk	0	- to 0	0	-	0	0	0	0	0	- to 0	0	0	-
Research	WGOM	Alt. 3C (preferred)	++	++	0	0	0 to ++	0	+	0	0	0	0	0	0	0	0	0
Research	GB	Alt. 4 (preferred)	+ to ++	+	0	0	0 to ++	++	+	0	0	0	0	0	0 to +	0	0	0
Research	n/a	Alt. 5 (preferred)	- to +	- to +	0	0	0	0	0	0	0	0	0	0	- to 0	0	0	0

Table 16 – Human community impacts of the preferred alternatives.

Type	Sub-region or region	Alternative	Economic short-term	Economic long-term	Large mesh mults fishery	Small mesh mults fishery	Monkfish fishery	Skate fishery	Sea scallop fishery	Herring fishery	Red crab fishery	Clam fishery	Bluefish fishery	Mackerel, squid, butterfish fishery	Dogfish fishery	Summer flounder,scup, black sea bass fishery	Golden tilefish fishery	Shrimp fishery	Lobster fishery
Habitat	EGOM	Sm. Eastern Maine (preferred)	-	+	-to+	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	CGOM	CL GF, CL HMA, JB HMA, FL HMA, AR HMA (preferred)	+	+	+	0	0	-to0	0	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt 1 with modified boundary (preferred)	++	++	++	0	+	0	0	0	0	-	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 7A (preferred)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 8 (preferred)	0	0 to +	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0
Habitat	GB	Alt. 10 (preferred)	+++	+++	+ to ++	0	+	0 -++	++	0	0	--- to --	0	0	0	0 -+	0	0	-to0
Habitat	GSC-SNE	Alt. 4 with temporary clam dredge exemption (preferred)	-	0 -++	-	0	+	0	+	0	0	---	0	+	0	-to0	0	0	0
Spawning	GOM	Alt. 1A (Reg. No Action, pref.)	++	++	0 -+	0	-	-to0	-to0	-	0	0	0	0	0	0	0	0	0
Spawning	GOM	Alt. 3 (preferred)	-	+	0 -+	0	-	0	-to0	0	0	0	0	0	0	0	0	0	0
Spawning	GOM	Alt. 4 (preferred)	-	+	0 -+	0	-	0	0	0	0	0	0	0	0	0	0	0	0
Spawning	GB-SNE	Alt. 3B	+	+	+	0	+	0 to +	+	0 -+	0	0	+	+	0 to +	0 -+	0	0	-to0
Spawning	GB-SNE	Alt. 3C (preferred)	+	+	0	0	+	0 to +	0	0	0	0	0	0	0	0	0	0	-to0
Research	WGOM	Alt. 3C (preferred)	0	+	0	0	-to0	++	0	0	0	-to0	0	0	-to0	0	0	0	0
Research	GB	Alt. 4 (preferred)	-	+	-	0	0	+	++	0	0	-to0	0	0	0	0	0	0	0
Research	n/a	Alt. 5 (preferred)	0	+	0	0	0 -+	0	0	0	0	0 -+	0	0	0	0	0	0	0

Table 17 – Protected resource impacts of the preferred alternatives.

Alt. type	Sub-region or region	Alternative	Marine mammals	Sea turtles	Sturgeon	Salmon
Habitat	EGOM	Sm. Eastern Maine	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	CGOM	CL GF, CL HMA, JB HMA, FL HMA, AR HMA	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	WGOM	Alt. 1 with modified boundary	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	WGOM	Alt. 7A	Neutral	Neutral	Neutral	Neutral
Habitat	WGOM	Alt. 8	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	GB	Alt. 10	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Habitat	GSC-SNE	Alt. 4	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to neutral
Spawning	GOM	Alt. 1A (Regulatory No Action)	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Spawning	GOM	Alt. 3	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Spawning	GOM	Alt. 4	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Spawning	GB-SNE	Alt. 3	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Research	WGOM	Alt. 3	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Research	GB	Alt. 4	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Research	n/a	Alt. 5	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive

The combined direct effects of the preferred alternatives across all VECs generally range from slightly negative to highly positive. The one exception to this is that impacts of two of the habitat management alternatives on the clam fishery are expected to be highly to moderately negative, due to the magnitude of potential displacement from current fishing grounds. A trailing action to OHA2 is considering clam dredge exemptions from these management areas, which could mitigate these negative impacts but also limit conservation benefits. Similar to the No Action scenario, impacts on a number of managed resources and fisheries are expected to be neutral, due to limited overlap between the management areas proposed in this amendment and those resource and fisheries, or because the gears used to prosecute those fisheries are generally not regulated via the management areas proposed. Also similar to No Action, the largest magnitude resource impacts are expected in the habitat and large mesh multispecies groundfish categories, and to a lesser extent on skate species. The largest magnitudes of human community impacts are for the large mesh multispecies fishery, scallop fishery, and to a lesser extent, the skate fishery, but these impacts generally trend towards the positive, or a worst slightly negative. As noted above, the clam fishery is an exception here. Slight positive or negative impacts of some alternatives are expected in other fisheries. Again, similar to the No Action scenario, impacts on protected resources are expected to be slight.

Focusing next on habitat impacts, the preferred habitat management alternatives are expected to have positive impacts overall. The effects of the roller gear measure and shrimp exemption in the western Gulf of Maine are likely neutral or slightly positive, but other alternatives are generally expected to have moderately to highly positive impacts in heavily fished areas where the HMAs are well located to encompass vulnerable habitat types (i.e. in the western Gulf of Maine, on Georges Bank, and in the Great South Channel/Southern New England sub-regions). In the eastern Gulf of Maine sub-region, habitat impacts are expected to be slightly positive, due to the smaller size and scope of the area proposed, and due to the relatively small amount of fishing activity occurring in that sub-region at present that requires adverse effects minimization. The effects of the research alternatives are generally expected to be positive because these areas are specifically designed to focus scientific efforts on questions that will improve habitat management over time. The effects of the preferred spawning alternatives tend to be slight. Slightly negative effects are associated with the Gulf of Maine spawning proposals because they displace effort without providing an obvious habitat conservation benefit. Impacts of the Georges Bank spawning alternatives tend towards the positive, because they actually increase flexibility relative to No Action, such that efficiency could increase and area swept could decrease, but again, the seasonality of the measures limit the direct conservation benefits on more vulnerable habitat types with longer recovery times. Overall, the preferred alternatives likely maintain or improve upon habitat benefits associated with existing area management under No Action.

In terms of the large mesh groundfish resource, the habitat, spawning, and research alternatives are generally expected to have positive impacts. Slight negative impacts are associated with exempting scallop dredges from the Georges Bank spawning areas. In some sub-regions, including the central and western Gulf of Maine, and Great South Channel/Southern New England, impacts are neutral relative to those under No Action. On Georges Bank, moderately positive impacts are associated with preferred habitat management measures, but this is a reduction in benefits relative to No Action. Slightly to moderately positive impacts are associated with new research areas, and with a new habitat management area in eastern Maine. Overall, the

preferred alternatives likely maintain groundfish conservation benefits associated with existing area management under No Action.

Other managed resources may experience low positive impacts in association with new habitat and research areas, including small mesh groundfish, skates, sea scallops, herring, summer flounder/scup/black seabass, and lobster. Other spatial management alternatives may have slight positive or negative impacts on these same stocks. Shifting from year-round to seasonal groundfish closures on Georges Bank may have slight negative effects on resources that overlap these areas. In other cases, adjustments in management areas maintain positive impacts currently occurring under No Action, for example shifting from No Action to Alternative 10 on Georges Bank is expected to maintain conservation benefits for the lobster resource on the eastern part of the bank.

As noted above, human community impacts of the preferred alternatives trend towards the positive. Unlike with the No Action scenario, which would continue areas that have generally been in place for many years, the short-term vs. long-term impacts of the preferred alternatives are often different from one another. Specifically, preferred alternatives that designate new areas may have some short-term slight negative impacts via displacement of fishing activities. This is true of new areas habitat areas in eastern Maine and the Great South Channel/Southern New England, as well as of new spawning areas in the western Gulf of Maine. However, long term economic impacts are expected to be neutral to highly positive, across all alternatives. The most substantial change relative to No Action is on Georges Bank, where changes in management areas will allow additional yield to be generated in the scallop fishery. The Great South Channel/Southern New England HMAs are expected to generate positive impacts relative to No Action over the short and long term. In both sub-regions, these long term conclusions consider possible changes in patterns of fishing effort, both positive and negative, in combination with conservation benefits that could improve stock and therefore fishery conditions.

As with No Action, the combined direct impacts of the preferred alternatives on protected resources are expected to be slight. In general, the effort shifts associated with spatial management areas are expected to have some indirect effects on fishery interactions with protected resources, but these interactions are also managed directly via gear-based measures and seasonal restrictions.

2.4.3 Example combinations of alternatives

This section describes the impacts associated with three specific combinations of alternatives. The purpose is to put the combined direct effects of the No Action and preferred alternatives into context, relative to the full range of measures considered in the amendment.

Scenario 1: No year round habitat management areas, seasonal spawning closures

This amendment analyzes some alternatives that are less restrictive than No Action. These alternatives would remove year-round habitat and groundfish management areas entirely, and make other year-round groundfish management areas seasonal. The alternatives included in this scenario are listed below. This scenario does not include any dedicated habitat research areas.

- Habitat, EGOM Alt. 1/No action, continues with no habitat management areas
- Habitat, CGOM Alt. 2, no habitat management areas, Cashes and Jeffreys Ledge Habitat Closure Areas removed
- Habitat, WGOM Alt. 2, no habitat management areas, Western Gulf of Maine Habitat Closure Area removed
- Habitat, GB Alt. 2, no habitat management areas, Closed Area I and Closed Area II Habitat Closure Areas removed
- Habitat, GSC-SNE Alt. 2, no habitat management areas, Nantucket Lightship Habitat Closure Area removed
- Spawning, GB-SNE Alt. 3A and 3C, CAII and CAI N as seasonal closures from February 1-April 15; recreational gears and scallop dredges not included in restrictions; Nantucket Lightship Closed Area and May seasonal closure removed
- Spawning, GOM Alt. 2A, previous sector rolling closures only, year round closures in Western Gulf of Maine and Cashes Ledge removed

Scenario 2: Fewer/smaller habitat management areas

This scenario includes alternatives that incorporate year-round area management, but are generally smaller than existing management areas. The alternatives included in this scenario are listed below. Dedicated habitat research areas are incorporated when they overlap proposed habitat management areas. The scenario assumes the areas are implemented as mobile bottom-tending gear closures (Option 1). The year round groundfish closures in the Gulf of Maine would be removed, and those in the Georges Bank/Southern New England region would be removed or made seasonal.

- Habitat, EGOM preferred alternative, Small Eastern Maine HMA only
- Habitat, CGOM Alt. 4 Option 1, includes modified Cashes Ledge and Jeffreys Bank HMAs, plus Ammen Rock HMA
- Habitat, WGOM Alt. 6 Option 1, includes Large Stellwagen HMA
- Habitat, GB Alt. 7 Option 1, includes EFH South and Georges Shoal 2 HMAs
- Habitat, GSC-SNE, Alt. 5 Option 1, includes Nantucket Shoals HMA
- Spawning, GB-SNE Alt. 3A and 3C, CAII and CAI N as seasonal closures from February 1-April 15; recreational gears and scallop dredges not included in restrictions; Nantucket Lightship Closed Area and May seasonal closure removed
- Spawning, GOM Alt. 2A, previous sector rolling closures only, year round closures in Western Gulf of Maine and Cashes Ledge removed
- Research, EGOM Alt. 2, Eastern Maine DHRA
- Research, WGOM Alt. 3C (preferred), Stellwagen DHRA without reference area
- Research, Alt. 5 (preferred), sunset provision

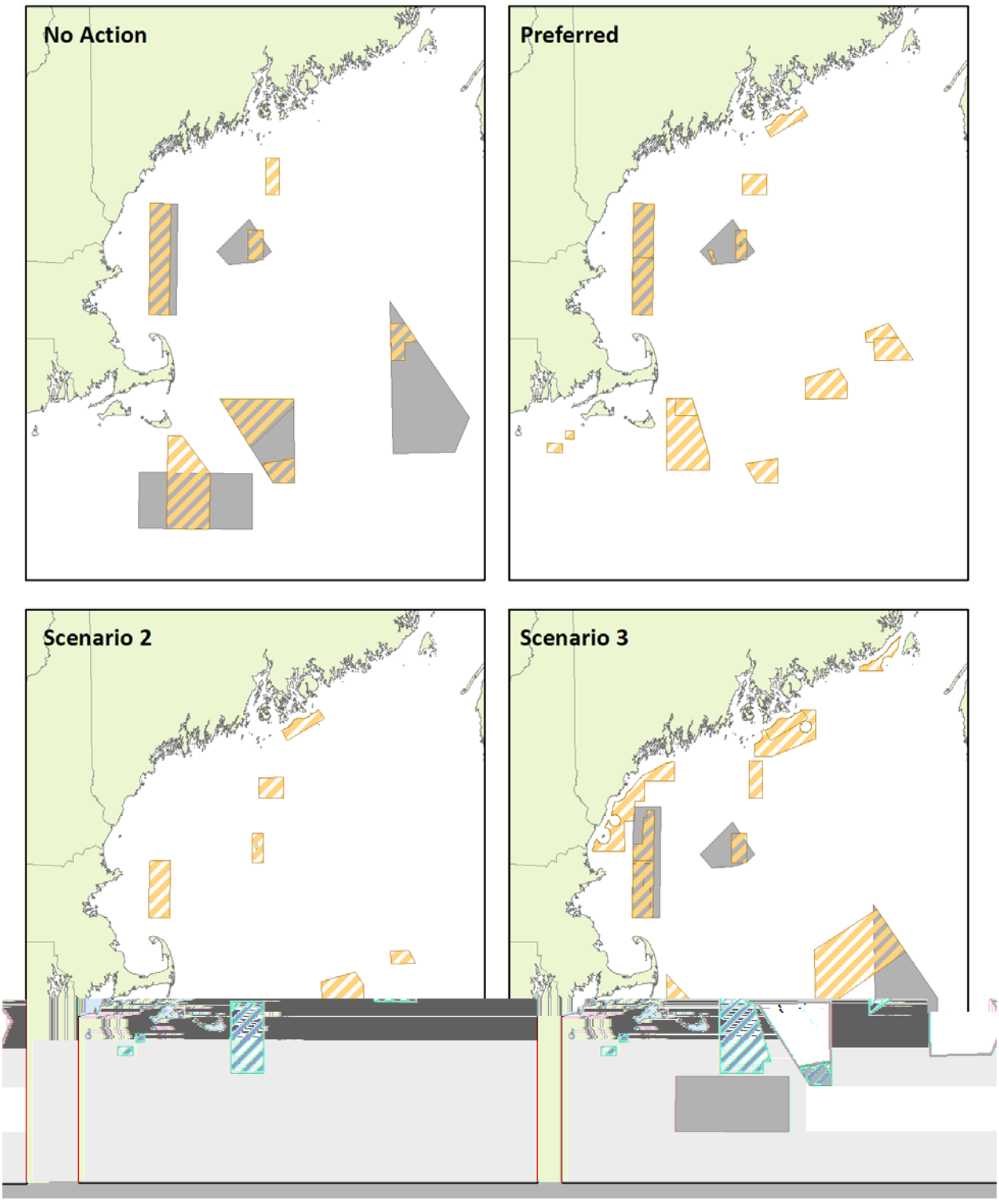
Scenario 3: More/larger habitat management areas

This scenario includes alternatives that are generally more restrictive than current management approaches. Existing year-round closures would be maintained, and habitat closures would be maintained or expanded to include additional areas.

- Habitat, EGOM Alt. 3, Options 1, includes Large Eastern Maine HMA and Machias HMA
- Habitat, CGOM Alt. 1/No action, includes Cashes Ledge and Jeffreys Ledge Habitat Closures, and Cashes Ledge Closure Area
- Habitat, WGOM Alt. 4, Option 1, include Large Bigelow Bight HMA, Jeffreys Ledge HMA, Small Stellwagen HMA
- Habitat, WGOM, Alt. 7A (preferred); makes existing roller gear restricted area a habitat measure
- Habitat, GB, Alt. 8, Option 1, includes Northern Georges MBTG HMA
- Habitat, GSC-SNE, Alt. 3, Option 1, includes Great South Channel East HMA
- Spawning, GB-SNE, Alt. 1/No Action, maintains CAI, CAII, NLCA year round, plus seasonal closure during May
- Spawning, GOM, Alt. 1B (Baseline No Action), maintains prior set of sector and common pool rolling closures, Cashes Ledge and Western Gulf of Maine Closure Areas, and Gulf of Maine Cod Spawning Protection Area
- Spawning, GOM Alt. 3 (preferred), adds Massachusetts Bay Cod Spawning Protection Area
- Research, EGOM Alt. 2, Eastern Maine DHRA
- Research, WGOM Alt. 3A, Stellwagen DHRA with reference area closed to recreational gear
- Research, GB Alt. 4 (preferred), Georges Bank DHRA

Map 5 compares the year-round management areas associated with the No Action alternatives, the preferred alternatives, Scenario 2, and Scenario 3. Scenario 1, which does not include any year-round management areas, is not shown. As is evident from the maps, the four options vary in terms of total area managed on a year-round basis. Accounting for spatial overlaps between areas, and only considering the areas shown on the figure, No Action encompasses 23,109 km^2, the preferred alternatives encompass 10,095 km^2, Scenario 2 encompasses 6,343 km^2, and Scenario 3 encompasses 32,980 km^2. Total area managed is only a very rough proxy for costs and benefits, but is nonetheless worth noting here because the four scenarios vary significantly in this regard. For example, the year-round groundfish closures have various exemptions such that they are not uniformly managed in terms of gear restrictions, and the habitat management areas are not equally vulnerable to fishing gear impacts. These nuances and many other factors are accounted for in the impacts assessment in Volumes 4 and 5.

Map 5 – Year-round management areas included in scenarios evaluated in the cumulative effects analysis. Scenario 1, which does not include any year-round management areas, is not shown.



Impacts associated with the three scenarios are summarized in Table 18 (habitat and biological resources), Table 19 (fishing communities), and Table 20 (protected resources). Protected resource impacts are similar across all three scenarios, and expected to be slight in all cases, but managed resource, habitat, and human community impacts vary substantially.

Impacts to habitat and large mesh groundfish tend to be strongly negative under Scenario 1, slightly to moderately positive under Scenario 2, and moderately to highly positive under Scenario 3. Impacts to other managed resources follow a similar pattern across the scenarios, but are generally less extreme, and many alternatives are expected to have neutral impacts. The patterns in human community impacts are somewhat opposite, although more mixed, because fishery conditions depend on resource conditions. In the short-term, the impacts of Scenario 1 are overwhelmingly positive, but over the long-term, impacts are mixed, in accordance with negative habitat and resource impacts affecting the fisheries for those resources. Across the various individual fisheries, the impacts of Scenario 1 are generally neutral to positive. The groundfish fishery could be negatively affected by Scenario 1, given negative impacts expected on the groundfish resource.

Scenario 2 includes fewer and smaller year-round habitat management areas, combined with seasonal spawning closures. Habitat and groundfish resource impacts are slightly to moderately positive, and long term economic impacts are generally slightly positive as well. Some slightly negative economic outcomes are possible in the central and western Gulf of Maine sub-regions, where the No Action and preferred alternatives are similar, but Scenario 2 eliminates some existing management areas. Across the various individual fisheries, the impacts of Scenario 2 are generally neutral to positive. The exception here is some alternatives with negative to highly negative impacts on the clam fishery.

Scenario 3, which includes more and larger habitat management areas and tends towards year round closures for spawning protection has the most strongly positive impacts on habitat and the large mesh groundfish resource. Some other managed resources including small mesh groundfish, skates, herring, summer flounder/scup/black seabass, and lobster could also see slightly to moderately positive impacts. However, Scenario 3 has the most strongly negative human community impacts of any combination of alternatives evaluated. Moderately to highly negative impacts could be felt by the large and small mesh groundfish fisheries, skate fishery, scallop fishery, clam fishery, and shrimp fishery. These negative impacts are associated with areas that are heavily fished by gears that would be regulated via this amendment, i.e. the western Gulf of Maine, Georges Bank, and the Great South Channel. (While eastern Maine is heavily fished by the lobster industry, this gear would not be regulated via the habitat amendment so no negative impacts on the fishery are expected.)

Despite some negative impacts at the individual fishery level, combined, long-term economic impacts under Scenario 3 would be positive in the Gulf of Maine. However, long term combined economic impacts of the habitat and spawning alternatives would be negative on Georges Bank and in the Great South Channel/Southern New England sub-regions, due to effort displacement in the large mesh groundfish, scallop, and clam dredge fisheries. Given the relatively large fraction of scallop, clam, and groundfish resources that overlap the Northern Georges HMA and Great South Channel East HMA, the net long-term economic impacts are expected to be

negative, despite potential conservation benefits of these two areas for large mesh groundfish and other species.

The combined impacts of both the No Action and preferred alternative scenarios likely fall somewhere between Scenario 2 and Scenario 3. Habitat and resource impacts are less strongly positive than Scenario 3, but human community impacts across the various fisheries are less strongly negative than Scenario 3 as well. In most sub-regions, the anticipated habitat and large mesh groundfish benefits associated with the preferred alternatives exceed those expected under the alternatives included in Scenario 2, but generally do not match those that would be afforded under Scenario 3. The preferred alternative performs well relative to No Action in sub-regions where the habitat and large mesh groundfish impacts of No Action are slightly negative to slightly positive, i.e. in the eastern Gulf of Maine and in the in the Great South Channel and Southern New England sub-reigons. The preferred alternative also performs well relative to No Action in terms of eliminating some negative human community impacts. The exception here is the surfclam fishery, where impacts of the preferred alternative scenario could be mitigated through a trailing action, but might be moderately to highly negative if long term exemptions from the closures are not provided. For VECs or elements of VECs that are more substantially affected by the alternatives in this amendment, the no closure scenario (Scenario 2) performs poorly relative to all other scenarios considered. As noted previously, while Scenario 2 affords positive short-term economic impacts, long-term impactsin many sub-regions are likely negative. The exception here is the Georges Bank sub-region, where long-term net economic impacts are driven by the potential for increased yield in the scallop fishery.

Table 18 – Habitat and managed species impacts associated with each of three combination scenarios.

No year round areas, seasonal spawning closures

Type	Sub-region or region	Alternative	Habitat	Large mesh mults groundfish resource	Small mesh mults groundfish resource	Monkfish resource	Skate resource	Sea scallop resource	Herring resource	Deep-sea red crab resource	Surfclam and ocean quahog resources	Bluefish resource	Mackerel, squid, and butterfish resources	Dogfish resource	flounder, scup, and black sea bass	Golden tilefish resource	Northern shrimp resource	Lobster resource
Habitat	EGOM	Alt. 1 (No action)	-	- to 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	CGOM	Alt. 2 (No area)	--- to --	--	0	0	- to 0	0	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 2 (No area)	---	---	-	0	-- to 0	0	-	0	0	0	0	0	- to 0	0	0	0
Habitat	GB	Alt. 2 (No area)	--	---	0	0	- to 0	0	-	0	0	0	0	0	- to 0	0	0	-
Habitat	GSC-SNE	Alt. 2 (No area)	0	-	0	0	- to 0	0	-	0	0	0	0	0	- to 0	0	0	0
Spawning	GOM	Alt. 2A	-	++	Unk	0	-- to 0	0	-	0	0	0	0	0	0	0	0	0
Spawning	GB-SNE	Alt. 3A	0 to +	+	Unk	0	- to 0	+	-	0	0	0	0	0	- to 0	0	0	-

Fewer/smaller habitat management areas

Type	Sub-region or region	Alternative	Habitat	Large mesh mults groundfish resource	Small mesh mults groundfish resource	Monkfish resource	Skate resource	Sea scallop resource	Herring resource	Deep-sea red crab resource	Surfclam and ocean quahog resources	Bluefish resource	Mackerel, squid, and butterfish resources	Dogfish resource	flounder, scup, and black sea bass	Golden tilefish resource	Northern shrimp resource	Lobster resource
Habitat	EGOM	Sm. Eastern Maine (preferred)	+	+	0 to +	0	0 to +	0	0	0	0	0	0	0	0	0	0	+
Habitat	CGOM	Alt. 4 Options 1 and 2	+	+	0	0	- to 0	0	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 6 Options 1 and 2	+	+	- to 0	0	- to 0	0	+	0	0	0	0	0	0 to +	0	0	0
Habitat	GB	Alt. 7 Option 1	+	---	0	0	- to 0	0	+	0	0	0	0	0	0 to +	0	0	-
Habitat	GSC-SNE	Alt. 5 Option 1	+ to ++	0 to +	0	0	- to 0	0	+	0	0	0	0	0	0 to +	0	0	0
Spawning	GOM	Alt. 2A	-	++	Unk	0	-- to 0	0	-	0	0	0	0	0	0	0	0	0
Spawning	GB-SNE	Alt. 3A	0 to +	+	Unk	0	- to 0	+	-	0	0	0	0	0	- to 0	0	0	-
Research	EGOM	Alt. 2	++	++	0 to +	0	0 to ++	0	0	0	0	0	0	0	0	0	0	0
Research	WGOM	Alt. 3C (preferred)	++	++	0	0	0 to ++	0	+	0	0	0	0	0	0	0	0	0
Research	n/a	Alt. 5 (preferred)	- to +	- to +	0	0	0	0	0	0	0	0	0	0	- to 0	0	0	0

More/larger habitat management areas

Type	Sub-region or region	Alternative	Habitat	Large mesh mults groundfish resource	Small mesh mults groundfish resource	Monkfish resource	Skate resource	Sea scallop resource	Herring resource	Deep-sea red crab resource	Surfclam and ocean quahog resources	Bluefish resource	Mackerel, squid, and butterfish resources	Dogfish resource	flounder, scup, and black sea bass	Golden tilefish resource	Northern shrimp resource	Lobster resource
Habitat	EGOM	Alt. 3 Options 1 and 2	+	+ to ++	0 to +	0	0 to +	0	+	0	0	0	0	0	0	0	0	+
Habitat	CGOM	Alt. 1 (No action)	+++	+ to ++	0	0	+	0	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 4 Options 1 and 2	+++	+++	+	0	0	0	+	0	0	0	0	0	0 to +	0	0	+
Habitat	WGOM	Alt. 7A (preferred)	0 to +	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	GB	Alt. 8 Option 1	+++	+++	0	0	- to 0	0	+	0	0	0	0	0	0 to +	0	0	-
Habitat	GSC-SNE	Alt. 3 Option 1	+++	+ to ++	0	0	- to 0	0	+	0	0	0	0	0	0 to +	0	0	+
Spawning	GOM	Alt. 1B (Baseline No Action)	-	++	Unk	0	0 to ++	0	+	0	0	0	0	0	0 to +	0	0	0
Spawning	GOM	Alt. 3 (preferred)	-	++	Unk	0	0 to +	0	-	0	0	0	0	0	0	0	0	0
Spawning	GOM	Alt. 4 (preferred)	-	++	Unk	0	0 to +	0	0	0	0	0	0	0	0	0	0	0
Spawning	GB-SNE	Alt. 1 (No Action)	- to 0	++	Unk	0	0 to ++	0	+	0	0	0	0	0	0 to +	0	0	+
Research	EGOM	Alt. 2	++	++	0 to +	0	0 to ++	0	0	0	0	0	0	0	0	0	0	0
Research	WGOM	Alt. 3A	++	++	0	0	0 to ++	0	+	0	0	0	0	0	0	0	0	0
Research	GB	Alt. 4 (preferred)	+ to ++	+	0	0	0 to ++	++	+	0	0	0	0	0	0 to +	0	0	0

Table 19 – Human community impacts associated with each of three combination scenarios.

No year round areas, seasonal spawning closures

Type	Sub-region or region	Alternative	Economic short-term	Economic long-term	Large mesh mults fishery	Small mesh mults fishery	Monkfish fishery	Skate fishery	Sea scallop fishery	Herring fishery	Red crab fishery	Clam fishery	Bluefish fishery	Mackerel, squid, butterfish fishery	Dogfish fishery	Summer flounder,scup, black sea bass fishery	Golden tilefish fishery	Shrimp fishery	Lobster fishery
Habitat	EGOM	Alt. 1 (No action)	0	-- to 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	CGOM	Alt. 2 (No area)	+	-	-	0	+	0 to +	+	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 2 (No area)	++	--	-- to ++	0	+ to ++	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	GB	Alt. 2 (No area)	+++	+++	-- to ++	0	+	0 to +	++	0	0	0	0	0	0	0 - +	0	0	- to 0
Habitat	GSC-SNE	Alt. 2 (No area)	++ to +++	0 to +	0	0	+	0 to +	+	0	0	+	0	+	0	0 - +	0	0	0
Spawning	GOM	Alt. 2A	0 - +	- to 0	0 - +	0	-	0 to +	0 - +	+	0	0	0	0	0	0	0	0	0
Spawning	GB-SNE	Alt. 3A	+	+	+	0	+	0 to +	+	0 - +	0	0	+	+	0 to +	0 - +	0	0	- to 0

Fewer/smaller habitat management areas

Type	Sub-region or region	Alternative	Economic short-term	Economic long-term	Large mesh mults fishery	Small mesh mults fishery	Monkfish fishery	Skate fishery	Sea scallop fishery	Herring fishery	Red crab fishery	Clam fishery	Bluefish fishery	Mackerel, squid, butterfish fishery	Dogfish fishery	Summer flounder,scup, black sea bass fishery	Golden tilefish fishery	Shrimp fishery	Lobster fishery
Habitat	EGOM	Sm. Eastern Maine (preferred)	-	+	- to +	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	CGOM	Alt. 4 Options 1 and 2	+	-	- to +	0	+	0 to +	+	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 6 Options 1 and 2	+	-	- to +	0	+ to ++	0	+	0	0	-	0	0	0	0	0	0	0
Habitat	GB	Alt. 7 Option 1	+++	+++	-- to ++	0	+	0 - ++	++	0	0	--- to --	0	0	0	0 - +	0	0	- to 0
Habitat	GSC-SNE	Alt. 5 Option 1	- to 0	0 - +	0	0	+	0	+	- to 0	0	---	0	+	0	- to 0	0	0	0
Spawning	GOM	Alt. 2A	0 - +	- to 0	0 - +	0	-	0 to +	0 - +	+	0	0	0	0	0	0	0	0	0
Spawning	GB-SNE	Alt. 3A	+	+	+	0	+	0 to +	+	0 - +	0	0	+	+	0 to +	0 - +	0	0	- to 0
Research	EGOM	Alt. 2	-	+	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Research	WGOM	Alt. 3C (preferred)	0	+	0	0	- to 0	++	0	0	0	- to 0	0	0	- to 0	0	0	0	0
Research	n/a	Alt. 5 (preferred)	0	+	0	0	0 - +	0	0	0	0	0 - +	0	0	0	0	0	0	0

More/larger habitat management areas

Type	Sub-region or region	Alternative	Economic short-term	Economic long-term	Large mesh mults fishery	Small mesh mults fishery	Monkfish fishery	Skate fishery	Sea scallop fishery	Herring fishery	Red crab fishery	Clam fishery	Bluefish fishery	Mackerel, squid, butterfish fishery	Dogfish fishery	Summer flounder,scup, black sea bass fishery	Golden tilefish fishery	Shrimp fishery	Lobster fishery
Habitat	EGOM	Alt. 3 Options 1 and 2	-	+	- to +	0	0	0	0	0	0	-	0	0	0	0	0	0	0
Habitat	CGOM	Alt. 1 (No action)	+	+	+	0	0	- to 0	0	0	0	0	0	0	0	0	0	0	0
Habitat	WGOM	Alt. 4 Options 1 and 2	--	++	-- to ++	--	+ to ++	0	0	-	0	-	0	0	0	0	0	---	0
Habitat	WGOM	Alt. 7A (preferred)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat	GB	Alt. 8 Option 1	---	---	-- to ++	-	-	-- to -	--- to --	0	0	--- to --	0	0	0	0 - +	0	0	0
Habitat	GSC-SNE	Alt. 3 Option 1	---	---	-	0	+	0	--- to --	- to 0	0	---	0	+	0	- to 0	0	0	0
Spawning	GOM	Alt. 1B (Baseline No Action)	++	++	0 - +	0	-	- to 0	- to 0	-	0	0	0	0	0	0	0	0	0
Spawning	GOM	Alt. 3 (preferred)	-	+	0 - +	0	-	0	- to 0	0	0	0	0	0	0	0	0	0	0
Spawning	GOM	Alt. 4 (preferred)	-	+	0 - +	0	-	0	0	0	0	0	0	0	0	0	0	0	0
Spawning	GB-SNE	Alt. 1 (No Action)	---	---	--	0	-	- to 0	0	-	0	0	0	0	0	- to 0	0	0	0
Research	EGOM	Alt. 2	-	+	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Research	WGOM	Alt. 3A	-	+	-	0	- to 0	++	0	0	0	- to 0	0	0	- to 0	0	0	0	0

Table 20 – Protected resource impacts associated with each of three combination scenarios.

No year round

Alt. type	Sub-region or region	Alternative	Marine mammals	Sea turtles	Sturgeon	Salmon
Habitat	EGOM	Alt. 1 (No action)	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	CGOM	Alt. 2 (No area)	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to neutral
Habitat	WGOM	Alt. 2 (No area)	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Habitat	GB	Alt. 2 (No area)	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Habitat	GSC-SNE	Alt. 2 (No area)	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to neutral
Spawning	GOM	Alt. 2	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Spawning	GB-SNE	Alt. 3	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive

Less restrictive

Alt. type	Sub-region or region	Alternative	Marine mammals	Sea turtles	Sturgeon	Salmon
Habitat	EGOM	Sm. Eastern Maine	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	CGOM	Alt. 4	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to neutral
Habitat	WGOM	Alt. 6	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Habitat	GB	Alt. 7	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Habitat	GSC-SNE	Alt. 5	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to neutral
Spawning	GOM	Alt. 2	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Spawning	GB-SNE	Alt. 3	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Research	EGOM	Alt. 2	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Research	WGOM	Alt. 3	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Research	n/a	Alt. 5	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive

More restrictive

Alt. type	Sub-region or region	Alternative	Marine mammals	Sea turtles	Sturgeon	Salmon
Habitat	EGOM	Alt. 3	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	CGOM	Alt. 1 (No action)	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Habitat	WGOM	Alt. 4	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Habitat	WGOM	Alt. 7A	Neutral	Neutral	Neutral	Neutral
Habitat	GB	Alt. 8	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Habitat	GSC-SNE	Alt. 3	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to neutral
Spawning	GOM	Alt. 1B (Baseline No Action)	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Spawning	GOM	Alt. 3	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Spawning	GOM	Alt. 4	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive	Slightly negative to slightly positive
Spawning	GB-SNE	Alt. 1 (No Action)	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Research	EGOM	Alt. 2	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Research	WGOM	Alt. 3	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral
Research	GB	Alt. 4	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral	Slightly negative to neutral

2.5 Cumulative effects summary

This section discusses how the management actions proposed in this amendment combined with likely future actions outside of this amendment are expected to influence the trajectory of each valued ecosystem component. Given the number and diversity of current and future foreseeable management actions, combined with uncertainties about direct effects of the alternatives considered in this action, these assessments are qualitative and highly uncertain. The same five scenarios discussed in the previous section are considered here. Table 21 summarizes the influence that each of the four categories of future forseeable actions is likely to have on the VECs evaluated in this amendment. Table 22 combines information about the direct effects of the scenarios evaluated in this amendment, as summarized in the previous section, with the expected influence of future forseeable actions, summarized in this section, to estimate the overall trajectory of each VEC that could result from each of the five management scenarios. Discussion is provided by VEC below the table.

Table 21 – Combined influence of future foreseeable actions and the five management scenario evaluated in this amendment on the trajectory of each VEC.

	Valued Ecosystem Component			
Future forseeable action	Physical and biological environment	Managed species	Human community	Protected resources
Fishery management	↔	↑	↑	↔
Protected resources management	↔	↔	↓ to ↔	↑
Other industrial uses of the marine environment	↓	↓	↓	↓
Climate change	↓	↓	↓	↓

Key	
↑	Positive influence on trajectory of VEC
↔	Neutral influence on trajectory of VEC
↓	Negative influence on trajectory of VEC

Table 22 – Combined influence of future foreseeable actions and the five management scenario evaluated in this amendment on the trajectory of each VEC.

	Valued Ecosystem Component			
Management scenario	Physical and biological environment	Managed species	Human community	Protected resources
No Action	↑	↔ to ↑	↑	↓ to ↑
Preferred	↑	↔ to ↑	↑	↓ to ↑
Scenario 1	↓	↓ to ↔	↓ to ↑	↓ to ↑
Scenario 2	↑	↔ to ↑	↑	↓ to ↑
Scenario 3	↑	↔ to ↑	↓ to ↑	↓ to ↑

Key	
↑	Positive influence on trajectory of VEC
↔	Neutral influence on trajectory of VEC
↓	Negative influence on trajectory of VEC

Physical and biological environment

As discussed in the baseline status section, fishery management actions have likely had a positive cumulative impact on the status of the physical and biological environment. Effort control measures and catch limits are included in each of the various fishery management plans in the region, which puts a ceiling on the magnitude of adverse impacts to EFH that may result from these fishing activities. Thus, regardless of the scenario considered, the background level of fishing impacts to habitat is not expected to change substantially in the near term. It is possible that new fisheries could be developed within the ten year timeframe considered in this cumulative effects anlysis, but any new federal FMP will be governed by catch limits and need to consider conservation of other managed and protected resources. Hopefully, depleted fishery resources including various large mesh groundfish stocks will recover, allowing for some growth in effort in that fishery. Both new fisheries and growth of existing fisheries could increase habitat impacts overall. Conversely, improvements in fishing gear could help to minimize seabed impacts, via reduced contact with the seafloor, or catching the target stocks more efficiently. Overall, there is no particular reason to expect that fishing-related impacts would increase or decrease significantly over the ten-year timeframe considered in this analysis.

Protected resource management is unlikely to have a substantial impact positive or negative on EFH conservation, but could have some influence, as measures include time/area closures that may shift effort spatially, and gear configuration requirements for certain fisheries. For example, while sinking groundlines are employed to reduce interaction risks with marine mammals in fixed gear fisheries, these groundlines increase seafloor contact and could lead to greater impacts to more sensitive habitat features, such as deep-sea corals. However, overall, protected resource management actions are not likely to cause significant increases or decreases in impacts to EFH over the ten-year timeframe considered in this analysis.

Non-fishing activities that could impact EFH, including energy development, sand mining, and coastal development, are likely to increase over the next ten years. Environmental review requirements under NEPA and other federal laws will hopefully limit the negative effects these types of activities may have on fish habitats. The EFH consultation requirements in particular provide a forum for NMFS and the Councils to make habitat conservation recommendations on any project that requires a federal permit, and NMFS' consultation obligations extend beyond species managed under federal FMPs to include all trust resources. However, ensuring EFH conservation in the face of the combined effects of these activities may be challenging. Overall, these types of activities are likely to have a slightly negative impact on fish habitats over the next ten years.

Climate change will continue to affect ocean acidity and temperature, although such changes will occur gradually and may not be substantial over the ten-year timeframe considered here. These environmental changes will affect seafloor ecology, and may have a particular negative impact on species that have calcareous skeletons, such as mollusks or corals. While the magnitude is very uncertain, climate change-related environmental change is likely to have slight negative impacts on fish habitats over the next ten years.

As described in the previous section on direct effects, the actions contemplated in this amendment will impact fish habitats. These impacts range from negative for Scenario 1, to mixed but generally positive for No Action, the preferred alternative, and Scenario 2, to highly positive for Scenario 3. Assuming that fishery and protected resources management are not likely to have substantial effects on fish habitats, positive or negative, and assuming that non-fishing activities and climate change have some magnitude of negative effects on fish habitats, the future forseeable actions in combination will likely have negative effects on the physical and biological environment. These make the negative outcomes under Scenario 1 more likely, and reduce the magnitude of positive outcomes under the other scenarios, but are not expected to change the overall trajectory of impacts resulting from the scnearios.

Managed species

Fisheries management actions are typically focused on improving the conditions of managed resources. While these actions are not uniformly successful in this regard, the overall trend amongst the managed resources evaluated in this amendment is towards improved status. Given guiding requirements in the Magnuson Stevens Act to improve stock conditions when resources are depleted, it is assumed that fishery management actions will keep most or all managed resources on a positive trajectory over the next ten years. Fishery management measures beyond those contemplated in this action will likely have the largest influence on fishery resource conditions over the next ten years. These measures set annual and trip-based catch limits, and allocate resources amongst fishery participants and across management sub-areas.

Similar to the physical and biological environment discussion above, protected resource management has indirect effects on managed species stock condition. Given that protected resource management measures are not focused on improving outcomes for fishery resources, it is likely that these actions will not have a major effect on fishery stock conditions in the region, positive or negative.

Again, similar to the physical and biological environment discussion above, both non-fishing uses of the marine environment and climate change-related effects on the ocean ecosystem may have negative effects on managed resources over the next ten years. Hopefully, given environmental regulations and consultations, non-fishing activities will not generate substantial negative impacts. As noted above, climate change effects are likely to be relatively subtle over a ten-year timeframe, but some species are more susceptible than others. Given a high degree of climate sensitivity, and the importance of inshore habitats to eggs, larvae, and juveniles, winter flounder stocks are likely to be most susceptible to negative effects of non-fishing activities and climate change. Given a high degree of climate sensitivity, ocean quahog stock condition would be the most likely to tend towards a declining trajectory.

As described in the previous section on direct effects, the actions contemplated in this amendment will impact fishery resources. In particular, the measures in this amendment will affect large mesh groundfish stocks, for which many of these measures were designed, although the impacts of direct management via catch limits and other measures may ultimately have a greater influence on large mesh stock conditions. For non-groundfish resources, the measures in this amendment are likely to have a relatively small influence on stock conditions as compared to direct management via catch limits, etc.

Considering large mesh groundfish only, direct impacts of the measures considered in this amendment range from negative for Scenario 1, to mixed but generally positive for No Action, the preferred alternative, and Scenario 2, to highly positive for Scenario 3. Considering all managed resources combined, the direct effects of the measures in this amendment are likely neutral to positive for No Action, the preferred alternative, Scenario 2, and Scenario 3, and negative to neutral for Scenario 1.

When combined with other foreseeable future actions, No Action, the preferred alternative, Scenario 2, and particularly Scenario 3, are likely to result in a a neutral to positive trajectory for managed resources. Scenario 1, combined with other forseeable future actions, will likely have a neutral to negative influence on managed resources.

Human communities and the fishery

With the exeptions of large mesh groundfish and northern shrimp, fisheries considered in this amendment are generally in good condition. Similar to the managed resources targeted by these fisheries, the fishing communities are expected to benefit, generally, from fishery management measures. In some cases, these benefits may be realized in the short-term, but for depleted stocks, including some groundfish and northern shrimp, the benefits of fishery management restrictions to the fishery may be delayed, and could be realized within or beyond a ten-year timeframe.

Protected resources management measures have differential effects by fishery, because they spatially overlap with some fisheries more than others, and because gear-based measures affect fisheries differently. Overall, these measures are expected to have a neutral to slightly negative impact on fishery conditions over the next ten years.

Non-fishing industrial uses and climate change are likely to have a least some degree of negative impact on fisheries prosecuted in the New England region in the next ten years, but the magnitude of these impacts is hard to pinpoint. Non-fishing uses may have direct negative impacts on fisheries via temporary or long-term displacement of fishing activities, or could have indirect negative impacts if stocks or fish habitats are impacted. Climate change-related effects on the marine environment may contribute to uncertainty and unpredictability in ocean systems, which could have negative effects on fisheries. Fisheries that target species that are particularly vulnerable to climate change may be most greatly affected. To the extent that stock distributions shift as a result of climate change, existing fishery management plans and allocations may need to be revised. It is not clear that these shifts will have net negative impacts across all fishery participants; there are likely to be some winners and losers as managed species move, but the overall trajectory is likely negative.

Combined with these other forseeable future actions, the suites of measures considered in this amendment could affect the trajectory of certain fisheries. The direct effects of the all alternatives considered in this amendment are expected to be neutral, or at most slightly negative or slightly positive, for the herring, red crab, bluefish, mackerel/squid/butterfish, dogfish, summer flounder/scup/black seabass, tilefish, and lobster fisheries. Thus, regardless of the scenario considered here, other fishery restrictions, protected resource measures, non-fishing activities, and climate change are likely to be more influential than this amendment on the condition of these fisheries. Despite the possibility of negative effects associated with protected resource management, other industrial uses of the marine environment, and climate change, fishery management actions are likely to have the greatest influence on these fisheries. Thus, these fisheries are likely to continue on a positive trajectory, tempered by any negative effects of climate change and non-fishing uses.

Considering the fisheries for large mesh and small mesh groundfish, monkfish, skates, sea scallops, clams, and shrimp, some of the alternatives considered in this amendment are expected to have more substantial effects. Negative climate change-related effects on target species could combine with negative impacts of some scenarios considered here to cause a possible negative trajectory for certain fisheries. The large mesh groundfish fishery includes some climate-sensitive species, in particular winter flounder, and could experience negative impacts as a result of Scenario 1 and Scenario 3 that might lead to further declines in fishery condition. The No Action and preferred scenarios, in addition to Scenario 2, could help to prevent further declines, via improved resource conservation, improved fishery access, or both.

The small mesh groundfish fishery will likely continue on a positive trajectory, although localized negative impacts might be possible under Scenario 3, if a new habitat area designation overlaps key fishing grounds in the inshore Gulf of Maine. The monkfish and skate fisheries could benefit locally from increased fishery access under certain alternatives, but overall impacts are slight. Cumulatively across all future actions, conditions in the monkfish and skate fisheries are not expected to change regardless of the management scenario considered.

The clam and scallop fisheries, which are both in good condition at present, would experience varying impacts depending on the scenario considered. While surfclams are the primary species

occurring within the management areas considered in this amendment, ocean quahogs are sensitive to climate change and constitute slightly less than half of the landed value of the fishery overall. Thus, cumulatively, the preferred alternative, as well as Scenarios 2 and 3, could contribute to negative conditions in the clam fishery, because under these scenarios, fishing grounds generating a relatively large fraction of surfclam yield would close. A trailing fishery management action to provide some exemptions within these closure would mitigate these negative effects.

In the scallop fishery, if substantial amounts of biomass are within closed areas, total yield in the fishery can be limited given how the overfishing definition is applied. For this reason, the No Action Georges Bank alternative has moderately negative impacts on the fishery. Other No Action alternatives have slight negative to neutral effects. The No Action scenario overall, combined with other factors that could have slight negative effects on the fishery (i.e. non-fishing activities, climate change) could contribute to a slight negative trajectory on the fishery overall. The preferred alternative, and Scenarios 1 and 2, would likely result in a neutral to slightly positive trajectory for the fishery overall. While non-fishing and climate-related effects would remain a concern, these scenarios would provided increased yield opportunities in the fishery. Scenario 3, combined with other future actions, would put the fishery on a negative trajectory. The relatively large fraction of biomass that would be encompassed within closures in these alternatives would lead to reduced yield.

The shrimp fishery is currently in poor condition, given that it is under moratorium. Northern shrimp are at the southern end of their range in the Gulf of Maine, are very sensitive to warm temperatures, such that climated-related changes in environmental conditions are an important factor in the overall condition of the fishery. Most of the scenarios (No Action, preferred, 1 and 2) would not affect prosecution of the shrimp fishery should it reopen, and would therefore not change the trajectory of the fishery positive or negative when combined with other actions. However, one of the management areas proposed in Scenario 3 would overlap significantly with the fishery's historical distribution. Therefore, when combined with climate change, the measures in Scenario 3 would likely lead to a negative trajectory in the fishery.

Given the diversity of fisheries considered here, and the various ways they could be affected by the alternatives proposed in this amendment and by the future actions considered in this section, it is difficult to generalize how the management scenarios will perform in combination with the future actions to influence the trajectory of the human community VEC overall. Focusing on the long-term net economic impacts summarized in section 2.3, combined with the effects of future actions, the following scenarios will likely have positive effects on the human community: No Action, preferred alternative, and Scenario 2. Scenarios 1 and 3 will likely have mixed effects on the human community, positive in some locations and fisheries and negative in others. The negative effects of Scenarios 1 and 3 could be mitigated by future fishery management actions.

Protected resources

Across the various species occurring in the region, large whale and pinniped population sizes are generally increasing. Atlantic sturgeon stock condition is still being evaluated, and the species was listed fairly recently, so the trajectory of the stock is unclear. Atlantic salmon are stable or

declining. These conditions are not expected to change under the five scenarios considered, given that the direct effects associated with the alternatives in this amendment are minor, across all alternatives and all types of protected resources. Protected resources management actions are expected to have a greater influence on the trajectory of the various groups of protected species, because these management actions serve to mitigate negative outcomes that could be caused by non-fishing activities, and climate change. While some fisheries do have negative effects on some protected species, future fishery management actions that influence spatial patterns and magnitudes of fishing effeort may have a range of effects on protected resources, from negative to positive. On average these fishery management actions are likely to have impacts closer to neutral, as fisheries with substantial negative effects are subject to conservation measures under various biological opinions. Cumulatively, given past successes in management of large whales and pinnipeds, these species are likely to continue on a positive trajectory. The trajectory of Atlantic sturgeon in unclear, but increased attention via the species recent listing under ESA may lead to improvements. Atlantic salmon will likely continue to be affected by non-fishing activities including loss of spawning habitat and coastal development, and may be susceptible to climate change-related environmental change, but various habitat restoration projects may mitigate these outcomes. Across all protected resources, considering the effects on all future actions, the trajectory could range from somewhat negative to positive. Again, the management scenario considered in this amendment is not expected to influence this trajectory.

3 Compliance with the EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act

Mandatory contents of FMPs related to EFH are described in the Magnuson-Stevens Act itself, with detailed guidance provided in the EFH regulations, which can be found at 50 CFR §600.815. This section describes how OHA2 is compliant with these EFH-related requirements.

3.1 Description and identification of EFH and HAPCs

Regulations require all FMPs to include a description of applicable EFH for each life stage of managed fish species, based on the best available sources of information (50 CFR 600.815(a)(1)(iii)(A)):

- Level 1: Presence only, based on species distributions (by life stage);
- Level 2: Relative abundance or habitat-related densities;
- Level 3: Data based on habitat-related growth, reproduction, and/or survival by life stage; and
- Level 4: Data on production rates of a species by habitat type.

Essential Fish Habitat descriptions are implemented through the appropriate fishery management plan (FMP). The existing/No Action designations were developed in Omnibus EFH Amendment 1 in 1999 and in several additional management actions, generally using Level 2 information. EFH text descriptions and corresponding maps exist for all Council FMPs: Northeast Multispecies FMP (Acadian redfish, American plaice, Atlantic cod, Atlantic halibut, Atlantic

wolffish, haddock, ocean pout, pollock, white hake, windowpane flounder, winter flounder, witch flounder, yellowtail flounder, silver hake, red hake, and offshore hake); Monkfish FMP; Skate Complex FMP (smooth skate, thorny skate, barndoor skate, little skate, winter skate, rosette skate, and clearnose skate); Atlantic Sea Scallop FMP; Atlantic Herring FMP; Deep Sea Red Crab FMP; and Atlantic Salmon FMP. The OHA2 amendment development process included a comprehensive and detailed review of the EFH designations for all species managed by the Council, and relied on updated catch data and scientific literature describing habitat use as appropriate. The updated EFH text and map descriptions are available as part of this FEIS in Volume 2, Section 2.1.1.

HAPCs are a subset of EFH designations that require more attention based on one or more of the following criteria: (1) Importance of historic ecological function, (2) importance of current ecological function, (3) sensitivity to anthropogenic stressors, (4) extent of current or future development stressors, and (5) rarity of the habitat type. Omnibus EFH Amendment 1 designated Habitat Areas of Particular Concern (HAPCs) for Atlantic salmon and Atlantic cod. This amendment retains those HAPCs and includes additional HAPCs in the Gulf of Maine, on Georges Bank, in various major submarine canyons to a maximum depth of 1500 meters, and on seamounts within the EEZ in waters shallower than 2000 meters (the maximum depth of red crab EFH). The HAPC designations are available as part of this FEIS in Volume 2, Section 2.2.1.

Regulations also require the Councils to periodically review the EFH provisions of FMPs and revise or amend EFH provisions as warranted based on available information. The regulations recommend that a complete review of all EFH information should be conducted as recommended by the Secretary, but at least once every 5 years. The habitat amendment development process included a review of information related to both the designation of EFH and the identification of adverse impacts to those habitats from fishing and non-fishing activities. The review conducted during the early stages of OHA2 development constitutes the five year review of EFH desginations for all Council-managed species, and these designations will be implemented once review of this amendment is complete.

3.2 Adverse effects determination

Regulations state that FMPs must identify and analyze adverse impacts caused by fishing on EFH. For those fishing impacts that are more than minimal and not temporary, fishery management plans must identify measures to avoid, minimize, or compensate for adverse impacts in these areas (C.F.R. 600.815). The Council must evaluate which impacts are minimal and temporary based on the best scientific information available, and consider which management measures minimize adverse effects to the extent practicable.

3.2.1 Analytical approaches

Omnibus Habitat Amendment 1 (OHA1) identified the major threats to EFH from both fishing and non-fishing related activities and proposed conservation and enhancement measures. OHA1 concluded that “gear types which fish in a static fashion on the seafloor such as traps, gillnets and longlines are thought to minimally impact the seabed. However, the cumulative effects of static gear remain unknown.” OHA1 concluded that essential fish habitats for a number of species with benthic life stages are vulnerable to the adverse effects of mobile bottom-tending

gear and that the effects were more than minimal and not temporary in nature, and, therefore, required mitigation measures to reduce impacts. The following is a list of species and life stages that were determined to be adversely affected according to gear type (E=eggs, L=larvae, J=juveniles, A=adults):

- Otter trawls: American plaice (J, A), Atlantic cod (J, A), Atlantic halibut (J, A), Atlantic sea scallop (J), haddock (J, A), ocean pout (E, L, J, A), red hake (J, A), redfish (J, A), white hake (J), silver hake (J), winter flounder (A), witch flounder (J, A), yellowtail flounder (J, A), red crab (J, A), black sea bass (J, A), scup (J), tilefish (J, A), barndoor skate (J, A), clearnose skate (J, A), little skate (J, A), rosette skate (J, A), smooth skate (J, A), thorny skate (J, A), and winter skate (J, A).
- New Bedford scallop dredge: Acadian redfish (J, A), American plaice (J, A), Atlantic cod (J, A), Atlantic halibut (J, A), Atlantic sea scallop (J), haddock (J, A), ocean pout (E, L, J, A), red hake (J, A), white hake (J), silver hake (J), winter flounder (J, A), yellowtail flounder (J, A), black sea bass (J, A), scup (J), barndoor skate (J, A), clearnose skate (J, A), little skate (J, A), rosette skate (J, A), smooth skate (J, A), thorny skate (J, A), and winter skate (J, A).
- Hydraulic clam dredges: Atlantic sea scallop (J), ocean pout (E, L, J, A), red hake (J), silver hake (J), winter flounder (A), yellowtail flounder (J, A), black sea bass (J, A), scup (J), clearnose skate (J, A), little skate (J, A), rosette skate (J, A), and winter skate (J, A).

The Swept Area Seabed Impact (SASI) approach is the primary framework used in OHA2 to evaluate the impacts of fishing on the physical and biological environment. SASI is summarized in Section 4.2.2 of Volume 1 and more fully outlined in Appendix D. The analysis takes a more systematic and spatially-oriented approach to evaluating impacts relative to the analyses completed during the development of OHA1. The SASI vulnerability assessment, which was published as Grabowski et al 2014, concluded that mobile bottom-tending gears such as bottom trawls and dredges have a greater per unit area impact than fixed bottom-tending gears such as gillnets, longlines, and traps. Also, individual mobile gear fishing events contact more of the seabed than individual fixed gear fishing events, because mobile gears have a wider footprint. Combining both the per unit area impact and the footprint of various gear types, the SASI analysis concluded that bottom trawls have the largest overall magnitude of impacts, followed by scallop dredges. While hydraulic clam dredges have a high per unit area impact, the overall footprint of the clam dredge fishery is small relative to other regional fisheries, such that the magnitude of impacts is lower than for other mobile bottom-tending gears. Fixed gears including demersal longlines, sink gillnets, and traps have both a low per unit area impact and a relatively low swept area, producing lower magnitudes of adverse impacts region-wide. The SASI report acknowledges the difficulty of generating accurate swept area estimates for fixed gears, and the number of studies evaluating the quality of fixed gear impacts on the seabed per unit area is limited.

3.2.2 Federally managed fisheries that generate adverse effects

Based on the SASI analyses summarized above, fisheries that use mobile bottom-tending gears including bottom trawls and dredges are understood to be generating adverse effects on seabed habitats for which minimization should be considered via the Council's fishery management plans. Federally managed fisheries using these gears are listed in Table 23. It is important to note

that because the Council's habitat measures in OHA2 have been developed in an omnibus fashion, they apply to gear types, and not to fisheries. With the exception of clams and scallops, where landings are almost exclusively taken with mobile bottom-tendings gears, the fisheries listed below also rely on other methods of fishing including fixed bottom-tending gears, or hook and line. The managed species and fisheries descriptions in Volume 1, Section 4.3 provide information on the gears used in each fishery and the spatial distribution of fishing effort. The only type of mobile bottom-tending gear not listed in the table below is shrimp trawls, which are described below in the non-MSA fisheries section.

Table 23 – Fisheries that use mobile bottom tending gears

Fishery	Gear types used	Notes
Northeast multispecies (large and small mesh)	Bottom trawl	Specific trawl configurations, for example haddock separator trawl, Ruhle trawl, and flounder trawl, are defined by regulation and are required in specific areas, for example in special access program areas on in accountability measure areas. Smaller mesh nets used in the small-mesh fishery for red and silver hake are used in specific exemption areas, and large mesh (6.5-inch codend) is required otherwise.
Monkfish	Bottom trawl	When fishing on a monkfish day at sea, trawls must have 10-inch diamond mesh in the codend.
Skate	Bottom trawl	The skate fishery is subject to multispecies gear requirements as there are no separate skate days at sea.
Atlantic sea scallop	Sea scallop dredge, scallop trawl	Chain mats and turtle deflector dredges are required west of 71° W (roughly New Bedford, MA) from May 1-November 30. Scallop trawls are less commonly used and are not permitted in access areas.
Atlantic herring	Bottom trawl	A small fraction of herring landings are taken with small mesh bottom trawls, off the coast of Rhode Island, and occasionally in the Gulf of Maine (see Volume 5, Section 7.2)
Surfclam ocean quahog	Ocean quahog and surfclam dredge	Includes hydraulic dredges used in the Mid-Atlantic, southern New England, and on Georges Bank, and dry or toothed dredges, which are used in eastern Maine.
Bluefish	Bottom trawl	A very small fraction of bluefish landings are taken with bottom trawls (see Volume 5, Section 11.2).
Atlantic mackerel, squid, and butterfish	Bottom trawl	Mackerel are mostly caught in mid-water gear, but some mackerel and most squid and butterfish are taken with bottom trawls (see Volume 5, Section 12.2)
Spiny dogfish	Bottom trawl	Less than 20% of dogfish landings are taken with bottom trawls (see Volume 5, Section 13.2).
Summmer flounder, scup, and black sea bass	Bottom trawl	The majority of summer flounder and scup landings and about half of black sea bass landings are taken with otter trawls (see Volume 5, Section 14.2)

3.2.3 Non-MSA fishing activities that may adversely affect EFH

FMPs must identify any fishing activities that are not managed under the Magnuson-Stevens Act that may adversely affect EFH. Such activities may include fishing managed by state agencies or other authorities. Northern Shrimp is managed by the Atlantic States Marine Fisheries Commission. The most recent assessment indicates collapse of the stock and recruitment failure, and as a result, the Atlantic States Marine Fisheries Commission's Northern Shrimp Section

approved a moratorium for the 2014 and 2015 northern shrimp fishing season. Currently, there is no fishing in the Gulf of Maine for shrimp, though data from past years indicate that shrimp fishing was concentrated in the western Gulf of Maine (see Volume 1, Section 4.3.14). The shrimp fishery is prosecuted using pots and trawls, and shrimp trawls may have an adverse effect on EFH. Therefore, shrimp trawls are generally included in habitat management area restrictions, although an exemption is provided in the northwest corner of the Western Gulf of Maine Habitat Closure Area (WGOM Habitat Alternative 8) in areas of mud habitat.

The SASI analysis focused on evaluating gears that are commonly used in federally-managed fisheries. Stevenson et al. (2004) catalogued the full diversity of gear types used in state and federal waters fisheries (see table 3.3). Their threshold for including a gear type on their inventory was that it accounted for 1% or more of any state's total landings, so some of the listed gears are likely used infrequently. Mobile bottom-tending gears noted by Stevenson et al. include dredges for various types of invertebrates (clams, mussels, oysters, bay scallops, sea scallops, whelks, crabs and urchins) and bottom otter trawls used to target both fish and invertebrates (crabs, finfish, scallop, shrimp). The impacts of these gear in nearshore, state-managed fisheries are expected to be similar to impacts in federal waters. An exception to this would be cases where these gears are used in habitat types not found offshore, for example eelgrass beds. Three fixed gear types, bottom gillnet, bottom longline, and trap, were evaluated in the SASI analysis. In general the per-unit-area impact of these gears was estimated to be low, but impacts could be adverse in certain habitat types (for example deep-sea corals) or if the magnitude of gear use in an area is substantial.

3.2.4 Prey species evaluation

The EFH regulations indicate that:

1. Fishery management plans should list the major prey species for the species in the fishery management unit and discuss the location of prey species' habitat.
2. Loss of prey may be an adverse effect on EFH and managed species because the presence of prey makes waters and substrate function as feeding habitat, and the definition of EFH includes waters and substrate necessary to fish for feeding. Actions that reduce the availability of a major prey species, either through direct harm or capture, or through adverse impacts to the prey species' habitat that are known to cause a reduction in the population of the prey species, may be considered adverse effects on EFH if such actions reduce the quality of EFH. Adverse effects on prey species and their habitats may result from fishing and non-fishing activities.

Two appendices to this amendment provide information about prey species. Appendix B, the EFH supplementary tables, lists the major prey species consumed by each species managed by the Council, as determined using the Northeast Fisheries Science Center food habitats database. This appendix fulfills the first part of requirement 1 above, to list major prey types. The appendix also provides additional information about habitat requirements and spawning times and locations for managed species.

Appendix H summarizes information about the vulnerability of major invertebrate prey types to fishing impacts and provides maps of the general distribution of fish and invertebrate prey

species. The maps fulfill the second part of requirement 1, to identify the location of the prey species' habitats. The relationship between prey resources and adverse effects minimization is discussed in Volume 4, in the analysis of the impacts of the habitat management alternatives on physical habitat and EFH.

While some managed species are more specific about their preferred foods than others, in general these species are generalist feeders and consume a variety of items depending on their location, season, and lifestage (see details in Appendix B). Combining this with a review of the prey maps provided in Appendix H, and the relatively rapid recovery rates evidenced for many prey types in the fishing impacts literature summarized in Appendix H, the Council did not elect to make prey taxa a focus of habitat impacts modeling or adverse effects minimization alternatives development. Thus, in response to requirement 2 above, the Council did not find that fishing activities are causing adverse effects on the prey element of fish habitat in particular. While none of the adverse effects minimization measures were designed solely to minimize adverse effects on specific prey species, the adverse effects minimization measures in this amendment are expected to support the ability of a habitat area to provide prey resources for managed stocks.

The NEFMC Habitat Plan Development Team developed the Swept Area Seabed Impact (SASI) approach to estimate the magnitude, location, and duration of adverse effects across gears types and FMPs, and to evaluate the cumulative impacts of alternatives to minimize those effects. Because all fishing effort is converted into area swept units, regardless of whether trawl, dredge, or fixed gears are being evaluated, SASI allows for comparisons between gear types in terms of the magnitude of adverse effects they generate. Ideally, the SASI model would spatially resolve fishing effects across all components of habitat. In particular, the prey of managed fish species is an important component of fish habitat that is potentially affected by fishing gears. While the PDT recognized the importance of incorporating prey vulnerability into the assessment of the adverse effects of fishing on EFH, including prey as another habitat component in SASI would have further decoupled the model results from local spatial empirics because prey features, like biological habitat features, would need to be inferred to substrate/energy regimes. In the future, it may be appropriate to include prey in the vulnerability assessment and make SASI regionally specific, thereby reducing errors in habitat vulnerability estimates at the local level.

3.3 Adverse effects minimization

The Magnuson-Stevens Act requires Councils to "minimize to the extent practicable adverse effects on such habitat caused by fishing".

3.3.1 Adverse effects minimization measures included in OHA2

The EFH regulations provide more specific guidance, including the following:

- Councils must act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is more than minimal and not temporary in nature.
- Fishery management options may include, but are not limited to:

- Fishing equipment restrictions (e.g. areal restrictions on the use of specified equipment, equipment modifications to allow escapement of particular species or life stages, prohibitions on fishing activities that cause significant damage to EFH)
- Time/area closures (e.g. closures during spawning, migration, foraging, and nursery activities; and designating zones to limit adverse effects of fishing practices on certain vulnerable or rare areas/species/life stages)
- Harvest limits (e.g. limits on the take of species that provide structural habitat or of prey species)

OHA2 includes preferred alternatives that are intended to improve habitat protection by reducing fishing impacts on complex habitat for vulnerable life stages of managed species. The focus of mitigation measures is on fishing equipment restrictions, specifically for those gear types that have impacts that are more than minimal and temporary, which includes bottom trawls, scallop dredges, and hydraulic clam dredges. Due to the much greater magnitude of mobile vs. fixed bottom-tending gear impacts, eliminating mobile bottom-tending gear use in an area is expected to reduce the adverse effects of fishing on seabed habitats within that area. In terms of protecting vulnerable seabed habitats from the adverse effects of fishing, the greatest local reduction in adverse effects to the seabed will be achieved if all mobile bottom-tending fishing is prohibited from the area. OHA2 proposes mobile bottom-tending gear restrictions in areas throughout the region (Table 24).

Table 24 – Mobile bottom-tending gear restrictions intended to minimize the adverse effects of fishing on essential fish habitat.

Proposed closures	Restriction	Existing, modified, or new area
Small Eastern Maine HMA (year round)	No MBTG allowed	New
Jeffreys Bank HMA (year round)	No MBTG allowed	Modified boundaries with existing restrictions
Cashes Ledge Habitat Closure Area (year round)	No MBTG allowed	Modified boundaries with existing restrictions
Ammen Rock HMA (year round)	No gear allowed, except lobster traps	New
Fippennies Ledge HMA (year round)	No MBTG allowed	New
Western Gulf of Maine (Habitat) HMA (year round)	No MBTG allowed, with shrimp trawl exemption in the northwest corner of closure	Existing area with same restrictions, but adds an exemption area for shrimp trawl gear in the northwest corner.
Inshore Roller Gear (year round)	Trawl roller gear limited to 12” in diameter	Existing
Georges Bank – Northern Edge Reduced Impact HMA	No MBTG, except scallop dredges and bottom trawl for limited fishing;	New
Georges Bank – Northern Edge MBTG Closure	No MBTG	New
Georges Bank – Georges Shoal 2 HMA	No MBTG with one-year clam exemption	New

Proposed closures	Restriction	Existing, modified, or new area
Great South Channel HMA	No MBTG in northeast corner, and clam dredge exemption in remaining area for one year after date of implementation.	New
Cox Ledge HMA	No hydraulic clam dredges, trawls may not use groundcables	New

OHA2 also includes time/area closures intended to minimize fishing impacts on groundfish during time periods when they are expected to be spawning. These closures generally restrict gears that capture groundfish, rather than gears that disturb the seabed. However, OHA2 does not focus on spawning in a comprehensive fashion across all stocks and fishery management plans. Rather, the OHA2 objective is improved groundfish spawning protection. This objective stemmed from the fact that this amendment included an evaluation of and possible adjustment to the year-round groundfish closed areas, which in part serve a spawning protection function, although their original purpose was generally mortality reduction.

Table 25 – Time/area closures in OHA2

Proposed closures	Restriction	Existing, modified, or new area
Cashes Ledge HMA Closure Area	No gear allowed, with some exemptions that include clam dredges and shrimp trawls	Existing
Western Gulf of Maine Closure Area (year round)	No gear allowed, with some exceptions that include clam dredges and shrimp trawls	Modified boundaries
Cod Protection Blocks (seasonal)	No gear allowed, with some exceptions (i.e. clam dredges, shrimp trawls, scallop dredges on DAS or within scallop exemption area, and raised footrope whiting trawl)	Existing (modified since DEIS publication; new regulations were implemented May 2015); Modified in OHA 2 final action to include Block 125 April 15-30
Mass Bay Cod Spawning Protection Area	Closed Nov.-Jan. No gear allowed, with some exceptions that include clam dredges and shrimp trawls	New
Cod Spawning Protection Area (Whaleback)	Closed Apr. 1-Jun. 30; No gear allowed, with some exceptions that include clam dredges and shrimp trawls	Existing
Closed Area I North	No gears allowed, with some exceptions including scallop dredges	Modified closure from year-round to seasonal spawning closure (Feb 1-April 15)
Closed Area II	No gears allowed, with some exceptions including scallop dredges. In addition, no MBTG north of 41°30'N within Closed Area II Jun.15-Oct.31 as a lobster conservation measure.	Modified closure from year-round to seasonal spawning closure (Feb 1-April 15).

Harvest limits are not used as an adverse effects-minimization strategy in this amendment.

3.3.2 Practicability of management measures

The Essential Fish Habitat regulations refer to 'practicability' in regards to the feasibility of implementing particular measures to minimize the adverse effects of fishing on EFH. From 50 CFR §600.815(a)(2)(iii):

- In determining whether it is practicable to minimize an adverse effect from fishing, Councils should consider the nature and extent of the adverse effect on EFH and the long and short-term costs and benefits of potential management measures to EFH, associated fisheries, and the nation, consistent with National Standard 7 [Costs and Benefits]. In determining whether management measures are practicable, Councils are not required to perform a formal cost/benefit analysis.

The National Standard 7 analytical guidance discusses what criteria should be considered in cost/benefit analysis. From 50 CFR §600.340(d):

- The supporting analyses for FMPs should demonstrate that the benefits of fishery regulation are real and substantial relative to the added research, administrative, and enforcement costs, as well as costs to the industry of compliance. In determining the benefits and costs of management measures, each management strategy considered and its impacts on different user groups in the fishery should be evaluated. This requirement need not produce an elaborate, formalistic cost/benefit analysis. Rather, an evaluation of effects and costs, especially of differences among workable alternatives, including the status quo, is adequate. If quantitative estimates are not possible, qualitative estimates will suffice.
- Management measures should be designed to give fishermen the greatest possible freedom of action in conducting business and pursuing recreational opportunities that are consistent with ensuring wise use of the resources and reducing conflict in the fishery. The type and level of burden placed on user groups by the regulations need to be identified. Such an examination should include, for example: Capital outlays; operating and maintenance costs; reporting costs; administrative, enforcement, and information costs; and prices to consumers. Management measures may shift costs from one level of government to another, from one part of the private sector to another, or from the government to the private sector. Redistribution of costs through regulations is likely to generate controversy. A discussion of these and any other burdens placed on the public through FMP regulations should be a part of the FMP's supporting analyses.
- The relative distribution of gains may change as a result of instituting different sets of alternatives, as may the specific type of gain. The analysis of benefits should focus on the specific gains produced by each alternative set of management measures, including the status quo. The benefits to society that result from the alternative management measures should be identified, and the level of gain assessed.

The purpose of the impacts analysis provided throughout Volumes 4 and 5 of this FEIS is, in part, to describe the potential burdens and gains (costs and benefits) associated with measures intended to minimize the adverse effects of fishing on EFH in a comparative fashion that allows decision makers and interested parties to discriminate between the various alternatives. Major

challenges to developing such an analysis are that there is uncertainty regarding the magnitude of both costs and benefits, and there is variation amongst decision makers and interested parties in terms of their risk tolerance and the time horizon over which they are willing to delay gains, if burdens are immediate but gains are more long-term. Also, tradeoffs between user groups and other stakeholders are inherent to many of the alternatives, and a measure may appear practicable to some individuals but not to others depending on their economic, social, or ecological interests or values.

As the overarching objective of the Magnuson-Stevens Act is to achieve optimum yield in the various fisheries, both benefits and costs can be viewed in this framework. Generally, the habitat management measures in this amendment seek to conserve areas vulnerable to the impacts of fishing so that fish dependent on these areas, particularly juveniles, can have better opportunities for recruitment, survival, growth, and reproduction. The concept is that fishing restrictions enhance the ability of the habitat area to provide these opportunities, and that in aggregate, increased fitness for individuals will contribute to the stock being more productive. This in turn allows for improved harvest opportunities and therefore increases economic benefits. A less tangible benefit is that habitat protection measures may help to buffer the stock against negative conditions and thereby reduce risk. For example, providing the best possible habitat conditions for recruitment of juvenile fish may be more important in years where spawning was less successful and there are fewer potential recruits. Management of risk may be especially important for stocks at low abundance.

Because habitat-specific production rates are rarely known, quantifying these benefits is very challenging in a single species context, let alone in a multispecies context amidst shifting regulations and environmental conditions. Benefits can be described qualitatively in terms of a particular alternative's likelihood of producing positive outcomes across various stocks, which may then translate over the long term into positive economic outcomes for various fisheries.

Costs may appear to be more readily quantifiable but are also difficult to evaluate. The analyses for this amendment estimate potential revenue displacement from currently fished areas, which can be viewed as an upper bound of the costs associated with area closure. However, depending on fishing opportunities outside of the proposed management area, it may be possible to fully or at least partially redistribute displaced effort to other fishing locations. Fishing in these other locations could have higher or lower variable costs depending on factors such as fish abundance, distance from port, environmental characteristics such as depth or bottom type that make fishing more efficient or more challenging, etc. For areas currently closed to fishing, costs and benefits are somewhat more difficult to evaluate, because there is less information available to evaluate potential fishing opportunities inside the closure.

Short-term (occasionally refered to as short-run in the impacts analysis) generally means impacts that accrue within a one to two year timeframe, i.e. before fishery participants would have the ability to adjust their capital investment to compensate for management changes. Generally, long-term or long-run is anything beyond short-term, but in this analysis the long-term time horizon is a bit longer, and assumes that enough time has been allowed to see improvements in stock production via conservation measures. This time is going to vary based on the life history and current status of the resource under consideration, but is closer to a 5-10 year timeframe than

a 2-5 year timeframe. Obviously, assuming that other fishery measures remain constant, habitat management-mediated changes will accrue gradually over time, but clear benefits may not be demonstrated until later.

Throughout the development of this amendment, decision makers on the involved oversight committees (mainly Habitat, but also Groundfish, for some issues) and the Council as a whole used the impacts analysis and the information provided through public comments to assess the practicability of management measures under consideration. The final suite of preferred alternatives are neither the most conservation oriented, nor are they the least restrictive to the fishing industry. Rather, they reflect tradeoffs between conservation-oriented costs and benefits and impacts to the human community; in other words, a balancing of social, economic, and ecological considerations. Practicability requires a complex consideration of multiple factors. The remainder of this section details the tradeoffs discussed by the Council as they selected specific management alternatives during final action.

In the eastern Gulf of Maine, the Council selected a single habitat management area, the Small Eastern Maine HMA, as a closure to mobile bottom-tending gears. They selected this measure from a range of alternatives including No Action/no HMAs, and two additional combinations of HMAs that would have encompassed additional areas. In discussing their preferred alternative, the Council considered that the Large Eastern Maine HMA encompassed additional groundfish hotspots, and could have long-term benefits, but was concerned that closing the area to mobile bottom-tending gears could affect the local scallop fishery, and might preclude fishing in a future, revitalized groundfish fishery in the region. The Council discussed that practicable was taken to mean sensible, achievable, and judicious, and that in this location, selection of the largest alternative was not required to improve protection.

In the central Gulf of Maine, the Council adopted a range of management areas that in large part continues No Action management, with minor adjustments. The discussion started with a Committee proposal to adopt modified habitat management areas on Cashes Ledge and Jeffreys Bank, plus new habitat management areas on Fippennies Ledge and Ammen Rock. The Council also discussed combining the Cashes Ledge and Fippennies Ledge HMAs into a single larger area. With either of these proposals, proponents suggested that targeted HMAs focusing on the most vulnerable habitat areas were a good strategy that would allow for some fishing access in Cashes Basin, and for lower impact gears to be used on the ledges. Ultimately, however, the Council agreed that maintenance of the larger Cashes Ledge Closure Area was important given stock status of Gulf of Maine cod, and continued this existing area along with the modified habitat areas as noted above.

In the western Gulf of Maine, the Council maintained the existing habitat closure and reduced the size of the existing groundfish closure. The Council also added an exemption area for shrimp trawl gear west of Jeffreys Ledge, and adopted the existing roller gear restricted area as a habitat measure that would apply to all bottom trawl gears. While the Council agreed that it was important to maintain the broad range of gear restrictions associated with the groundfish and habitat closures in combination, they agreed that allowing access to fishing grounds east of Jeffreys Ledge and Stellwagen Bank would provide opportunites to access stocks such as

pollock, but that the modified closures combined with various other management measures would provide sufficient conservation for cod and other depleted stocks.

Also in the western Gulf of Maine, the Council adopted the Stellwagen Dedicated Habitat Research Area, but without any reference area closed to recreational groundfishing. While the Council was generally in favor of the research area, there was extensive debate on the merits of the reference area. Those in favor of having a reference area argued that it would provide the data needed to fully evaluate the impacts of closures, but others felt that continued access for fisheries like lobster would compromise the usefulness of the reference site, and were concerned about recreational fishery impacts. At the recommendation of the Habitat Committee, The Council also adopted the Georges Bank DHRA but did not adopt the Eastern Maine DHRA. Both DHRAs were adopted with the sunset provision allowing for the areas to be removed administratively subject to specified criteria.

On Georges Bank, the Council discussed a range of options over two meetings plus an intervening Committee meeting, focusing their attention on Alternatives 1, 7, 8, 9, and 10. While the initial Habitat Committee preference was for Alternative 7, Alternative 9 was developed at the first of the two Council meetings out of concern that Alternative 7 would have negative impacts on habitat and managed resources relative to No Action. The Council's final recommendation for Alternative 10 was made at the second of the two Council meetings. Alternative 10 was fully evaluated as a package after final action, but combined elements of Alternatives 7 and 9. When selecting their final preferred alternative, the Council weighed impacts to the lobster resource and fishery, scallop fishery, clam fishery, and groundfish resource and fishery. The Council agreed that the economic impacts of Alternative 8 were simply too great, and debated between the western area included in Alternative 9 and the Georges Shoal HMA included in Alternatives 7 and 10. Ultimately the Council agreed that the western area in Alternative 9 would have unacceptable levels of impacts on the groundfish fishery, focusing in particular on the Georges Bank winter flounder fishery. As part of Alternative 10, a seasonal closure for scallop dredges was adopted in order to minimize the possibility of negative effects on lobster and the lobster fishery. This seasonal closure was adopted in lieu of maintaining the entire No Action alternative in Closed Area I and II. The Council also agreed that a short window to adopt long-term clam dredge exemptions on Georges Shoal was a reasonable compromise between habitat protection and impacts on the clam fishery.

In the Great South Channel/Nantucket Shoals, the Council adopted Alternative 4 after extensive debate over two meetings. The intial Committee preference was for Alternative 5, with the northeastern section of the area set aside as a mobile bottom-tending gear closure, and a three year exemption for hydraulic dredges in the remaining area. While the Council recognized the likelihood of negative economic impacts on the clam fishery, they were also concerned about the negative effects of hydraulic dredges on complex habitats occurring in the region. Comparing Alternatives 3, 4, and 5, there was concern that Alternative 5 did not affort adequate benefits to habitat and managed resources, but that the potential economic impacts of Alternative 3 were substantial. Even under Alternative 4, concerns were raised regarding access to catch winter flounder, but ultimately the Council agreed that this intermediate area between Alternatives 3 and 5 was a reasonable compromise. The Council shifted from a three year to one year exemption period for hydraulic dredges, feeling that this timeframe from implementation would

be adequate to develop a long-term exemption area or areas. On Cox Ledge, the Council adopted an HMA with two sub-areas, a trawl gear modification, and a closure to hydraulic dredges but not scallop dredges. While there was some opposition to the use of gear modification measures in general, industry supported continued access for scallop dredge and trawl vessels.

In terms of spawning protections in the Gulf of Maine, the Council's final preferred alternative built upon the Cod Protection measures adopted earlier via Framework 53 to the Northeast Multispecies FMP, adding an additional conservation measure during two weeks in April in Block 125 (Alternative 4) in response to concerns that there was a gap in spawning protection during this time. The Council also approved Alternative 3 (Massachusetts Bay Cod Spawning Protection Area), applying the same fishing restrictions used for Gulf of Maine Cod Spawning Protection Area (known as the Whaleback Area). Alternative 3 is similar to measures enacted via Framework 53, but includes more comprehensive gear restrictions.

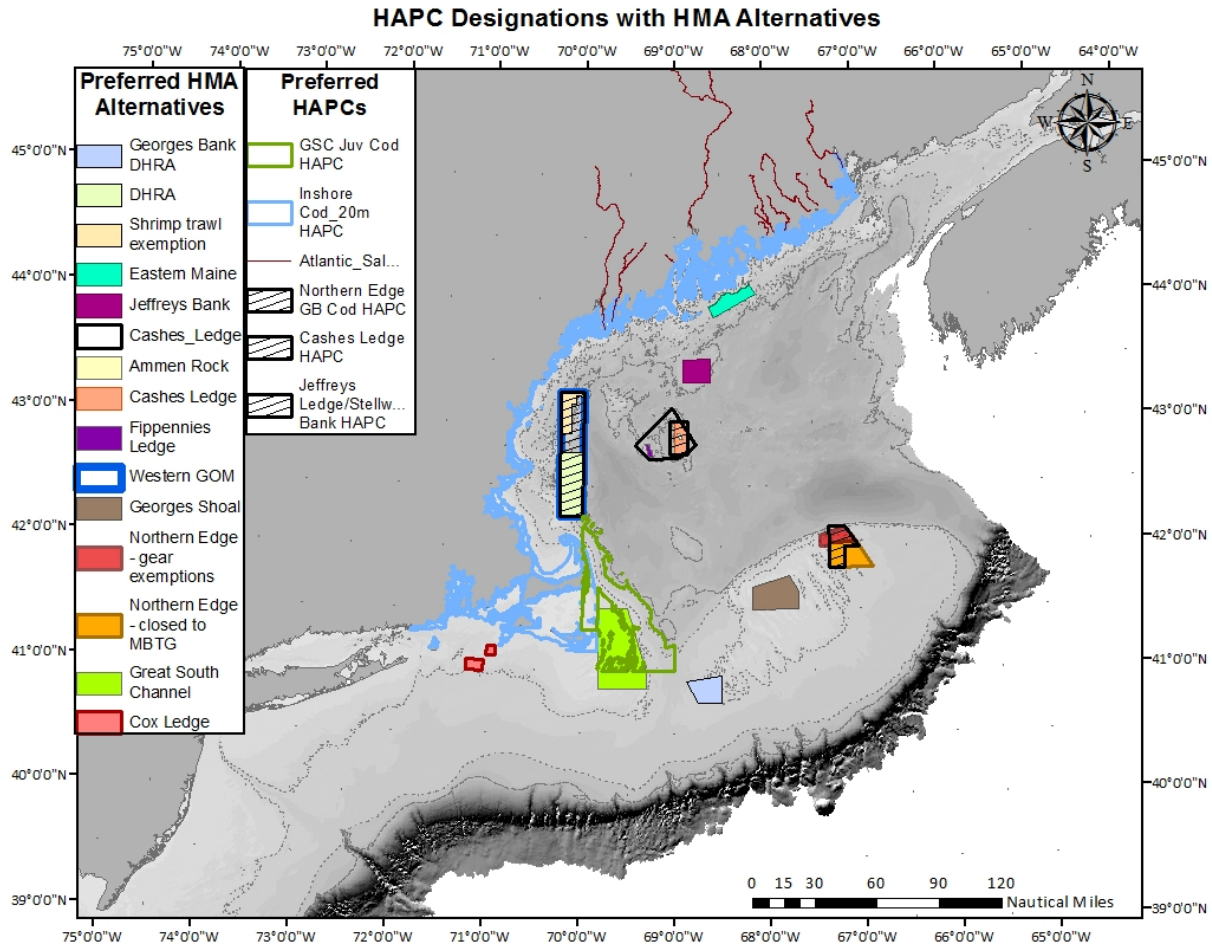
In terms of spawning protections on Georges Bank, the Council agreed to shift two existing management areas, Closed Area I North and Closed Area II, to seasonal vs. year-round closures, agreeing that many of the spawning protection benefits would remain under the seasonal closures, while allowing for increased fishery access during other seasons. In addition, the Council agreed to eliminate the Nantucket Lightship Closed Area and the southern portion of Closed Area I, although the far southern portion of Closed Area I would remain in place as a research area.

3.3.3 Adverse effects minimization within Habitat Areas of Particular Concern

Habitat Area of Particular Concern (HAPC) designations themselves do not restrict fishing activity or fishing methods. However, evaluation of adverse effects of fishing on habitat areas of particular concern should be given special attention, particularly for EFH that is vulnerable to fishing activities. Some of the Council's preferred HAPCs overlap with the Council's preferred habitat management areas, which do carry restrictions on fishing activities, particularly for mobile bottom-tending gears. This section describes the preferred alternative adverse effects minimization measures within the various preferred alternative HAPCs.

Specific actions are proposed in this amendment to minimize the adverse effects of fishing within large portions of the preferred HAPCs. The Inshore Juvenile Cod HAPC, Jeffreys Ledge/Stellwagen Bank HAPC, Cashes Ledge HAPC, Great South Channel HAPC, and the Northern Edge HAPC overlap with some of the habitat management areas identified as preferred alternatives. There are also overlaps between existing fishing restrictions and some of the canyon HAPCs, including those in Lydonia, Gilbert, Oceanographer, and Veatch canyons. The specifics of these overlaps are discussed further below. Map 6 through Map 11 show the areas of overlap along the continental shelf.

Map 6 – Overlap between Council's Preferred HAPCs and HMAs



3.3.3.1 Jeffreys Ledge/Stellwagen Bank HAPC

In the western Gulf of Maine sub-region, the preferred alternative maintains the Western Gulf of Maine Habitat Closure Area, which has equivalent boundaries to the Jeffreys Ledge/Stellwagen Bank HAPC as a year-round habitat closure to all mobile bottom-tending gears. The Jeffreys Ledge/Stellwagen Bank HAPC (Map 7) is proposed due to importance of its ecological function and sensitivity to anthropogenic stress, including stress from fishing activities, although such stresses are largely eliminated at the present time as the area is managed as a closure. The Western Gulf of Maine Habitat Closure Area (part of Alternative 1/No Action in that sub-region) has been in effect since 2003 as a closure to all mobile bottom-tending gears, including all bottom trawls and dredges. There would be an exemption for shrimp trawls from the mobile bottom-tending gear prohibition in the northwestern corner of the area, located in the deep waters west of Jeffreys Ledge.

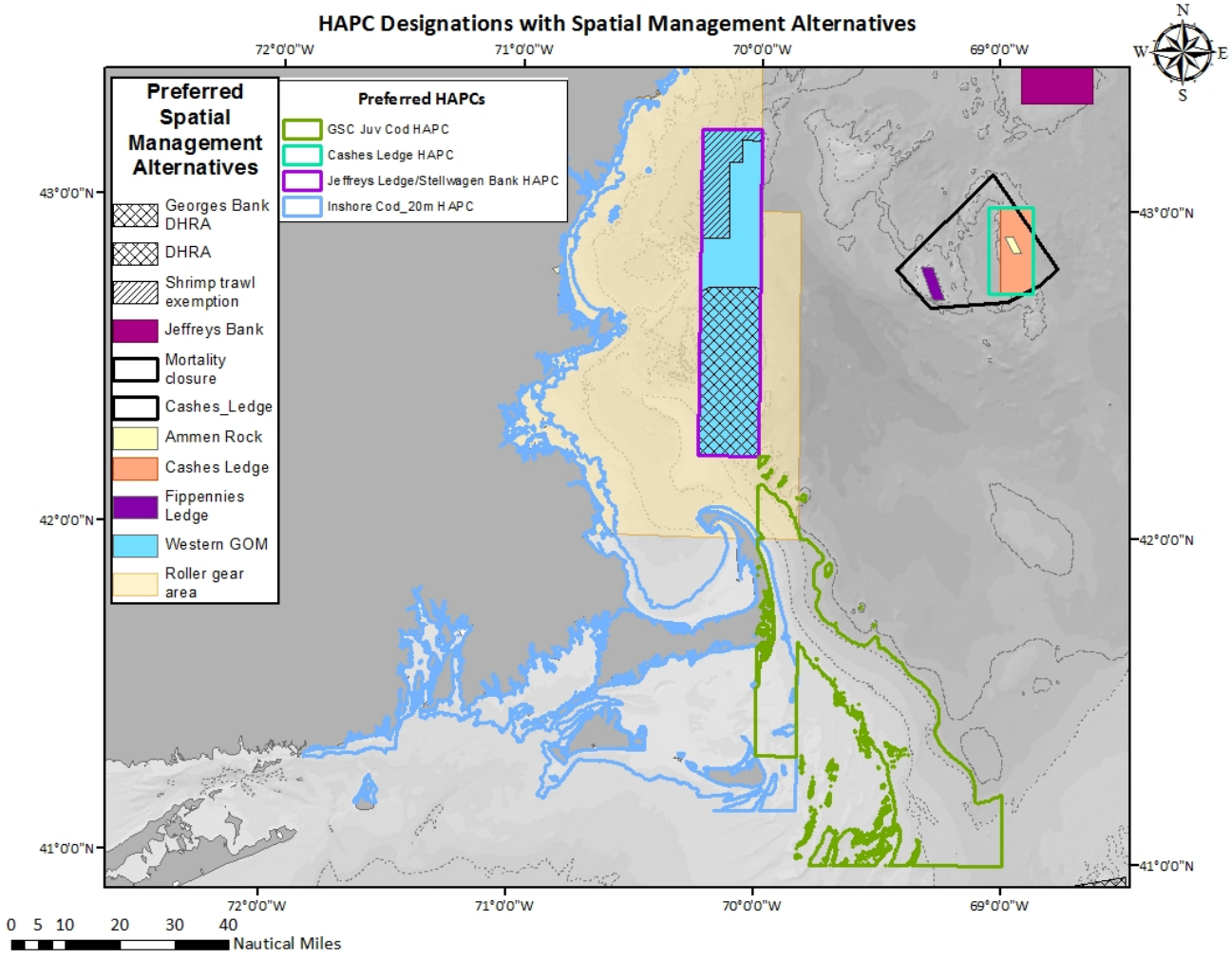
The Jeffreys Ledge/Stellwagen Bank HAPC also overlaps the Western Gulf of Maine Groundfish Closure Area, which has been in effect since 1998 as a closure to many gears capable of catching groundfish. Specifically, the Western Gulf of Maine Closure Area is closed year-

round to all fishing vessels except party/charter vessels with an LOA, vessels fishing with exempted gears (i.e. pelagic hook and line, pelagic longline, spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dipnets, stop nets, pound nets, pelagic gillnets, pots and traps, shrimp trawls with a properly configured grate, and surfclam and ocean quahog dredges), vessels participating in the mid-water trawl exempted fishery, and vessels participating in the purse seine exempted fishery.

In addition, the HAPC overlaps the GOM/GB Inshore Restricted Roller Gear Area, which limits the size of any part of the trawl footrope, including discs, rollers, or rockhoppers, to a maximum of 12 inches (30.5 cm) in diameter. This currently applies to all trawl vessels fishing on a NE multispecies DAS or sector trip, but would apply to all types of trawl vessels pending approval of this amendment. The roller gear size restriction is expected to continue to minimize fishing activity over structurally complex habitat because these roller gears are used to minimize gear damage and allow trawl vessels to operate within complex habitat (i.e. allows footrope to remain in contact with the seafloor while skipping over rocks or other structures encountered during trawling).

In combination, these measures have in the past and will continue to minimize the adverse impacts of fishing on the Jeffreys Ledge/Stellwagen Bank HAPC.

Map 7 - Council's preferred Jeffreys Ledge/Stellwagen Bank HAPC and preferred HMAs



3.3.3.2 Cashes Ledge HAPC

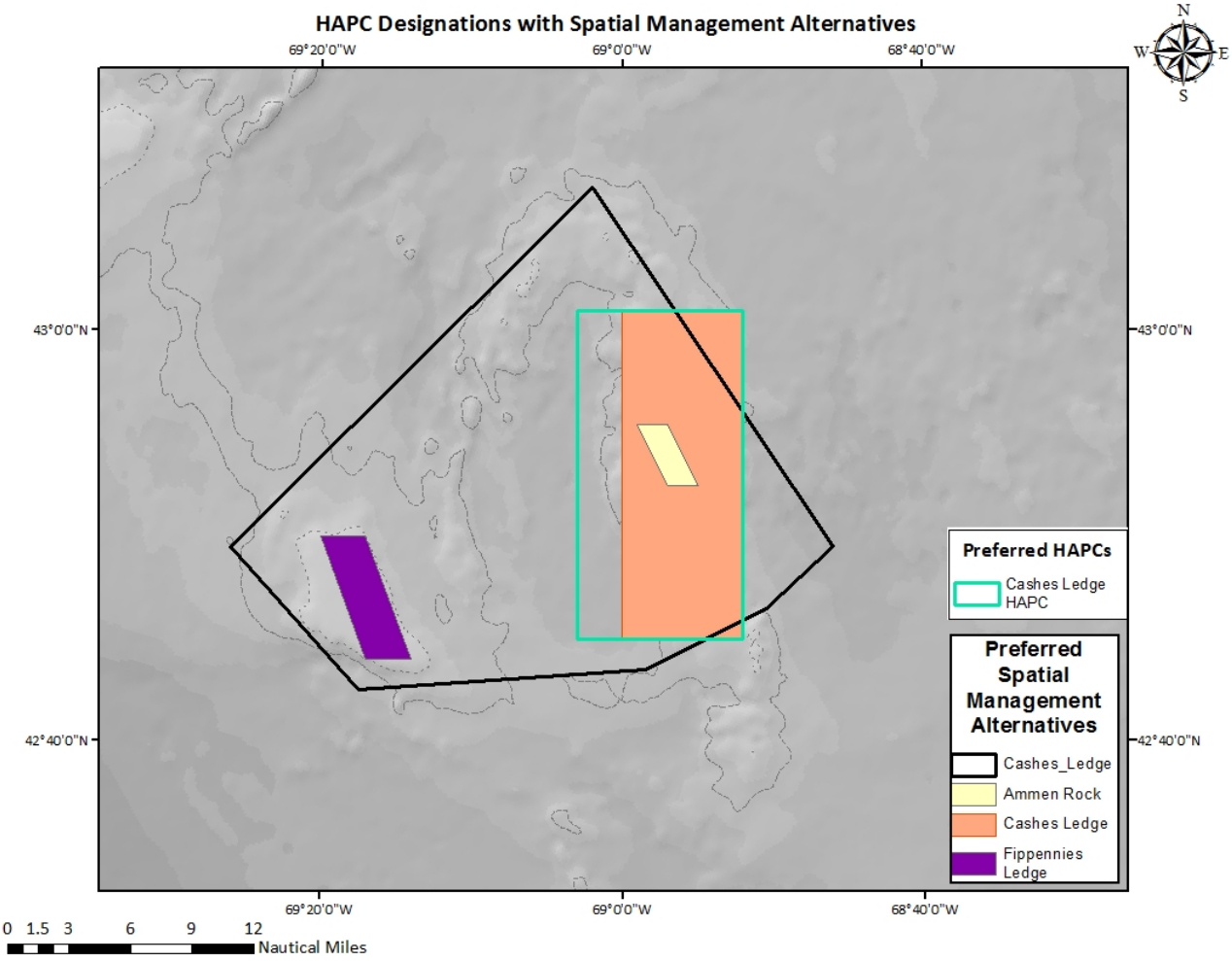
The Cashes Ledge HAPC (Map 8) is proposed based on the following criteria: importance in terms of its ecological function, habitat rarity, and sensitivity to anthropogenic stress, including stress from fishing activities, although such stresses are largely eliminated at the present time as the area is managed as a closure. This area encompasses a rare offshore kelp forest habitat, as well as abundant populations of large predatory fish including cod, pollock, wolffish, and sharks.

The Cashes Ledge HAPC overlaps with the No Action Cashes Ledge Habitat Closure Area, extending two nautical miles to the west of the modified habitat closure as proposed in this amendment. The new Ammen Rock HMA is a small subset of the preferred alternative, encompassed within the Cashes Ledge Habitat Closure Area and the Cashes Ledge Closure Area. The Cashes Ledge Habitat Closure is and will continue to be managed as a mobile bottom-tending gear closure, and Ammen Rock will be managed as a closure to all gear types if approved, with the exception of lobster traps, which are managed by the Atlantic States Marine Fisheries Commission and NMFS.

In addition, the preferred alternative maintains the Cashes Ledge Closed Area. The area is closed year-round to all fishing vessels except: party/charter vessels with an LOA, vessels fishing with exempted gears (i.e. pelagic hook and line, pelagic longline, spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dipnets, stop nets, pound nets, pelagic gillnets, pots and traps, shrimp trawls with a properly configured grate, and surfclam and ocean quahog dredges), vessels participating in the mid-water trawl exempted fishery, and vessels participating in the purse seine exempted fishery.

In combination, these measures have in the past and will continue to minimize the adverse impacts of fishing on the Cashes Ledge HAPC. The Cashes Ledge Habitat closure area would continue to restrict mobile bottom tending gear, which overlaps almost entirely with the Cashes Ledge HAPC and would therefore continue to minimize adverse impacts from fishing. In addition, the Ammen Rock sub-area within the Cashes Ledge Closure Area is closed to all mobile bottom tending gear with no exceptions, largely reducing adverse impacts to this rare habitat type within Cashes Ledge. The broader groundfish closure restrictions currently exempt shrimp trawls and clam dredges, which can generate adverse effects. However, the Gulf of Maine shrimp trawl fishery is currently closed and generally occurs much further west when it is open given the seasonal movement of shrimp inshore during the winter fishing season. Clam dredging has not occurred in the past in the central Gulf of Maine around Cashes Ledge.

Map 8 – Council's Preferred Cashes Ledge HAPC and preferred central Gulf of Maine HMAs



3.3.3.3 Inshore Juvenile Cod HAPC

The Inshore Juvenile Cod HAPC is proposed based on the following criteria: importance in terms of its ecological function, and sensitivity to anthropogenic stress, including stress from fishing activities. The HAPC extends from Maine through Southern Massachusetts including Cape Cod, and has some overlap with the coastal portions of various existing and proposed seasonal closures described below and shown on Map 9. There are no year-round habitat management areas overlapping this HAPC. The Small Eastern Maine HMA is approximately 4 nautical miles east of the Inshore Juvenile Cod HAPC, but the two areas do not overlap at any point.

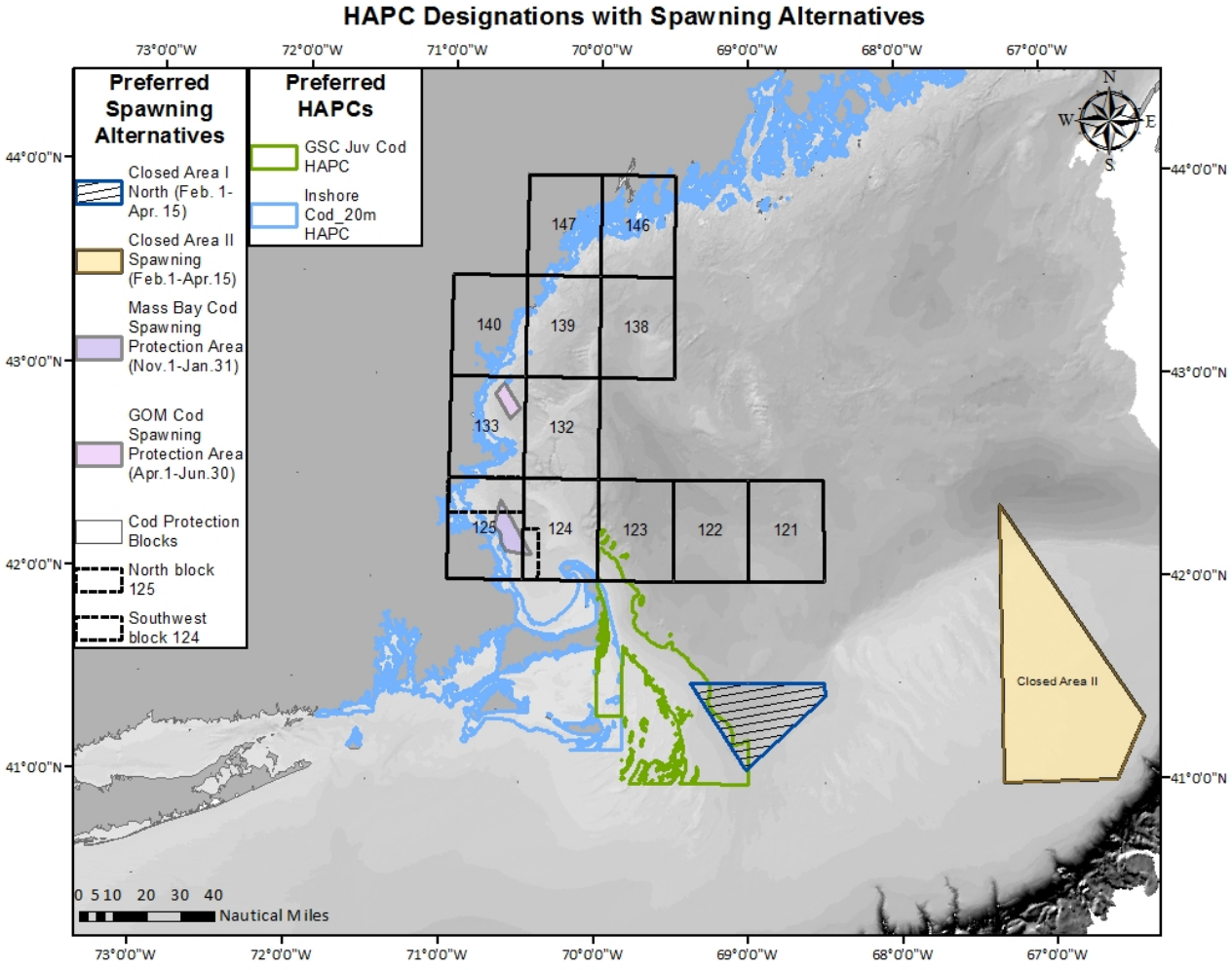
Although there are no overlapping year-round closures within this inshore HAPC, there are seasonal fishing restrictions that provide protection for groundfish stocks, including spawning Atlantic cod. The Council took final action to adopt seasonal spawning protections that include the Gulf of Maine Cod Spawning Protection Area (Whaleback area, April 1-June 30) and various thirty minute blocks in March, May, June, October, November, December, and January, referred

to as the GOM Cod Protection Closures (formerly referred to as groundfish rolling closures for sector and common pool vessels). The Council also proposes to include thirty minute block 125 for spawning protection from April 15th through April 30th. The Gulf of Maine Cod Protection Closure is closed to commercial fishing with some exceptions, which include shrimp trawls, surf clam/ocean quahog dredges, scallop dredges, and raised footrope whiting trawls. The Council also approved the Massachusetts Bay Cod Spawning Protection Area, applying the same fishing restrictions used for Gulf of Maine Cod Spawning Protection Area (closed to all fishing with some exemptions that include scallop dredges on a Days-At-Sea (DAS) trip or scallop dredges fishing in an exemption area).

These seasonal measures have and will continue to reduce adverse impacts to the habitat and protect the areas during specific time periods such as spawning, where species are known to aggregate, thereby increasing survivorship for cod and improving protections during spawning activity that may increase species productivity in the Gulf of Maine. Although there are mobile bottom-tending gear allowed in the area, the restrictions are an improvement to the current measures because there are additional cod protections in December and January within Block 125, and the Council proposes to maintain spawning protection for Block 125 during April. Cod Protection blocks overlap the Inshore Juvenile Cod HAPC on a seasonal basis and affords protections during spawning activity, when cod are most vulnerable to disturbance from fishing vessels. Reduction in mortality of cod within the Inshore Juvenile Cod HAPC is likely reduced on a seasonal basis when cod are expected to aggregate and spawn.

State-only permitted vessels are excluded from the cod protection measures; however, Massachusetts Division of Marine Fisheries (MA DMF) regulations restrict state vessels capable of catching cod from areas within the Massachusetts Bay referred to as the Cod Conservation Zone, from November 15th through January 31st through the Winter Cod Conservation Zone, and April 16th through July 21st through the Spring Cod Conservation Zone (M.G.L. c. 130, §§ 2, 17A, 80 and 104). In addition, MA DMF also implemented rolling closures in November (Blocks 123-125), April (Blocks 123-125) and May (Block 133). These state closures apply to state vessels and are subject to change under the management authority of MA DMF. Currently, MA DMF is considering modifications to its rolling closures applied to commercial groundfish vessels operating in Massachusetts state waters (MA DMF Marine Fisheries Advisory Notice, May 27, 2015). Compared to existing restrictions in the Great South Channel, these proposed measures would be expected to improve the utility of the Great South Channel area closure, which likely indirectly improves habitat protection within the HAPC.

Map 9 – Council's Preferred inshore HAPCs and Gulf of Maine and Georges Bank seasonal closures

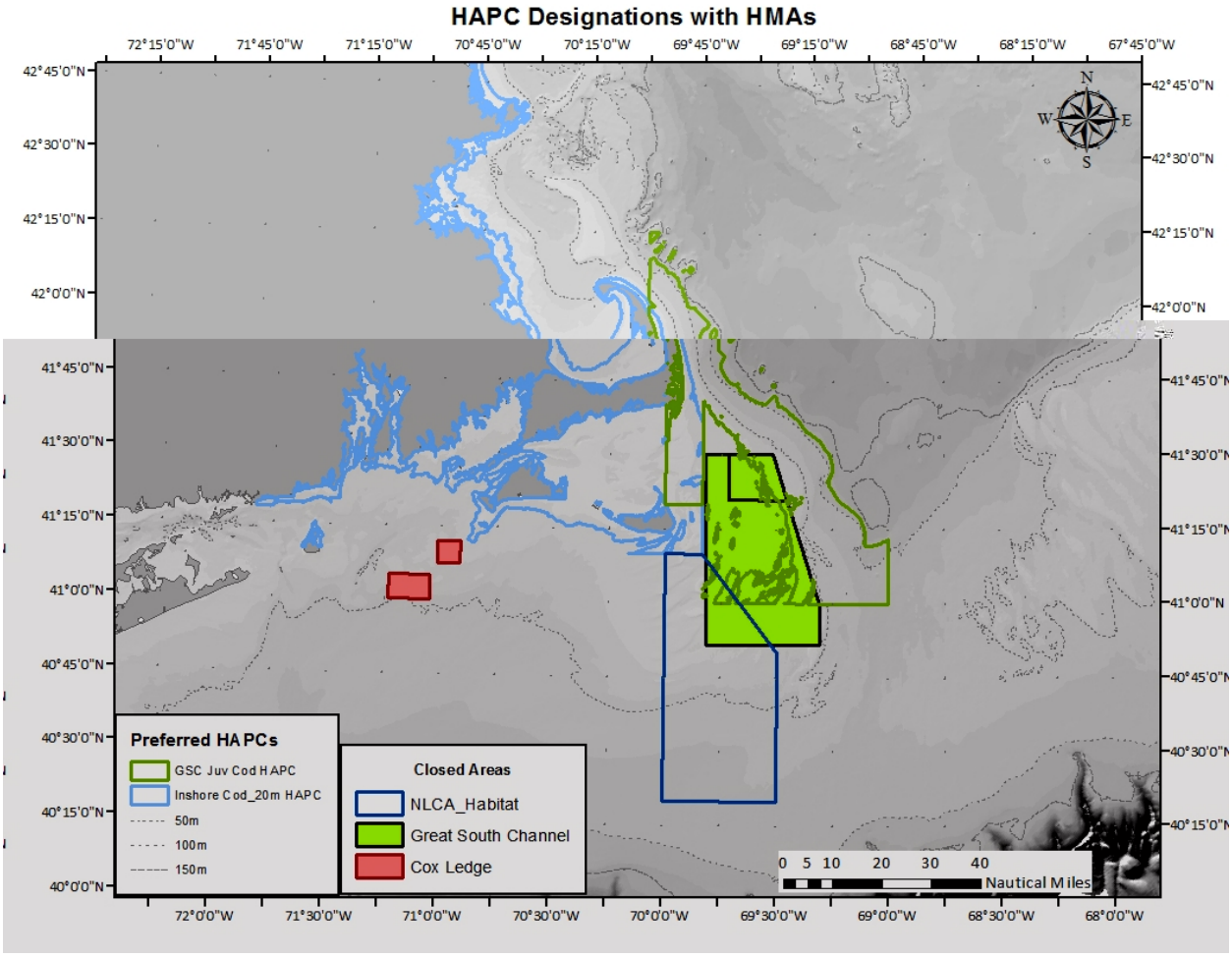


3.3.3.4 Great South Channel HAPC

The Great South Channel Juvenile Cod HAPC is proposed based on the following criteria: ecological importance and sensitivity to anthropogenic stress, including stress from fishing activities. The Great South Channel Juvenile Cod HAPC overlaps with some of the proposed Great South Channel HMAs. The boundary of the Great South Channel HMA is shifted northeast of the existing Nantucket Lightship Habitat Closure. If the Council's Great South Channel HMA is approved, it would increase habitat protection within the Juvenile Cod HAPC due to an increase in overlap between the proposed Great South Channel HMA and the proposed HAPC compared to current Nantucket Lightship Habitat Closure. The Great South Channel HMA is proposed as a year-round closure with complete restriction on use of mobile bottom-tending gears in the northeast corner and a one year hydraulic clam dredge exemption in the remainder of the area.

Although clam dredges have adverse impacts on fish habitats, they are not considered a gear type capable of catching groundfish; therefore, it is not likely that the clam dredges would increase mortality of groundfish species, particularly cod. The preferred alternative restrictions in the Great South Channel HMA will minimize adverse impacts of fishing within part of the HAPC. A variation of the Great South Channel HMA (Great South Channel East) was considered by the Council, but due to substantial potential displacement of scallop dredge and groundfish trawl effort, the area was viewed as not practicable and was not selected during final action.

Map 10 – Council's Preferred HAPCs and Great South Channel Closures (existing and proposed)

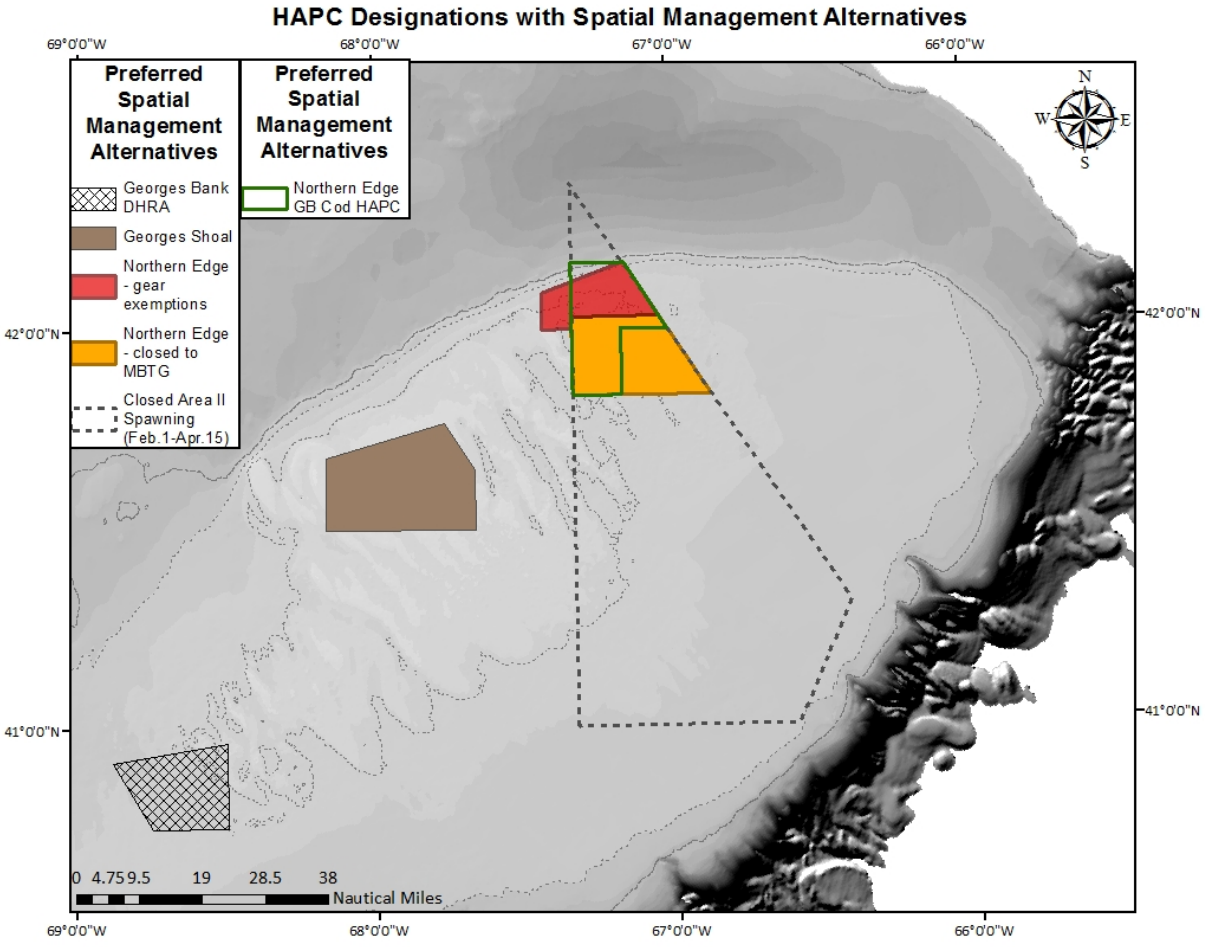


3.3.3.5 Northern Edge HAPC

The Northern Edge HAPC (Map 11) was designated for juvenile Atlantic cod based on the following criteria: importance in terms of its ecological function; sensitivity to anthropogenic stress, including fishing; and habitat rarity relative to the Georges Bank region. The Northern Edge HAPC is almost entirely overlapping with two of the Council's proposed HMAs in the Georges Bank region, the Northern Edge Reduced Impact HMA and the Northern Edge MBTG HMA. The Northern Edge Reduced Impact HMA would be closed to mobile bottom-tending gears, with limited fishing access for scallop dredges, and to a lesser extent, bottom trawls. Throughout the area, rotational access for the scallop fishery would be allowed, with the

specifics of the program to be developed in a subsequent scallop amendment or framework. Groundfish trawl fishing would be allowed west of 67° 20' W, consistent with current special access program regulations. Scallop vessels, through this amendment, and sector trawl vessels, through a gear sharing agreement, would be restricted from fishing in the area between June 15 and October 31 to protect ovigerous female lobsters. In addition, the area would be closed between February 1st and April 15th as a spawning measure, although scallop dredges would be exempt. In combination, these seasonal closures restrict access for mobile bottom-tending gear from the Northern Edge area seven months each year. Currently, the Closed Area II Habitat Closure, which has the same boundaries as the HAPC, is closed year-round to mobile bottom-tending gears. Although the fishing measures under the Council's proposed HMAs are less restrictive compared to current restrictions, the preferred alternatives limit fishing within the HAPC to extent practicable

Map 11 – Council's Preferred Northern Edge HAPC and Preferred Georges Bank HMAs



3.3.3.6 Atlantic Salmon HAPC

The Gulf of Maine Atlantic salmon population was listed as endangered in December 2000, and there is a prohibition on commercial fishing for salmon in the Gulf of Maine. The rivers comprising the Atlantic Salmon HAPC provide an important ecological function for spawning

and early life stage salmon. The habitat of these rivers is sensitive to anthropogenic stressors, from dam construction and hydropower operations to logging, agriculture, and aquaculture activities.

Seven small, coastal drainages located in the downeast and mid-coast sections of Maine hold the last remaining populations of native Atlantic salmon in the United States (USFWS 1996). These important rivers are the Dennys, Machias, East Machias, Pleasant, Narraguagus, Ducktrap, and Sheepscot. In 1998 (Omnibus EFH Amendment 1), the Council concluded that the designation of the following eleven rivers in Maine met at least two criteria for designation as a Habitat Areas of Particular Concern for Atlantic salmon: Dennys, Machias, East Machias, Pleasant, Narraguagus, Ducktrap, Sheepscot, Kennebec, Penobscot, St. Croix, and Tunk Stream. The Council took action to maintain the current Atlantic Salmon HAPC. However, mitigation measures for Atlantic salmon recovery are under the jurisdiction of the USFWS and NMFS.

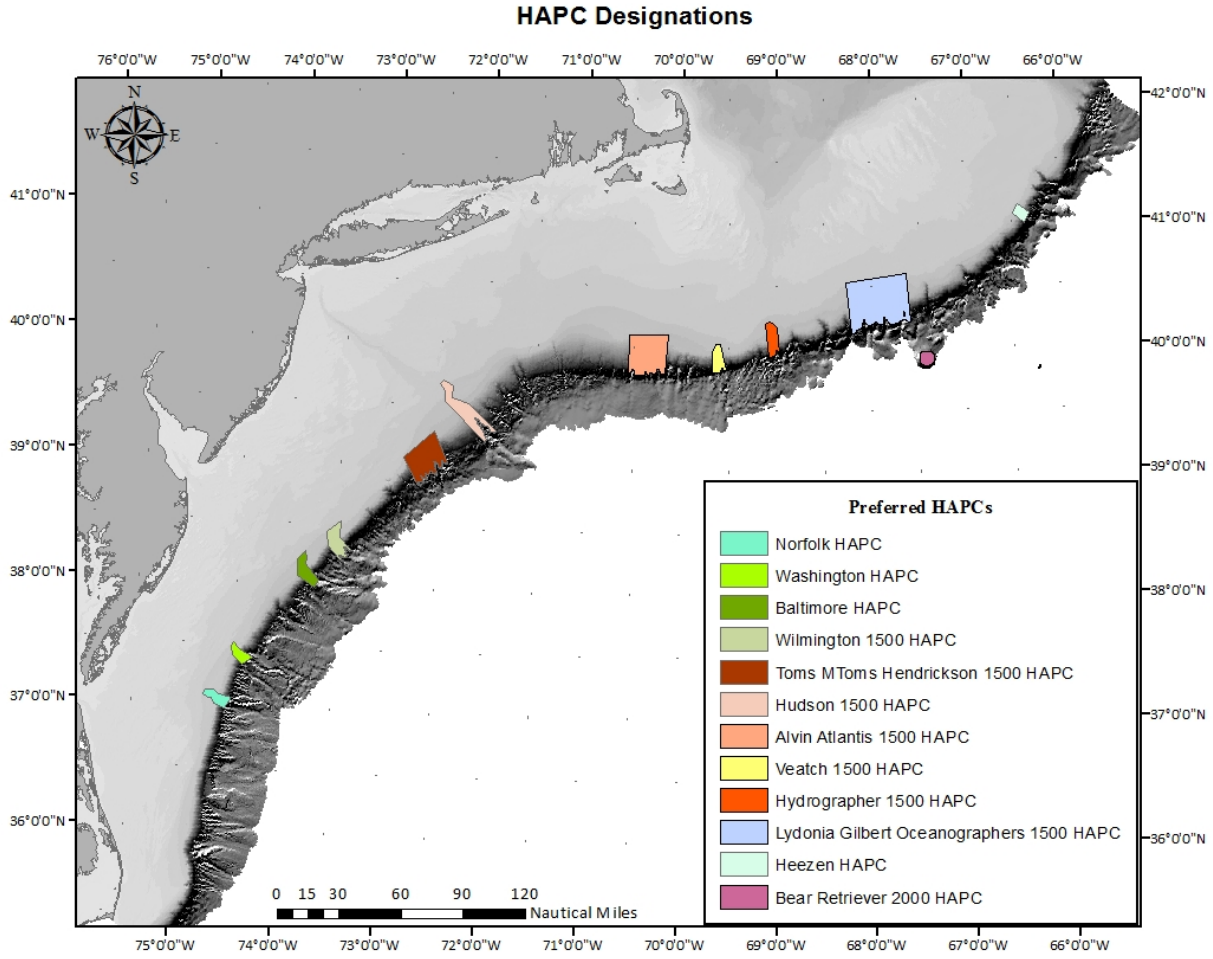
There is a Council FMP for Atlantic salmon, which prohibits salmon harvest in Federal waters and designates Atlantic salmon EFH. Atlantic salmon is managed under an international treaty organization, the North Atlantic Salmon Conservation Organization (NASCO), and the Council is exempt from the Magnuson-Stevens Act requirement to develop a rebuilding plan for Atlantic salmon. However, NMFS and the U.S. Fish and Wildlife Service are required to develop a recovery plan under the Endangered Species Act (Gulf of Maine Distinct Population Segment was listed as endangered in November 2000). The Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (*Salmo salar*) was implemented in November 2005 (http://www.greateratlantic.fisheries.noaa.gov/nero/hotnews/salmon/FinalATSRPlan.pdf). Although the Salmon HAPC does not overlap with any habitat management areas, there is currently a restriction on fishing for salmon, and the Council does not manage other directed fisheries that operate within the rivers that comprise the HAPC.

3.3.3.7 Seamount and Canyon HAPCs

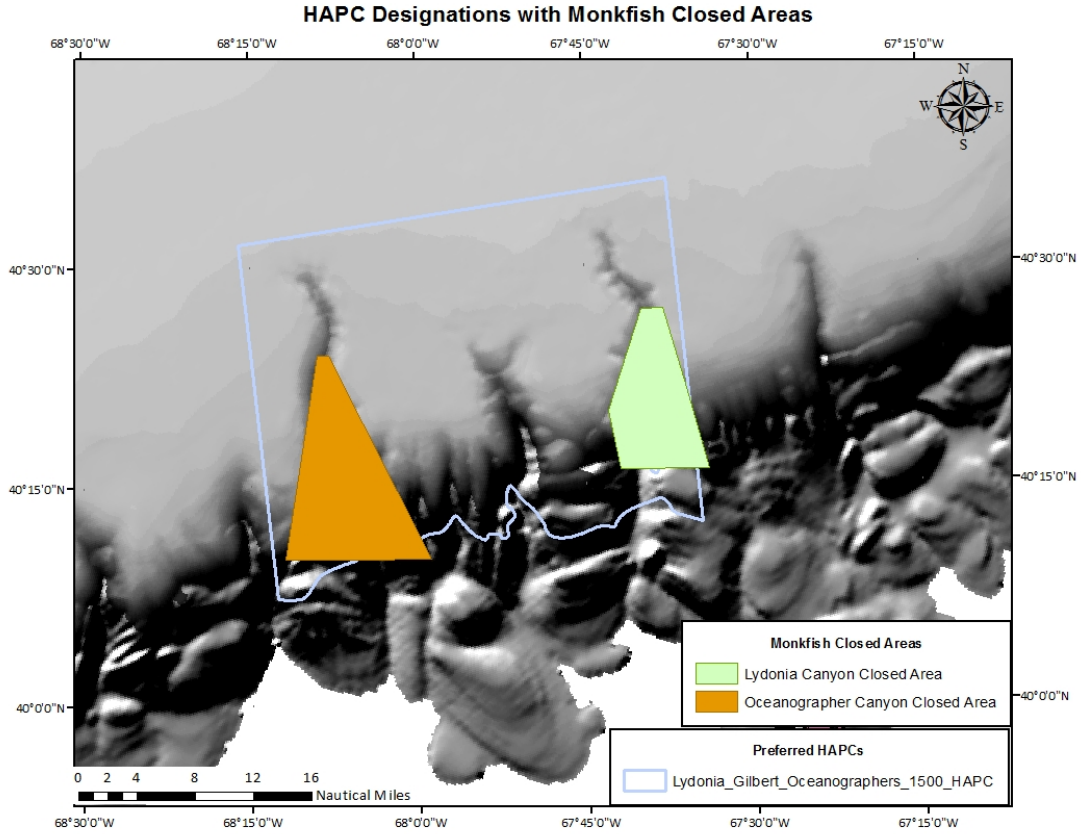
HAPCs located in the seamounts and canyons (Map 12) do not overlap with the spatial management alternatives in this amendment. However, current measures in the New England Fishery Management Council's Monkfish FMP restrict fishing on a Monkfish day at sea in the Lydonia Canyon Closed Area and the Oceanographer Canyon Closed Area. The Lydonia/Gilbert/Oceanographer HAPC combines the Lydonia, Gilbert, and Oceanographer Canyons into a single HAPC. Lydonia and Oceanographer Monkfish Closed Areas are encompassed almost entirely within the HAPC (Map 13). In addition to the monkfish regulations, the Mid-Atlantic Fishery Management Council's Golden Tilefish FMP implemented gear restricted areas for Oceanographer Canyon, Lydonia Canyon, Veatch Canyon, and Norfolk Canyon, with complete restriction of mobile bottom-tending gears applicable to all fisheries. Combined, the existing fishing restrictions within the Monkfish FMP and Golden Tilefish FMP would reduce impacts from mobile bottom-tending gear along the canyon areas. There are five additional canyons or seamounts in the Northeast region that have been designated as HAPCs, including: Bear and Retriever, Heezen, Hydrographer, Veatch, and Alvin and Atlantis. Management actions to minimize fishery impacts within these HAPCs will be considered through the Council's Coral Amendment.

The Mid-Atlantic Fishery Management Council is currently taking action to address deep-sea coral protections in its Coral Amendment, which include protections in the following canyons: Hudson Canyon, Toms Canyon, Hendrickson Canyon, Wilmington Canyon, Baltimore Canyon, Washington Canyon, and Norfolk Canyon. . These canyons make up the remaining list of Council-preferred HAPCs along the canyons and seamounts. The Draft Coral Amendment was approved by the Mid-Atlantic Fishery Management Council in June 2015, which includes a range of management options that include broad scale coral designation areas for protection and discreet coral designation areas for protection. Broad management areas would include the canyons and areas extending from the canyons southeast to the boundaries of the Mid-Atlantic jurisdiction and the EEZ line. Refer to the Mid-Atlantic Fishery Management Council's website for a visual representation of the management alternatives drafted in the Coral Amendment (http://www.mafmc.org/actions/msb/am16).

Map 12 – Council's Preferred HAPCs along the canyons and seamounts



Map 13 – Overlap of Monkfish Closed Areas and Preferred HAPCs



3.4 Conservation and enhancement of EFH

EFH regulations require FMPs to identify actions to encourage the conservation and enhancement of EFH, including recommended options to avoid, minimize, or compensate for adverse effects, especially in habitat areas of particular concern. Adverse effects on essential fish habitat caused by fishing activity, including within HAPCs, are discussed above. This amendment also proposes two habitat research areas, which provide control sites for scientific study that can be used to improve the design and efficacy of habitat management measures in future fishery management plan actions.

Non-fishing impacts to EFH are addressed through an EFH consultation process conducted by NMFS. EFH designations serve as a tool that can be used by the Council and NMFS when they engage in the EFH consultation process. NMFS is responsible for the EFH consultation process under the Code of Federal Regulations (CFR), 50 CFR 600.905-600.930, and consultation is triggered when a Federal agency (including NOAA) proposes an activity that may adversely affect designated EFH. NMFS may make written EFH conservation recommendations to the Federal agency if mitigation measures are necessary. Permitting agencies are not required to comply with these recommendations, but in most cases conservation measures are employed by the Federal agency in order to minimize adverse effects on EFH, in response to NMFS' consultations.

3.5 Summary of non-fishing related activities that may adversely affect EFH

FMPs must identify activities other than fishing that may adversely affect EFH. For each activity, the FMP should describe known and potential adverse effects to EFH. Non-fishing impacts that affect the benthic habitats summarized below and detailed in Appendix G. These activities include pollution, energy-related activities, coastal development, anthropogenic alterations to the freshwater and marine environment, marine transportation and water discharge, agriculture, invasive species, and aquaculture.

Table 26 – Non-fishing activities that potentially have a high impact on the benthic marine environment

Category	Impact type	Potential effects
	Cables and Pipelines	Impacts from construction activities, physical barriers to habitat, impacts to migration
	Liquified Natural Gas	Discharge of contaminants
	Offshore Wind Energy Facilities	Loss of benthic habitat, habitat conversion
	Petroleum Exploration, Production and Transportation	Oil spills, habitat conversion
Marine transportation	Construction and Expansion of Ports and Marinas	Loss of nearshore benthic habitat
	Fish Waste Disposal	Introduction of pathogens, release of nutrients/eutrophication, release of biosolids, loss of benthic habitat types
	Offshore Dredge Material Disposal	Burial/disturbance of benthic habitat, conversion of substrate/habitat, changes in sediment composition
	Offshore Mineral Mining	Loss of benthic habitat types, change in community structure, conversion of substrate/habitat, changes in sediment composition
	Petroleum Extraction	Contaminant releases, drilling mud impacts
	Vessel Disposal	Conversion of substrate/habitat, changes in community structure
	Combined Sewer Overflows	Release of nutrients, chemicals, and pathogens; changes in species composition and trophic interactions; siltation and sedimentation
	Industrial Discharge Facilities	Release of organic compounds (e.g. PCBs)
	Sewage Discharge Facilities	Release of nutrients/eutrophication, release of contaminants, introduction of harmful algal blooms, contaminant bioaccumulation/biomagnification
Physical effects - water intake and discharge facilities	Intake Facilities	Entrainment/impingement
Introduced/nuisance species	Introduced/ Nuisance Species	Changes in species diversity
	Climate Change	Alteration of temperature regimes, changes in community structure
	Ocean Noise	Mechanical injury to marine organisms

Table 27 – Non-fishing activities that potentially have a high impact on the pelagic marine environment

Category	Impact type	Potential effects
	Liquefied Natural Gas	Discharge of contaminants
	Offshore Wind Energy Facilities	Underwater noise
	Petroleum Exploration, Production and Transportation	Oil spills
	Fish Waste Disposal	Introduction of pathogens, release of nutrients/eutrophication
	Petroleum Extraction	Contaminant releases, drilling mud impacts
	Combined Sewer Overflows	Release of nutrients, chemicals, and pathogens; changes in species composition and trophic interactions; siltation and sedimentation
	Sewage Discharge Facilities	Release of nutrients/eutrophication, release of contaminants
Physical effects - water intake and discharge facilities	Intake Facilities	Entrainment/impingement
	Atmospheric Deposition	Mercury loading/bioaccumulation
	Climate Change	Alteration of hydrological regimes, alteration of temperature regimes, alteration of weather patterns, changes in community structure
	Military/Security Activities	Noise impacts
	Ocean Noise	Mechanical injury to marine organisms

3.6 Cumulative impacts analysis

Cumulative impacts are impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. EFH regulations indicate that to the extent feasible and practicable, FMPs should analyze how the cumulative impacts of fishing and non-fishing activities influence the function of EFH on an ecosystem or watershed scale. An assessment of the cumulative and synergistic effects of multiple threats, including the effects of natural stresses (such as storm damage or climate-based environmental shifts) and an assessment of the ecological risks resulting from the impact of those threats on EFH, also should be included. A cumulative effects analysis is included in this volume, section 2.

3.7 Research and information needs

EFH regulations state that each FMP should contain recommendations, preferably in priority order, for research efforts that the Councils and NMFS view as necessary to improve upon the description and identification of EFH, the identification of threats to EFH from fishing and other activities, and the development of conservation and enhancement measures for EFH.

Regulations also require that research be considered in order to evaluate impacts of fishing on EFH. This amendment adopts dedicated habitat research areas within the western Gulf of Maine (Stellwagen DHRA) and Georges Bank (Georges Bank DHRA). These areas will help promote habitat research to evaluate the effects of fishing on EFH. This information will better inform fishery managers on the adverse effects of fishing and improve mitigation methods that would help improve the most critical habitat types. Volume 3, Section 2.4 describes in detail the types of habitat research needed to improve the quality of information currently used to inform habitat management decisions.

4 EFH Assessment

4.1 Description of action

The purpose of this amendment is to review and revise the essential fish habitat designations, habitat area of particular concern designations, and adverse effects minimization measures for all New England Fishery Management Council fishery management plans, including designation of dedicated habitat research areas. The amendment also reviews and revises spawning protection measures for the Northeast Multispecies FMP, and updates framework and monitoring provisions related to habitat management measures.

The proposed EFH designations for all 28 species managed by the Council are described in detail in Volume 2 of this environmental impact statement. EFH text descriptions summarize the life history information necessary to understand the relationship of each species and life history stage to, or its dependence on, various habitats. A major improvement in the new text descriptions is their inclusion of specific depth ranges that more explicitly correspond with the map representations of EFH and the identification of preferred bottom habitat types that are associated with benthic life stages. EFH maps display, within the constraints of available information, the geographic boundaries within which EFH for each species and life stage exists, subject to the habitat requirements as defined in the text descriptions. The approach used for the proposed EFH maps for each species and lifestage are summarized below (Table 28). Most of the maps were generated using relative abundance data derived from historical time series of bottom trawl and ichthyoplankton surveys, with ten minute squares limited to those that conformed to species- and lifestage-specific temperature ranges, and then the temperature-limited data layers were clipped by species- and lifestage-specific depth limits. A range of alternatives was considered for each species and lifestage where relative abundance data were used, from the ten minute squares that encompassed 50% of the species' distribution, to a species range approach where 100% of the ten minute squares containing the species were designated. Alternatives encompassing 75% and 90% of the species relative abundance were also developed, and were typically preferred over the 50% and 100% approaches, which were viewed as too narrow, and too general, respectively, for many species.

Table 28 – Summary of mapping methodology used to develop preferred alternative EFH designations. Asterisk (*) indicates slight adjustment from no action designation, for example filled in ten minute squares removed, inshore estuarine area boundaries adjusted.

Species	Eggs	Larvae	Juveniles	Adults
Acadian redfish	No designation	Juv abundance + habitat (90%) + 100% larvae	Abundance (90%) + habitat	Abundance (90%) + habitat
American plaice	Abundance (75%)*	Abundance (75%)*	Abundance (75%) + habitat	Abundance (75%) + habitat
Atlantic cod	Abundance (90% juvs + eggs)	Abundance (90% juvs + larvae)	Abundance (90%) + habitat	Abundance (90%) + habitat
Atlantic halibut	Abundance (juvs + adults) + habitat (90%)			
Atlantic herring	Presence of eggs + larval abundance (%TBD)	Larval abundance (%TBD)	Abundance (75%)	Abundance (75%)

Species	Eggs	Larvae	Juveniles	Adults
Atlantic salmon	10 year presence in rivers			
Atlantic sea scallop	Species range (100% abundance)			
Barndoor skate	No designation		Abundance (90%) + habitat	Abundance (90%) + habitat
Clearnose skate	No designation		Abundance (75%) + habitat	Abundance (75%) + habitat
Deep-sea red crab	Depth range (spawning females)	Depth range (juvs + adults)	Depth range	Depth range
Haddock	Abundance (100%)*	Abundance (100%)*	Abundance (90%) + habitat	Abundance (90%) + habitat
Little skate	No designation		Abundance (75%) + habitat	Abundance (75%) + habitat
Monkfish	Abundance (100% adults + 100% larvae)	Abundance (100% adults + 100% larvae)	Abundance (75%) + habitat	Abundance (75%) + habitat
Ocean pout	Abundance (75% adults) + depth range	No designation	Abundance (75%) + habitat	Abundance (75%) + habitat
Offshore hake	Abundance (75%)	Abundance (75%)	Depth range	
Pollock	Abundance (90% adults)	Abundance (90% adults)	Abundance (90%) + habitat	Abundance (90%) + habitat
Red hake	Abundance (75% juvs) + habitat	Abundance (75% juvs) + habitat	Abundance (75%) + habitat	Abundance (90%) + habitat
Rosette skate	No designation		Abundance (75%) + habitat	Juv abundance (75%) + habitat
Silver hake	Abundance (90% juvs)	Abundance (90% juvs)	Abundance (75%) + habitat	Abundance (75%) + habitat
Smooth skate	No designation		Abundance (90%) + habitat	Abundance (90%) + habitat
Thorny skate	No designation		Abundance (75%) + habitat	Abundance (90%) + habitat
White hake	Abundance (90% adults)	Abundance (90% juvs)	Abundance (90%) + habitat	Abundance (90%) + habitat
Windowpane flounder	Abundance (90%)*	Abundance (90%)*	Abundance (90%) + habitat	Abundance (90%) + habitat
Winter flounder	Adult + depth range	Abundance (90% adults) + habitat	Abundance (90%) + habitat	Abundance (90%) + habitat
Winter Skate	No designation		Abundance (90%) + habitat	Abundance (90%) + habitat
Witch flounder	Abundance (100%)*	Abundance (100%)*	Abundance (90%) + habitat	Abundance (90%) + habitat
Yellowtail flounder	Abundance (100%)*	Abundance (100%)*	Abundance (90%) + habitat	Abundance (90%) + habitat

Proposed habitat area of particular concern (HAPC) designations are also described in Volume 2. An area's status as an HAPC should lead to more careful evaluations of the impacts of fishing in that area. Management measures such as gear restrictions are not proposed as part of the HAPC designations in this amendment.The Atlantic Salmon HAPC and the Northern Edge Cod HAPC are currently in place. The preferred HAPCs include the two No Action HAPCs, plus the following new areas:

- Inshore Juvenile Cod
- Great South Channel Juvenile Cod
- Cashes Ledge
- Jeffreys Ledge/Stellwagen Bank
- Bear and Retriever Seamounts
- Heezen Canyon
- Lydonia/Gilbert/Oceanographers Canyons
- Hydrographer Canyon
- Veatch Canyon
- Alvin/Atlantis Canyon
- Hudson Canyon
- Toms, Middle Toms, and Hendrickson Canyon
- Wilmington Canyon
- Baltimore Canyon
- Washington Canyon
- Norfolk Canyon

The adverse effects minimization measures, dedicated habitat research areas, spawning areas, and framework adjustment provisions are described in detail in Volume 3 of this environmental impact statement (preferred alternatives are described as a group in Volume 3, section 2.1). The habitat management and spawning protection alternatives consist of sub-regional (habitat) or regional (spawning) combinations of current areas, modified versions of current areas, or newly identified areas. Fishing restriction measures vary by area and alternative type. Habitat areas generally restrict mobile bottom-tending gears to minimize negative effects of fishing on vulnerable seabed habitats, and spawning areas generally restrict gears that catch groundfish to limit fishery impacts on spawning activity. The proposed action is summarized below (Table 29).

Table 29 – Proposed spatial management alternatives

Alt. type	Sub-region or region	Alt#	Areas included	Fishing restriction options
Habitat	Eastern Gulf of Maine	3	Small Eastern Maine HMA only (excludes Machias HMA and Toothaker Ridge HMA)	Closure to all mobile bottom-tending gears
Habitat	Central Gulf of Maine	3	Modified Jeffreys Bank EFH HMA, Modified Cashes Ledge EFH HMA, Ammen Rock HMA, and Fippennies Ledge HMA (excludes Platts Bank HMA). Also Cashes Ledge Closure Area with current restrictions (Alternative 1)	Closure to all mobile bottom-tending gears, Ammen Rock closed to all fishing, except lobster trap
Habitat	Western Gulf of Maine	1, 8	Western Gulf of Maine Habitat Closure Area, Western Gulf of Maine Closed Area (boundary redefined to match WGOM HMA), WGOM Shrimp Trawl Exemption Area	Closure to all mobile bottom-tending gears and to commercial gears capable of catching groundfish. Shrimp trawls exempted from mobile bottom-tending gear closure in the northwest corner of closure

Alt. type	Sub-region or region	Alt#	Areas included	Fishing restriction options
Habitat	Western Gulf of Maine	7a	Inshore Roller Gear Restricted Area	Trawl roller gear limited to 12 inches diameter
Habitat	Georges Bank	10	Georges Shoal 2, Northern Edge Reduced Impact HMA, Northern Edge MBTG HMA	Closed to mobile bottom-tending gears. The Northern Edge reduced impact area would allow limited fishing access for bottom trawls west of 67° 20' W and scallop dredges throughout. Clam dredges will be exempt from restrictions in the Georges Shoal 2 area for one year, with longer-term access to be considered in a trailing framework adjustment.
Habitat	Great South Channel	4	Great South Channel HMA, Cox Ledge HMA	Option 1 (complete restriction on use of mobile bottom-tending gears) in the northeast corner of the Great South Channel HMA, and a one year hydraulic clam dredge exemption in the remainder of the area, with longer-term access to be considered in a trailing framework adjustment. Cox Ledge HMA would be closed to hydraulic dredges and bottom trawls would be prohibited from using ground cables.
Spawning	Gulf of Maine	1A	Western Gulf of Maine Closure Area, Cashes Ledge Closure Area, seasonal cod protection areas, GOM Cod Spawning Protection Area	Current measures that restrict gears capable of catching groundfish.
Spawning	Gulf of Maine	3	Massachusetts Bay Spawning Protection Area	Closed to all fishing with some exemptions (GOM Cod Spawning Protection Area exceptions apply)
Spawning	Gulf of Maine	4	Block 125 Closure (April 15-30)	Closed to all commercial fishing except exempted fisheries, exempted gears, and vessels transiting the area
Spawning	Georges Bank/ Southern New England	3	Closed Areas IN and II (February 1 – April 15)	Closed to commercial and recreational gears, with a scallop dredge exemption
Research	Western Gulf of Maine	3C	Stellwagen DHRA without a reference area	Option 1
Research	Georges Bank	4	Georges Bank DHRA	Option 1
Research	All	5	Applies to any DHRAs designated	DHRA sunsets after 3 years if not being used

4.2 Expected impacts of the proposed action on EFH

Many of the alternatives proposed in this amendment are expected to generate non-neutral impacts on essential fish habitats. These impacts are both positive and negative in direction and range from slight to high in magnitude. This is not unexpected given that the amendment was developed as a re-evaluation of existing measures and explores many possible alternative approaches to adverse effects minimization. The preferred alternatives are neither the most conservative approach considered with respect to protection of EFH, nor are they the alternatives which offer the least protection. Generally speaking, the Council selected alternatives that improve or at least maintain existing levels of habitat conservation, while considering the effects the measures might have on a range of managed resources and associated fisheries. Acknowledging the uncertainties inherent in estimating the degree to which a particular suite of management areas will be effective in reducing adverse impacts of fishing on EFH, the preferred alternatives are expected to improve adverse effects minimization in New England regional fisheries. This conclusion was reached by examining the habitat impacts analysis for the preferred alternatives vs. the No Action alternatives (Table 30). Table 31 presents the habitat management areas another way, indicating by sub-region which areas are newly designated, modified, maintained as-is, or removed, given the preferred alternatives selected relative to No Action. Major conclusions of the impacts analysis are provided below the tables.

Table 30 – Summary of the impacts of the No Action and preferred alternatives on physical habitats and EFH

Type	Sub-region/region	Alternative	No Action	Preferred	Habitat impacts
	EGOM	Alt. 1 (No action)	X		Neutral
	EGOM	Sm. Eastern Maine (preferred)		X	Slightly positive
	CGOM	Alt. 1 (No action)	X		Highly positive
	CGOM	Elements of Alts 1 and 3 (preferred)		X	Highly positive
	WGOM	Alt. 1 (No action)	X		Highly positive
	WGOM	Alt 1 with modified boundary (preferred)		X	Positive
	WGOM	Alt. 7A (preferred)	X	X	Slightly positive
	WGOM	Alt. 8 (preferred)		X	Neutral
	GB	Alt. 1 (No action)	X		Positive
	GB	Alt. 10 (preferred)		X	Positive
	GSC-SNE	Alt. 1 (No action)	X		Slightly negative
	GSC-SNE	Alt. 4 with clam exemption (preferred)		X	Slightly positive
	GOM	Alt. 1A (Regulatory No Action, preferred)	X	X	Slightly negative
	GOM	Alt. 1B (Baseline No Action)	X		Slightly negative
	GOM	Alt. 3 (preferred)		X	Slightly negative
	GOM	Alt. 4 (preferred)		X	Slightly negative
	GB-SNE	Alt. 1 (No Action)	X		Slightly negative
	GB-SNE	Alt. 3B (preferred)		X	Slightly positive
	GB-SNE	Alt. 3C (preferred)		X	Slightly positive
	n/a	Alt. 1 (No Action)	X		Negative
	WGOM	Alt. 3C (preferred)		X	Positive
	GB	Alt. 4 (preferred)		X	Positive
	n/a	Alt. 5 (preferred)		X	Neutral

Table 31 – Management area designations that minimize adverse impacts of fishing on EFH. Areas are year-round mobile bottom-tending gear closures unless otherwise specified.

Sub-region	Newly designated areas	Modified areas	Areas maintained as-is	Areas removed
Eastern GOM	Small Eastern Maine HMA	None	None	None
Central GOM	Fippennies Ledge HMA, Ammen Rock HMA (closed to all fishing except lobster traps)	Cashes Ledge Habitat Closure Area and Jeffreys Bank Habitat Closure Area	Cashes Ledge Closure Area (current fishing restrictions)	None
Western GOM	None	Western Gulf of Maine Closure Area (current fishing restrictions); Inshore Roller Gear Restricted Area, Western Gulf of Maine Habitat Closure Area	None	None
Georges Bank	Georges Shoal 2 HMA (1 year clam exemption)	Closed Area II Habitat Closure Area – boundary and fishing restriction changes, Closed Area II (converted to seasonal), Closed Area I (boundaries modified, converted to seasonal), Closed Area I S (converted to DHRA, same measures but 3 year sunset provision)	None	Closed Area I N Habitat Closure
Great South Channel/Southern New England	Great South Channel HMA (1 year clam exemption in part), Cox Ledge (closed to hydraulic dredges, no trawl ground cables permitted)	None	None	Nantucket Lightship Habitat Closure, Nantucket Lightship Closed Area

In the eastern Gulf of Maine, there are currently no habitat management areas. In fact, in the Gulf of Maine overall there are no year-round habitat management areas that abut state waters. Thus, the proposed Small Eastern Maine HMA may have important benefits for groundfish and other stocks that are more abundant inshore. Of the 23 species evaluated in the EFH overlap analysis[2], 22 species (42 lifestages) have benthic EFH designations overlapping the Small Eastern Maine HMA. Mobile bottom-tending gear restrictions in this new HMA should help to improve the functional value of seabed habitats within the HMA, although the magnitude of benefits is expected to be slight, given that the overall amount of fishing activity with these gear types is relatively small in comparison to other locations around New England. The No Action

[2] Offshore hake, deep-sea red crab, rosette skate, clearnose skate, and salmon were excluded due to having no overlap with proposed or existing habitat management areas evaluated in this amendment.

alternative in this sub-region was expected to have neutral impacts on EFH, so the proposed action will improve upon adverse effects minimization.

In the central Gulf of Maine, the proposed action is expected to have highly positive impacts on seabed habitats and EFH. Habitat-specific protections are added on Fippennies Ledge, and enhanced fishing restrictions are proposed for the shallow Ammen Rock pinnacle atop Cashes Ledge. The Jeffreys Bank HMA is re-oriented spatially to better encompass shallow hard-bottom habitats, but continues to encompass deeper mud habitat areas between topographic highs. The boundary of the Cashes Ledge Habitat Closure was adjusted, shifting the western boundary east to better focus on shallow ledge habitats. Maintenance of the Cashes Ledge Closure Area with associated restrictions on various gears will allow for continued minimization of fishing impacts within mud habitats in Cashes Basin. While the Cashes Ledge Closure Area does not restrict clam dredges, only trawls and scallop dredges, clam gear is unlikely to be used in deep mud habitats in the Gulf of Maine, and shallower areas of Cashes and Fippennies Ledges are closed to this gear. Overall, relatively minor adjustments are proposed relative to current measures, and the proposed management areas continue mobile bottom-tending gear restrictions within areas of vulnerable habitat in the central part of the Gulf. The No Action alternative in this sub-region was expected to have highly positive impacts on EFH, so the proposed action will maintain similar levels of adverse effects minimization.

In the western Gulf of Maine, existing areas that help to minimize the adverse impacts of fishing on EFH are maintained to a large extent, with some adjustments. Most importantly in the context of estimating impacts, the proposed action removes the eastern five minutes (approximately five miles) of the Western Gulf of Maine Closure Area. Similar to the Cashes Ledge Closure Area, this area restricts trawl and scallop dredges but not clam dredges, although it effectively has functioned as a mobile bottom-tending gear closure given the general lack of clam dredging in the Gulf of Maine. Most of the habitats in the area to be opened are deep and muddy, although some shallower features occur, for example Wildcat Knoll. However, the existing and new versions of this closure overlap very similarly with designated EFH and the change should not materially affect conservation of habitats for a broad array of stocks. Other changes in the western Gulf of Maine include expanding the 12 inch roller gear restrictions associated with the Inshore Roller Gear Restricted Area to cover all trawl gears. The main effect this would have is to cap roller size on shrimp trawls. As the shrimp fishery is currently under moratorium and many shrimp vessels already use rollers below this size limit, this change is expected to have very slight positive impacts on EFH relative to No Action. Overall impacts of the roller gear restricted area may be important for habitat consevation, however, as the area covers a large area of the western Gulf of Maine and overlaps with habitats for many species.

The proposed action includes an exemption for shrimp trawls in the northwestern corner of the Western Gulf of Maine Habitat Closure Area. Impacts of this exemption are expected to be neutral, mainly because the fishery tended not to operate this far to the east, even prior to the moratorium, so shrimp trawl activity in the exemption area is expected to be limited in magnitude when the fishery does reopen. Shrimp move inshore during spawning, and earlier in the shrimp fishing season, the animals tend to be present further east. The fishery has typically reached its annual catch limit before the shrimp return to habitats within the proposed exemption area. Finally, the proposed action includes a dedicated habitat research area in the southern part

of the Western Gulf of Maine Habitat Closure, the Stellwagen DHRA. This area is expected to generate indirect, positive benefits on habitat management decisionmaking over the long term. In combination, the changes in the western Gulf of Maine area expected to result in neutral impacts relative to No Action.

The spawning management areas in the Gulf of Maine are generally expected to have slight impacts relative to EFH. Current seasonal closures in the Gulf of Maine are not expected to have substantial impacts on habitat positive or negative, given that the fishing restrictions in these areas are not particularly oriented towards the gears that have the greatest magnitude of habitat impacts, because dredges are generally exempt, although they do restrict bottom trawls. In addition, the seasonal nature of these areas mean that there is limited opportunity for recovery of long-lived epifaunal species vulernerable to impact before the areas are again open to fishing. Finally, closures during spawning times when fish may be spatially aggregated may simply shift fishing activity into other areas, or into times of years when fish are less concentrated. This could lead to slightly negative effects on EFH. However, substantial management changes in seasonal spawning closures in the Gulf of Maine are not proposed in this action; the amendment builds on recent changes in the Northeast Multispecies FMP, adding areas offshore Massachusetts in April and in the late fall/early winter. Therefore, major changes in the magnitude of EFH impacts are not expected relative to No Action spawning management.

Substantial changes in area management are proposed on Georges Bank. In Closed Area I, the northern portion of the area will be retained as a spawning closure between February 1 and April 15. The southern portion will be maintained as a dedicated habitat research area, which should have indirect, positive impacts on habitat management over the long term. Both the Georges Bank and Stellwagen DHRAs could be reopened if they are no longer being used for habitat research. Closed Area I as currently managed likely provides limited habitat benefits, given the lower vulnerability habitat types present.

Closed Area II will also be converted to a seasonal closure under the proposed action, with February 1 to April 15 restrictions for spawning, and restrictions on scallop dredges north of 41° 30’ N from June 15 to October 31.[3] The most vulnerable habitat types within Closed Area II, and on Georges Bank overall, are still managed for adverse effects minimization under the proposed action, but fishing restrictions are different than under No Action. The proposed habitat management areas overlapping the northern part of Closed Area II represent a spatial expansion of the existing habitat closure, with approximately two thirds of the area managed going forward as a mobile bottom-tending gear closure. The remaining portion of the area, which is located in the northern part of the existing habitat closure, will be fished on a rotational basis with scallop dredges, but largely closed to trawls, and closed entirely to clam dredges. In addition, this amendment proposes a new habitat management area further west, overlapping Georges Shoal. The Georges Shoal area contains structured hard-bottom habitats vulnerable to impact, but has higher benthic boundary shear stress relative to the existing Closed Area II Habitat Closure which indicates that sediments in the area may be less stable relative to those on the northern

[3] This portion of Closed Area II is also closed to trawl vessels during the summer and fall as a result of an agreement between the lobster and groundfish industries.

edge. On balance, the changes on Georges Bank within Closed Areas I and II are expected to have neutral impacts on EFH.

In the Great South Channel/Southern New England area, the Nantucket Lightship Closed Area and the Nantucket Lightship Habitat Closure Area will be removed. A new Great South Channel Habitat Management Area will be designated north and east of the existing habitat closure, in an area that is more vulnerable to fishing impacts. Part of the Great South Channel HMA will be managed as a mobile bottom-tending gear closure, and the remainder will continue to allow clam dredging, for at least one year following implementation of OHA2. Longer term exemptions for clam dredges may be developed in a trailing management action. In addition, two smaller habitat management areas will be designated in the vicinity of Cox Ledge of Rhode Island. These areas will be closed to clam dredging, and trawl vessels will not be allowed to use ground cables, which may reduce swept area and thereby habitat impacts generated by bottom trawls depending on how the gear change affects efficiency. Overall, the changes in this sub-region will better minimize the adverse effects of fishing on EFH. The impacts are slight compared to some other sub-regions because there is relatively limited fishing activity overlapping the proposed management areas.

Considering all sub-regions in combination, given that neutral to slightly positive impacts are expected within each sub-region, the proposed action overall is expected to reduce the adverse effects on fishing on EFH in the New England region as a whole, across the various fisheries managed by the New England Fishery Management Council.

4.3 Proposed measures to avoid, minimize, or mitigate adverse impacts of fishing on EFH

The habitat management alternatives proposed in this amendment are designed to minimize the adverse effects on regional fisheries on EFH. These measures and their associated impacts are described in section 4.2 above. Collectively, the measures are expected to have neutral to slightly positive impacts on EFH relative to No Action. Further, since the preferred alternatives in this amendment update the suite of measures that are currently relied upon for adverse effects minimization in New England Council-managed fisheries, implementation of this amendment will ensure that adverse impacts continue to be minimized in these fisheries, to the extent practicable.

4.4 Conclusions

Most of the management changes proposed in this amendment are intended to minimize, to the extent practicable, the adverse impacts of fisheries in the New England region on essential fish habitat. As such, and given the conclusions of the impact analyses provided in this document, the action overall is expected to reduce adverse impacts of fishing in the region. Therefore, the conclusion of this assessment is that there are no adverse impacts from this activity, and no EFH consultation is required.

5 Compliance with other requirements of the Magnuson-Stevens Act

5.1 National standards

The ten national standards for fishery management plans are as follows:

1. Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

OHA2 does not directly manage overfished stocks because the management of overfished stocks is part of the Council's individual FMP process. As a set of omnibus habitat measures, OHA2 aims to enhance the role that area management plays in achieving optimum yield, by proposing management measures that consider social, economic, and ecological factors and would likely increase species productivity and improve the overall health of fish stocks. OHA2 analyses are based on the premise that species productivity would be enhanced by protecting habitats that are important to critical life stages of managed fish species, and protecting habitat areas that are most susceptible to adverse impacts from fishing.

OHA2 identified alternatives for habitat protection in each subregion, and spawning protections in the Gulf of Maine and Georges Bank/Southern New England. The seasonal spawning protection measures shift the management focus from mortality reduction to the improvement of species productivity, particularly for Atlantic cod. Improved survival and growth could result in increased recruitment of juveniles into the fishery, potentially improving overall fish production. OHA2 aims to improve the health of fish stocks through increased survivorship and reproductive success. Sucessful implementation of proposed management measures that meet the goals of OHA2 would be expected to increase optimum yield in the long term.

The Council's Fishery Management Plans address additional specific goals and regulations regarding achievement of optimum yield for managed species. Individual FMP management actions consider the sustainability of managed species, which is affected by fishing pressures, in addition to factors that affect natural mortality. For the reasons listed above, OHA2 complies with National Standard 1.

2. Conservation and management measures shall be based upon the best scientific information available.

The DEIS identified a set of alternatives for habitat protection in each of the following sub-regions: Eastern Gulf of Maine, Central Gulf of Maine, Western Gulf of Maine, Georges Bank, and the Great South Channel/Southern New England. Based on the results of Swept Area Seabed Impact analysis, and in consultation with the Council's Closed Area Technical Team, habitat protection in each of the subregions is expected to improve protection for juvenile groundfish species. These year-round spatial management alternatives were identified based on applications of advanced scientific information that include:

a) Swept Area Seabed Impact model (analysis of habitat vulnerability): The purpose was to better understand: (1) the nature of fishing gear impacts on benthic habitats, (2) the spatial distribution of benthic habitat vulnerability to particular fishing gears, and (3) the spatial and temporal distribution of realized adverse effects from fishing activities on benthic habitats. The model combines area swept fishing effort data with substrate data and benthic boundary water flow estimates in a geo-referenced, GIS-compatible environment. The vulnerability assessment quantifies both the magnitude of the impacts that result from the physical interaction of fish habitats and fishing gears, and the duration of recovery following those interactions. The following gear types were analyzed for adverse impacts: otter trawl, shrimp trawl, squid trawl, raised footrope trawl, scallop dredges, hydraulic clam dredges, demersal longline, sink gillnets, and traps. Geological and biological features are generally most susceptible to impacts from hydraulic dredges as compared to other gear types, followed by trawls and scallop dredges. Impacts from gears that do not directly impact the bottom and therefore were not included in the SASI analysis (e.g., mid-water trawls) were directly or indirectly considered in the other analyses, including the groundfish hotspot analysis, species diversity indices, fishing effort information, or literature review.
b) Local Indicators of Spatial Association (LISA) statistics: LISA statistics were used to identify contiguous areas for habitat protection, based on Swept Area Seabed Impact model results.
c) Groundfish hotspot analysis: The Closed Area Technical Team evaluated the distribution of age 0 and 1 groundfish to identify "hotspots" based on distribution and abundance information collected from various surveys. A hotspot was identified when there was a cluster of significantly above average catches ($p>0.05$) for each survey over the 10-year period (2002-2011 in the fall and summer surveys; 2003-2012 for the spring surveys). Hotspots associated with stocks that are in greater need of rebuilding were weighted more heavily. The weighted hotspot results were used to identify critical habitat areas for juvenile groundfish. Only stocks that either "occur in a variety of substrates including gravels" or had "strong affinity for coarse or hard substrates" were given non-zero weights. The species that were given non-zero weights in the composite scoring to identify habitat areas included cod, haddock, pollock, redfish, halibut, pout, and wolffish. All other species were given zero weights, and as a result, are not factored into any of the weighted hotspot analyses.
d) Species Diversity: Species diversity is a measure of both species richness (the number of species in a sample) and species evenness (the relationship between the levels of abundance of each species in a sample). Two widely used species diversity measures were used to measure fish community diversity. The Shannon Diversity Index (SDI) is the most suitable for comparing areas to identify those with highest overall diversity. The Simpson Index is more sensitive to changes in the abundant species in a sample, so it may be more appropriate for focusing on abundant managed species. The average Shannon and Simpson diversity indices per tow were calculated using the survey data from the NEFSC fall/winter/spring trawl survey, the MADMF spring/fall trawl survey, and industry-based surveys for cod, yellowtail flounder and monkfish from 2002-2012. This information was used to compare alternatives under consideration.
e) Fishing effort information: Information on the magnitude and locations of fishing effort within proposed management areas was evaluated based on vessel trip report, dealer

report, and/or and observer data. This information was used to assess impacts to the fishing communities, which helped inform management decisions regarding preferred alternatives in each subregion.

f) Literature review: An extensive review of literature was completed in order to analyze the alternatives under consideration in the DEIS. Research continued after the development of the DEIS in order to provide new and updated information for the FEIS.

Other alternatives in the amendment are intended to protect and enhance groundfish spawning habitats. The impacts associated with these alternatives were evaluated using a large adult groundfish hotspot analysis (similar to the juvenile analysis described in item c, above, but for large adult fish), fishing effort information, and literature review.

Based on the scientific information listed above, OHA2 complies with National Standard 2.

3. To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

Direct management of stocks are developed through the appropriate FMP. This amendment does not include any substantial changes or significant new information bearing on the unit management or stocks determinations made in those plans. OHA2 management measures address individual stocks as units throughout their ranges and interrelated stocks as determined under the FMPs. OHA2 aims to protect habitat that species rely on for survival, food, protection from predators, and spawning activity. OHA2 measures would then be codified into each FMP, if applicable.For the reasons listed above, OHA2 complies with National Standard 3.

4. Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

OHA2 does not directly manage fish species or fish stocks. It does, however, affect access to different fishing grounds depending on the type of fishing gear used. National Standard 4 guidelines define an “allocation” or “assignment” of fishing privileges as a direct and deliberate distribution of the opportunity to participate in a fishery among identifiable, discrete user groups or individuals. Management measures that assign ocean areas to different gear users may be considered allocative, if not intended to be considered a direct assignment of privileges. To the degree that these measures may be considered to affect discrete user groups’ access to different ocean areas, they do so fairly and equitably. Each management measure associated with a particular region has been adopted after careful consideration of the benefits and hardships among user groups as well as broad social, economic, and ecological costs and benefits. Given these considerations, OHA2 complies with National Standard 4.

5. Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

The measures in this amendment have both administrative costs and costs to the fishing community that result primarily from effort displacement. The Council considered the practicability of measures when identifying preferred alternatives for this amendment, i.e. balancing the needs of the fisheries in addition to the benefits of habitat protections for managed species. Impacts to the human community including economic information were provided to the Council in the DEIS, and voting members considered oral and written input from its oversight committtees, advisory panels, and fishing industry members attending its meetings. For the reasons listed above, OHA2 complies with National Standard 5.

6. Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

Fishing effort is subject to change based on market demand, weather variability, response to fishing regulations, and availability of fish. Potential fishing effort displacement as a result of the measures in this amendment was analyzed in Volumes 4 and 5 of this FEIS. OHA2 does not propose changes to fishing limits; therefore, economic impacts are only considered with regard to shifts in effort among areas and differences between areas that may affect catch per unit effort. General trends in each fishery, as well as the potential for changes in the future, were considered when estimating impacts. For example, the northern shrimp fishery is currently under a moratorium, so the impacts analysis discusses short term effects on the fishery, as well as longer term effects should the fishery resume operations.

In addition to changes in fishing behavior, the status of stocks can also change, which can lead to subsequent management action to remedy stock declines. Although OHA2 does not set specifications for allowable catches, its proposed measures consider the status of stocks that would benefit from habitat protections. For example, more stringent measures would be appropriate if a stock is in decline, overfished, or overfishing is occurring. Status of the stock was considered in the weighted hotspot analysis, which was used to identify habitat management areas important to fish stocks requiring more attention. Additional spawning protections are proposed to help rebuild declining stocks such as the Gulf of Maine Atlantic cod.

The amendment also proposes methods to alter management action to meet the goals of the amendment. The Council proposes to implement a management system that would allow changes in HMA designations and fishing restrictions to be modified through a framework action. The Council also proposes to establish a 10-year review process for habitat and spawning protection measures and identifies additional data and monitoring needs.

Impacts to habitat from non-fishing activities are described in Appendix G to this FEIS. While non-fishing activities are beyond the purview of the Council, the EFH and HAPC designations developed in this amendment help to ensure that fishery resource needs are considered when federal agency activities may negatively effect fish habitats. Specifically, the habitat impact

implications of some of federally permitted actions are considered during the EFH consultation process, and mitigation measures are recommended when necessary to protect EFH.

The amendment also proposes habitat research areas that can be utilized to conduct before and after habitat studies to better inform managers on the recovery rates and susceptibility of habitat types. The Council proposes to implement a DHRA in the western GOM (Stellwagen Bank) and on Georges Bank. The Council also encourages habitat research within its habitat management areas more generally, to better understand the impacts of fishing on habitat.

For the reasons listed above, OHA2 complies with National Standard 6, to allow for flexibility to react to changing circumstances in the Council-managed fisheries.

7. Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

Habitat protection is necessary as mandated under the Magnuson-Stevens Act; therefore, proposed actions to maintain or establish habitat closures are required. During the development of habitat protection measures, the Council considered the costs to the industry, managers, and the resource it aims to protect. The Council is taking action to address habitat protection in the federal waters within its jurisdiction, which eliminates duplicative efforts to develop and implement regulations outside of its management authority. Collaboration between NMFS, the Mid-Atlantic Fishery Management Council, and the Atlantic States Marine Fisheries Commission further prevents duplication of effort. Costs to implement regulations under OHA2 must be compared to the benefit to the resource, which includes the species and habitats that they rely upon. Cost analysis considered the following factors as outlined in Federal guidelines: *Capital outlays; operating and maintenance costs; reporting costs; administrative, enforcement, and information costs; and prices to consumers*. Benefit analysis includes consideration of gains from habitat protection as modified in the amendment. Long-term gains to the resource is expected to generate long-term gains to the fishery if increased catches result from reduced habitat impacts. The cost/benefit analysis can be found in Volume 4, Section 4. For the reasons listed above, OHA2 complies with National Standard 7.

8. Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities by utilizing economic and social data that meet the requirements to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

Impacts to the fishing community were considered throughout the decision-making process. In cases where adverse impacts to the fishing community were anticipated, a balance of the short-term and long-term costs and benefits to fishing communities were considered during the Council's decision making process. Throughout the final deliberations process, Council members heard from the public and fishing industry regarding the short- and long-term social and economic implications that alternatives present. In addition, social and economic analyses were

provided to the Council to help inform their decision regarding preferred HMAs, spawning closures, and DHRAs. For the reasons listed above, OHA2 complies with National Standard 8.

9. Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

Mitigation measures to reduce bycatch and bycatch mortality are directly addressed in each FMP. This amendment does not include any substantial changes or significant new information to directly minimize bycatch or bycatch mortality determinations made in those plans. When adopting the management measures in this amendment, the Council considered short- and long-term costs and benefits to the different user groups affected as well as a broad array of social, economic, and ecological factors. For the reasons listed above, OHA2 complies with National Standard 9.

10. Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

Practicability standards were applied to each alternative selected by the Council during OHA2 final action in April and June 2015. Constraints on the fishery were minimized when practicable. These efforts to minimize time constraints on the fishery reduce the likelihood that fishermen would risk operating in severe weather. During the public comment period, the Council received a large number of comments regarding the ability of recreational fishermen to operate safely if they would be required to travel an additional distance to reach fishing grounds under the restrictions of the Stellwagen Bank DHRA's Northern Reference Area. The Council took these concerns seriously, and did not elect to approve the Northern Reference Area. In addition, Amendment 16 to the Northeast Multispecies FMP likely reduced the risks taken by fishermen in severe weather by managing fishing effort based on an annual quota in pounds of total allowable catch for each species under the FMP, thereby reducing the use of the days-at-sea system. For the reasons listed above, OHA2 complies with National Standard 10.

5.2 Other required provisions

Any fishery management plan which is prepared by any Council, or by the Secretary, with respect to any fishery, shall:

1. Contain the conservation and management measures, applicable to foreign fishing and fishing by vessels of the United States, which are (A) necessary and appropriate for the conservation and management of the fishery to prevent overfishing and rebuild overfished stocks, and to protect, restore, and promote the long-term health and stability of the fishery; (B) described in this subsection or subsection (b), or both; and (C) consistent with the national standards, the other provisions of this Act, regulations implementing recommendations by international organizations in which the United States participates (including but not limited to closed areas, quotas, and size limits), and any other applicable law;

OHA2 proposed measures do not apply to foreign fishing vessels.

2. Contain a description of the fishery, including, but not limited to, the number of vessels involved, the type and quantity of fishing gear used, the species of fish involved and their location, the cost likely to be incurred in management, actual and potential revenues from the fishery, any recreational interest in the fishery, and the nature and extent of foreign fishing and Indian treaty fishing rights, if any.

Fishery information is discussed throughout the FEIS. OHA2 characterizes the fisheries affected by this action in Volume 1, Section 4.3 (decription of fisheries), Volume 4, Section 4 (economic impacts), and throughout Volume 5 (impacts to specific resources and fisheries). For the reasons listed above, OHA2 is compliant with this provision. This amendment does not affect any foreign fishing regulations or Indian Treaty regulations. Proposed measures that are implemented would be codified in the appropriate FMP, where concerns regarding foreign fishing and fishing under an Indian treaty would be addressed, if applicable.

3. Assess and specify the present and probable future condition of, and the maximum sustainable yield and optimum yield from, the fishery, and include a summary of the information utilized in making such specification.

OHA2 does not propose to implement fishery specifications for any of the Council's managed stocks. These fishing restrictions are implemented within the Council's fishery management plans. OHA2 proposed fishing restrictions would be codified in the appropriate FMPs for those fisheries affected by these regulations.

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), (B) the portion of such optimum yield which, on an annual basis, will not be harvested by fishing vessels of the United States and can be made available for foreign fishing, and (C) the capacity and extent to which United States fish processors, on an annual basis, will process that portion of such optimum yield that will be harvested by fishing vessels of the United States.

OHA2 does not propose management measures related to catch limits and fishery specifications; rather, it proposes regulations to modify areas available for fishing and areas for habitat and groundfish spawning protections. The Council's fishery management programs develop fishery specifications and would consider the potential harvest capabilities.

5. Specify the pertinent data which shall be submitted to the Secretary with respect to commercial, recreational, charter fishing, and fish processing in the fishery, including, but not limited to, information regarding the type and quantity of fishing gear used, catch by species in numbers of fish or weight thereof, areas in which fishing was engaged in, time of fishing, number of hauls, economic information necessary to meet the requirements of this Act, and the estimated processing capacity of, and the actual processing capacity utilized by, United States fish processors.

OHA2 does not intend to provide NMFS with information that would characterize the fisheries affected by these proposed regulations, as described above. The Council's FMPs describe this information and there is not a requirement to duplicate that effort. The information contained in the FEIS addresses the types of fishing effort, magnitude of fishing effort, quantity of gear used (or other fishing effort measure such as swept area), catch by landings information, and spatial distribution of fishing effort. Information regarding the magnitude of fishing effort and location of fishing effort was used to analyze the potential for displaced fishing effort, and to quantify potential loss and gains in revenue affected by the proposed management measures. Information on processors and their capacity to process fish is not discussed in the amendment nor EIS; this information would be discussed in the appropriate FMPs.

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 affecting the safe conduct of the fishery; except that the adjustment shall not adversely affect conservation efforts in other fisheries or discriminate among participants in the affected fishery.

OHA2 does not propose regulations that would affect fishing access privileges. Current regulations, including permit access rights, are not proposed for modifications under the OHA2.

7. Describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary under section 305(b)(1)(A), minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat.

OHA2 identifies and describes Essential Fish Habitat, including HAPCs, within Volume 2 of this FEIS. Alternatives to minimize adverse effects caused by fishing are decribed in Volume 3 of the document. The Council identified and described current measures that meet habitat protection goals and spawning protection goals. Current measures were proposed as an alternative (Alternative 1/ No Action) to the developed management alternatives in each sub-area. This action also addresses future actions to further improve habitat protections, including the development of a Deep Sea Coral Amendment within the New England Fishery Management Council's jurisdiction.

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) (including any plan for which an amendment is submitted to the Secretary for such review) or is prepared by the Secretary, assess and specify the nature and extent of scientific data which is needed for effective implementation of the plan.

OHA2 does not propose to develop any new FMPs. Rather, existing FMPs would incorporate habitat protections measures once regulations are implemented by NMFS.

9. Include a fishery impact statement for the plan or amendment (in the case of a plan or amendment thereto submitted to or prepared by the Secretary after October 1, 1990) which shall assess, specify, and analyze the likely effects, if any, including the

> cumulative conservation, economic, and social impacts, of the conservation and management measures on, and possible mitigation measures for (A) participants in the fisheries and fishing communities affected by the plan or amendment; (B) participants in the fisheries conducted in adjacent areas under the authority of another Council, after consultation with such Council and representatives of those participants; and (C) the safety of human life at sea, including whether and to what extent such measures may affect the safety of participants in the fishery.

Information that makes up a fishery impact statement are covered in the OHA2 analysis document (FEIS). Analysis of the affected environment includes biological, physical, and human communities. Fishery impact analysis is described the the FEIS: (A) Volume 1 describes the affected environment, which includes fisheries and fishing communities; (B) Non-Council managed species affected by these proposed regulations include northern shrimp and American lobster, which is discussed throughout the document; (C) Volume 3 discusses the rationale for the Council's preferred alternative, where safety at sea was considered, especially in reference to the Western Gulf of Maine DHRA, Northern Reference Area. In addition, the summary of public comments also discusses safety at sea in response to alternatives considered in the DEIS

10. Specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished (with an analysis of how the criteria were determined and the relationship of the criteria to the reproductive potential of stocks of fish in that fishery) and, in the case of a fishery which the Council or the Secretary has determined is approaching an overfished condition or is overfished, contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery.

To protect the health of managed fish stocks and rebuild overfished stocks, the Council and NMFS set criteria for identifying when a fishery is overfished and implement fishing regulations in the appropriate FMPs, which include harvest limits, limits on the types of gear used, and other fishing effort measures to prevent overfishing or end overfishing and rebuild the fishery when necessary. OHA2 does not change the FMP determinations or address protections that directly relate to the health of fish stocks. Rather, measures in OHA2 are intended to indirectly benefit fish stocks.

11. Establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided.

OHA2 does not propose direct management of fisheries, including direct bycatch reduction and monitoring standards that have been implemented through the appropriate FMPs.

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, and include conservation and management measures that, to the extent practicable, minimize mortality and ensure the extended survival of such fish.

Conservation measures to minimize mortality of incidental bycatch in the recreational fishery are addressed in the Council's FMPs, where applicable. OHA2 addresses limited restrictions on recreational fishing within proposed closed areas, and does not include regulations that directly reduce incidental bycatch mortality.

13. Include a description of the commercial, recreational, and charter fishing sectors which participate in the fishery, including its economic impact, and, to the extent practicable, quantify trends in landings of the managed fishery resource by the commercial, recreational, and charter fishing sectors.

Trends in commercial, recreational, and charter landings are considered throughout the FEIS to evaluate impacts to human communities from proposed regulations. Volume 4 and 5 discuss these impacts to the fisheries using landings and revenue information.

14. To the extent that rebuilding plans or other conservation and management measures which reduce the overall harvest in a fishery are necessary, allocate, taking into consideration the economic impact of the harvest restrictions or recovery benefits on the fishery participants in each sector, any harvest restrictions or recovery benefits fairly and equitably among the commercial, recreational, and charter fishing sectors in the fishery.

Conservation measures proposed in OHA2 do not include harvest restrictions. Instead, area-based management measures are proposed in order to increase species productivity and protect those areas on the seafloor that are considered essential habitat areas for juvenile groundfish and other managed species, and those areas deemed important for spawning activity. Harvest restrictions are implemented throught the Council's FMP process.

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.

Harvest restrictions and accountability measures are implemented through the Council's FMP process. The OHA2 does not restrict harvest nor does it apply accountability measures to precent overfishing; these measures are implemented through the Council's FMP process.

6 Compliance with 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. This document is designed to meet the requirements of both the Magnuson Stevens Act and NEPA. The Council on Environmental Quality has issued regulations specifying the requirements for NEPA documents (40 CFR 1500 – 1508). All of those requirements are addressed in this document, as referenced below.

This document includes the standard contents of an EIS:

- Cover sheet
- An abstract is provided behind the cover sheet of Volume 1.
- An Executive Summary can be found in Volume 1.
- A table of contents can be found at the beginning of each volume.
- The need and purpose for this action is described in Volume 1.
- The alternatives that were considered are described in Volume 2 (EFH and HAPC designations) and Volume 3 (habitat, spawning, and research area alternatives, and monitoring alternatives).
- A description of the affected environment is in Volume 1.
- The environmental impacts of the Proposed Action are described in Volume 2, 4, and 5; cumulative impacts of the alternatives are described in Volume 6.
- A list of preparers is in Volume 6, section 6.2.
- References are in Volume 6, section 8.1.
- The EIS distribution list is in Volume 6, section 6.4.
- The index is in Volume 6, section 7.
- The agencies and persons consulted on this action are listed in Volume 6, section 6.3.
- Supporting appendices are provided in Volume 7.

6.1 Scoping process and opportunities for public comment

On February 24, 2004, the Council published in the Federal Register a Notice of Intent (NOI) to prepare this EIS (69 FR 8367). The Council solicited written comments to determine the issues of concern and the appropriate range of management alternatives to be addressed in the EIS and notified the public of five scoping hearings (Table 32). The Council received 13 written comments during the scoping period.

On September 9, 2005, the Council published a NOI to communicate its intent to develop the Omnibus EFH Amendment via a phased approach, separating out the development and review of EFH and HAPC designation alternatives from alternatives intended to minimize the adverse effects of fishing on designated EFH (70 FR 53636). The Council received 2 written comments during the 30 day comment period. A notice of availability for the Phase 1 Draft EIS (DEIS) was published on April 6, 2007 (72 FR 17157). Public hearings were conducted in 2007 to gather feedback on the alternatives proposed in the Phase 1 DEIS (Table 32). The Council received 6 written comments during the 45 day comment period.

On October 5, 2009, the Council published a NOI to indicate that a final EIS for the Phase 1 components would not be published separately, but rather a complete DEIS containing alternatives from both phases would be produced upon completion of Phase 2 (74 FR 51126, correction 74 FR 64049). The Council received 2 written comments during the comment period, which was initially 30 days but extended for another 14 days due to an incorrect email address in the original notice.

On June 17, 2011 the Council published a NOI indicating its intent to consider changes to the Northeast multispecies closed areas in the Omnibus EFH Amendment (76 FR 35408). The Council received 7 written comments during the 30 day comment period.

On July 27, 2012, the Council published a NOI indicating its intent to possibly remove further consideration of alternatives to protect deep-sea corals from the Omnibus EFH Amendment (77 FR 44214). The Council received 2 written comments during the 30 day comment period. These alternatives were removed by the Council into a separate Omnibus action in September 2012.

Between November 24, 2014 and January 7, 2015, the Council held twelve public hearings on Omnibus Essential Fish Habitat Amendment 2. Council staff presented information within the Council's DEIS as updated on October 1, 2014. On June 18, 2015, the Council held an information session in Portland, Maine, to discuss the updated analysis relative to the HMA alternatives on Georges Bank, to reflect the Council's mix and match approach referred to as Alternative 9 in the FEIS.

The amendment was developed and discussed at the following meetings (Table 32). Opportunities for public comment were provided at Advisory Panel, Committee, and Council meetings, and of course during public hearings. There are limited opportunities to comment during technical meetings and conference calls (i.e. Plan Development Team and Closed Area Technical Team). The Council also held three days of informational interviews during August 2013. These were closed sessions by appointment with individuals and small groups. Registration was open to the public but the meetings were targeted towards groundfishermen.

Table 32 – List of public meetings related to the development of Omnibus EFH Amendment 2. PDT = Plan Development Team, CATT = Closed Area Technical Team, AP = Advisory Panel.

2004		
Date	**Meeting type**	**Location**
January 27-29, 2004	Council	Newport, RI
March 5, 2004	Scoping Meeting	Rockland, ME
March 10, 2004	Scoping Meeting	New Bedford, MA
March 15, 2004	Scoping Meeting	Stonington, CT
March 16, 2004	Scoping Meeting	Wrightsville Beach, NC
March 23, 2004	Scoping Meeting	Gloucester, MA
March 23-25, 2004	Council	Gloucester, MA
May 25-26, 2004	PDT	Woods Hole, MA
June 16, 2004	Committee/AP	Portsmouth, NH
July 13-15, 2004	Council	Portland, ME

September 8, 2004	Committee	Braintree, MA
September 14-16, 2004	Council	Fairhaven, MA
2005		
Date	**Meeting type**	**Location**
January 10-12, 2005	Scientific Workshop	Mystic, CT
February 1-3, 2005	Council	Portsmouth, NH
April 13, 2005	PDT/AP	Narragansett, RI
May 26, 2005	Committee	Narragansett, RI
June 21-23, 2005	Council	Portland, ME
August 22, 2005	Committee	Portland, ME
September 13-15, 2005	Council	Hyannis, MA
September 27, 2005	PDT	Woods Hole, MA
October 18, 2005	PDT	Mansfield, MA
October 27, 2005	PDT	Woods Hole, MA
November 14, 2005	Committee	Mansfield, MA
November 15-17, 2005	Council	Hyannis, MA
December 1, 2005	PDT	Newburyport, MA
December 14-15, 2005	PDT	Woods Hole, MA
2006		
Date	**Meeting type**	**Location**
January 11, 2006	Committee	Mystic, CT
January 25, 2006	PDT	Woods Hole, MA
January 31 – Feb 2, 2006	Council	Portland, ME
March 13-14, 2006	PDT	Woods Hole, MA
March 7, 2006	AP	Plymouth, MA
March 20, 2006	Committee	Plymouth, MA
April 4-5, 2006	Council	Mystic, CT
April 18, 2006	PDT	Woods Hole, MA
May 17-18, 2006	PDT	Woods Hole, MA
May 8, 2006	AP	Portsmouth, NH
June 6-7, 2006	Committee	Mansfield, MA
June 13-15, 2006	Council	Newport, RI
July 26, 2006	PDT	Woods Hole, MA
August 15, 2006	AP	Danvers, MA
September 7, 2006	Committee	Fairhaven, MA
September 26, 2006	Council	Peabody, MA
October 3, 2006	PDT	Woods Hole, MA
October 11, 2006	Council (MAFMC)	Kitty Hawk, NC
November 14, 2006	Committee	Gloucester, MA
November 14-16, 2006	Council	Gloucester, MA
December 12-14, 2006	Council (MAFMC)	New York, NY
2007		
Date	**Meeting type**	**Location**

January 16, 2007	Committee	Providence, RI
February 6-8, 2007	Council	Portsmouth, NH
April 10-12, 2007	Council	Mystic, CT
April 11, 2007	Public hearing	Mystic, CT
April 18, 2007	Public hearing	Ocean City, MD
May 31, 2007	PDT	Woods Hole, MA
June 5, 2007	AP, then Committee	Mystic, CT
June 19-21, 2007	Council	Portland, ME
August 15, 2007	PDT	Narragansett, RI
September 17, 2007	Committee	Plymouth, MA
September 18-19, 2007	Council	Plymouth, MA
November 6, 2007	PDT	Newport, RI
December 10, 2007	PDT	Plymouth, MA
2008		
Date	**Meeting type**	**Location**
January 27, 2008	PDT	call
February 4, 2008	Committee	Mansfield, MA
February 12-14, 2008	Council	Portsmouth, NH
March 3, 2008	PDT	Narragansett, RI
May 8, 2008	PDT	call
May 16, 2008	Committee	Mansfield, MA
June 3-5, 2008	Council	Portland, ME
June 11, 2008	PDT	call
July 10, 2008	Committee	Mansfield, MA
July 24, 2008	PDT	Portland, ME
September 30, 2008	PDT	call
October 2, 2008	Committee	Plymouth, MA
November 3, 2008	PDT	Gloucester, MA
November 4, 2008	PDT	Gloucester, MA
November 10, 2008	PDT	call
November 14, 2008	Committee	Mansfield, MA
November 18-20, 2008	Council	Danvers, MA
December 1, 2008	PDT	call
2009		
Date	**Meeting type**	**Location**
January 7, 2009	PDT	Woods Hole, MA
January 8, 2009	PDT	Woods Hole, MA
February 11, 2009	PDT	Portsmouth, NH
February 13, 2009	PDT	call
March 26, 2009	PDT	Plymouth, MA
March 18, 2009	SSC	Boston, MA
March 27, 2009	PDT	Plymouth, MA
May 28, 2009	PDT	Woods Hole, MA
May 29, 2009	PDT	Woods Hole, MA

June 22-25, 2009	Council	Portland, ME
August 31, 2009	PDT	Boston, MA
September 1, 2009	PDT	Boston, MA
October 28, 2009	PDT	call
November 17, 2009	PDT	Newport, RI
December 9, 2009	SSC	Boston, MA
2010		
Date	**Meeting type**	**Location**
January 26-28, 2010	Council	Portsmouth, NH
February 22, 2010	PDT	Boston, MA
February 23, 2010	PDT	Boston, MA
April 27-29, 2010	Council	Mystic, CT
June 7, 2010	PDT	Newburyport, MA
June 8, 2010	PDT	Newburyport, MA
June 10, 2010	Committee	in person
June 22-24, 2010	Council	Portland, ME
July 26, 2010	PDT	Boston, MA
July 27, 2010	PDT	Boston, MA
August 25, 2010	SSC	Boston, MA
September 16, 2010	PDT	Boston, MA
September 27, 2010	Committee	in person
October 28, 2010	Committee	in person
2011		
Date	**Meeting type**	**Location**
January 6, 2011	Committee	East Boston, MA
January 25-27, 2011	Council	Portsmouth, NH
February 15, 2011	Ad-hoc SASI review panel	Providence, RI
March 10, 2011	Committee	Portsmouth, NH
April 26-28, 2011	Council	Mystic, CT
June 8, 2011	PDT	Boston, MA
June 9, 2011	PDT	Boston, MA
June 21-23, 2011	Council	Portland, ME
July 21, 2011	Committee	Mansfield, MA
August 15, 2011	PDT	Boston, MA
August 30, 2011	Committee	Portsmouth, NH
October 17, 2011	PDT	Woods Hole, MA
October 18, 2011	PDT	Woods Hole, MA
October 25, 2011	PDT	call
December 7, 2011	PDT	Boston, MA
2012		
Date	**Meeting type**	**Location**
January 4, 2012	PDT	call
January 12, 2012	PDT	call

January 31-February 2, 2012	Council	Portsmouth, NH
February 7, 2012	PDT	Boston, MA
February 23, 2012	Committee	Portsmouth, NH
March 7, 2012	PDT	Boston, MA
April 6, 2012	Committee	Providence, RI
April 24-26, 2012	Council	Mystic, CT
June 6, 2012	PDT	Boston, MA
June 8, 2012	Committee	Portland, ME
June 19-21, 2012	Council	Portland, ME
August 9, 2012	PDT	Boston, MA
August 23, 2012	Committee	Providence, RI
September 4, 2012	CATT	call
September 12, 2012	CATT	Braintree, MA
September 25-27, 2012	Council	Plymouth, MA
October 1, 2012	Groundfish PDT	call
October 10, 2012	PDT, AP	Hampton, NH
October 11, 2012	Groundfish Committee	Hampton, NH
October 12, 2012	CATT	Mansfield, MA
October 29, 2012	CATT	Braintree, MA
November 2, 2012	PDT	call
December 4, 2012	Committee	New Bedford, MA
December 12, 2012	CATT	Braintree, MA
2013		
Date	**Meeting type**	**Location**
January 9, 2013	CATT	Braintree, MA
January 10, 2013	CATT	Braintree, MA
January 15, 2013	PDT	call
January 17, 2013	PDT and CATT	Milford, MA
January 18, 2013	CATT	Milford, MA
January 24, 2013	Groundfish Committee and Groundfish AP	
January 29-31, 2013	Council	Portsmouth, NH
February 15, 2013	CATT	Braintree, MA
March 6, 2013	PDT	Boston, MA
March 7, 2013	CATT	Braintree, MA
March 19, 2013	Committee	Salem, MA
March 28, 2013	CATT	Braintree, MA
April 17, 2013	Groundfish Committee	Mansfield, MA
April 23-25, 2013	Council	Mystic, CT
April 29, 2013	PDT and CATT	Mansfield, MA
May 6, 2013	PDT	call
May 10, 2013	PDT and CATT	Rockland, MA
May 16, 2013	SSC	Mansfield, MA
May 17, 2013	Committee (Habitat and Groundfish)	Portsmouth, NH

May 29, 2013	PDT and CATT	Rockland, MA
May 30, 2013	PDT and CATT	Rockland, MA
June 11, 2013	Committee (Habitat and Groundfish)	Providence, RI
June 18-20, 2013	Council	Portland, ME
August 19, 2013	PDT and CATT	Rockland, MA
September 5, 2013	Committee (Habitat and Groundfish)	Portsmouth, NH
September 18, 2013	CATT	Taunton, MA
September 19, 2013	PDT	Taunton, MA
September 24-26, 2013	Council	Hyannis, MA
October-November 2013	CATT-PDT	5 conference calls
December 3, 2013	CATT-PDT	Rockland, MA
December 20, 2013	Council	Danvers, MA
2014		
Date	Meeting Type	Location
January 28, 2014	Council	Portsmouth, NH
February 6, 2014	PDT-CATT	Conference Call
February 19, 2014	Groundfish Recreational Advisory Panel	Danvers, MA
February 20, 2014	PDT-CATT	Conference Call
February 25-26, 2014	Council	Danvers, MA
June 18, 2015	Information Session	Portland, ME
November 24, 2014	Public Hearing	Portsmouth, NH
November 25, 2014	Public Hearing	Plymouth, MA
December 2, 2014	Public Hearing	Warwick, RI
December 4, 2014	Public Hearing	Riverhead, NY
December 5, 2014	Public Hearing	Cape May, NJ
December 9, 2014	Public Hearing	Baltimore, MD
December 16, 2014	Public Hearing	New Bedford, MA
December 17, 2014	Public Hearing	Gloucester, MA
December 18, 2014	Public Hearing	Newport News, VA
2015		
Date	Meeting type	Location
January 5, 2015	Public Hearing	Webinar
January 6, 2015	Public Hearing	Brewer, ME
January 7, 2015	Public Hearing	Portland, ME
February 3, 2015	PDT	Conference Call
February 24, 2015	Committee	Mansfield, MA
March 11, 2015	PDT	Braintree, MA
March 18, 2015	AP	Fairhaven, MA
March 23-24, 2015	Committee	Portland, ME
April 7, 2015	PDT	Conference Call
April 9, 2015	Committee	Warwick, RI
April 22-23, 2015	Council	Mystic, CT
June 1, 2015	Committee	Portsmouth, NH

June 15, 2015	Public Information Session	Newport, RI
June 16, 2015	Council	Newport, RI

6.2 List of preparers

This document was prepared primarily by members of the New England Fishery Management Council staff, Habitat Plan Development Team, and Closed Area Technical Team. There have been numerous personnel changes over time due to the lengthy development of this action.

Habitat Plan Development Team

Michelle Bachman, NEFMC staff, Chair 2009-present
David Stevenson, NMFS GARFO
Jessica Coakley, MAFMC
Kiley Dancy, MAFMC
Moira Kelly, NMFS GARFO
Katie Richardson, NMFS GARFO
Geret DePiper, NEFSC
David Packer, NEFSC
Kathryn Ford, MA Division of Marine Fisheries
Page Valentine, United States Geological Survey
Peter Auster, U. of Connecticut, Sea Research Foundation
Heather Deese, Island Institute
Jonathan Grabowski, Northeastern University
Steve Earys, Gulf of Maine Research Institute

Closed Area Technical Team

Andrew Applegate, NEFMC staff, Chair
David Thomas, NEFMC
Fiona Hogan, NEFMC
David Stevenson, NMFS GARFO
William Whitmore, NMFS GARFO
Timothy Cardiasmenos, NMFS GARFO
Laurel Smith, NEFSC
Geret DePiper, NEFSC
Anna Henry, NEFSC
Sean Lucey, NEFSC

Previous Habitat Plan Development Team members
Chad Demarest, NEFMC staff, Chair 2007-2009, then at NEFSC 2009-2012
Leslie-Ann McGee, NEFMC staff, Chair 2004-2007
Anna Henry, NEFSC
Tom Hoff, MAFMC
Jennifer Anderson, NMFS GARFO
David Dow, NEFSC

Steve Edwards, NEFSC
Patricia Clay, NEFSC
Bradley Harris, SMAST/UMASSD, currently Alaska Pacific University
Jeremy Collie, U. Rhode Island
Joe DeAlteris, U. Rhode Island
Vincent Malkoski, MA Division of Marine Fisheries
Mark Lazzari, ME Dept. of Marine Resources
Melissa Smith, ME Dept. of Marine Resources
Allen Collins, NMFS/ National Systematics Lab (Ad-Hoc)

Additional current and former NEFMC staff who contributed written materials, or were consulted during preparation of this document, included Talia Bigelow, Deirdre Boelke, Jaime Cournane, Rachel Feeney, Patricia Fiorelli, Lou Goodreau, Demet Haksever, Philip Haring, Anne Hawkins, Fiona Hogan, Maria Jacob, Christopher Kellogg, Rachel Neild, Thomas Nies, Jonathon Peros, and Lori Steele. Administrative support, including compilation of the administrative record, was provided by Woneta Cloutier, Sherie Goutier, Joan O'Leary, and Karen Roy.

6.3 Agencies and persons consulted

The following agencies and organizations were consulted during the development of this amendment:

- New England Fishery Management Council, which includes representatives from the following additional organizations:
    - Connecticut Department of Environmental Protection
    - Rhode Island Department of Environmental Management
    - Massachusetts Division of Marine Fisheries
    - New Hampshire Fish and Game
    - Maine Department of Marine Resources
- Mid-Atlantic Fishery Management Council
- National Marine Fisheries Service, NOAA, Department of Commerce
- United States Coast Guard, Department of Homeland Security
- Atlantic States Marine Fisheries Commission

6.4 Document circulation list

US Environmental Protection Agency EIS Filing Section Office of Federal Activities Ariel Rios Building (South Oval Lobby) Mail Code 2252-A 1200 Pennsylvania Avenue NW Washington, DC 20460	H. Curtis Spalding Regional Administrator USEPA, Region 1 5 Post Office Square, Suite 100 Boston, MA 02109 617.918.1010 spalding.curt@epa.gov

Judith A. Enck Regional Administrator USEPA, Region 2 290 Broadway, 25th Floor New York, NY 10007 212.637.5000 enck.judith@epa.gov	Shawn M. Garvin Regional Administrator USEPA, Region 3 1650 Arch Street Philadelphia, PA 19103 215.814.5155 garvin.shawn@epa.gov
Heather McTeer Toney Regional Administrator USEPA, Region 4 61 Forsyth Street Atlanta, GA 30303 404.562.9900	RDML Linda Fagan District Commander First Coast Guard District 408 Atlantic Avenue Boston, MA 02210 617.223.8515
William Gibbons-Fly Director Office of Marine Conservation Department of State 2201 "C" Street, NW Washington, DC 20520 202.647.2335	Rebecca Lent, Ph.D. Executive Director Marine Mammal Commission 4340 East-West Highway, Suite 700 Bethesda, MD 20814 301-504-0087 rlent@mmc.gov
Willie R. Taylor Office of Environmental Policy and Compliance Department of Interior 1849 "C" Street, NW MS 2462 Washington, DC 20240 202.208.3891 willie_taylor@ios.doi.gov	

6.5 Public comments and responses

Between October 10, 2014 and January 8, 2015, the Council accepted written comments on Omnibus Essential Fish Habitat Amendment 2 and its associated Draft Environmental Impact Statement. These comments were submitted to National Marine Fisheries Service Regional Administrator John Bullard, and forwarded to the Council by Greater Atlantic Regional Fisheries Office staff. Between November 24, 2014 and January 7, 2015, the Council held twelve public hearings on Omnibus Essential Fish Habitat Amendment 2. The hearings were moderated by the Habitat Committee chairman and staffed by Council analysts. At each hearing, public comments were taken on the measures proposed in the amendment.

Overall, the public comments provided both in writing and at the hearings are substantial in their breadth and depth. Comments were received from individuals and organizations throughout this region, and beyond. Many comments are highly detailed and were drafted upon careful review of

the draft amendment and environmental impact statement. Organizational comments were provided by federal and state agencies, fishery management groups, conservation organizations, fishing industry organizations, and others. Group comments where multiple individuals with different organizational affiliations signed on to the same comment letter were submitted by scientists, fishermen, and others. Individual comments were submitted by commercial and recreational fishermen, scientists, business owners, and interested members of the general public.

All of the written comments on the DEIS were made available for review by the Council and the public. In total, 195 individual, group, or organizational written comments were submitted. Additionally, five different petitions and form letters were circulated by various groups and submitted directly by individuals, or by the organizer on their behalf (see Table 33). A separate document detailed the testimony provided at the public hearings. Based on the attendance sheets, over 532 people attended the hearings, although some individuals attended more than one hearing, and additional people may have attended without signing in. Comments were made by 174 different individuals, with some people commenting at multiple hearings. Many of these individuals submitted written comments as well.

Table 33 – Summary of form letters received in response to the Draft Environmental Impact Statement

Form letter source and/or topic	Number received
Earthjustice/Pew Charitable Trusts; letter requesting strong habitat protections	149,920
Recreational Fishing Alliance, letter opposing Stellwagen Dedicated Habitat Research Area	318
Stellwagen Bank Charter Boat Association, letter opposing Stellwagen Dedicated Habitat Research Area	12
Letter requesting protection of Cashes Ledge	2,233
Protect vital ocean habitat letter	411

6.5.1 Comments related to the EFH and HAPC designations

Comment: A commenter generally supported the No Action EFH designation alternatives, arguing that more, not less, area should be protected. Other commenters generally supported the preferred alternative EFH designations.

Response: In June 2007, the Council selected preferred alternatives for updated EFH designations. There have not been any substantive changes to the EFH designations since 2007, although the Plan Development Team corrected some errors that were made when the preferred alternatives were inserted into the Phase I DEIS during 2009 and 2010 and made minor modifications to other designations. These revisions to the EFH designations for managed species remain the Council's preferred alternative. In general the preferred alternative designations are more specific in terms of the text descriptions and while the mapped areas may be smaller, they are also more specific and better align with the text. In many cases the preferred alternative maps limit EFH to appropriate depth ranges, rather than being mapped at the spatial resolution of whole ten minute squares. More specific and focused preferred alternative designations are expected to enhance rather than detract from their ability to be used effectively

in fishery management and EFH consulation processes. These actions to update the text and maps do not intend to reduce protections for the species. If a designation area is reduced as a result of the Council's proposed action, then the area likely should not have been originally designated based on updated information that suggests the habitats used by managed species at various life stages.

Comment: Regarding specific designations, a commenter recommended that the Council should consider updating the preferred alternatives from those described in the draft EIS for all lifestages of Atlantic sea scallop, all lifestages of winter flounder, juvenile Atlantic cod, and Atlantic herring eggs and larvae.

Response: The Council generally agreed with this comment, and during final action the Council proposed updates to these EFH text and map descriptions (see Volume 2, Section 2.2 for details). In general, the modifications to the EFH designations more accurately represent the habitat areas important for managed species at a particular life stage. The scallop designation was updated to include additional detail in the text, and the mapped area was limited to 110 meters (Section 2.2.5). Winter flounder EFH was limited to waters north of Absecon Bay, New Jersey, south of which winter flounder abundance is low (Section 2.2.1.11). Juvenile Atlantic cod EFH was updated to remove depth cropping in shallower areas designated based on the NEFSC trawl surveys, which is more consistent with the text (Section 2.2.1.3). The Atlantic herring egg designation was updated to include additional areas where very small larvae have been found in high abundance in plankton surveys (Section 2.1.6). The larval herring designation was not updated.

Comment: For the winter flounder EFH designation, multiple commenters recommended examining the southern part of the species' range, in particular considering geographic extent, influence of siltation on habitat suitability, and economic impacts of associated habitat conservation measures on activities including harbor dredging and beach renourishment. Specifically, man-made harbors and bays in Cape May County, New Jersey should not be considered EFH for winter flounder eggs given the rate of siltation in such areas.

Response: The Council agreed with these comments. Regarding winter flounder, the Council proposes to revise the southern boundary of the winter flounder EFH designation (eggs, juveniles, and larvae/adults) established at 39° 22' N latitude, such that Absecon Bay New Jersey would represent the southern limit of winter flounder EFH (Volume 2, Section 2.2.1.11).

Comment: The Council should ensure that EFH designations reflect the current understanding of EFH for the affected stocks, and that data used represent the best available science, are not stale, and that designations do not arbitrarily ignore newly available information.

Response: The Council's Habitat PDT and Committee worked to incorporate new information into the EFH text and map descriptions; these updates are the Council's preferred alternative. Volume 2, Section 2.2 provides details on the proposed updates for each managed species, which include details on the information used to update the EFH designation. While many of the designations rely on trawl survey data only through 2005, and not on more recent distribution data, they are based on a long time series beginning in 1968. This long time series makes the

designations less sensitive to the inclusion of additional years of data. In addition, although much of the work to update the designations was completed during 2004 and 2005, the designations have been continually reviewed by the PDT during the entire development timeframe for this amendment, and modifications have been suggested as needed. In the case of winter flounder, where the designation has significant bearing on conservation recommendations made during the EFH consultation process, more recent survey data and literature related to the southern limit of the designation were used to evaluate the preferred alternative.

Comment: A mechanism should be in place to allow the Council to revise EFH and HAPC designations when new information becomes available.

Response: EFH regulations recommend that a complete review of all EFH information should be conducted at least once every 5 years. However, the Council can update EFH designations via FMP amendment at any time. No formal mechanism was developed in this action to review and update designations. However, this amendment includes recommendations for updated monitoring and data collection that may provide new habitat information that could be used to update the EFH designations. In addition, this amendment proposes Dedicated Habitat Research Areas in the Western Gulf of Maine and on Georges Bank, which will hopefully generate data to inform updated designations. Also, during final action, the Council expressed support for cooperative habitat research within HMAs to better inform management decisions, including EFH designations.

Comment: The amendment document should discuss inshore EFH loss related to eutrophication and climate change.

Response: EFH regulations require the Council to identify those non-fishing related activities that may have adverse impacts to EFH. A summary of those impacts (including both climate change and eutrophication) are found in Volume 6, Section 3.5. Non-fishing impacts are summarized in greater detail in Appendix G. The focus of the management measures is on minimization of fishery impacts in federal waters, and a very detailed evaluation of inshore impacts is beyond the scope of the amendment.

Comment: Various commenters supported the preferred Habitat Area of Particular Concern alternatives generally. In particular, comments expressed support for the Atlantic salmon rivers HAPC given endangered status of GOM DPS, the Jeffreys Ledge/Stellwagen HAPC given diverse and highly productive habitats associated with these two features, and the Cashes Ledge HAPC given unique features of this area including kelp forest, high biodiversity of invertebrates, fishes, mammals, and seabirds. A comment recommended expanding the HAPC to include the entirety of the Cashes Ledge groundfish closure, which encompasses Fippennies Ledge and Cashes Basin. Comments supported continued designation of the Northern Edge cod HAPC given presence of structurally complex habitat types that provides key ecological functions for juvenile cod, designation of the Inshore Juvenile cod HAPC, given both the ecological function and sensitivity to anthropogenic impacts of inshore areas, and the Great South Channel HAPC.

Response: The Council agrees that the proposed HAPCs are appropriate based on the rationale used to designate these areas (Volume 2, Section 2.2), and chose not to modify its preference for

HAPC designations from 2007. These proposed HAPC designations include the Northern Edge HAPC, Jeffreys Ledge HAPC, the Great South Channel Juvenile Cod HAPC, Atlantic Salmon HAPC, and the Inshore Juvenile cod HAPC. These HAPC designations are non-regulatory in nature, and do not implement fishing restrictions; they are used in the EFH consultation process when analyzing activities that may affect habitats within a more broadly-defined EFH area that are of particular ecological importance, sensitive to anthropogenic stresses (including fishing), or are rare.

The Council recognizes the importance of the Cashes Ledge area, and has recommended maintaining the existing habitat closure area on Cashes Ledge, with a boundary modification, and including additional restrictions in a subset of the Cashes Ledge HMA on Ammen Rock, to continue to minimize adverse impacts from fishing in this area. Specifically, the proposed HMAs in the Cashes Ledge area will continue current fishing restrictions on mobile bottom tending gear. The Council did consider a more expansive version of the Cashes Ledge HAPC that would have extended further in all directions to more completely encompass the entirety of the ledge feature, plus additional deepwater areas adjacent to the ledge. However, the Council chose to define the current Cashes Ledge Habitat Closure Area as an HAPC.

The Council also recommended habitat management areas overlapping the Northern Edge HAPC and the Great South Channel Juvenile Cod HAPC. Parts of these areas would be managed as mobile bottom-tending gear closures, and parts of the Northern Edge HAPC would be managed as an area where mobile bottom-tending gear use would be limited to scallop access dredging only, with no open access days at sea scallop dredging, no trawling, and no clam dredging.

Comment: The Council should support the designation of the seamount and canyon HAPCs because the areas contain high habitat- and bio-diversity, including species new to science. The Council should expand the list of canyon HAPCs to include Nygren, Munson, Powell, Welker, Dogbody, Nantucket, Block, Ryan, McMaster, Emery, Jones, Babylon, Mey, Lindenkohl, North Heyes, South Wilmington, South Vries, Warr, Phoenix, Accomac, and Leonard canyons. The Council should consider deep-sea coral HAPCs in the omnibus NEFMC coral amendment rather than in this amendment.

Response: Some of these canyons mentioned fall under the management jurisdiction for the Mid-Atlantic Fishery Management Council, including Block, Ryan, McMaster, Emery, Mey, Lindenkohl, Wilmington, South Vries, Warr, Phoenix, Accomac, and Leonard canyons. The Mid-Atlantic Fishery Management Council took final action in June 2015 to address protections for deep-sea canyons within its jurisdiction through a Deep Sea Coral Amendment to the Atlantic Mackerel, Squid, and Butterfish FMP, including a broad coral zone that will encompass all of the canyons in their region, if approved by NMFS. The New England Fishery Management Council has proposed various HAPCs in the seamount and canyon areas in OHA2, although these HAPCs do not include the minor New England-region canyons listed above (i.e. Nygren, Munson, Powell, Welker, Dogbody, and Nantucket). Details regarding the Council's preferred Canyon HAPCs can be found in Volume 2, Section 3.1.8. The Council has chosen to address fishing restrictions within these areas in a separate FMP amendment focused on deep-sea coral conservation, in part because large portions of these canyons lie beyond the depths of designated EFH for managed fishery resources. The coral amendment will rely on the discretionary

authority in section 303(b) of the Magnuson-Stevens Act, which provides additional flexibility to manage fishing impacts to corals beyond areas identified as essential fish habitat. The Mid-Atlantic coral amendment is also based on the discretionary authority. In the coral amendment, discrete coral protection zones are under consideration within Nygren, Munson, Powell, and Welker canyons, and a broad zone is under consideration that could encompass the entire continental slope off Georges Bank within the New England Council's jurisdiction. Despite the more comprehensive management proposals included in the ongoing coral amendment, the Council felt it was reasonable to identify the shallower parts of the major Atlantic coast canyons as habitat areas of particular concern in this action, and kept these measures as part of this amendment.

Comment: The Council should protect HAPCs with specific management measures. Specifically, the Council should protect the three juvenile cod HAPCs from all fishing and designate the coral HAPCs as no-take marine reserves.

Response: Designation of habitat areas of particular concern (HAPCs) is intended to indicate which areas within EFH should receive more of the Council's and NMFS' attention when considering Federal and state actions that may adversely impact EFH, and in establishing higher standards to protect and/or restore such habitat. At this time, the Council does not recommend further actions to reduce or eliminate adverse effects under the HAPC designations. However, in many cases, the HAPCs on the continental shelf overlap with proposed HMAs, where fishing restrictions would reduce fishing impacts. The proposed seasonal and year-round habitat closures do overlap in part with the juvenile cod HAPCs, as discussed in this volume, Section 3.3.2.

Comment: The Council should continue coordination with the MAFMC on coral conservation in the HAPCs to ensure consistent and complementary management approaches.

Response: The Council plans on continue coordination with the Mid-Atlantic Fishery Management Council regarding deep-sea coral protections and HAPC designations in the seamount and canyon areas, and has established a Memorandum of Understanding to clarify the roles and responsibilities of each Council.

Comment: The Council should evaluate the potential for adverse effects from fishing in the proposed HAPCs and avoid, minimize, or compensate for impacts where appropriate. The Council should ensure designations continue to meet HAPC criteria and reflect the current understanding about the rarity, vulnerability, and susceptibility of areas to fishing impacts.

Response: The FEIS addresses these issues. The rationale for HAPC designations (i.e. rarity, vulnerability, and susceptibility of areas to fishing impacts) is provided in Volume 2, Section 2.2. The extent to which various habitat management alternatives minimize adverse effects within HAPCs is discussed throughout the habitat impacts analysis in Volume 4, Section 3.2.This volume, Section 3.3.2 discusses the overlap between HAPCs and HMAs, so that fishing restrictions proposed within HMAs would also provide protections in some portions of the HAPCs where overlap occurs. With respect to fishing impacts, the Council's preferred management measures help to minimize adverse effects in many of the HAPCs that are in federal waters where Council-managed fisheries are prosecuted. As described above, the Council is

developing a deep-sea coral amendment that addresses fishing impacts in the canyon and seamount HAPCs.

Comment: The Council should identify major prey species and their habitats in order to determine if conservation measures are required to conserve the prey element of EFH.

Response: See Section 3.2.4 for a discussion of this issue. Appendix B identifies the major prey species consumed by each managed species and is used to fulfill the prey species evaluation requirement in the EFH regulations. The measures in this amendment are expected to provide protection for the prey component of habitat, but the Council did not determine that it was necessary to identify specific alternatives focused on prey species conservation. Impacts to Atlantic herring, a prey resource managed directly by the Council, are discussed in Volume 5, Section 7.1. The preferred habitat management alternatives are expected to have neutral to slightly positive impacts on the herring resource via mobile bottom-tending gear restrictions in locations overlapping herring egg essential fish habitat.

6.5.2 Comments related to habitat management measures to minimize the adverse impacts of fishing on EFH

Comment: A number of comments were in support of the No Action alternative for the Eastern Maine sub-region. Specific points made included that: (1) various proposed areas could impact emerging and existing fisheries, e.g. scallop fishery, as well as halibut and quahog fisheries; (2) the Machias area and Grey Zone overlap, such that it would still be fished by Canadian mobile bottom-tending gear fleets; (3) there is limited groundfish infrastructure, groundfish permits, and quota access in eastern Maine that could be utilized if groundfish resources recover, which makes any potential future restrictions on the lobster fishery in these areas of even greater concern; (4) the analyses appear to underestimate the impacts of the Eastern Maine Large area on local shrimpers and on federal scallop permit holders; (5) the analyses appear to underestimate the impacts of the Machias area on quahog fishermen; (6) the Large Eastern Maine area contains very productive lobster grounds; closing the area would adversely affect the Downeast Maine fishermen. (7) The clam industry should be exempt from habitat management areas in eastern Maine.

Response: During final action, the Council proposed the Small Eastern Maine HMA for habitat protection. The Small Eastern Maine HMA is expected to increase habitat protection in the sub-region because there are currently no HMAs designated within the eastern Gulf of Maine. The Council did consider impacts to the Maine fisheries mentioned by the commenters, but chose to balance habitat needs with opportunities for current and future local fishing in Eastern Gulf of Maine. The Council did not recommend designation of the Machias, Large Eastern Maine, or Toothaker Ridge HMAs. The Council does not propose an exemption for the clam industry in the eastern Gulf of Maine subregion at this time, but the Small Eastern Maine HMA is not expected to be a major center of clam dredging (see section 4.2.1 of Volume 4). Two additional years of data are included in the FEIS analysis as compared to the DEIS. None of the alternatives in the eastern Gulf of Maine (preferred or otherwise) contemplate restrictions on lobster gear.

Comment: A number of comments were in support of Alternative 2, the Large Eastern Maine and Machias HMAs. Some comments recommended expanding the Large Eastern Maine HMA

further towards shore to protect Atlantic herring spawning grounds, and others were in support of a restriction on all gears capable of catching groundfish in these areas. Some comments were in support of just the Small Eastern Maine HMA in Alternative 3, but not the Machias or Toothaker Ridge HMAs. Others supported Alternative 3 without the Toothaker Ridge HMA. Another comment expressed general support for the designation of HMAs in the eastern GOM sub-region.

Response: The Council proposes the Small Eastern Maine HMA because the Large Eastern Maine HMA would adversely impact Maine local fishing community in that region. The Council proposes the Small Eastern Maine HMA as a closure to all mobile bottom-tending gears. The Small Eastern Maine HMA was analyzed in the DEIS as part of Alternative 3, which also included the Machias HMA and Toothaker Ridge HMA. The Council did not propose the Machias HMA due to concerns among Council members regarding the grey zone, because a large percentage of the area overlaps a disputed part of the EEZ boundary and is therefore fished by both Canadian and U.S. fishermen. Council members were concerned that habitat protection benefits in the Machias HMA would be jeopardized if Canadian fishermen were allowed to fish in the area while U.S. fishermen would be restricted. The Council did not propose the Toothaker Ridge HMA due to its importance to Maine local fishing communities.

Comment: A number of comments were in support of the No Action alternative for the central Gulf of Maine sub-region. Most of these comments were interpreted as specifically indicating support for the Cashes Ledge [Groundfish] Closure Area. Specific points made included that: (1) the unique biodiversity and habitat types of Cashes Ledge should be considered when making decisions; (2) opening Cashes might lead to short term gains but with long term consequences; (3) catch limits do not eliminate the need for closures; (4) gillnets could target cod and other groundfish on Cashes Ledge under the DEIS preferred alternative; (5) removing the Cashes Ledge groundfish closure would compromise ability to achieve goals and objectives; (6) poor cod stock status argues for maintaining the area; (7) in terms of its size, Cashes Ledge is a small fraction of the overall size of the GOM; (8) continued closure will sustain recovery already underway; (9) continuing closure will create stability in the regulations; (10) Cashes Ledge should be protected from all types of fishing; (11) Cashes Ledge and adjacent Cashes Basin should be designated as a marine reserve; (12) assumptions made in the analysis about the nature of habitats in Cashes Basin are inappropriate and uncertainties are not adequately acknowledged. If there is uncertainty in the characterization of habitat types in Cashes Basin, as indicated in the DEIS, precautionary protection of the area is a better management approach; (13) deep waters west of Cashes Ledge inside the Cashes Ledge groundfish closure area appear to have large numbers of halibut; (14) DEIS analysis indicates limited positive economic benefits of reopening areas and much higher conservation benefits to keep areas closed and maintain the status quo. Another comment was in support of maintaining the existing Jeffreys Bank habitat area, which seems to have helped flounder stocks. West of the existing Jeffreys Bank area is an important fishing ground and the northern part of the existing area has many lobster traps and tows would be difficult to reestablish.

Response: The Council acknowledges the importance of the Cashes Ledge Closure Area and it will be maintained as it is part of both the No Action and preferred management alternatives. The Cashes Ledge Habitat Closure Area is shifted to the west in the Council's preferred Alternative

3. Two additional HMAs were added, and they are encompassed in the Cashes Ledge Closure Area, known as Fippennies Ledge HMA and Ammen Rock HMA. The Council does not have the authority to designate Marine Protected Areas, although it can make recommendations to the MPA registry. However, the proposed designation of the Cashes Ledge HAPC does require the Council and NMFS to pay special attention to adverse impacts from fishing and non-fishing activity within HAPCs. The Council proposes to modify the Jeffreys Bank HMA, but maintains the same area size for habitat protections. The Council proposes to modify the boundaries of the existing closures on Jeffreys Bank so that the eastern and western boundaries are expanded in each direction, and the northern boundary is reduced by 10 latitudinal minutes. Data information used to inform Council deliberations on Cashes Ledge are discussed in Volume 4, Section 3.1.3. Impacts to human communities from Central Gulf of Maine alternatives, including Cashes Ledge are discussed in Volume 4, Section 4.2.2. Impacts to protected resources from Central Gulf of Maine alternatives, including Cashes Ledge are discussed in Volume 4, Section 5.1.2. Impacts to managed resources from Central Gulf of Maine alternatives, including Cashes Ledge are discussed in Volume 5, by fishery.

Comment: A comment supported Alternative 3 without designation of the Platts Bank HMA (i.e. designating modified Cashes and Jeffreys Bank HMAs, Ammen Rock HMA, and Fippennies Ledge HMA, and removing Cashes Ledge Closure Area). Many comments were opposed to the Platts Bank HMA based on impacts to the day boat scallop and groundfish fisheries.

Response: The Council proposes Alternative 3 in the central Gulf of Maine without Platts Bank. During final action in April 2015, Council members raised concerns that the Platts Bank HMA would impact the Maine scallop fishery. Therefore, the Council did consider the specific issues addressed by the commenter, and chose not to adopt the Platts Bank HMA in an effort to balance the goals and objectives outlined in OHA2 with the needs of the fishery. A brief summary of the Council's rationale regarding Platts Bank is discussed in Volume 3, Sections 2.1 and 2.2.2. The Council proposes to maintain the Cashes Ledge Closure Area for its importance to managed species.

Comment: Some comments were in support of Alternative 4 (modified Cashes Ledge and Jeffreys Bank HMAs, Ammen Rock HMA, removal of Cashes Ledge Closure Area). Comments supported protection for Cashes Ledge generally, but suggested protections should focus on shoal areas, not the larger groundfish closure area, and should allow fishing on Fippennies Ledge to harvest valuable scallops there. Some of these commenters expressed concern that many individuals and groups supporting no action in the larger Cashes Ledge groundfish closure area are relying on information from the shoal areas of the ledge itself including Ammen Rock, and much less so on any benefits associated with the larger closure.

Response: The Council agreed that the boundaries of the Cashes Ledge Habitat Closure Area should be modified to better focus on shallower habitats, but maintained the broader groundfish closure and its protections for groundfish, given the condition of groundfish stocks such as GOM cod. The Council did not recommend designation of the the Platts Bank HMA due to concerns about impacts to the fishery, but did recommend designation of the Fippennies Ledge HMA, which is expected to minimize fishing impacts on vulnerable habitats.

Comment: The Ammen Rock HMA should be designated as a closure to all fishing.

Response: The Council agrees with this comment and proposes the Ammen Rock HMA as a closure to all fishing, but would allow lobster trap fishing, which is managed by the Atlantic States Marine Fisheries Commission and NMFS.

Comment: Fippennies Ledge should be incorporated into the Northern Gulf of Maine Scallop Management Area. Fippennies Ledge, Platts Bank, and Jeffreys Ledge should be managed rotationally for scalloping.

Response: OHA2's goals are to reduce adverse impact from fishing on Essential Fish Habitat. In order to balance the goals of the amendment with the needs of the fisheries, including scallop fishing, the Council proposes Fippennies Ledge and Modified Jeffreys Bank HMAs be closed to all mobile bottom tending gear, which includes scallop vessels. Analysis shows that mobile bottom-tending gear has adverse impacts to fishing that are more than minimal and temporary. Therefore, OHA2 attempts to mitigate some of these impacts by establishing closure areas to protect the benthic habitat that is vulnerable to impacts from fishing and important to managed fish species. The impacts to the scallop fishery as it is currently managed is covered in Volume 5, Section 6. Changes to the scallop management program, including changes or additions to the rotational management program would need to be considered more explicitly in a scallop FMP action.

Comment: A number of commenters supported Alternative 1/No Action in the western Gulf of Maine (maintenance of existing WGOM Habitat and Groundfish Closures). Some commenters were concerned about including both habitat and groundfish closures in Alternative 1. WGOM was originally a mortality closure, and the groundfish closure only portion east of 70 degrees should be reopened, given the transition to catch share management for fishing effort control. Other commenters recommended expanding existing protections, including designation of the Large Bigelow Bight HMA, or an extension of the WGOM area to include more of Jeffreys Ledge and Atlantic herring spawning grounds. Some comments pointed to the importance of the WGOM Closure Area to the lobster fishery, which would indicate support for the No Action alternative that maintains restrictions on other mobile and fixed gears in the area.

Some comments were opposed to the Bigelow Bight areas (Alternatives 3-5) because they would harm the inshore fleet. Comments were in support of Alternative 6/Large Stellwagen HMA only, which would allow access to historical fishing grounds and provides relief to the fleet. As an alternate option to Alternative 6, one comment was in support an alternative that includes the Jeffreys Ledge and Stellwagen Small areas. The Council could consider opening select areas of the WGOM closure where scallops have been found. Other comments were opposed to opening the northern edge of the current WGOM closed area around Jeffreys Ledge via Alternative 6.

Response: The Council proposes to maintain elements of Alternative 1, including the Western Gulf of Maine Habitat Closure area, but modify the boundaries of the Western Gulf of Maine Groundfish Closure Area to precisely match the boundaries of the Western Gulf of Maine Habitat Closure Area. These closures encompass the Stellwagen Large and Small areas and the

Jeffreys Ledge area. The Council's proposal to maintain the habitat closure is expected to minimize adverse impacts from fishing on benthic habitat. None of the Council's proposed HMAs would restrict lobster fishing.

The HMAs were grouped in this way (current groundfish closure as part of No Action) to help with the analysis of impacts. The groundfish closures in general were considered part of the No Action alternatives because the areas currently afford some habitat protections given their gear restrictions.

The Council does not propose to close the Bigelow Bight area, which would relieve the commenter's concerns for fisheries affected by a closure in that region. The Council did not shift the boundaries of the Western Gulf of Maine Closures to encompass more of Jeffreys Ledge. In August 2011, the Habitat PDT recommended extending the Jeffreys Ledge area to the southwest to cover the part of the ledge feature outside of the existing Western Gulf of Maine closure. However, the Council preferred to work on making refinements to areas already managed, as opposed to additional areas. However, the Council does propose the existing inshore roller gear restriction area (trawl roller gear limited to 12" in diameter) as a habitat management measure. The Council's rationale was that the existing management areas afford the best protection for the Gulf of Maine cod stock.

Comment: A comment supported selection of Alternative 7A in the western Gulf of Maine sub-region, designation of the inshore roller gear restriction area as a habitat measure applicable to all bottom trawl gears.

Response: The Council agrees with the commenter's statement, and proposes to maintain the existing inshore roller gear restriction area (all trawl roller gear limited to 12" in diameter) as a habitat management measure. This will expand the restriction to all bottom trawling, not just to those vessels fishing under the Northeast Multispecies FMP.

Comment: A number of comments supported Alternative 8, designation of a shrimp trawl exemption area west of Jeffreys Ledge if the No Action alternative was selected in the western Gulf of Maine sub-region.

Response: The Council agrees with the commenter's statement, and proposes for implementation Alternative 8, which would allow shrimp trawl gears in the northeast corner of the Western Gulf of Maine HMA.

Comment: The Council received a large number of comments on habitat management measures for Georges Bank, which are summarized here. Regarding habitat management on Georges Bank, the Council should:

- Support Alternative 1/No Action Closed Area I and Closed Area II habitat and groundfish closures. Areas include abundant mature haddock, and the southern part of Closed Area II contains large fraction of GB yellowtail flounder. The Closed Area II habitat closure (i.e., the HAPC) should be maintained to provide protection for juvenile

cod. Alternatives 3, 4, 6a, and 6b are too small to offer substantive benefits for groundfish.

- Support Alternative 2, no closures.
- Support Alternatives 1, 3, 4, 6a, or 8, which maintain protections in the areas of the northern edge with dense epifaunal coverage.
- Support Alternative 7 which allows access to scallop grounds and fishing areas along the Hague line as well as other healthy stocks such as winter flounder. Some comments indicated that the alternative is only acceptable if clam dredges are exempted.
- Support Alternative 8, which contains diverse habitat types and areas with far and very far above average fish persistence scores. Will protect Atlantic herring spawning grounds. However, offers little protection for GB yellowtail.
- Develop an alternative other than what was presented in the DEIS, including:
    - Alternative 8 and Alternative 1 in combination.
    - The Council should develop an alternative to no action that encompasses the northern edge of Georges Bank from the HAPC west through the fingers. Maintaining CAII Habitat Closure alone is not sufficient to improve protection for juvenile cod and other groundfish.
    - Consider existing CAII Habitat Closure combined with parts of Alternative 8, or consider Alternative 6A.
    - Consider an area that consists of the Georges Bank SASI/LISA clusters and straddles the existing CAII habitat area and Alternative 8.
- Not support any alternatives for Georges Bank unless the clam fishery is exempted, i.e. support Option 2.
- Not open Closed Area II to scalloping unless seasonal restrictions are put in place to prevent gear conflict. The Council should formulate a gear separation agreement. Depth specific gear requirements could mitigate gear conflicts in this area.
- Allow for reasonable and safe access to the northern edge of Georges Bank, coinciding with periods when scallop yields are high and fishing mortality on scallops is therefore minimized.

Response: The Council considered all alternatives within the DEIS, with particular considerations for the following areas: Georges Shoal 2 MBTG HMA and a combination of area closures that overlap with the boundary of the Northern Edge HAPC. Ultimately, the Council proposes a mix and match approach that includes the Georges Shoal 2 MBTG HMA, and modifications for closures in the alternatives for the Northern Edge (i.e. Alternative 10). The area furthest to the northeast is proposed as a Reduced Impact Habitat Management Area with limited fishing for scallop and groundfish vessels, and an adjacent area to the south is proposed as a mobile bottom-tending gear closure. The Council also proposes to maintain aspects of Alternative 1 as a DHRA (Closed Area I South EFH), seasonal spawning protection area (Closed Area I North, Closed Area II), and seasonal area for protection of ovigerous female lobsters (Closed Area II north of 41° 30’ N). In order to meet the goals and objectives of habitat protection in the Georges Bank region, the Council does not propose to eliminate all closures (Alternative 2). The Council does not propose Alternative 8 because the area is much larger than all other alternatives, which does not align with the Council’s intent to more efficiently protect habitat by closing areas that are more discrete, to reduce adverse impacts to the fishing community, and protect the most vulnerable habitats that are most important to the managed fish

species that utilize the areas. The Council's proposed HMAs in the Northern Edge, in combination, encompass most of the area designated as the Northern Edge HAPC. The Council agrees that Alternatives 3, 4, 6a, and 6b alone may be too small to offer substantive benefits for habitat protections. The Council also proposed a one-year exemption from the Georges Shoal HMA for hydraulic clam dredges. The allowance for clam dredges sunsets one year after implementation of the amendment, allowing time for a discrete exemption area or areas to be developed.

Comment: Because Closed Area II (Groundfish) Closed Area is an important fishing ground for the federally permitted offshore lobster fleet, the Council should grant exclusive access to this area between June 15 and October 31, with no mobile gear access allowed.

- Roughly 35% of combined GOM/GB stock' egg bearing lobsters reside in Closed Area II seasonally. Egg loss would probably result from increased interaction between these egg bearing females and mobile gear. A high level of connectivity between these stocks is shown in the most recent assessment, such that increased bycatch could affect the stock as a whole. The Georges Bank stock is unique in that it has many large, old lobsters, which would be difficult to replace.
- Impacts analysis should focus on the Georges Bank fleet and/or Lobster Management Area 3 vs. averaging impacts across the entire lobster fishery
- The DEIS does not fully consider impacts on resource and fishery of reopening CAII to the scallop fishery – trap losses will occur; traps on GB valued at around 4 million. Within CAII during the fishing season, traps fished in trawls one mile long with 35 traps each. These trawls are spaced at 1-2 microseconds apart, such that gear is very dense in the closed area.
- Spatial shifts in the lobster fishery to the north and west of Closed Area II could increase interactions with marine mammals.

Response: The Council considered information available in the recent lobster stock assessment report (preliminary June 2015 and final August 2015) that discusses empirical evidence to suggest seasonal movement of lobsters between the Gulf of Maine and Georges Bank, and the need for seasonal protection of female lobsters within Closed Area II. Due to concerns about impacts to the lobster fishery and resource, the Council proposes to close portions of what is currently known as Closed Area II north of 41°30' N to the scallop fishery between June 15th and October 31st. The Council supports gear sharing agreements among fishing industries to reduce gear conflicts. Such an agreement already exist between the offshore lobster fleet and the groundfish sector vessels, which is adopted through the Atlantic States Marine Fisheries Commission's Interstate Fishery Management Plan for American Lobster, Addendum XX (May 2013). There are no regulations associated with the groundfish sector/lobster agreement and none are propsed via this amendment.

Comment: The Council should support scallop fishery access to the northern edge of Georges Bank.

- DEIS analysis of benefits associated with reopening areas currently closed to the scallop fishery is inadequate.

- Scallop fishing removes older animals giving room for growth of younger ones, which improves the beds and the fishery overall.
- Limited access scallop fleet access to biomass on the northern edge will relieve pressure on nearshore areas and allow for recovery there.
- Analysis should consider how scallop stocks and scallop management will be adversely affected if major scallop beds are left out of the rotational management scheme.
- Analysis should consider impacts to economics, management, yield per recruit, and recruitment.

Response: The Council agrees with the commenter's statement that fishery access on the northern edge of Georges Bank is important, and the preferred alternative would allow some access for the scallop fishery in the Northern Edge Reduced Impact HMA, once developed in a subsequent scallop amendment or framework. Additional NEPA analysis specific to scallop fishing in the Reduced Impact HMA would consider the impacts from limited scallop fishing in the area using a rotational management system. These impacts to the scallop fishery and resource are discussed in Volume 5, Section 6.

Comment: On Georges Bank and in the Great South Channel/Southern New England, the Council should either select Alternative 2, no management areas, or should exempt the clam fishery from mobile bottom-tending gear restrictions in all HMAs.

- Sub-areas composed predominately of sand substrate should be identified as clam management areas within broader habitat closures, and clam dredges should be exempt from habitat closure restrictions within these sub-areas. Surfclams are targeted in high-energy sand environments and not in complex habitat types.
- Surfclam and ocean quahog hydraulic dredges operating solely on high energy sandy habitat and mud habitat that are not essential fish habitat for groundfish must be allowed to continue current operations. High energy sand and mud habitats on Nantucket Shoals, Cultivator Shoals, and Georges Shoals do not provide meaningful habitat for juvenile cod or groundfish.
- The clam fishery has little groundfish or other bycatch and therefore does not conflict with other regional fisheries.
- Overall area swept by clam dredges is low relative to other gear types
- The clam fishery has been found to have minimal and temporary impacts on essential fish habitat.
- Specific to the Georges Shoal fishery, comments noted that substantial NOAA NOS and private industry effort was expended to develop a Paralytic Shellfish Poisoning testing protocol which allows for the operation of Georges Bank clam fishery. This fishery reduces pressure on mid-Atlantic clam stocks because a substantial fraction of clam biomass occurs on Georges Bank
- Viability of small business would be compromised if any portion of Nantucket Shoals is closed to clam dredging
- Closures impacting clam vessels contravene some of the Magnuson Stevens Act National Standards for fishery management plans, including national standards 1, 2, 3, 5, 7, and 8.

Response: The purpose of the amendment is to reduce or eliminate adverse impacts from fishing on EFH. In order to minimize adverse impacts from fishing that are more than minimal and temporary, many of the Council's proposed HMAs would be closed to mobile bottom tending gears, which includes clam dredges. The Council proposes to allow clam dredges in some of its proposed HMAs for one year, including the Georges Bank HMAs and the Great South Channel HMA. These actions are in response to concerns raised by the clam industry regarding substantial loss of revenue. The allowance for clam dredges is temporary, to allow time for the clam industry to collaborate with managers and develop more discrete areas within HMAs for long-term clam dredge allowance. Fishing effort maps provided by the clam industry suggest that clam dredges can operate in areas mapped as cobble-dominated. The amendment does comply with the national standards of the Magnuson-Stevens Act, which is discussed in Volume 6, Section 5.1.

Comment: Some surfclams and most ocean quahogs live in complex habitats. Clamming in deeper waters has harmful impact. Clam dredges have a rock drop behind the carrier which allows dredging in rock areas. Clamming conflicts with other fisheries in that the habitat requires recovery time to correct itself.

Response: The Council agrees that impacts on habitat from clam dredges are more than minimal and not temporary. However, the Council must balance the needs of the fishing industry with the goals of the amendment, to protect complex habitat important to managed fish stocks. Additional review of and action on possible clam dredge exemption areas is already planned for a trailing framework adjustment. Impacts from clam dredges is discussed in further detail in Volume 4, Section 3.1.2.

Comment: In the Great South Channel/Nantucket Shoals area, the Council should:

- Support Alternative 1/No Action (maintain Nantucket Lightship habitat and groundfish closures)
- Support Alternative 2, no habitat management areas
- Support Alternative 3, Great South Channel East. Area could be extended further east/northeast into the Northeast Channel to protect Atlantic herring spawning grounds. There are large numbers of sub-legal cod in the Channel.
- Oppose Alternative 3; the northern near shore portion of area is an important fishing ground for nearby small boat fishermen, and closing it causes safety concerns for these vessels that would have to shift their operations further offshore. Others agreed with these comments for the scallop fishery, noting that scallop fishery is limited to near shore waters by the dredge exemption area, and effectively limited to near shore waters by the possession limit. One comment recommended that the Council not close any areas north of 41° 30' N latitude in this region due to impacts on general category scallop fishery. Oppose Alternative 3 because it will cause negative economic impacts. The area does not encompass any juvenile groundfish hotspots.
- Support some combination of Alternative 3 and Alternative 5.
- Support a modified version of Alternative 3 that focuses more closely on cobble and boulder habitats.

- Support Alternative 4 or Alternative 5, provided an exemption is provided for clam dredges.
- Support Alternative 4, but less than Alternative 5, which has the least impacts on the groundfish fishery.
- Support Alternative 5 to minimize impacts to the groundfish and scallop fleets, if any closed areas must be implemented in this location.
- Support Alternative 6; support Alternative 6 in addition to Alternative 1.
- Support some sort of protections in the Great South Channel region but consider different measures than those presented to date. Some of the areas in the various Great South Channel HMAs are not productive habitat and do not need to be closed. Closures do not achieve a balance between rebuilding stocks and economic harm to industry.

Response: In the Great South Channel, the Council's preferred alternative is to designate the Great South Channel HMA, with management Option 1 (complete restriction on use of mobile bottom-tending gears) in the northeast corner and an allowance for hydraulic clam dredges in the remainder of the area for one year. The intent of this one year exemption is to allow for the development of a possible longer-term exemption that would balance habitat conservation needs with negative effects on the clam fishery due to effort displacement. The Council was concerned about the economic impacts associated with Alternative 3 (Volume 4, Section 4.2.5.3), including impacts on the scallop and groundfish fisheries, and the approvability of Alternative 5. There was concern raised during final action that Alternative 4 would negatively affect the Rhode Island winter flounder fishery; however, the southern New England winter flounder stock is in poor health leaving some members less concerned about the winter flounder fishery in Rhode Island and more concerned with habitat protection. Analysis of impacts to the Rhode Island winter flounder fishery is discussed in Volume 4, Section 4.2.5.4. The Council's preferred Great South Channel HMA balances concerns regarding economic harm to the fishing industries while protecting habitat areas that are vulnerable to adverse fishery impacts.

Comment: Related to the Cox Ledge Habitat Management Areas in the Southern New England sub-region, the Council should:

- Support designation of Cox Ledge HMAs 1 and 2, provided the areas are managed separately from other areas given local differences in the fisheries and stocks in the area compared to other HMAs
- Oppose any gear exclusions from the areas at this time
- Oppose blanket exemptions for any user group or gear type
- Support modification of areas via framework action and also support sunset clauses
- Support designation of Cox Ledge areas as mobile bottom-tending gear closures and suggest coordination with Rhode Island Special Area Management Plan and/or Northeast Regional Ocean Council
- Oppose any closure of Cox Ledge at this time due to its importance for Rhode Island fishermen, particularly in the winter months
- Support further habitat research in area provided that fishermen are not displaced
- Oppose the Cox Ledge 1 area; very active bottom due to both routine and storm-related disturbance, which is mostly not towable by mobile gears
- Support Cox Ledge 2 area provided lobster access continues

- Allow for the possibility of gear modification measures
- Consider the particulars of the general category scallop vessels when making decisions about the Cox Ledge areas, e.g. small number of vessels, vessel size and horsepower, etc.
- Consider that offshore development in this area could constrain mobile fishing gears and their impacts on EFH

Response: The Council's preferred alternative would establish both of the Cox Ledge HMAs, with a prohibition on trawl ground cables (bridles capped at 30 fathoms per side) and a prohibition on hydraulic clam dredges. The Council's preferred HMAs do not restrict access for lobster vessels. The Council agrees with the commenter that modifications to HMAs should be frameworkable. In addition, the Council is suggesting a comprehensive review process for habitat and spawning protection measures every 10 years.

Comment: The Council should improve upon existing habitat protections, including protections for a greater diversity of habitats, and protection of diverse habitats over a greater geographic extent. The Council should increase the region's overall amount of protected area and improve the diversity of habitats and life history stages represented.

Response: The Council agrees that habitat protections should be improved through OHA2. The underlying premise of this amendment is that there are habitats linked to higher survival and/or growth rates of juvenile fish which are vulnerable to adverse fishing impacts. By protecting these habitats, individual growth rates and fitness will hopefully increase, leading to better recruitment to the fishery. OHA2 measures were not explicitly developed with habitat diversity in mind, although some HMAs and groundfish closures, particularly the No Action areas, do protect a more diverse range of habitat types, and some of these areas, for example the Cashes Ledge Closure Area and most of the Western Gulf of Maine Closure Area, were selected as preferred during final action. Instead, the meaures in the amendment focus on highly vulnerable habitats that have a greater proportion of hard bottom than the region overall. While particular species do rely on soft bottom habitats during some or all of their life history, the Council opted generally not to focus on habitat conservation measures for these areas because they are less vulnerable to accumulating the adverse impacts associated with fishing activity. The preferred alternatives collectively do increase the geographic range over which habitat management areas are designated, with proposals as far north as eastern Maine and as far south as Rhode Island, compared to the existing habitat closure areas which occupy a smaller geographic extent. The Council considered the types of habitats within management areas, and the potential for effort displacement, when making final decisions, and did not use area size/coverage as a primary criteria for alternative selection.

Comment: The arguments to reduce habitat protection are not compelling. The Council should oppose the no closure alternative and this alternative should be removed from the amendment altogether.

Response: The Council does not propose a no closure alternative for any of the sub-areas. The alternative does remain a part of the amendment and FEIS.

Comment: The Council should select alternatives that have highly positive conservation impacts. The Council should select alternatives that are based on SASI analysis and protect important lifestages of groundfish stocks, particularly cod. Alternatives should enhance the survival and growth of juvenile fish and encompass more juvenile groundfish hotspots than they do. Alternatives should encompass more high vulnerability clusters identified by the SASI LISA analysis. Alternatives should better protect juveniles in near-shore waters; the Council should analyze the inshore GOM 15nm/90 meter alternative described by the CATT (April 2013) and close the area to gears capable of damaging juvenile habitat or disrupting spawning fish. The best available science should be used to refine closures in areas of hard-bottom substrate.

Response: The Plan Development Team and Closed Area Technical Team used the Swept Area Seabed Impact analysis and associated LISA cluster analysis, combined with the juvenile hotspot analysis to identify HMAs presented in the DEIS for Council deliberations. The hotspot analysis is described in Volume 1, section 4.4, and is referenced throughout Volume 5, section 2.2. The alternatives selected during final action are intended to improve habitat conservation to the extent practicable, and encompass vulnerable habitats for groundfish and other stocks while considering impacts to the fishery industry that could result from effort displacement associated with new or modified closures. The Council's preferred alternatives maintain habitat management and groundfish management areas in the central and western Gulf of Maine, add new protections in the eastern Gulf of Maine, encompass cod EFH and the cod HAPC on the northern edge of Georges Bank, and overlap with cod EFH in the Great South Channel. This preferred alternatives also include seasonal spawning protections, some of which are focused specifically on Atlantic cod.

The 15 nm/90m area would have encompassed Gulf of Maine habitats within 15nm of the coast, or shallower than 90m, whichever threshold was reached first. The Council did not analyze areas that would have resulted in year-round management within state waters in this amendment, in part because Council-managed fishing activity tends to occur in federal waters, and much of the 15nm/90m area suggested along the coasts of Massachusetts, New Hampshire, and Maine would have fallen within this boundary limit. (Four of the New England states (New Hampshire, Maine, Rhode Island, and Massachusetts) do have regulations pertaining to the use of mobile gear or gear capable of catching groundfish, either seasonally or year-round, within their state waters.) In addition, the Council was concerned about large economic impacts that might result from closure of additional parts of the 15nm/90m area beyond the state waters limit. Although the 15nm/90m alternative was not analyzed specifically, in the DEIS, the economic analysis of the Bigelow Bight HMAs, which are adjacent to state waters, appears consistent with these concerns (see Volume 4, section 4.2.3).

Comment: Best available science is clear that fish and other animals depend on habitat, and there is a strong and general scientific foundation for protecting animals and their habitat as a strategy for population recovery and resource stability. Long-term closures offer refuge for larger/old fish.

Response: The Council agrees, and proposes habitat management measures to improve protections of vulnerable habitats, particularly those habitats utilized by juvenile fish. These areas are intended as long-term management areas, although they could be revisited through

future Council action, and the amendment does maintain part or all of some existing, long-term management areas.

Comment: Locations important to cod feeding, breeding, and growth should be off-limits to fishing activities.

Response: The Council's preferred alternatives are expected to continue to protect Atlantic cod (Refer to Volume 5, Section 2). Habitats important to juvenile cod represent important fishing grounds, and the Council considered potential impacts to the fishing community when selecting final preferred measures for OHA2.

Comment: The scientific record does not provide information that proves closures will have positive effects on fish stocks, but the economic effects of the current and proposed closed areas are very real. Research does not support the theory that broad-based closures in productive fishery areas of temperate zones support increased productivity. The conclusion that larger closed areas are better is speculative.

Response: The Magnuson-Stevens Act requires Councils to minimize adverse fishing impacts on EFH to the extent practicable. Closures to mobile bottom-tending gears are one route towards adverse effects minimization. Other types of closures have been implemented to reduce fishing mortality on specific stocks through targeted gear restrictions. In general, the areas proposed in this amendment are more narrowly spatially focused on areas of vulnerable habitat, or are more narrowly focused both spatially and temporally on areas where spawning groundfish are likely to occur. While there is not conclusive proof in the scientific literature that closures are required to achieve these objectives, nor is there proof that closures are entirely unhelpful in this regard. While there is no quantitative metric for how much habitat protection is necessary, better growth and survival at younger ages is a reasonable expected benefit from areas where habitat function is protected through gear restrictions, and better survival is expected to have positive benefits in terms of increasing recruitment to the fishery. The Council agreed that larger areas are not necessarily better and selected as preferred a range of areas that should enhance conservation of vulnerable seabed while protecting fishing opportunities. The Council also supports habitat research that would better inform future habitat management decisions.

Comment: Studies have shown that analyses associated with closures overestimate biological benefits and underestimate economic impacts.

Response: While no specific studies were referenced in this comment, the Council agrees that impacts analysis of fishery closures are challenging to develop. While current revenues in an area can be estimated with relative certainty, shifts in effort under a modified management regime are difficult to predict, which means economic impacts are necessarily qualitative. Potential biological benefits (see comment above) are also difficult to estimate, and many factors besides a closure regime will influence stock dynamics. Environmental impact analyses for OHA2 focus on impacts to the physical environment, biological environment, and human communities. These environmental impact analyses are available in Volumes 4 and 5 of the FEIS. The analyses in this EIS document rely on science to the extent possible, and are intended to be objective and balanced, with no intent to overestimate biological benefits or underestimate

economic impacts. The Council's preferred alternatives, which were selected following review of the draft analyses, reflect a balance between the environmental benefits (biological and physical) and the cost to the industry and fishing communities.

Comment: The ecosystem impacts of year round closures of productive fishing grounds are likely to be negative due to displaced effort and lower CPUE. The Council should analyze this issue in the EIS.

Response: The positive and negative impacts of displacement of fishing effort in response to proposed changes is a recurrent theme throughout the impacts analysis in this EIS. It is difficult to know how exactly fishing effort and catch composition would change in response to adjusting or removing closed areas.

Comment: The success of scallop fishery depends on rotational management, and area closures can lead to die-offs of scallops.

Response: The Council agrees that scallops will eventually die in long-term closures, because they are relatively sessile, especially as they age, and will not move long distances into areas where they might be subject to fishing mortality. However, increasing scallop yield is not the only goal of fisheries management in the Northeast. In selecting preferred measures, the Council weighed the need for habitat protection against impacts on scallop yield. There may be some benefits to the scallop resource from area closures if total recruitment increases, but there are costs as well from the yield lost within the closed area. The costs and benefits of these closures are evaluated from many perspectives with the EIS and the Council's proposed closures are a reflection of that balance between the needs of the fishing industry and the requirements to reduce adverse fishing impacts on EFH. Detailed information regarding the impacts to the scallop resource is provided in Volume 5, Section 6.1.

Comment: The available range of alternatives, except for those that do not designate closures, do not protect against effects that are more than minimal or not temporary, and are not practicable.

Response: The Council's actions address fishing impacts that are more than minimal and not temporary. This is based on thorough analysis of gear types and their impact on the benthic habitat designated as EFH. The results of this analysis suggest that mobile bottom tending gears have substantial effects on benthic habitat, which is more than minimal and temporary. The Council proposes closure areas that generally restrict mobile bottom-tending gear, and the Council found the preferred alternatives to be practicable based on the environmental analysis provided.

Comment: Closing productive fishing grounds on the U.S. side of Georges Bank is the worst way to protect and enhance ecosystem productivity, our main goal.

Response: The Council does not agree with the commenter's statement, and feels that targeted area closures reduce the adverse effects from fishing on EFH, which is expected to increase stock productivity over the long term.

Comment: While the potential for bottom fishing gears to remove emergent epifauna is well documented, many studies indicate that these potential effects are not universal and depend on local processes.

Response: The Council agrees with this comment. For example, the impacts analysis suggests that epifauna occurring highly dynamic (high energy) areas are sand are expected to recover more quickly from impact as they are expected to be better adapted to these dynamic environments. Refer to Volume 1, Section 4.2.1 for more discussion related to impacts to emergent epifauna from habitat protection measures.

Comment: Reopening existing closures could create gear conflicts for the lobster fishery. Habitat areas should not displace lobster fishermen.

Response: The Council supports gear sharing agreements between industries. The Council's preferred alternative would open Closed Area II to trawl and dredge vessels. To mitigate any potential gear conflicts, the amendment includes a provision that would prevent scallop dredging in the area during certain times of the year when lobsters and lobster vessel are present in greater numbers.

Comment: Some commenters concluded that offshore closures could displace larger offshore vessels to inshore fishing grounds under certain conditions, which is an undesirable effect. Others argued that carefully selected, discrete offshore areas are preferable.

Response: The preferred management areas in this amendment include a combination of nearshore and offshore locations. Habitat areas were selected based on their vulnerability to impact and importance to benthic juvenile fish, not only on the basis of expected effort displacement and associated community impacts.

Comment: Closed areas as a management approach are of concern for day boat vessels in the Gulf of Maine, due to the limited ability of these vessels to shift to new fishing grounds. With key stocks at low levels, protecting EFH while avoiding disproportionate harm to the inshore (traveling less than 50 nm) fleet is important.

Response: The Council's preferred HMAs and spawning measures are not intended to disproportionately affect one fishing group, and include a mix of inshore and offshore areas.

Comment: The Council should not approve any new closures in the NGOM scallop management area.

Response: The Northern Gulf of Maine Scallop Management Area overlaps with three of the Council's preferred HMAs that would affect the use of scallop dredges: the existing Western Gulf of Maine HMA, the Jeffreys Bank HMA, which is an existing area recommended for boundary modification, and the Small Eastern Maine HMA, which is new. A relatively small amount of scallop fishing effort occurs in the Small Eastern Maine HMA and no scalloping activity was identified within the currently open portions of the modified Jeffreys Bank HMA

that would be closed under the preferred alternative. The Council did not select the Platts Bank HMA as a preferred alternative due in part to concerns about displacing the scallop fishery from the area, where it has been relatively active in recent years.

Comment: In general, the Council should maintain existing areas closures, and in particular, areas that have been closed to bottom trawling should not reopen. Existing closures should be protected from all types of fishing.

Response: Alternative 1 in each subregion refers to the current measures in place that serve as areas for habitat protection. In some cases, the Council propose to maintain the existing closure (i.e. the Western Gulf of Maine existing closures are generally maintained). In other instances, the Council proposes new HMAs to replace existing closures, based on updated analysis within the EIS.

Comment: Habitat management areas should be managed as closures to all mobile bottom-tending gears. Gear modifications options (trawl ground cable modifications) or exemptions for certain mobile bottom-tending gears should not be permitted. Gear modifications do not minimize adverse effects on EFH. Clam dredges are disruptive to the seabed and exemptions are not appropriate; exemption areas for clam dredges should be used instead.

Response: The majority of the Council's proposed HMAs would be managed as closures to all mobile bottom-tending gears. There are some instances in which the Council proposes to allow particular gear types to operate within proposed HMAs. These gear allowances reflect the Council's intent to balance continued opportunities for the fishing industry with the benefits for habitat protection in the closure areas. The OHA2 DEIS included management options with gear modifications (Options 3 and 4). However, the Council did not generally elect either of these management options in its proposed HMAs, with the exception of the Cox Ledge HMAs where trawl ground cables are prohibited under the preferred alternative. The Council does propose to maintain the existing Inshore Roller Gear Restricted Area, which limits the size of trawl roller gear to 12 inches in diameter. The roller gear facilitates the use of the gear in complex habitats, but size limits for sweep gear are thought to reduce the likelihood that trawl gears would actively fish within the most complex and highly structured habitats. The Council proposes clam dredge exemptions in the following HMAs: Cashes Ledge [Groundfish] Closure Area, Western Gulf of Maine [Groundfish] Closure Area, Georges Shoal 2 Habitat Management Area (one year exemption), and Great South Channel HMA (one year exemption). The HMA clam dredge exemptions approved in OHA2 are temporary and will be reviewed in a trailing action, and the groundfish closure exemptions are consistent with current regulations for the Western GOM and Cashes Ledge Closure Areas.

Comment: Gear restrictions in habitat management areas should include additional gear types beyond mobile bottom-tending gears, such as mid-water trawls and fixed gears that catch groundfish in order to protect prey species and reduce incidental impacts on groundfish.

Response: A primary purpose of the amendment is to reduce adverse fishing impacts on habitat that are more than minimal and not temporary. OHA1 and the Swept Area Seabed Impact analysis developed for this amendment concluded that gear types which fish in a static fashion

on the seafloor such as traps, gillnets and longlines minimally impact the seabed. The fishing restrictions within most of the preferred management areas are not designed to limit groundfish mortality, with the exception of the seasonal spawning areas and the year round closure in the Gulf of Maine (WGOM and Cashes Ledge Closure Area). Other measures in the Council's fishery management plans, such as catch limits or mesh size restrictions, are designed to limit mortality of prey species and reduce incidental mortality.

Comment: The Council should identify major prey species and their habitats in order to determine if conservation measures are required to conserve the prey element of EFH. Prey species should be protected with ecologically appropriate harvest policies; the ecosystem would benefit from the elimination of pair trawling.

Response: While EFH includes forage as a component, the Council made the decision to focus this amendment on protecting the habitat most vulnerable to fishing rather than protecting forage fish directly (see Purpose and Need and Goals and Objectives, Volume 1, Section 2.1). The Essential Fish Habitat designations include text and map descriptions for the Council's managed species at all life stages. Considerations for prey species are available as Supplemental Information to these text and map descriptions. The prey species information is used to inform the Essential Fish Habitat consultation process conducted by NMFS. The purpose of the amendment is to minimize adverse impacts to habitat that are more than minimal and not temporary, which does not include pelagic gears such as pair trawls that operate in the water column. Therefore, any concern regarding modification to allowable mid-water trawl gears should be raised through the Atlantic Herring FMP process.

Comment: The Council should protect habitats vital for forage species including spawning areas for sea herring, bycatch hotspots for river herring and shad, and hotspots for sand lance within Stellwagen Bank National Marine Sanctuary. The Council should work with ASMFC to restore menhaden in the Gulf of Maine.

Response: The overall purpose of the OHA2 is to review and revise the EFH designations, and develop actions needed to minimize the adverse effects of fishing on EFH. The Council does not propose habitat protections for forage fish directly, but these ecosystem-based management approaches may be developed in the future.

Comment: The Council should phase out destructive fishing technology such as bottom trawling and dredging and provide funding to develop non-destructive fishing technologies. Fishing methods that generate high levels of bycatch and destroy the bottom should be eliminated.

Response: A purpose of the amendment is to minimize the adverse impacts of these fisheries on EFH to the extent practicable. Another purpose is to improve protection for juvenile groundfish. The approaches developed in this action focus on restricting the use of bottom trawls and dredges in specific, high vulnerability habitat types, rather than eliminating the use of these gears altogether. The Council will continue to work with the fishing industry, NMFS, and other partners to manage fisheries in a sustainable fashion, based on the best available scientific information. Adherence to Magnuson-Stevens Act's National Standard 8 requires that the Council provide for sustained fishery participation.

Comment: There is insufficient justification for the proposed restrictions on mobile bottom-tending gears. Scallop dredges have few or no negative impacts on scallop grounds.

Response: The Swept Area Seabed Impact (SASI) approach is the primary framework used to evaluate the impacts of the various habitat management alternatives on the physical and biological environment. The SASI analysis concluded that mobile bottom-tending gears such as bottom trawls and dredges have a greater per unit area impact than fixed bottom-tending gears such as gillnets, longlines, and traps. For these reasons, the Council proposes HMAs that generally restrict mobile bottom-tending gear, which includes scallop gear. In some cases, Council action will increase fishing opportunities for the scallop fishery, including limited fishing access in the Northern Edge Reduced Impact HMA.

Comment: The Council should not adopt restrictions on all gears capable of catching groundfish within habitat management areas. If this approach (Option 5) is selected in the eastern GOM sub-region, impacts to the herring fishery and lobster fishery should be evaluated.

Response: The Council proposes HMAs that generally restrict mobile bottom-tending gear (Option 1). The Council does not propose to implement management Option 5 in the eastern Gulf of Maine subregion, although potential impacts of this exclusion are evaluated in Volume 4, Section 4.2.1.2.

Comment: Various commenters expressed concerns about Option 5 specifically due to concerns that lobster traps might be identified as a gear capable of catching groundfish in the future and as such restricted within habitat management areas. Council actions that contemplate restrictions on lobster gear should be coordinated with the Atlantic States Marine Fisheries Commission and appropriate stakeholders.

Response: The Council proposes HMAs that generally restrict mobile bottom-tending gear. In addition, the Council does not propose any lobster fishing restrictions in any of the proposed HMAs.

Comment: The Council should study the interaction between lobster traps and bottom habitats.

Response: The Council agrees that more information on the impacts of lobster gear is necessary and has identified additional gear impacts research as a priority within DHRAs (see Volume 3, Section 2.4).

Comment: The Council should be clear on how exempted fisheries would be affected by the alternatives.

Response: The spatial management alternative descriptions in Volume 3 clearly indicate the gear types and fisheries that would be allowed and excluded in various management areas. Fishery exemptions relevant to OHA2 management areas include the mid-water trawl fishery and the purse seine fishery which are allowed in the various year-round groundfish closures and spawning closures, with the exception of the Massachusetts Bay Cod Spawning Area and the

GOM Cod Spawning Area. Mid-water trawls and purse seines would generally not be restricted in habitat or research areas. An exception to this is the Ammen Rock HMA, which is closed to all fishing except lobster traps, including purse seines, mid-water trawls, and the raised footrope trawl exempted whiting fishery.

Comment: The Nature Conservancy's (TNC) comment included maps and analysis evaluating species persistence within the various HMAs. The species persistence methodology was peer reviewed and is part of TNC's Northwest Atlantic Marine Ecoregional Assessment (2010). TNC overlaid the persistence analysis with the Council's SASI results, and interpreted those analyses as they pertained to the Council's stated goals and objectives for this Amendment. TNC used the results of their analysis to identify and recommend preferred habitat management measures.

Response: This analysis compliments the EFH overlap analysis and the hotspot analysis by demonstrating which areas under consideration might provide the most benefit to the greatest number of managed species. While this analysis was not explicitly incorporated into the document prior to the Council's final decision, the analysis and TNC's interpretation were available to Council members and the public at both the April and June Council meetings. The relationship between the management alternatives and species persistence are used to evaluate which species and lifestages might benefit from a particular management action. It has been incorporated into the FEIS in Volume 4, Section 3.2

Comment: It is unclear why the gear modification measures were selected for inclusion in the DEIS; the DEIS does not discuss scientific uncertainty regarding the effectiveness of the gear modification alternatives.

Response: The draft amendment did consider gear modifications (management options 3 and 4) in the habitat management areas section. The Council generally did not elect these management options for any its proposed HMAs, except within the Cox Ledge HMAs. The analytical approach sections of both the draft and final documents (see Volume 4, section 3.1.2.3) discuss the state of knowledge on trawl gear modifications and the resulting uncertainty associated with impacts assessment.

Comment: It is inappropriate to allow Habitat Management Area measures to be modified by the Framework Adjustment Process.

Response: The Council adopted an administrative measure that would allow changes to proposed HMAs to be developed through a framework actions, versus an amendment. However, the ability to utilize the framework process requires that changes be modest, because substantive changes would take place through an amendment process. Both administrative functions allow for public input through the request for comments at the proposed rulemaking stage, as well as opportunities for public input at committee meetings and Council meetings.

6.5.3 Comments related to spawning management alternatives

Comment: In the Gulf of Maine, the Council should support Alternative 1/No Action for spawning protection, which includes the existing year round groundfish closures, rolling closures, and GOM Cod Spawning Protection Area. Some commenters felt there are currently

too many exemptions associated with these areas, and that mid-water trawls and recreational gears that catch groundfish should be excluded as well. Another comment argued that changes to year round closures would take away existing spawning areas and essentially redirect spawning fish into new areas where spawning may not occur.

Response: In the Gulf of Maine region, the Council proposes Alternative 1A/Regulatory No Action, which includes the Gulf of Maine Cod Spawning Protection Area (Whaleback area, April 1-June 30) and various thirty minute blocks in March, May, June, October, November, December, and January, referred to as the GOM Cod Protection Closures. In response to concerns for increased protections during April, the Council added to these closures thirty minute block 125 for spawning protection from April 15th through April 30th (Alternative 4). The Council proposes to maintain the Massachusetts Bay Cod Spawning Protection Area (Alternative 3 in the DEIS; with similar measures implemented May 2015 through Framework 53), applying the same fishing restrictions used for Gulf of Maine Cod Spawning Protection Area. Midwater trawls are not allowed in the Mass Bay Cod Spawning Area and the GOM Cod Spawning Protection Area. Except for the GOM Cod Spawning Protection Area and Massachusetts Bay Cod Spawnign Protection Area, recreational fisheries that catch groundfish are not restricted from these spawning closures because it is not clear that recreational fishing would disturb more widely distributed spawning activity. Although recreational vessels can quickly target cod, there are measures already in place through the Council Northeast Multispecies FMP that restrict recreational catches for cod.

Comment: In the Gulf of Maine, the Council should not identify the existing groundfish closures, or the rolling closures, as spawning areas.

Response: The Council's preferred alternatives maintain the Cashes Ledge Closure Area and Western Gulf of Maine Closure Area (the latter with a modified boundary). Although these areas were designated as mortality closures, these areas do afford some spawning protection benefits as these are generally closed to gears that catch groundfish. Therefore, they were included in the No Action spawning protection alternatives for the Gulf of Maine for analysis purposes. Their associated regulations (except for the boundary modification) will not change under the preferred alternatives and they will not be identified as spawning closures.

Comment: Some commenters recommended that the Council support designation of the Massachusetts Bay Cod Spawning Protection Area (GOM Spawning Alternative 3) to protect discrete populations of winter spawning cod. Others argued that the alternative was no longer needed given overlapping protections implemented via Northeast Multispecies Framework Adjustment 53.

Response: The Council's preferred alternative designates the Massachusetts Bay Cod Spawning Protection Area. The goal of OHA2 is to improve spawning protections, which is particularly important for the Gulf of Maine cod stock given its current status. Although the area overlaps spatially and temporally with the Gulf of Maine Cod Protection Closures, the Massachusetts Bay Cod Spawning Protection Area is more restrictive than the larger overlapping GOM Cod Protection Closures.

Comment: There are conflicts between the cod protection measures in Northeast Multispecies Framework Adjustment 53 and the rolling closures analyzed in the habitat amendment. The Council should support the Framework 53 areas.

Response: The Council agrees and the preferred alternative maintains the seasonal cod spawning and cod protection areas implemented via Northeast Multispecies Framework 53 to address spawning protection objectives.

Comment: The Council should exclude both recreational and commercial gears that catch groundfish from the Gulf of Maine spawning areas.

Response: Some of the Council's preferred measures for Gulf of Maine spawning protection do exclude recreational gears, in particular the the Massachusetts Bay Cod Spawning Protection Area and the Closed Area I N and Closed Area II spring spawning closures. The Cod Protection Closure blocks do not. Although recreational vessels can target cod, there are measures already in place through the Council's Northeast Multispecies FMP that restrict recreational catches for cod.

Comment: The Council should analyze the 15 mile/90 meter inshore Gulf of Maine area developed by the Closed Area Technical Team as a closure to gears capable of damaging juvenile habitat or disrupting spawning fish.

Response: The Council considered this alternative, which was developed by the Closed Area Technical Team, but the Habitat Committee ultimately decided not to further consider the option and moved the alternative to the considered but rejected options in the DEIS document. The Habitat Committee discussed the elimination of this option at a joint meeting with the groundfish Committee on May 17, 2013. Committee members raised concerns that the 15-mile/90-meter inshore Gulf of Maine closure would have substantial economic impacts on the inshore trawl fishery. In addition, the action would cause displaced mobile gear fishing effort that would likely be replaced by fixed mobile gear for which bycatch of groundfish was a concern. Furthermore, the Committee made clear that they did not want to designate year-round habitat closures that included state waters.

Comment: For spawning protections on Georges Bank, the Council should support Alternative 1/No Action, which includes the existing year round groundfish closures and May closure. Some commenters felt taking these areas away would reduce protections that have helped increase haddock stocks. Another comment argued that changes to year round closures would take away existing spawning areas and essentially redirect spawning fish into new areas where spawning may not occur. Other comments were in support of Alternatives 2 and 3 (just Closed Areas I and II from February 1-April 15, with Alternative 3 including the northern part of Closed Area I only). Some comments supported the addition of Option C, the scallop dredge exemption.

Response: The Council approved Georges Bank Spawning Alternative 3 (Closed Area I North and Closed Area II, Feb 1-April 15) with restrictions for various commercial and recreational fishing gears that catch groundfish, and allowance for scallop dredges. The Council's proposed

measure is the result of practicability of other alternatives, and other analysis regarding spawning protection alternatives.

Comment: The amendment should be clearer about which groundfish are protected by the preferred alternative.

Response: The Council's analysis of the biological impacts on large mesh groundfish is discussed in Volume 5, Section 2.

Comment: The Council should consider spawning protections in Great South Channel. The truly important area to protect in the Great South Channel is the habitats between 29-31 fathoms; the Council could expand protection on either side of this. The hook fishery in this area collapsed about 10 years ago, but the area was historically productive.

Response: The Council's Closed Area Technical Team (CATT) reviewed relevant literature and conducted several types of analysis to identify concentrations of large mature groundfish. The CATT also examined the consistency of these areas with maturity condition of regulated groundfish caught on seasonal surveys. Using this information, the CATT proposed consideration of several areas in the Gulf of Maine and on Georges Bank for closure during seasons when groundfish were known to spawn. The results indicated areas in the Great South Channel; however, the Council focused its spawning alternatives on variations of existing areas, and recommended continued consideration of spawning measures in future groundfish actions.

Comment: The Council's analysis of spawning times is based on thin and in some cases old data. Recent information from Canada indicates spawning on eastern Georges Bank begins on February 15. The Georges Bank seasonal closure is not a spawning closure and there are no fish spawning in that area in May.

Response: The Council agrees that more information is needed to improve spawning protections and used all information available including survey data to assess spawning times. The Council's preferred alternative would implement spawning protection areas February 1 through April 15, and does not include spawning protections in May on Georges Bank. The May Georges Bank closure was evaluated as part of Alternative 1/No Action because it restricts some types of groundfishing and therefore could have limited positive effects on fish that spawn during May.

Comment: The amendment does not advance protections for spawning fish. Spawning alternatives should include stocks besides groundfish, including Atlantic herring.

Response: The Council disagrees, because the amendment includes seasonal spawning protections measures. Direct improvement of Atlantic herring spawning opportunities is not a purpose of the amendment.

Comment: The Amendment should further develop/analyze Closed Area Technical Team spawning area proposals, and does not consider best-available science. The Council should use un-weighted hotspots for all species in further development of spawning area measures.

Response: As indicated above, the Council focused its spawning alternatives on variations of existing areas, and recommended continued consideration of spawning measures in future groundfish actions. The hotspot analysis for the spawning area measures includes weighted and unweighted information expressed in summary tables in Volume 1, Section 4.4.2 and in the impacts analysis in Volume 5, Section 2. The weighted hotspot results were used to highlight hotspots for stocks with low biomass relative to B_{MSY}.

Comment: Spawning protections should be broad in time and space to account for natural variability in spawning behaviors (including differences by age or among spawning groups) as well as climate change-related uncertainties. While protecting the act of spawning is important, spawning closures should be year-round to protect the oldest, most fecund females more generally.

Response: The Council's preferred spawning alternatives are seasonal based on spawning activity that takes place during particular time periods, typically in the spring and summer, and in some cases in the winter (i.e. Atlantic cod). Therefore, protection for spawning fish are based on their seasonal spawning patterns, while balancing the needs of the fishery by reducing effort displacement. The hotspot analysis by the Closed Area Technical Team is based on the large spawning individuals during the months where spawning activity have been observed and recorded in the literature. OHA2 does continue some existing year-round groundfish closures which should provide protection for groundfish within them during all seasons. With regards to climate change related uncertainties, while some of the seasonal closures are relatively small, such as the Gulf of Maine and Massachusetts Bay Cod Spawning Protection Areas, others including the thirty minute square rolling closure blocks cover relatively large areas. The Council can revise these measures in the future as conditions change.

Comment: The Council should consider potential benefits associated with maintaining long-term closures.

Response: The Council proposes year-round closures in each sub-region and analyzes the benefits of the existing year-round closures throughout Volumes 4 and 5 of the FEIS under Alternative 1.

Comment: Spawning protections should be addressed in this amendment vs. within Northeast Multispecies FMP.

Response: The Council has addressed spawning protection both in this action and in the Northeast Multispecies FMP. Spawning protections have been addressed recently in May 2015 through Framework 53 to the Northeast Multispecies FMP. The Council affirmed these decisions in this amendment (GOM Alternative 1A/Regulatory No Action). The Council also proposes additional spawning protection measures in the Gulf of Maine, and spawning protection on Georges Bank. Nothing in this amendment precludes adoption of additional spawning protection measures for non-gorundfish stocks in other Council FMPs.

Comment: The Amendment should address the links between forage conservation and spawning, and should fully consider the potential impacts of the amendment on herring spawning activities.

Response: Action taken through OHA2 will have limited impacts on the Atlantic herring resource because herring are a pelagic species, so measures that restrict mobile bottom-tending gears to protect seabed habitats are not expected to have much benefit for herring stocks, and herring gears are typically exempt from spawning areas. However, OHA2 measures would likely protect demersal egg beds where there is spatial overlap. This is discussed in more detail in Volume 5, Section 7 of the FEIS.

Comment: The Council should create a new suite of alternatives that uses hydroacoustics and telemetry to identify current spawning areas, rather than using data from random sampling techniques that identify historic spawning areas.

Response: Biological data, including maturation stages, are collected on NEFSC and state trawl surveys. These surveys provide accurate information regarding the reproductive status of fish through direct observations. In addition, survey information has been collected systematically for decades, and the information is updated based on dedicated sampling effort. Sampling design for these surveys are based on stratified random sampling protocols. Stations are randomly assigned based on a predetermined set of locations where effort should be focused. More focused acoustic surveys were used to identify the Masschusetts Bay Cod Spawning Protection Area, which is a preferred alternative.

6.5.4 Comments related to dedicated habitat research areas and updates to habitat management measures

Comment: The Council should support Dedicated Habitat Research Areas in general. DHRAs could lead to a better understanding of: the link between EFH and yield, and the ecological impacts of fishing. Although analytical and empirical research tools to support fisheries management already exist in the region, the establishment of experimental units to serve as reference areas is critical. Some commenters recommended that the Council adopt the Eastern Maine DHRA (Alternative 2). Others were opposed to Alternative 2, and recommended the Council adopt the sunset provision if the Eastern Maine DHRA was selected. Some commenters recommended that the Council adopt the Georges Bank DHRA (Alternative 4). Some commenters recommended that the Council should adopt the DHRA sunset provision, Alternative 5. Others felt that the timeframe for the sunset provision (three years) was too short, and that five years (or longer) would be more appropriate.

Response: The Council agrees with the commenter's statement, and proposes to establish the Georges Bank DHRA and the Western Gulf of Maine/Stellwagen Bank DHRA with a 3-year sunset provision. The three-year sunset provision would allow administrative removal without further Council action three years after implementation if no research that is designed to evaluate habitat effects of fishing had been initiated. However, the DHRA could continue after the three-year review if there are pending proposals for research within the DHRA. The Council does not propose to establish a DHRA in the Eastern Gulf of Maine. The Council proposes to establish the Small Eastern Maine HMA, and also recommends that NMFS allow habitat research projects on

commercial vessels within the HMAs contingent on approval of an exempted fishing permit. The intent of this recommendation is that research conducted in HMAs should be allowed so the Council may evaluate the success of the closed areas.

Comment: Some commenters recommended that the Council adopt the Stellwagen DHRA, Alternative 3. Some recommended selection of Option A or B (southern or northern reference areas), some did not state a preference for A, B, or C (no reference area). Other commenters recommended that the Council oppose the Stellwagen DHRA.

The following comments were submitted in support:

- Northern Reference Area will leverage existing data and is therefore a good use of resources; proposal is well developed and reasonable
- Research of this type is needed, and the proposal with reference area should be adopted despite economic impacts
- Control-impact design considers habitat types, level of use, and proximity to fishing ports, and takes advantage of the existing WGOM closure area, in that it provides an area where habitat recover has already begun
- There is no similar reference site in the Gulf of Maine
- The northern reference area is distant enough from area ports to minimally impact recreational fishing, yet is fished sufficiently to function effectively as a control-impact reference site
- Analysis of VTR data is a valid method for understanding fishing patterns at the spatial scale of the Stellwagen DHRA, and peer-reviewed studies support this assertion
- Recreational fishery harvests a large fraction of GOM cod allocations
- DHRA is consistent with SBNMS final management plan objectives
- Fishing north or south of the preferred alternative reference area would add between 1-5 nm each way to reach fishing grounds, depending on the port of departure. These distances translate into increased travel times of between 6 and 38 minutes round trip, assuming travel speeds of 15 knots.

The following comments were submitted in opposition:

- Assuming principal species of interest is cod, significant ecosystem effects resulting from recreational groundfish removals from the reference area will never be discernable, and therefore reference area will not fulfill its intended purpose. Other comments echoed concerns about tagging studies, cod residency, and functionality of the DHRA
- Impact of recreational fishery on cod and fish stocks in general is minimal.
- Recreational vessels are already unable to fish for cod for five (now six) months, and have other limitations on cod harvest.
- Cod and other resource protection important, but restrictions on recreational fishing are not needed
- Climate change is affecting cod populations, not overfishing
- Recreational fishing does not impact the seabed

- Catch shares/sectors has allowed large vessels to fish inshore in the Gulf of Maine, which has negatively impacted cod stocks
- Charter/Party fleet has already been reduced in recent years
- Studies have already been done, can be done without this designation, and there are no funds available to do studies. Emergency and Framework 53 closures provide an important opportunity to do research without further closures.
- Reference area will force recreational fishermen to travel further to reach fishable areas, which will cause economic hardship and safety concerns
- Recreational vessels will need to give the reference area a wide berth to be certain that they avoid fishing within its boundaries and being fined, etc.
- Will force fishermen on the south shore of Boston to fish north of the reference area, 40-45 miles offshore, in an area with gillnets and tub trawl gear
- Reference area will force vessels out of prime shark fishing grounds
- Reference area could force charter operators out of business due to costs of traveling further to fishing grounds, or impact customer retention due to longer steam times
- Analysis of costs vs. benefits is not realistic/valid; concerns about use of VTRs in analysis; economic impacts on the fishing community and associated businesses are understated; analysis wrongly attributes most of the profits to a very small number of vessels
- Analysis should consider the crossover between recreational and commercial sectors (i.e. vessels unable to commercially fish may shift to recreational fishing)
- Concerns about cost to develop amendment/documents, with little effort expended towards estimating fishing community impacts
- Analysis should indicate the number of recreational vessels permitted to fish in the area
- Economic influence of recreational fishery is substantial
- Closure of the DHRA reference area betrays a promise made to area fishermen when the Stellwagen Bank National Marine Sanctuary was designated. Fishing closures are not allowed per the Sanctuaries Act.
- Research should be conducted in areas that displace as little fishing effort as possible.

Response: The Council proposes to establish the Western Gulf of Maine/Stellwagen Bank DHRA without a reference area. The Council discussed concerns that the reference area would create adverse impacts to the recreational fleet, referencing the comment letters and communications from charter and recreational fishermen, which include concerns for safety and increased steam time to fishing grounds. Council members also cited concerns about establishing a reference area for research if lobster gear would be permitted, which could compromise the ability of the area to serve as a true reference, citing anecdotal evidence of cod present in lobster traps. Stellwagen Bank in general is a highly productive area, and research that allows for control impact designs could help managers to better understand why the area is so productive, which may improve fisheries management in the Western Gulf of Maine. The Western Gulf of Maine DHRA overlaps with the existing Western Gulf of Maine Habitat Closure Area, making the area ideal for control impact studies. Therefore, it is beneficial to help maintain the area for research since there has been no mobile bottom-tending gear operating in the area. DHRAs are proposed to fulfill research needs, and are not intended to be mortality closures. The Council does consider other non-fishing impacts that may adversely impact EFH, including climate change (Appendix G).

Comment: The Council should designate DHRAs in the central GOM and Great South Channel/SNE areas.

Response: The Council evaluated a large number of locations to identify potential research area sites, and analyzed three areas in the DEIS: eastern Maine, Stellwagen Bank, and Georges Bank. The Council does not propose to establish DHRAs in the central GOM and Great South Channel/SNE areas. The Western Gulf of Maine and Georges Bank DHRAs, which are the two DHRAs recommended in this amendment, are ideal areas for control impact studies given available baseline data and current closure status. In addition, the Council expressed its support for habitat research within proposed HMAs (subject to EFP approval by NMFS).

Comment: DHRA reference areas should be closed to all fishing.

Response: The Council proposes to establish the Stellwagen DHRA as a closure to mobile bottom-tending gear, sink gillnet gear, and demersal longline gear on a year round basis. The Council considered but did not adopt additional restrictions on recreational fishing in the Stellwagen DHRA. These restrictions reflect the Council's intent to maintain current restrictions on gears capable of catching groundfish and gears that operate on the seafloor. The Council proposes to establish the Georges Bank DHRA as a closure to all mobile bottom-tending gear on a year round basis.

Comment: Some commenters recommended that the Council should support the No Action approach to framework and monitoring because EFH-related measures should not be added to the list of framework-able items. Others recommended that the Council should support Alternative 2. Gear restricted areas should be reviewed every three to five years, with restrictions possibly lifted or loosened based on trigger mechanism based on stock status.

Response: To improve the efficiency of habitat management, the Council proposes Alternative 2 as its approach to framework and monitoring, which allows for changes in HMA designations and fishing restrictions to be modified through a framework action. The Council also proposes to establish a 10-year review process for habitat and spawning protection measures and identify additional data and monitoring needs. Response to stock status conditions would occur through the appropriate fishery management plan. The Council does not propose to directly manage fish stocks through OHA2 because the overall purpose of the amendment is habitat protection, spawning protection, and habitat research areas.

6.5.5 Other comments

Comment: In keeping with Agency EFH Guidelines, the Council should take a more risk adverse approach to identifying vulnerable habitat where data gaps and uncertainty exist.

Response: The Swept Area Seabed Impact model was used to identify areas of vulnerable habitat. The development of the Swept Area Seabed Impact model identified areas where data gaps currently exist. The PDT describes these gaps in data and identified information that can be collected through research to update the Swept Area Seabed Impact model. This discussion can be found in Appendix D, Section 5.3.1 and Section 12.

Comment: Benefits of conservation areas are maximized when fishing levels are minimized and the size and age of area are increased. Many of the alternatives provided reduce size of closed area and open previously closed areas.

Response: The Council does not believe that the size of a closure is necessarily indicative of the success a closure would have at meeting its goals. The Swept Area Seabed Impact analysis and groundfish hotspot analysis are some of the tools used to design closure areas by identifying areas most vulnerable to adverse fishing impacts, including complex substrates and areas for which there have been higher observations of juvenile fish and large fish. The management areas proposed in the amendment also aim to be practicable.

Comment: The status of cod proves that current habitat protection is insufficient. The Council should consider areas that specifically provide no-take areas for cod in order to improve the age structure and spawning stock biomass.

Response: The purpose and need for OHA2 is discussed in Volume 1, Section 2.1. OHA2 does not propose to implement harvesting restrictions for Council-managed species. Individual FMPs (in this case, the Northeast Multi-Species FMP) should and do include measures to improve declining stock status.

Comment: The Council should follow the example of the Pacific and North Pacific Fishery Management Councils to be precautionary to protect more area from the adverse impacts of fishing.

Response: The Council selected its final preferred alternatives based on a balance between habitat protections and impacts to managed fisheries. The Pacific and North Pacific fisheries operate different than the Northeast fisheries, and the New England Fishery Management Council must address the needs of its fisheries.

Comment: The Council needs a more flexible, nimble, and adaptive approach for incorporating habitat considerations into the FMP process.

Response: The Council's proposed measures would be codified in the appropriate fishery management plans, with the intent that updates would be considered via an omnibus approach. The Council believes this procedure is generally adaptive because it reduces duplicative effort and inconsistencies in management that would likely occur if all FMPs separately addressed habitat protection measures. This amendment does include updated framework provisions that would allow habitat areas and measures to be reconsidered in a framework adjustment vs. an amendment. Framework adjustments are somewhat streamlined in terms of administrative requirements which is expected to allow for slightly faster modifications if needed.

Comment: The amendment is overwhelmingly detailed and it is difficult to discern whether the preferred alternatives or other alternatives add to, subtract from, or eliminate areas relative to no action. The amendment document should be clearer about area sizes.

Response: The amendment is detailed so that the impacts from Council's proposed actions are thoroughly analyzed. The DEIS analyzes alternatives by subregion and goal (habitat, spawning, research). Volume 3 describes alternatives in each area, and discusses the Council's preferred alternatives in each subregion. Many of the figures and maps within the DEIS summarize the analysis discussed in the EIS. Many of the maps overlay the spatial management alternatives, including the No Action alternative, to show how the areas compare. Area sizes are noted in various locations throughout the EIS, and all maps have scale bars to indicate differences in scale.

Comment: The Council should weigh equally general public comments and comments from the fishing industry. Fishermen are conservationists/good stewards by nature as they require fish to sustain their livelihoods. The Council should carefully consider the comments of active fishermen, who are knowledgeable, responsible, and the remaining participants out of a previously larger fleet.

Response: All comments provided on the DEIS were made available to the Council prior to final action. The Council's decision-making process allows for multiple opportunities for the general public and fishing industry to comment and become involved in the management measures proposed under OHA2. In addition, cooperative research involving the fishing industry and scientists are used to help inform fishery management decisions.

Comment: The Council may wish to consider some type of science translation effort to engage the wider public in the amendment process. The Council should notify fishery participants of proposed management changes, including recreational fishermen, who often find out about management changes after they are already finalized.

Response: The Council's use of its website, public meetings, news coverage of the OHA2 process, and NMFS industry outreach letters are all opportunities available to recreational fishermen. The Council held public meetings to discuss the alternatives within the amendment, and take public comment on the proposed alternatives. The Council published a public hearing document that generally described the list of alternatives by subregion, including the no action alternatives. Council staff presented the information, and answered clarifying questions before taking comments on the DEIS. This process took place months before the Council took final action on the amendment. In addition, the public hearing meeting at Plymouth, MA was attended by 90 audience members, the majority of these audience members was recreational fishermen, or those representing the Gulf of Maine recreational fishery. For this reason, the Council does not agree with the commenter's statement that there was a lack of communication to inform recreational fishermen on the development of OHA2. The public will also be able to comment on NMFS's proposed rule regarding OHA2 regulations.

Comment: There should be better coordination between this process, ocean planning efforts, and coastal wastewater mitigation efforts.

Response: OHA2 identifies and describes non-fishing adverse impacts to habitat in Appendix G to the FEIS (summarized in section 3.5 of this volume). The Council does not have authority to implement mitigation measures for non-fishing related activities on habitat. However, the

Council may comment on proposed activities that may affect Essential Fish Habitat, and can also make recommendations to NMFS regarding mitigation measures for activities that may adversely impact EFH. The Council is involved in ocean planning efforts through membership in the Northeast Regional Plannign Body.

Comment: Nearshore areas should be left open for fishing to minimize safety concerns and provide access to fishery resources. Access to historical fishing grounds is important. The Council should protect important commercial species while minimizing economic impacts to the extent possible. The Council should continue to balance livelihoods with ecosystem management.

Response: The Council considered impacts to the fishing industry during its deliberations for final preferred alternatives. The analysis of socioeconomic impacts to the fishing industry is provided in Volume 4 of the FEIS. The Council did receive input from the industry regarding the impacts from alternatives proposed in each sub-region. During the public comment period, the Council received input from numerous fishing groups and individuals regarding their preference for closures. This information was summarized and made available to the Council before deliberations on final preferred alternatives. This summary included comments that spoke against the Stellwagen Bank DHRA reference area, where safety concerns and increased operational costs were considered. The Council did not elect the reference area, which would have negatively affected the recreational fishing industry. The Council also did not elect to designate the Bigelow Bight HMAs, which are inshore of the existing Western Gulf of Maine management areas and elicited concerns about impacts to nearshore fishing operations.

Comment: Rolling closures and trip limits are going in the wrong direction; fishermen should be able to fish where and when they choose, which will help facilitate planning for the future.

Response: During development of this amendment the Council articulated an interest in highly focused (spatially and temporally spawning closures), and may move further in this direction in the future as stocks recover. Given current conditions, this amendment maintains and modifies seasonal closure areas intended to protect groundfish spawning activity.

Comment: Closure of new areas may have few species recovery benefits, given that recovery has not occurred despite major fleet disintegration and accompanying reductions in habitat disturbance.

Response: Many factors contribute to current stock conditions and it is impossible to know what those conditions might be in the absence of area closures. The Council supports research to better inform managers on the effectiveness of closure areas, and DHRAs could help to achieve these goals.

Comment: The most effective closed areas will be sited and managed so as to achieve multiple objectives.

Response: Measures in OHA2 were proposed to meet multiple goals, which are described in Volume 1. The Council developed distinct alternatives to meet habitat protection and groundfish

spawning protection objectives during the OHA2 process. Gear restrictions and seasons appropriate to one objective are not necessarily appropriate to the other. Nonetheless, some of the areas managed in the amendment include overlapping habitat protection and spawning protection areas, for example in the western Gulf of Maine, around Cashes Ledge in the central Gulf of Maine, and on eastern Georges Bank. These three locations include either seasonal or year round areas where gears that catch groundfish are restricted to protect spawning activity, and year round areas where the use of mobile bottom-tending gears is restricted to protect seabed habitats. Having distinct designations related to spawning and habitat protection allows the Council to modify one vs. the other as management needs change. Despite the more targeted purposes of individual areas, the FEIS impacts analyses evaluate all management areas with respect to various objectives/valued ecosystem components. Many of the areas are expected to provide multiple types of benefits.

Comment: Closed areas should focus on the most vulnerable stocks, including GOM and GB cod and GB yellowtail. The Council should choose alternatives that focus on the sustained recovery of stocks and do not take risks in opening areas that are critical for supporting stock recovery. Alternatives appear to reflect a time when cod were in better condition; want to see a return to healthy stocks.

Response: Areas selected for alternatives in the DEIS was partly based on weighted hotspot analysis, which placed greater emphasis to stocks having low biomass (i.e. overfished), existence of sub-populations, a high degree of residency, and high substrate affinity. The weighting framework for habitat management areas did not include yellowtail flounder, which is generally associated with lower vulnerability, sandy habitats. The Council agrees with the commenter's statement, and has taken action through the Northeast Multispecies FMP to address declines in groundfish stocks, particularly cod.

Comment: The Council must act to protect public trust resources for future generations using all the science available. The OHA2 process represents the best opportunity available now to comprehensively identify and protect important habitat features to ensure they are available to sustain fish populations and to put fishery interests on the radar of other users of the marine environment.

Response: The Council agrees with the commenter's statement that habitat protection would be best accomplished the OHA2. These measures, if approved, would be codified in the appropriate FMPs.

Comment: Measures should protect Stellwagen Bank and Stellwagen Bank National Marine Sanctuary.

Response: The Council proposes to designate the Jeffreys Ledge/Stellwagen Bank HAPC, which overlaps with the proposed HMAs in the Western Gulf of Maine. The Council proposes to maintain the Western Gulf of Maine Habitat Closure Area, with restrictions on all mobile bottom-tending gears, with the addition of a new exemption area for shrimp trawl gear in the northwest corner, beyond the boundaries of the Sanctuary.

Comment: The Council should consider artificial reefs and habitat restoration.

Response: Essential Fish Habitat designations identifies all habitat types utilized by fish at different stages of life, including artificial reefs (Refer to Volume 2, Section 2). However, OHA2 does not intend to protect artificial reefs nor restore habitat. The goals and objectives of the amendment are discussed in Volume 1, Section 2.1.

Comment: Closures are the only 100% effective tool available to NMFS; observer monitoring of fishing is less effective. Enforcement is critical to ensure compliance with regulations.

Response: OHA2 measures include closures to protect habitat and spawning. Observer monitoring requirements are addressed elsewhere in the Council process, and no changes to these requirements are included in the OHA2 proposed measures. The Council agrees with the commenter's statement regarding the importance of enforcement to legitimize closure areas.

Comment: Closures contain large cod and large spawning fish in general and the protection of these fish is important.

Response: The Council agrees that protections for cod are important, and OHA2 proposes to implement closure areas on a year round basis to protect juvenile cod and other groundfish species. OHA2 also proposes to protect spawning activity for cod and other groundfish. In addition, the Council has taken action through the Northeast Multispecies FMP to address the declining cod stock, including measures to reduce mortality of cod.

Comment: If closed areas are altered by the amendment, the Council should consider any adjustments as an experiment and commit to supporting research to study the effects of dynamic closed area management on groundfish abundance and ecology.

Response: The Council supports habitat research to better inform management decisions, which may include before and after controlled studies within the Council's proposed DHRAs. Proposed changes to HMAs are not experimental, but the Council's monitoring approach and research goals are expected to improve habitat information. Improvements in habitat research and information would better inform management decisions.

Comment: The amendment has developed an overly narrow definition of habitat to include the seafloor substrates but not the water column or other marine life (forage fish, sponges, and other epibenthic fauna).

Response: EFH designations proposed in this amendment describe the habitat requirements of managed species comprehensively, including information about water column vs. seabed use, preferred water temperature and salinity, and any important associations with benthic fauna. The Swept Area Seabed Impact analysis used to evaluate and map habitat vulnerability is based on both underlying seafloor substrates as well as the structure-forming epifauna typically living on those substrates. Substrate distributes were often a focus of the Council's discussions because they are readily mapped. Management of adverse effects is based on mitigating impacts from fishing that are more than minimal and not temporary. The Swept Area Seabed Impact analysis

makes an explicit, and the Council would argue, reasonable, assumption that the impacts of fishing on the water column are minimal. Thus, the focus of management measures is the seabed vs. the water column.

Comment: The Council and NMFS must select alternatives that meet goals and objectives of the amendment, within each sub-region. The amendment document should provide justification on how the preferred alternatives meet the goals and objectives in the Amendment.

Response: Essential Fish Habitat regulations apply within a broad regional context, where impacts should be mitigated overall. Analysis of the cumulative effects from fishing on Essential Fish Habitat is used to develop alternatives to mitigate fishery impacts. Volume 6, Section 3 contains the cumulative effects analysis used to justify a suite of alternatives for habitat protection in each subregion that, as a whole, meet the goals and objectives for the amendment.

Comment: The Council's fishery management should strive for high CPUE and maximum efficiency per bottom impact.

Response: This position is generally consistent with the Council's approach to management, but efficiency is not the only metric by which management actions are judged. While increased bottom fishing time would likely increase damage to the seafloor, habitat management areas tend to be more vulnerable to fishing impacts than the region as a whole. Therefore, effort displacement from habitat management areas would likely mean fishing effort becomes concentrated in less vulnerable habitats.

Comment: Analyses in this amendment assume that catch limits will be sufficient to prevent overfishing. Annual catch limits reduce, but do not eliminate, the need for closed areas to limit fishing mortality. Closed areas act as insurance policies against stock assessment errors.

Response: One of the original goals for the existing groundfish closed areas was to reduce fishing mortality of overfished stocks. However, OHA2 does not propose to implement measures directly aimed at preventing overfishing. In this amendment, the Council proposes to maintain the Western Gulf of Maine Closure Area and Cashes Ledge Closure Area on a year-round basis, and Closed Area I North and Closed Area II as seasonal closures, to protect essential fish habitat that fish rely on to survive and reproduce.

Comment: The Council should carefully question both the applicability of previous fishing impacts research to Georges Bank and the merits of the commonly employed management structures of closed areas and gear prohibitions to avoid self-validating loops associated with their policy actions.

Response: The Council reviewed a wide array of fishing impacts literature during SASI model development, and has incorporated more recent scientific information about fishing impacts into the FEIS as appropriate. The amendment includes a provision to conduct a comprehensive review of area management on a ten year schedule.

Comment: The Council should explicitly state the goals of the management system and set a research plan to determine if goals are being achieved**.**

Response: Volume 1, Section 3.2 of the FEIS goes into details regarding the goals for OHA2, including review and revision of the EFH designations (Purpose A), the development of actions needed to minimize the adverse effects of fishing on EFH (Purpose B), and the identification of other actions to conserve and enhance EFH (Purpose C), which includes proposed designations for DHRAs and HAPCs. The Council proposes to monitor the HMAs for effectiveness, and supports research to better inform management decisions.

Comment: Given uncertainties about the distribution and abundance of juvenile fish, closures are high risk because they may create unintended consequences. The Council should mitigate risk by developing ongoing data streams that directly address key questions.

Response: The Council agrees that closures may have unanticipated effects, and supports collection of additional data streams that will allow future actions to be better informed. Although the Council does not have direct data collection responsibilities, the amendment suggests new data sources that would help to monitor the effectiveness of the closures.

Comment: Make better use of information on the productive capacity of EFH in the stock assessment process. The Council should not assume that productive capacity will remain static given changing management regimes and environmental baselines.

Response: The Council does not have direct responsibility for stock assessments, although it does comment on terms of reference. The Council supports habitat research within HMAs and DHRAs, which would improve understanding of the ecological effects of fishing across a range of habitats, and ultimately improve model forecasts and inform future habitat management. This information could also be used to update model information used in stock assessment, if appropriate.

Comment: The NEFSC bottom trawl survey could be augmented to provide ecosystem monitoring information, and the NEFSC Ecosystem Assessment Group could convert data into products for use by the Council.

Response: The Council has an active Ecosystem Based Fisheries Management Committee and Plan Development Team and these groups are evaluating data products, including NEFSC surveys, for use in EBFM. NEFSC scientists are involved in the process via the PDT.

Comment: The Council's focus should be on understanding fish populations, particularly spawning aggregations, first, followed by spatial areas as appropriate. Spawning aggregations should be identified with telemetry and acoustics vs. trawl surveys that are not sufficiently precise. Fishermen should be hired to collect necessary data.

Response: Volume 5, Section 2.1.1.2 includes groundfish spawning analysis, which identifies hotspots of large, older, spawner groundfish, using survey weight per tow of the largest fish contributing to 20% of total biomass for each species during 2002-2012. Telemetry and acoustic

information has only been recently used on surveys, and require accompanying tows to collect biological samples of fish encountered during surveys. There are opportunities for fishermen to participate in cooperative research, which is sometimes used in stock assessments (i.e. scallop research set-aside projects). One new area proposed in this amendment, the Massachusetts Bay Spawning Protection Area, was developed based on acoustic information to encompass fairly precisely a specific population of winter spawning cod. In the absence of data to identify all spawning aggregations, the larger and more generalized spawning management areas included in this amendment are expected to provide protection for spawning fish.

Comment: The Council has ignored the best available science on juvenile and spawning groundfish protections. The amendment should but does not address rigorously the percentage of hotspots that need to be protected; the Council should involve SSC in this determination.

Response: The Council believes that the analysis for OHA2 was performed using the best available science. Substantive analytical tools are described in Volume 6, Section 7.6. At various points during the development of this amendment. The Council, Habitat Committee, Groundfish Committee, Habitat Plan Development Team, and Closed Area Technical Team discussed the issue of how much protection is enough. There are no analytical models that provide a clear answer to this question, and the comment is correct in that such an approach was not developed. However, an objective of the amendment is to improve habitat protection for groundfish stocks. This would suggest that an appropriate metric is that the alternatives selected in the amendment should increase the amount of hotspots protected. This metric (number of hotspots encompassed, and their relative weighting/species composition) is considered as part of the impacts analysis in Volume 5, section 2.

Comment: The impacts analysis should consider goals and objectives of this amendment as well as the goals and objectives of the Council's FMPs in general.

Response: The impacts analysis does consider the alternatives as they relate to the overall goals of OHA2. The FMP goals are analyzed within FMPs as they relate to existing or proposed regulations. FEIS analysis considers impacts to the managed resources themselves, but does not consider how OHA2 action would meet the goals outlined in separate FMPs; these types of analysis are not directly applicable to the goals outlined in OHA2.

Comment: The socio-economic analysis is lacking in that it does not consider the benefits of protecting wild places and things, or the economic multiplier effect recreational and commercial fishing have on local communities. The analysis does not adequately discuss potential revenue gains from opening existing closed areas. A behavioral model of fishing would generate more accurate estimates of impacts than the revenue "upper bound" of impacts currently used. The analysis does not model responses of fishermen to new habitat protection measures. A relatively low discount rate should be applied when assessing inter-temporal trade-offs. The precautionary approach to fishery management suggests that hedging, i.e. diversification, is an important paradigm which is not fully considered in the document.

Response: There are three main technical points expressed in this comment letter, which focused specifically on the economic analysis employed. The first point is that a behavioral model of

fishing would generate more accurate estimates of impacts than the revenue "upper bound" of impacts currently used. The second is a view that a relatively low discount rate should be applied when assessing intertemporal trade-offs. The third is that the precautionary approach to fishery management suggests that hedging, i.e. diversification, is an important paradigm which is not fully considered in the document. Each of these points is discussed in detail below.

The current analysis employed in assessing the commercial fishery costs of alternatives on human communities and the fishery relies on historical revenue estimates for the areas of interest currently open to fishing. This presents an upper bound for the impact of these alternatives on fishermen affected by each alternative. The extent to which the upper bound serves as a good proxy for actual impacts will depend on the exact fishery considered, and the ability of affected individuals to replace trips that would no longer be feasible.

The comment correctly points out that a behavioral model of fleet dynamics would provide better estimates of the actual welfare impacts of alternatives under consideration. Where existing behavioral models could easily be tailored to fit the analysis of alternatives, this was done. Specifically, the Scallop PDT employed the Scallop Area Management Simulator (SAMS) model to estimate total welfare impacts of 5 scenarios. For more details see the Scallop Fishery Economic Results discussion in the Volume 5, section 6.

Development of new location choice models in time to inform fishery managers is not possible. There are currently five sub-regions considered within the DEIS, with a total of 29 habitat management alternatives, 6 spawning protection area alternatives, and 5 alternatives to designate Dedicated Habitat Research Areas. Combined, these area management alternatives encompass 52 unique areas (40 Habitat Management areas, 9 spawning protection management areas, and 3 DHRAs). Further, there are a total of 110 different options (91 Habitat management options, 11 spawning protection management options, and 7 DHRA options) under consideration, which vary the gears affected by and duration of the management areas. At the very least, there are 10 different fleets that would need to be treated separately in the models, given the differential restrictions of the options under consideration. This lower bound would likely need to be increased, in order to acknowledge differences in gear catchability. For example, bottom trawls and Ruhle/Separator trawls would likely need to be treated separately due to differences in the mix of species that are caught by each gear. The permutations that would need to be separately modeled could easily reach into the thousands.

The Council could decide to focus a modeling endeavor on a subset of fleets and alternatives/options under consideration. However, there are still serious methodological issues that would need to be addressed in the development of new quantitative models of fishing behavior. Current state-of-the art in location choice models requires construction of expected profits in all feasible fishing areas. Data to support these models simply does not exist for areas that are currently closed because those areas are closed. Simulations could be used to generate predictions for the fishing activities that likely to occur in currently closed areas. However, the simulations would be sensitive to a number of key modeling assumptions that would be necessary. These include, but are not limited to, the relative distribution of fish inside versus outside the currently unfished areas, and how that distribution affects catch per unit effort, most preferably at the species level. The lack of biological survey tows within currently closed areas

has already been highlighted as problematic in understanding the benefits associated with closed area management. For unfished areas falling across multiple survey strata, the biological data needs to be post-stratified in order to generate unbiased biomass estimates, further complicating the analysis. These technical issues ultimately lead to a qualitative biological assessment of the expected impacts of management alternatives on groundfish stocks within the OHA2 EIS. A quantitative estimate of biomass would greatly benefit the development of scenarios for modeling fishermen behavior, and could be used to assess the relative impact of opening these areas to fishing through Monte-Carlo simulations. However, a substantial effort would be necessary to generate these estimates. Developing these models in time inform fishery managers is not possible.

The current analysis does look to identify along which margin, i.e. increased revenue or decreased costs of fishing, any benefits that could be generated from fishing in currently closed areas. The relative magnitudes of these benefits are also qualitatively described, as well as whether the area is likely to displace local effort, or engender an additional influx of effort "off the dock."

As the commenter correctly points out, whenever short-term and long-term trade-offs are to be made, the time horizon and discount rate utilized has the potential to impact the net present value of expected benefits for alternatives/options under consideration. The Office of Management and Budget's Circular A-4 (http://www.whitehouse.gov/omb/circulars_a004_a-4/) indicates that 3% and 7% discount rates should be used for regulatory analysis, and these are the rates currently employed in the Scallop PDT's SAMS modeling results. However, the majority of the economic analyses conducted are qualitative, which does not allow a rigorous discounting of short-term and long-term net benefits. The analysis therefore does not attempt to net these benefits across the two periods, and instead discusses short-term and long-term impacts separately. An explicit discussion of the role discounting plays in the netting of benefits is incorporated in the discussion of alternatives/options in which the short-term and long-term expected benefits differ in sign. The discussion identifies what role the choice of discount rate (low or high) would ultimately play in the netting of short-term and long-term benefits.

Finally, the precautionary approach to fisheries management does suggest risk aversion is an appropriate paradigm from which to consider impacts from various alternatives. This FEIS does attempt to categorize the major sources of uncertainty in order to better inform the Council's ultimate policy decision, and future drafts will further develop these discussions. However, risk aversion is by nature subjective, meaning there is no objective answer for defining the optimal level of risk and the council will need to decide what risk-reward trade-off is practicable. Additionally, the risk associated with not achieving biological objectives (i.e. deviations from MSY) does not necessarily correspond to risk aversion in economic terms. Optimal hedging strategies in economics, for example using modern portfolio theory, depend on minimizing the risk of achieving a target return (or benefit flow) from a portfolio of assets. This is often couched in terms of a mean-variance trade-off, although other distributional considerations are equally valid. Regardless, a given portfolio's risk profile is an empirical question. Diversification from one asset, which in this case would correspond to returns from a specific species or fishery, into another cannot be assumed to universally guarantee a decreased risk profile in economic terms. Although models aimed at elucidating this risk-reward trade-off within fisheries under NEFMC

management are under development (see for example Jin, DePiper, and Hoagland 2014), these will not be completed in time to inform decisions in the current amendment.

Comment: Analysis of impacts omits consideration of the unintended consequences that result from effort displacement associated with existing or new areas.

Response: Analysis of effort displacement impacts is discussed in Volume 4, Section 2.1.1.

Comment: Impacts analysis should more fully incorporate results of EFH overlap analysis.

Response: The Council agrees and the FEIS has been updated (see Volume 4, Section 3).

Comment: The Council should update realized adverse effect metric from SASI model to include more recent years (through 2013) to assist with decision making.

Response: The PDT considered the possibility of updating the dataset for the SASI realized z-scores (adverse effects, currently available for 1996-2009). The PDT concluded that given the large number of caveats about the interpretation of these results, data through 2009 would be sufficient to understand the general distribution of habitat impacts throughout the region. They agreed that updating the data set to include additional years of data would be interesting, to see more recent trends, but was not going to be worth the effort required to do so.

Comment: The purpose of 1996 SFA amendments is to give conservation of fisheries priority over short-term economic interests. There is a mandate for action when fishing activities causes more than minimal impacts to EFH, and the threshold compelling action to protect EFH is low. Where uncertainty is high, precaution is warranted.

Response: The Council agrees that EFH regulations within the Magnuson-Stevens Act require action to minimize adverse fishing impacts to EFH. For this reason, the Council proposes management measures in OHA2 to mitigate adverse impacts on EFH.

Comment: The term ‘practicability standard’ is inappropriately used in the DEIS. The practicability analysis is not an adequate basis for understanding long-term costs and benefits. Practicability does not mean ‘anything possible’ as an alternative – there should be habitat and economic benefits. The impacts analysis should weigh economic impacts with stock and productivity impacts.

Response: The Council agrees that the word ‘standard’ could imply a legal standard, which was not the intention of the language in the DEIS. The section has been edited. The practicability analysis in the DEIS was intended to help the Council understand major tradeoffs associated with various management approaches. However, the detailed impacts analysis evaluating impacts across all valued ecosystem components should be used to fully understand tradeoffs associated with the Council’s proposed action and other alternatives. The Council agrees that measures should consider habitat and economic benfits. The Council considered the practicability of its mitigation measures when making final decisions.

Comment: The Magnuson-Stevens Act requires plans to achieve optimum yield, and this requires access to fishing grounds and the gear necessary to catch fish. Fishermen should be able to fish efficiently in ways that minimize costs.

Response: One of the purposes of the amendment is to achieve optimum yield, by proposing management measures that would likely increase species productivity and improve the overall health of fish stocks. Impacts to the fishing industry are considered in the FEIS analysis. There have been efforts in the OHA2 development process to minimize impacts to the fishery industry, and the Council's proposed measures are a reflection of the balance of these two goals, increased optimum yield and maintaining access to fishing grounds.

Comment: The preferred alternatives do not meet MSA requirements to describe and identify EFH, minimize adverse effects of fishing on EFH to the extent practicable, and update and improve such actions at least every five years.

Response: Compliance with Essential Fish Habitat regulations is discussed is Volume 6, Section 3. This includes a summary of actions proposed by the Council to address regulatory requirements to reduce adverse fishing impacts using practicable management measures. The Council proposes monitoring measures that include a ten-year review. The ten year review is suggested because enough time needs to pass to gather sufficient data and information to analyze the effects of area closures and expect statistically significant changes in fish populations. Recent research has suggested that a minimum of three generation times are needed to see population changes due to closed areas (Moffitt et al. 2013).

Comment: Technical advice was not adequately considered and range of alternatives is inadequate. Many alternatives discussed earlier in the process of amendment development were arbitrarily rejected prior to analysis. As a result, several alternatives analyzed in the DEIS are at odds with the purpose, intent, and requirements of the MSA's EFH provisions, for example the no closure, gear modification, and clam dredge exemption alternatives. The "No closure" alternative is not only legally infeasible and therefore inappropriate for the DEIS, but it also has the effect of skewing the starting range of alternatives at such an extreme end of the scale that the breadth of the remaining alternatives is severely narrowed to the point of failing to comply with NEPA mandates.

Response: The range of alternatives in the DEIS is broad, and includes No Closures, existing closures, and a range of alternatives that are more restrictive than current measures, to alternatives that are less restrictive but more efficient at habitat protection. The Council considered other alternatives prior to development of the DEIS, but eventually chose to reject these alternatives, largely due to practicability considerations. The Council does not propose to implement the no closure alternative for any of the sub-regions. Alternatives are compared to one another, so that the analysis does not overly focus on the extreme ends of the spectrum for alternatives under consideration.

Comment: The Georges Bank spawning alternatives and habitat alternatives in various sub-regions do not include an alternative to increase protection from status quo, and thus are not in compliance with NEPA.

Response: The Council's proposed habitat management alternatives, spawning alternatives, and DHRA on Georges Bank as an entire suite of management measures, are expected to improve habitat protections. Analysis supports this claim, and is available within the FEIS, Volume 6: Cumulative Impacts Section. Compliance with NEPA is discussed in Volume 6, Section 6.

Comment: The NEPA process requires a federal agency such as NOAA Fisheries to take a "hard look" at the potential environmental impacts associated with its proposed action as well as fully investigating alternative actions that might reduce or mitigate those impacts. The DEIS for this Amendment fails to meet these fundamental NEPA requirements. Many of the alternatives that were discussed by Council staff and are in the record of this DEIS have simply been discarded out of hand for analysis by the NEFMC without explanation. The Council has allowed its process to be overly influenced by members of the industry, including Council members themselves, whose self-interested and anecdotal input in the process of developing alternatives rendered alternatives that are a mere shadow of what the science and staff advisors originally put forth, not to mention current conditions. These significant modifications to proposed alternatives occurred prior to, and without the guidance of, any analysis of the potential impacts or the practicability of the proposed alternatives. The result of that process is that several alternatives are inherently at odds with the purpose, intent and requirements of the MSA's EFH provisions, including the "no closure," gear modification alternatives and the surf clam dredge options.

Response: In addition to the alternatives analyzed in this environmental impact statement, additional management approaches were considered by the Plan Development Team, Closed Area Technical Team, Habitat and Groundfish Committees, and the Council. The alternatives in both the draft and final EIS represent a broad range, and include measures that are both more and less conservative than No Action with regards to habitat protection. The impacts analysis provided in this document considers this range of alternatives with respect to a variety of valued ecosystem components, and the Council believes this analysis constitutes a hard look at potential impacts.

Comment: Opening refugia to allow more fishing is not a legally defensible way to enhance EFH or rebuild depleted fish populations. The failure to provide a reasonable range of alternatives, including at least one that contemplates enhancement of EFH, does not comply with NEPA.

Response: The impacts of reopening existing areas are evaluated in the FEIS, including any tradeoffs associated with differences between No Action and preferred management areas. The FEIS describes net benefits to fishing communities, EFH, and managed resources associated with any area openings.

Comment: Some of the comparisons between alternatives are inconsistent, which makes review of the DEIS confusing and limits its usefulness as a decision making tool.

Response: Any inconsistencies within the DEIS are addressed in the FEIS.

Comment: Grouping of the no action habitat management alternatives in the large-mesh groundfish analysis is inappropriate given the analysis be sub-region in other sections of the DEIS.

Response: The large mesh groundfish analysis was updated for Volume 5, Section 2.1 of the FEIS to be more consistent with the analsyis for other valued ecosystem components.

Comment: Habitat protection should be integrated within an Ecosystem Based Fishery Management (EBFM) approach. EBFM would allow management of fish stocks on smaller spatial and temporal scales.

Response: The Council agrees, and is in the early stages of work on ecosystem based fishery management approaches and through an active EBFM Committee and Plan Development Team.

Comment: Ecosystem overfishing combined with climate change is causing a cascade of permanent adverse effects that are increasingly affecting marine ecosystems in New England. Habitat protections can help fish cope with changing environmental conditions, and good habitat areas will likely be good habitats in the future, although perhaps for different stock.

Response: The Council agrees that habitat protections could help improve the overall health and thereby resilience of fish stocks. Habitat management areas are generally intended as long-term measures, and it is hoped that they will provide positive benefits even as their overlaps with target stocks change. Climate change impacts are discussed briefly in section 2.

Comment: The Council should maintain restrictions on fishing in the Cashes Ledge Closure Area, in order to mitigate against ecological factors are contributing to stock declines. These include the loss of anadromous prey, related to both the large number of dams on rivers in the Gulf of Maine watershed without fish passages, and the impacts of increasing freshwater inflows on zooplankton populations in the Gulf of Maine.

Response: The habitat and spawning protection measures may help rebuild fish stocks, but the Council does not have a direct role in habitat restoration. The Council agreed that it was important to maintain the Cashes Ledge Closure Area as-is in this amendment.

Comment: Seals, dogfish, and cormorants are consuming juvenile fish and their populations should be reduced.

Response: OHA2 proposes measures are intented to protect habitat and spawning activity and facilitate research. They do not include regulation of species that may or may not have exceeded carrying capacity. In addition, shorebirds and seals are not regulated by the Council (they are protected by the U.S. Fish and Wildlife Service and NMFS, respectively); therefore, efforts to control their population sizes are not appropriate for OHA2 or other Council actions.

Comment: Given concerns about marine mammals, the Council should support Alternative 1/No Action in all cases, with the exception of the eastern Gulf of Maine, where Alternative 2 would

be acceptable. Reduction in the size or number of current closed areas will increase risk of entanglement-related injury or mortality for protected species including mammals and turtles.

Response: The Council's proposed measures are a reflection of the Council's intent to balance habitat protection needs with the needs of the fishing industry. Reductions in the size of closures do not necessarily mean that there would be an increase of injuries to marine mammals and sea turtles. OHA2 does not propose to exempt fisheries from existing measures to protect marine mammals and sea turtles. Therefore, existing management measures implemented specifically for protected resource conservation should mitigate any impacts that OHA2 has on the protected resources included in those plans (large whales and porpoises).

Comment: The amendment should include alternatives to restrict the use of gillnets in areas important for marine mammals, such as the western Gulf of Maine and the Great South Channel. The amendment does not include mitigation measures.

Response: Marine mammal mitigation measures are implemented through NMFS, and the purpose of this is amendment is not to propose mitigation measures for marine mammals in the gillnet fishery. However, existing management measures implemented specifically for marine mammal protection should mitigate any impacts that OHA2 has on existing mitigation measures. Existing marine mammal protection measures do currently exist under the Atlantic Large Whale Take Reduction Plan (2010), which includes gear restricted areas in the Great South Channel and the Western Gulf of Maine, Stellwagen Bank.

Comment: The analyses in the DEIS should be revised to address the following concerns related to marine mammals:

- The DEIS does not adequately consider adverse impacts to marine mammals caused by reopening closed areas.
- Although it acknowledges potential negative impacts, the DEIS analysis inappropriately minimizes risk to protected species and the language in the DEIS lacks adequate specificity.

Response: Analysis of the potential impacts to marine mammals and other protected resources is discussed in Volume 4, Section 5, and was revised for the final EIS to include additional rationale.

Comment: Stock-specific information is missing from the DEIS (e.g. key caveats in stock assessments) and analyses should be more explicit in identifying potential effects by species, rather than lumping various protected resources together.

Response: The impacts of OHA2 on marine mammals, sea turtles, and protected marine fish are analyzed in Volume 4, Section 5, and discussion is provided at the species level whenever possible. The impacts analysis considers potential species interactions based on information regarding species range and identifies those species whose range fall within a habitat protection area or areas that may be re-opened under OHA2. In addition, NMFS will complete a Section 7 program consultation as required for Federal management actions that may have advese impact

to species protected under the Endangered Species Act, which includes endangered and threatened protected species.

Comment: The DEIS does not discuss the willingness of industry to fish illegally in the closed areas.

Response: Closure areas are enforced by NOAA's Office of Law Enforcement for non-compliance with Federal fishing regulations, including closed areas. OHA2 does not propose changes to the manner in which non-compliance issues are addressed. Cases of violations are also handled by NOAA's Office of Law Enforcement.

Comment: The cumulative effects analysis is deficient. The EIS should not assume uniform spatial or temporal distribution of protected resources. The Council should review NMFS co-occurrence models. Maps in the DEIS need clearer legends/explanation and should incorporate additional sources of and more recent data.

Response: NMFS's Section 7 review would make a determination on whether the proposed action (OHA2) would jeopardize the continued existence of threatened or endangered marine species. Therefore, information regarding species range and impacts resulting from the proposed action would be addressed in more detail during NMFS's Section 7 consultation process. Analysis of impacts to protected resources has also been updated in the FEIS (refer to Volume 4, Section 5).

Comment: The DEIS includes inappropriate assumptions about direction of impacts given uncertainty about effort shifts.

Response: The potential for effort shift in relation to protected resource impacts is analyzed in Volume 5, Section 5.

Comment: The EIS should acknowledge that trends for large whales are in the direction of more frequent winter usage of the Gulf of Maine.

Response: Analysis of impacts to whales addresses this issue in Volume 4, Section 5.

Comment: Reliance on existing take reduction plans for harbor porpoise and Atlantic large whales is inappropriate and risk prone. The latest ALWTRP does not address gillnet risk nor does it require additional mitigation measures for gillnets. If areas are eliminated, ALWTRP and HPTRP should be amended as they will no longer reflect existing fisheries management. NMFS should also initiate Section 7 consultation under the ESA. The HPTRP has not met its own long term mandates under MMPA. FMP amendments cannot allow increased risk to endangered whales, which are already sustaining entanglement-related mortality and serious injury in excess of their statutorily mandated potential biological removals.

Response: OHA2 actions are not expected to increase the risk to endangered whales. Existing management measures implemented specifically for protected resource conservation should mitigate any impacts that OHA2 has on the protected resources included in those plans (large

whales and porpoises). NMFS will determine whether an informal Section 7 consultation, or a formal Biological Opinion is necessary to consider impacts to endangered species. OHA2 measures are not expected to jeopardize the continued existence of ESA-listed species. OHA2 is not expected to jeopardize critical habitat important to ESA-listed marine mammals.

Comment: Reduction in the size or number of current closed areas will increase the risk of entanglement-related injury or mortality for protected species, including mammals and turtles.

Response: The habitat and groundfish closed areas have been in place for almost 20 years. As a result, there is no history of bycatch/entanglement data in these areas over this timeframe, and therefore, no basis on which we can evaluate potential risks and impacts to protected species (ESA listed and non-listed species of marine mammals, sea turtles, or fish) from opening or reducing the size of existing closed areas. This lack of data results in an inability to accurately forecast what entanglement risks will exist if the closures are opened and therefore, quantify the potential effects to protected species from the proposed modifications to these closed areas. However, opening or changing the size of closed areas will likely result in some shifting of effort. It is not possible to accurately predict those shifts or the impact on protected species. Relative to current operating conditions in and around the closed areas, we do not expect overall fishing effort to be significantly different. This shift may result in several different scenarios. Volume 4, Section 5 includes detailed discussion of these potential scenarios and the range of impacts to protected species from those different scenarios.

Comment: The Amendment should include alternative to restrict the use of gillnets in areas important for marine mammals, and that the latest iteration of the Atlantic Large Whale Take Reduction Plan does not address gillnet risk, even though gillnets are the gear type most likely to interact with marine mammals in the U.S. and are the gear type associated for 84% of cetacean bycatch in the United States. The comment also stated that the status quo alternatives are the only alternatives that can adequately protect marine mammals.

Response: The purpose of the amendment does not include protections for marine mammals. Information regarding the purpose and need for this action is discussed in Volume 1, Section 2.1. The statute under which measures to minimize gillnet interaction with marine mammals is the Marine Mammal Protection Act. These activities have, and will continue to be, implemented through the Atlantic Large Whale and Harbor Porpoise Take Reduction Plans. Further, the Atlantic Large Whale Take Reduction Team did consider, but determined it was unnecessary, to implement additional regulatory and management measures for gillnets.

It is important to note that the purpose of the habitat and groundfish closed areas is not to protect marine mammals. While there may be an ancillary benefit to marine mammals from those closed areas, adequate protection of marine mammals, with or without these closures, exists under the regulations and management areas established under the Take Reduction Plans.

Comment: A comment stated that any reliance on a take reduction plan that has been inadequate to date to mitigate gillnet risk, and will not in any way address risk from gillnets when the new Atlantic Large Whale Take Reduction Plan goes into effect in mid-2015, is risk prone.

Response: Both the Atlantic Large Whale Take Reduction Plan, including the most recent modification, and the Harbor Porpoise Take Reduction Plans have been determined to be adequate in mitigating gillnet risk and interaction with marine mammals.

Comment: If existing areas are eliminated, Atlantic Large Whale Take Reduction Plan and the Harbor Porpoise Take Reduction Plan should be amended as they will no longer reflect existing fisheries management. The comment also stated that the DEIS did not include any Reasonable and Prudent Measures, and that the changes proposed would require a re-initiation of the Biological Opinion for all the Council's FMPs.

Response: The Take Reduction Teams will be responsible for determining what, if any, adjustments to management measures should occur upon implementation of these changes if new information indicates that additional interaction risks to marine mammals are occurring. Neither Take Reduction Plan is predicated on the fishery management closures, and in fact, many gear restriction areas in the Take Reduction Plans overlap with existing closures, providing for continued management under MMPA, even if the closed areas are removed.

Further, this Amendment is not required to provide reasonable and prudent measures, nor do the changes proposed automatically require re-initiation of a Section 7 consultation. The Magnuson Act has no authority to prescribe "reasonable and prudent measures;" development of such measures is done during the Endangered Species Act Section 7 consultation process. Specifically, RPMs are prescribed in association with the incidental take statement issued for the specific action under consultation.

Reinitiation of consultation is only required under the Endangered Species Act if the following triggers have been met: (1) The amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action (for further details see 50 CFR 402.16).

The key to trigger "3," referenced in the comment, is not that the action has been modified in a manner not considered, but modified in a manner that causes effects to listed species not considered in the Opinion. As a result, NMFS will determine if the proposed action modifies the management program in such a way to cause effects to listed species not previously considered. This is done through the Section 7 consultation process after the Council submits the action to NMFS.

Comment: Several commenters expressed concern over the protected species maps provided in the DEIS.

Response: Because the maps could be confusing, they have been removed and the section was modified to reflect the best available information instead of maps and will provide a comprehensive overview of species distribution and occurrence in the affected area. This level of detail will be more informative than maps alone would provide. The analysis provided in the

FEIS references distribution maps found at the following locations: http://seamap.env.duke.edu/, http://cetsound.noaa.gov/cda, http://www.nefsc.noaa.gov/psb/surveys/, http://www.nmfs.noaa.gov/pr/sars/pdf/ao2013_tm228.pdf

Comment: The Council should put deep-sea coral alternatives back in this amendment rather than in a separate action, and protect deep sea corals in Maine. Specifically, the Council should protect corals in the near-shore waters of eastern Maine.

Response: The Council chose to develop protection measures for deep sea corals in a separate amendment. The Deep Sea Coral Amendment would address protections for deep-sea corals located within the Council's jurisdiction. The Counil will provide opportunities to comment on the range of alternatives identified for the Deep Sea Coral Amendment.

7 Relationship to other applicable law

7.1 Marine Mammal Protection Act

Pursuant of 50 C.F.R. 229.1 through 50 C.F.R. 229.4, the Marine Mammal Protection Act (MMPA) allows for the lawful incidental take of marine mammals on commercial fishing trips under the exemption to the moratorium on the take of marine mammals. However, mitigation measures to reduce the incidental mortality of marine mammals are implemented through the Atlantic Large Whale Take Reduction Plan and the Harbor Porpoise Take Reduction Plan. The Act also applies monitoring requirements and reporting requirements. Analysis of impacts to protected resources, particularly marine mammals, is discussed in Volume 4, Sections 2.2.3, 2.3.3, and 2.4.3 for spatial management alternatives, spawning alternatives, and DHRA alternatives respectively. Based on the Council's preferred alternatives in each sub-region, impacts to marine mammals are expected to be minimal. MMPA regulations will continue to apply to the Northeast fisheries (e.g., gillnet and trap/pot). Therefore, actions taken in the habitat amendment, if conflicting, do not alter the restrictions that apply to these fisheries. If action alternatives do alter fishing behavior to increase fixed gear effort in areas proposed as MBTG closures, then mitigation measures, if deemed necessary, would be developed under the Atlantic Large Whale Take Reduction Plan and the Harbor Porpoise Take Reduction Plan. The Council has reviewed the impacts to marine mammals and concluded that the proposed actions under OHA2 are consistent with the MMPA regulations.

7.2 Endangered Species Act

The Endangered Species Act of 1973 (ESA) requires additional protections for those species listed as endangered or threatened, by designating critical habitat for these species, and implementing a prohibition on the "take" of species listed under the ESA. The Council has management jurisdiction for the Gulf of Maine Atlantic Salmon Distinct Population Segment, listed as endangered in 2000. There is currently a moratorium on the harvest of Atlantic salmon and the Council's Atlantic salmon HAPC includes critical habitat identified pursuant to the ESA. In addition, there is an ongoing rebuilding plan for the Atlantic salmon population. OHA2 does not propose to make any changes to the designation of the Atlantic Salmon HAPC, and does not propose action that would further threaten the health of the Atlantic salmon DPS in the Gulf of Maine.

Regulations require Federal agencies to consult with NMFS if actions are expected to impact ESA-listed species. NMFS' Section 7 consultations process is intended to assess the risk of harm to endangered species by considering the impacts from Federal actions. If actions are expected to adversely affect ESA-listed species, formal consulation is conducted to determine if the proposed action may jeopardize the continued existence of the species. If it is determined that the proposed action may adversely affect, but will not jeopardized the continued existence of listed species, a biological opinon is issued with an incidental take statement; reasonable and prudent measures and associated terms and conditions are issued with the statement to reduce, to the extent practicable, impacts to ESA-listed species. If necessary, NMFS will prepare a Biological Opinion (formal ESA consultation) or Section 7 Consultation (informal ESA consultation) to analyze OHA2 action and the potential impacts on ESA-listed species.

7.3 Administrative Procedure Act (APA)

The Administrative Procedures Act (APA) of 1946 establishes a set of procedures for Federal agencies to adhere to before the implementation of new or modified regulations. NMFS would act in its quasi-legislative role to consider implementing changes to the Federal regulations as proposed in OHA2. The Administrative Procedures Act establishes the process by which NMFS would take action to implement new regulations.

The Council held twelve public hearings on OHA2, and accepted oral comments at the following public meetings: Habitat Committee meetings, Habitat Plan Development Team meetings, Habitat Advisory Panel meetings, informational session, and Council meetings (see detailed list in section 6.1). The Council expects that NMFS will provide additional opportunities for public input when the notice of proposed rulemaking is published in the *Federal Register*.

NMFS will publish in the *Federal Register* a proposed rule with opportunity for public comment. The *Federal Register* notice is expected to include information on the proposed action, a description of the issues and individuals affected by proposed regulations, and the description of the management authority implementing the proposed regulations. NMFS will also allow for a 30-day "cool off" period between final rule and its effective date. For these reasons, OHA2 complies with APA regulations.

7.4 Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (PRA) requires NMFS to minimize the Federal paperwork burden for individuals, small businesses, state and local governments, and other persons, and maximize the usefulness of information collected by the Federal government. There are no changes to the existing reporting requirements previously approved under these FMPs for vessel permits, dealer reporting, or vessel logbooks. Therefore, this action does not contain a collection-of-information requirement for purposes of the PRA.

7.5 Coastal Zone Management Act

Section 307(c)(1) of the Coastal Zone Management Act (CZMA) of 1972, as amended, requires that all Federal activities that directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. The CZMA provides measures for ensuring stability of productive fishery habitat while striving to balance development pressures with social, economic, cultural, and other impacts on the coastal zone. It is recognized that responsible management of both coastal zones and fish stocks must involve mutually supportive goals. The Council has developed this action and will submit it to NMFS; NMFS must determine whether this action is consistent to the maximum extent practicable with the CZM programs for each state (Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina). Letters documenting NMFS' determination and requesting concurrence will be sent to the coastal zone management program offices of each state.

7.6 Data Quality Act

The Data Quality Act as promulgated under Public Law 106-554 (referred to as Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001) requires NOAA's 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. The quality of information is judged by three characteristics: utility of information, integrity of information, and objectivity of information. The Council, in consultation with NMFS, determined that the collection-of-information requirement under PRA regulations do not apply to this action. Therefore, information demonstrating the utility of public information is included in this section. The Council's compliance with Section 515 is outlined below:

Utility of Information Product: Information related to OHA2 have been presented to a diverse set of audience members, which include the fishing industry, other stakeholders, regulatory agencies, advocacy groups, educational institutions, and the general public. Information related to the development of OHA2 was disseminated through electronic mail, printed mail, website, public meetings, and news media outlets.

OHA2 information itself was organized and presented in a useful manner to outline issues and considerations that generated much discussion throughout the public input phase of OHA2 development. Often, complex statistical or other types of analysis was necessary to utilize the best available science. Therefore, thorough explanations of the methodology and information application was vital to effective communications of analysis performed within the OHA2 document itself. The public was given opportunity to ask clarifying questions during the public hearing sessions conducted by Council staff and the Chairman of the Habitat Committee. Council staff presented the information, including the range of alternatives under consideration, in a clear and concise manner to allow the public to make inferences on the information presented and ask questions if further clarification was needed.

Volume 1 of this document includes information on the purpose of the proposed changes within OHA2, and the need for action. The alternatives under consideration were divided based on the management action, including habitat protections, spawning protections, research needs, and methods for implementing changes to the OHA2. In addition to these distinctions, each type of management action includes proposed changes based on regions or sub-regions to facilitate discussion. These include the eastern Gulf of Maine, western Gulf of Maine, central Gulf of Maine, Georges Bank, and the Great South Channel/Southern New England. This method of organization helps stakeholder to understand the particular action being proposed by sub-region so that actions affecting a particular group of fishermen is easily discernible from other proposed actions. Along with text descriptions of the management alternatives, geospatial information was also presented for proposed changes to EFH regulations. The remainder of the document is also organized to allow information on OHA2 to be efficiently relayed to the audience.

Integrity of Information Product: Prior to dissemination, NOAA information, independent of the intended mechanism for distribution, 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 NOAA adheres to the standards set out in Appendix III, "Security of Automated Information Resources," OMB Circular A-130; the Computer Security Act; and the Government Information Security Reform Act. If information is confidential, it is safeguarded pursuant to the Privacy Act and Titles 13, 15, and 22 of the U.S. Code (confidentiality of census, business and financial information). OHA2 analysis required the use of confidential data to evaluate potential impacts of proposed measures on fishing communities. The Council staff members have been trained to use confidential data while exercising the appropriate precautions to safeguard against the violation of the Privacy Act, and remain in compliance with NOAA's data use agreements and information technology operating guidelines. Therefore, the Council believes that the integrity of the data used was maintained throughout the process for development of OHA2 and EIS.

Objectivity of Information Product: To the maximum extent possible, information disseminated by the Council during the development of this amendment has been accurate, clear, complete, and unbiased. The Council used the best available science to analyze alternatives presented in the EIS. Using scientific information from reputable authors and their published works provides reliable data for informed decisions during final action. The information related to OHA2 has been complete, exploring likely outcomes in the short term and longer term based on application of proposed measures. In addition, working groups such as the Closed Area Technical Team collaborated on the development of analyses for the amendment, based on their expertise regarding closed area habitat management. The use of fishery-dependent and fishery-independent data provides an unbiased assessment of impacts from alternatives under consideration. The Council and NMFS worked together to analyze literature cited within public comments, written and oral, to determine if the information was used in the analysis at the time of DEIS publication. Reliable scientific information referenced from commenters was added to the document when appropriate.

7.7 Regulatory Flexibility Act

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, on small entities. Ultimately, the goal of the RFA analysis is to understand to what extent the action induces significant economic impacts on small 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:

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

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

7.7.1 Reasons for Considering the Action

The statement of the problem(s) that this document addresses can be found in the Need and purpose for action section (Volume 1, Section 3.1) and should be referenced for additional information. The goals and objectives of Omnibus Habitat Amendment 2, which are closely related to the need and purpose, are discussed in Volume 1, Section 3.2.

7.7.2 Objectives and Legal Basis for the Action

The objective of the action is to review and, where needed, refine and redefine essential fish habitat and habitat area of particular concern designations, to minimize to the extent practicable adverse effects on such habitat caused by fishing, and to identify other actions to encourage the conservation and enhancement of such habitat, all as directed by the Magnuson-Stevens Fishery Conservation and Management Act, Public Law 94-265, as amended by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (P.L. 109-479).

7.7.3 Description and Number of Small Entities to Which the Rule Applies

The RFA recognizes three kinds of small entities: small businesses, small organizations, and small governmental jurisdictions. The small business criteria in the finfish fishing industry (NAICS 114111) is a firm that is independently owned and operated and not dominant in its field of operation, with gross annual receipts of $20.5 million or less. In the shellfish fishing industry (NAICS 114112) the threshold for a small business designation is $5.5 million. In the for-hire fishing industry (NAICS code 487210) the threshold for a small business designation is $7.5 million. Small organizations and small governmental jurisdictions are not directly regulated by this action. Following guidelines set by the Small Business Administration, businesses were classified as a finfish, shellfish, or for-hire based off of the most recent calendar year revenue (2014), and a three-year average revenue (2012 – 2014) was used to determine classification as small or large business. Throughout this section, revenue is presented in 2011 dollars, for consistency with the remainder of the document, although classification was made using 2014 dollars, consistent with SBA guidelines. Further, SBA rules of affiliation are used to define a business entity. Thus, the following analysis is conducted upon unique business interests, which can represent multiple vessel-level permits.

The Omnibus Habitat Amendment 2 regulates all fishermen with federal permits allowing the holder to fish in the federal waters off Southern New England, Georges Bank, and the Gulf of Maine. In 2014 this represents 4,071 small businesses (925 finfish, 2,713 shellfish, 433 for-hire) and 18 large businesses (all shellfish).

Table 34 – Buisness revenue by type.

Year	NAICS Classification	Business Type	Business Revenue	Shellfish Revenue	Finfish Revenue	For-hire Revenue
2012	FINFISH	Small	217,560,996	33,546,543	183,380,312	634,141
2012	FORHIRE	Small	56,153,981	331,674	611,532	55,210,775
2012	SHELLFISH	Large	265,665,371	242,801,113	22,860,746	3,512
2012	SHELLFISH	Small	710,485,816	679,195,607	30,897,738	392,471
2013	FINFISH	Small	191,870,635	25,008,297	166,326,851	535,487
2013	FORHIRE	Small	55,556,751	125,755	588,984	54,842,012
2013	SHELLFISH	Large	228,892,465	208,244,173	20,642,659	5,633
2013	SHELLFISH	Small	690,608,565	663,848,959	26,381,386	378,220
2014	FINFISH	Small	209,370,022	23,888,931	185,335,274	145,817
2014	FORHIRE	Small	57,843,562	15,735	412,061	57,415,766
2014	SHELLFISH	Large	223,065,022	202,580,548	20,484,474	-
2014	SHELLFISH	Small	741,518,137	717,031,087	24,316,466	170,584

The rules defined within this amendment primarily affect two non-mutually exclusive fishing operations; fishermen using gears capable of catching groundfish, and fishermen using mobile bottom-tending gears. Midwater trawls, clam dredges, and recreational fishing operations represent three additional categories of gears/modes explicity managed by the rules defined within this amendment in a unique manner. The description and number of small entities are categorized by these groupings given the differential impact that is expected. Mobile bottom-tending gears (including clam dredges) are defined in Volume 3, Table 5. Gears capable of catching groundfish (including midwater trawls) are defined in Volume 3, Table 7. Table 35 presents a count of and total revenue generated from each of these gear classifications, by business type. For-hire revenue and counts are presented in Table 34, and are thus not repeated for brevity. The vast majority of the revenue reported in VTR data is generated using gears classified as both mobile bottom-tending and capable of catching groundfish.

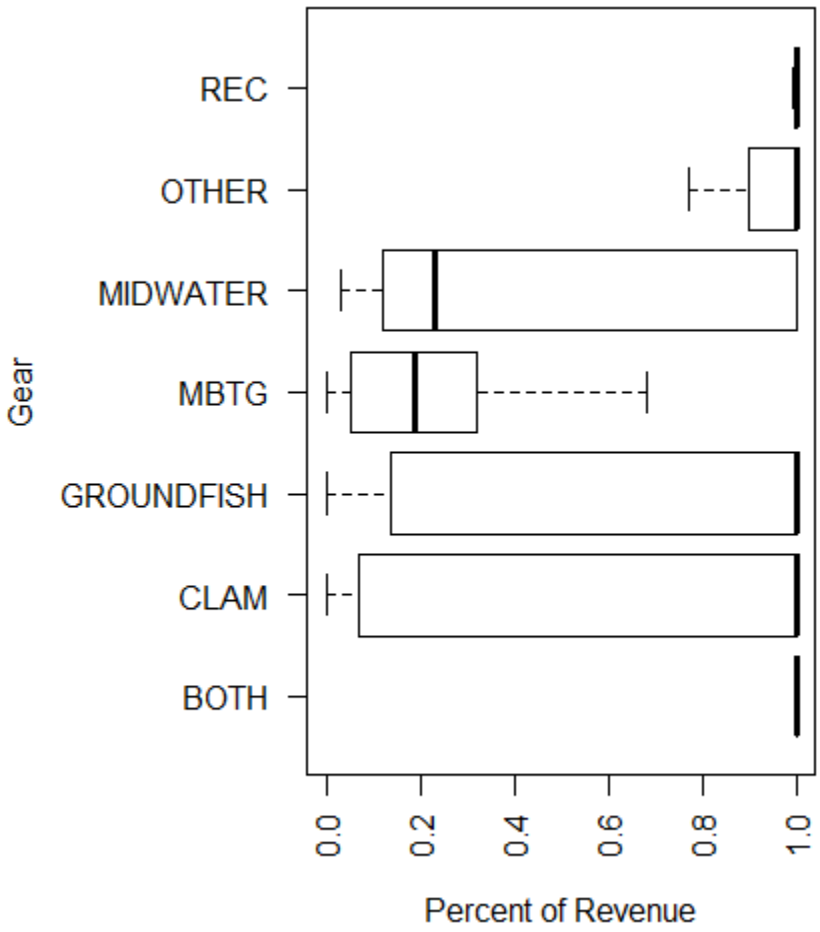
Table 35 – Number of businesses and revenue generated by small and large businesses, by commercial gear classification. MBTG = Mobile bottom-tending gear, GROUNDFISH = gear capable of catching groundfish, BOTH = Both MBTG and GROUNDFISH designation, MIDWATER = Midwater trawls, CLAM = clam dredge. Note that some data is not presented for privacy concerns.

Year	Gear Type	Business Type	Number of Businesses	VTR Revenue
2012	BOTH	Large	17	231,658,238
2012	BOTH	Small	574	580,827,338
2013	BOTH	Large	17	185,435,086
2013	BOTH	Small	539	445,971,382
2014	BOTH	Large	17	173,348,111
2014	BOTH	Small	528	396,470,511
2012	CLAM	Large	5	31,160,893
2012	CLAM	Small	42	27,738,596

Year	Gear Type	Business Type	Number of Businesses	VTR Revenue
2013	CLAM	Large	4	30,008,134
2013	CLAM	Small	47	27,874,110
2014	CLAM	Large	2	-
2014	CLAM	Small	41	26,867,813
2012	GROUNDFISH	Large	2	-
2012	GROUNDFISH	Small	668	74,103,358
2013	GROUNDFISH	Large	2	-
2013	GROUNDFISH	Small	605	47,920,414
2014	GROUNDFISH	Large	1	-
2014	GROUNDFISH	Small	592	48,959,328
2012	MBTG	Large	3	1,072,716
2012	MBTG	Small	125	6,120,800
2013	MBTG	Large	3	1,375,902
2013	MBTG	Small	87	2,940,183
2014	MBTG	Large	3	1,216,387
2014	MBTG	Small	26	2,857,405
2012	MIDWATER	Large	3	9,289,884
2012	MIDWATER	Small	14	22,865,976
2013	MIDWATER	Large	3	5,535,922
2013	MIDWATER	Small	13	26,214,983
2014	MIDWATER	Large	3	4,909,077
2014	MIDWATER	Small	14	25,058,119
2012	OTHER	Large	2	-
2012	OTHER	Small	566	79,087,347
2013	OTHER	Large	4	-
2013	OTHER	Small	539	80,355,177
2014	OTHER	Large	3	-
2014	OTHER	Small	514	84,446,720

Figure 1 presents the firm-level revenue percentage generated by each gear type differentially managed by this action. While 50% of fishermen using gears capable of catching groundfish, clam dredges, both mobile bottom tending and capable of catching groundfish, and other gears use only that type gear, individuals fishing with mobile bottom-tending gear and midwater trawls tend to generate a substantial portion of their revenue from other gear types. Interestingly, the vast majority of individuals either fishing with mobile bottom-tending gear capable of catching groundfish or for-hire do not deviate from that mode, which could speak to the specialized nature of either the boats employed in or the captains' skills needed for these types of fishing.

Figure 1. Distribution of revenue percentage gerated by gear types for small businesses in 2014 (outside values suppressed).



The HAPC and EFH designations, and the dedicated habitat research area sunset provision do not directly regulate any entities external to NOAA Fisheries and the Northeast Fisheries Management Council. Given the spatial nature of the remaining management alternatives, the discussion below relies in part on self-reported VTR data, combined with the model of spatial precision and assumptions as detailed in Volume 4, section 4.1 of this Omnibus Amendment. Volume 4, section 4 details the expected impacts to human communities and the fishery, including a description of the expected impacts associated with a broad range of alternatives and options that have been considered in the development of this amendment. The analysis referenced above includes an indication of the expected costs and/or benefits associated with each alternative, when compared to the no-action alternative. Volume 5, sections 2-17 provide more detail of expected impacts at the species/fishery management plan/fishery level. This RFA analysis augments the above by providing an estimate of the number and type of businesses expected to be affected by the proposed action.

Figure 2 indicates the distribution of total (commercial and for-hire) revenue in areas currently open to fishing that would be potentially displaced under the proposed action, by business type.

The figure indicates that the median large business generates a somewhat larger percentage of their total revenue from these areas when compared to the median small business, although there is substantial variation in the percentage of a business' overall revenue this represents. The gross revenue estimate is an upper bound on the cost of closing these currently open areas, in that they consider neither the trip costs nor the behavioral response to closure, which will offset some of the losses which would otherwise accrue to the business. Nevertheless, given that a substantial number of the areas encapsulated by the proposed action are currently closed to fishing (and therefore have no current fishing within their waters that would be displaced), the revenue numbers in Figure 2 understates the full exposure of firms to the proposed action. The revenue estimate also excludes the clam revenue generated within the Great South Channel, due to the one year exemption provided, and assuming that a longer-term exemption is forthcoming.

Figure 2 – Revenue in currently open areas that is potentially displaced by habitat and spawning alternatives of the OA2 Amendment.

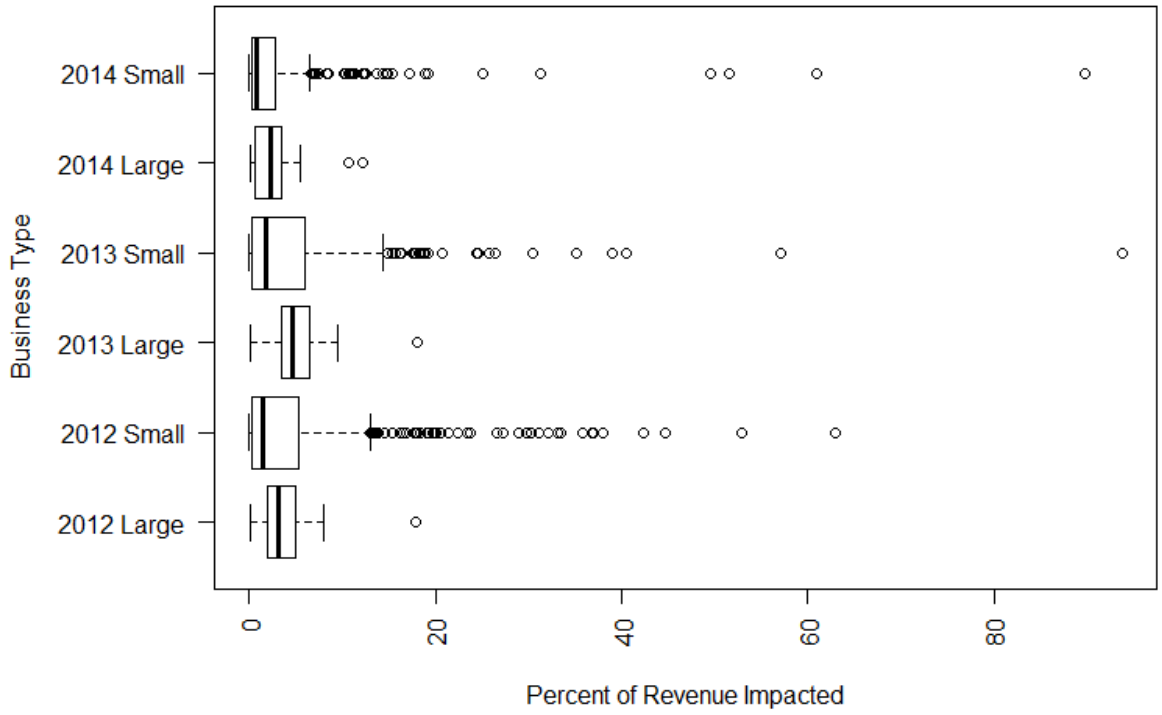


Figure 3 presents an assessment of the distribution of percentage of revenue displaced assuming the clam exemption does not continue past the single year indicated in the proposed action. Although the general shape of the distribution is consistent with Figure 2, the tail of the distribution indicates substantially higher exposure for some firms when clam exemptions sunset.

Figure 3 – Percent of revenue historically generated from currently open areas of the proposed action, with no clam exemption.

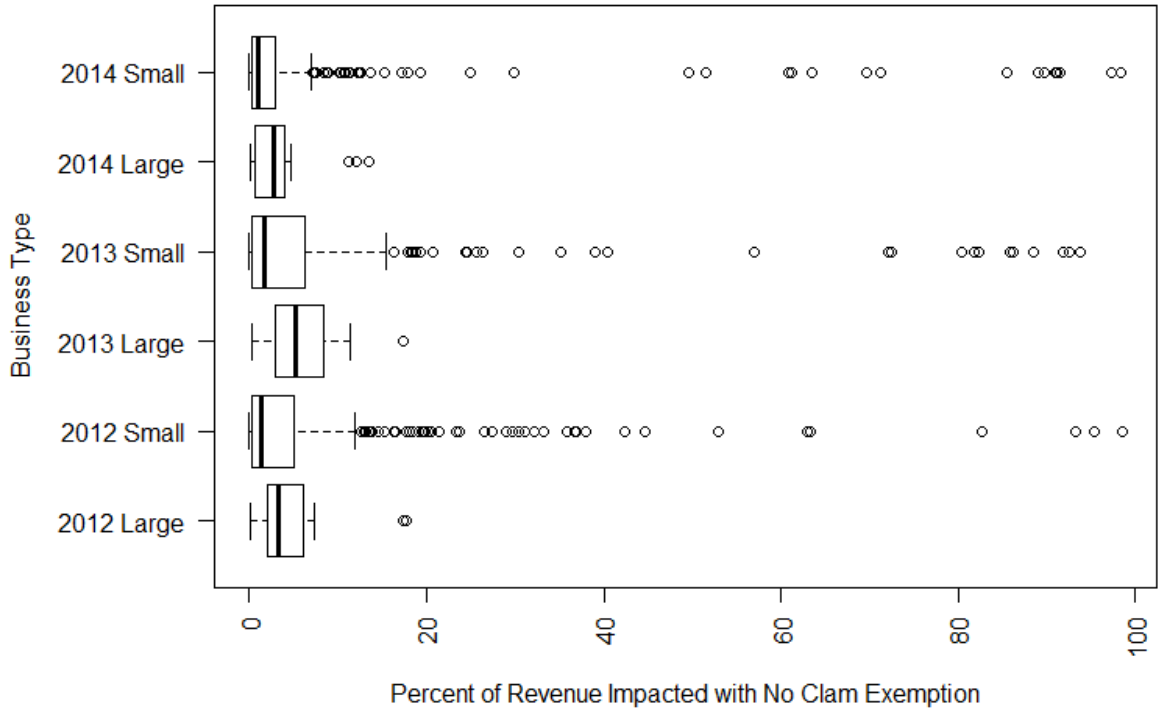


Figure 4 presents the total number of businesses estimated to have been fishing within areas of the proposed action currently open to fishing. The downward trend in the number of exposed businesses across time is a result of an overall contraction in the number of fishermen due to very low allowable catches for some stocks, particularly within the Northeast Multispecies fishery, and not primarily driven by changes in fishing location as evidenced by Table 35. This highlights the issue of cumulative effects in the fisheries under management that warrant a brief discussion. The overall contraction of fishing businesses seen over the last three years is likely to continue for the forseeable future, given the decline of a number of species/fisheries (including northern shrimp and Gulf of Maine cod). Given this environment, the impacts of actions such as those considered in the Omnibus Amendment 2 and separately in the at-sea monitoring cost allocation considerations currently under deliberation, are likely to be amplified in terms of profitability and fishery exit. Identifying the proximal cause of fishery exit decisions is problematic given the large shifts occurring. Nevertheless, the first-order effect is driven primarily by the decline in TACs, with secondary effects such as the lost opportunity cost of fishing presented in the Omnibus Amendment 2 likely to affect the decision of the marginal fisherman. It is not possible to assess how large a marginal effect this represents.

Figure 4 – Number of businesses historically fishing in areas of preferred alternatives currently open to fishing.

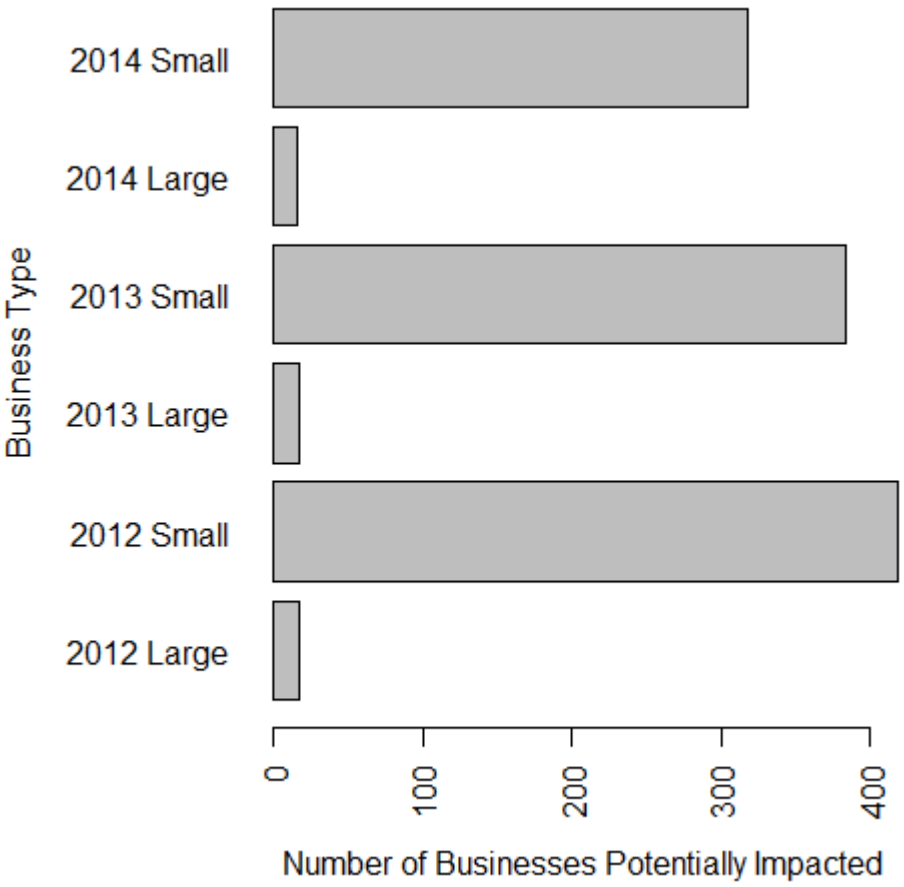


Figure 5 presents the number of businesses exposed to the proposed action if and when the clam exemption sunsets. A quick comparison with Figure 4 indicates that the number of businesses exposed to the proposed action does not vary drastically with and without the clam exemption.

Figure 5 – Number of businesses exposed to proposed action with no clam exemption.

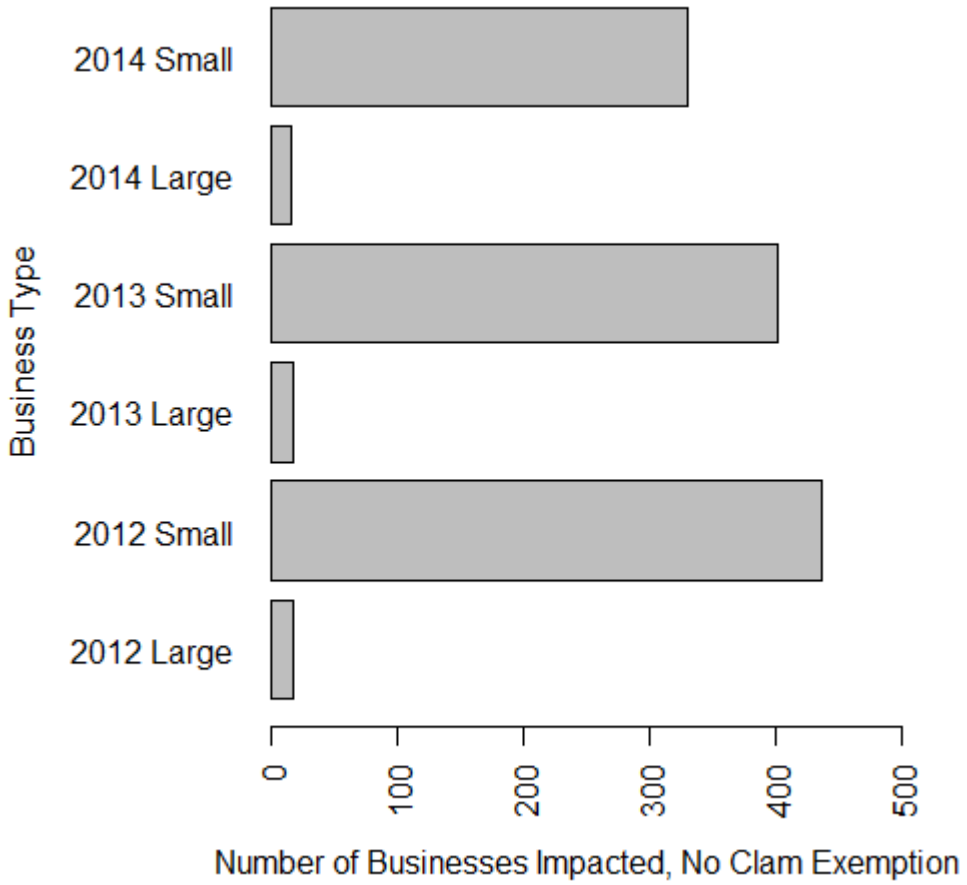
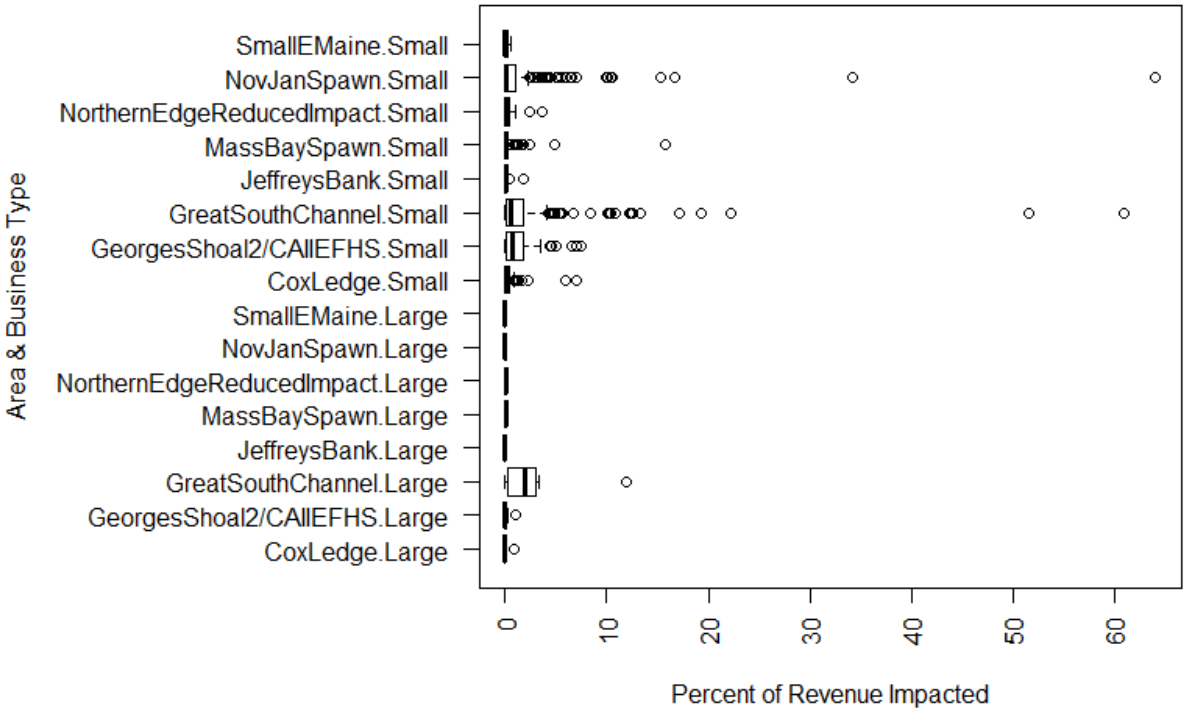


Figure 6 presents the data in Figure 2, broken out by area. This highlights the fact that, due to spatial extent, fishing quality, and temporal extent, the fishing activity across areas is not uniform. In terms of current fishing activity, the Great South Channel, Georges Shoal 2 Area, and Nov-Jan spawning area generate a substantially larger amount of some individual business' revenue than the other preferred alternative areas. This result is not readily apparent from the analyses of Volume 4. The revenue from the clam exemption areas, which is not included in Figure 6, would increase the tails of the distribution in both the Great South Channel and Georges Shoal 2 areas.

Figure 6 – Percent of total revenue generated from currently open areas of the prefered alternatives (by area and business type).



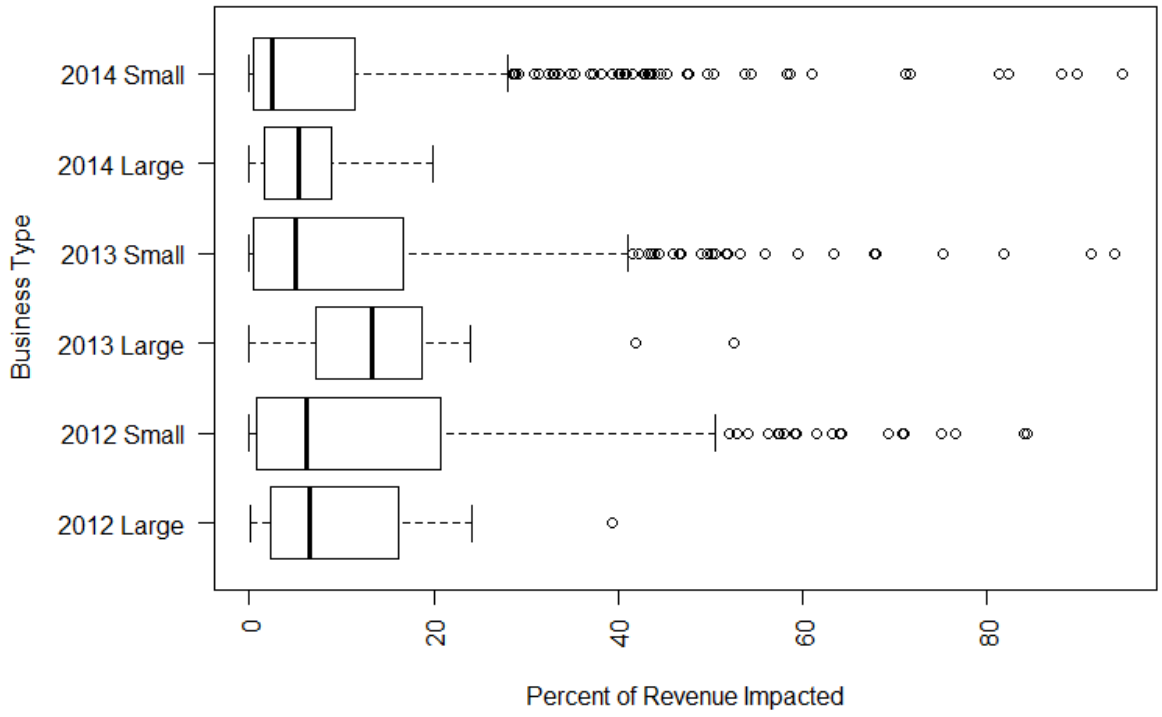
Comparison of Proposed Action with Alternate Areas

Given the sheer number of alternatives and options considered within the Omnibus Habitat amendment, it is impossible to assess relative impacts of even a representative distribution of potential combinations. However, by selecting the set of alternatives expected to have the largest short-term impact to the regulated fisheries under management, this analysis provides a sense of the extent to which impacts to fisheries were mitigated while attempting to achieve the goals of the Omnibus Habitat Amendment 2. The list of alternatives assessed in this additional analysis include Eastern Gulf of Maine HMA Alternative 3, Central Gulf of Maine HMA Alternative 3, Western Gulf of Maine HMA Alternative 5, Georges Bank HMA Alternative 8, Great South Channel HMA Alternative 3, Gulf of Maine Spawning Alternative 2, and Georges Bank Spawning Alternative 2. All of the HMA alternatives are assumed to be implemented with option 1, which is a probibition on all mobile bottom-tending gear, while the Spawining Alternatives are assumed to be implemented under option B, which includes a probibition on all fishing except exempted gears (Pelagic hook and line, pelagic longline, spears, rakes, diving gear, cast nets, tongs, harpoons, weirs, dipnets, stop nets, pound nets, pelagic gillnets, pots and traps, shrimp trawls with a properly configured grate, and surfclam and ocean quahog dredges), the mid-water trawl exempted fishery, the purse-seine exempted fishery, sa scallop dredges, and raised footrope trawl exempted whiting fishery. Both private and for-hire recreational fishing would be prohibited under this alternative. The assessment again overestimates impacts in areas currently open to fishing due to the use of gross revenue and not accounting for the behavioral response of fishermen, but under-estimates total exposure due to the fact that at least a portion of these areas

are currently closed to fishing, and thus represent a realized opportunity cost, and the lack of private recreational fishing in the analysis.

Figure 7 presents the exposure analysis for the areas under what, for ease of reference, will be referred to as the more expansive set of management alternatives. Of note is that there is no recreational fishing reported to have occurred between 2012 and 2014 inside the Georges Bank Spawning Alternative 2 between Feb 1 and April 15 (the period which would exclude recreational fishing from the areas). A comparison of the distribution of revenue exposed to the preferred alternatives (Figure 2) and the more expansive set of alternatives (Figure 7) makes clear that the exposure to the former set of alternatives is substantially lower than the latter.

Figure 7 – Percent of revenue currently sourced from areas in the more expansive set of management alternatives.



As previously mentioned, a number of areas within the proposed action are currently closed to fishing. The comparison between Figure 2 and Figure 7 is thus complicated by the fact that the preferred alternative in the Western Gulf of Maine (the Western Gulf of Maine Habitat Closure) is currently closed to fishing. A comparison of Figure 2 and Figure 8 indicates that the exclusion of the Large Bigelow Bight area, which provides a more comparable juxtaposition against the proposed action, tends to affect the tail of the distribution, attenuating some of the highest exposure rates but not affected the general distribution of exposure levels.

Figure 8 – Percent of revenue currently sourced from areas in the more expansive set of management alternatives, minus the Large Bigelow Bight area, for more comparable juxtaposition against the proposed action areas.

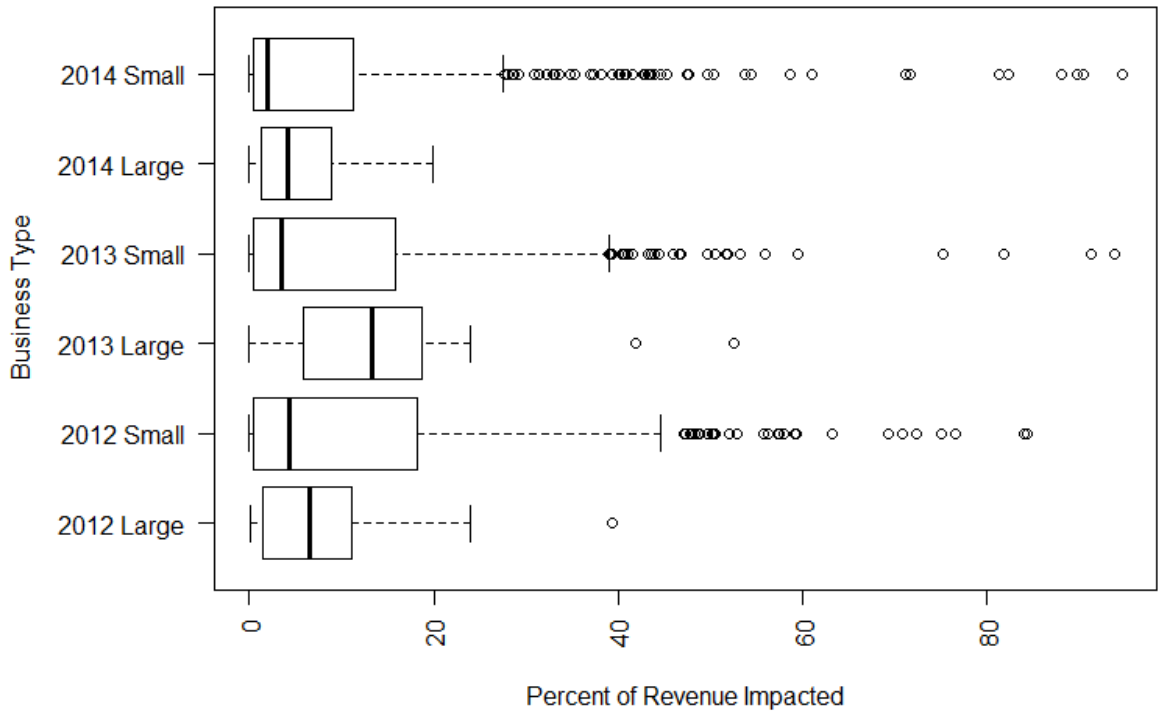


Figure 9 presents the estimated number of businesses exposed to the more expansive set of management alternatives. Again, a comparison of the number of businesses exposed to the proposed action (Figure 4) and the more expansive set of alternatives (Figure 9) indicates substantially higher exposure to the latter. In 2014, the more expansive set of alternatives expose 58% more businesses to the regulations than the preferred alternatives do. Again, the drop in total number of fishermen fishing seems to be driving the time trend in Figure 9, rather than shifts away from fishing in the proposed areas.

Figure 9 – Number of businesses exposed to the more expansive set of management alternatives.

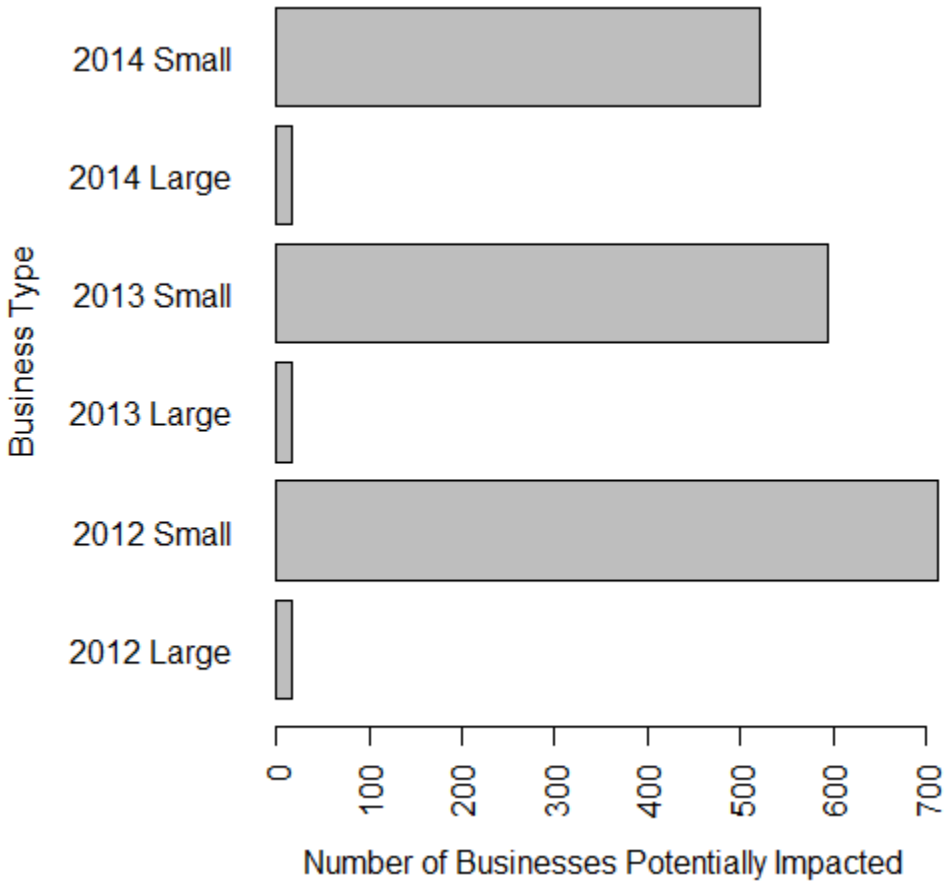


Figure 10 indicates that even without factoring in the Large Bigelow Bight area, the more expansive set of management alternatives exposes a much higher number of businesses to the regulation, with 48% more businesses exposed to the former.

Figure 10 – Number of businesses exposed to the more expansive set of management alternatives, excluding the Large Bigelow Bight area.

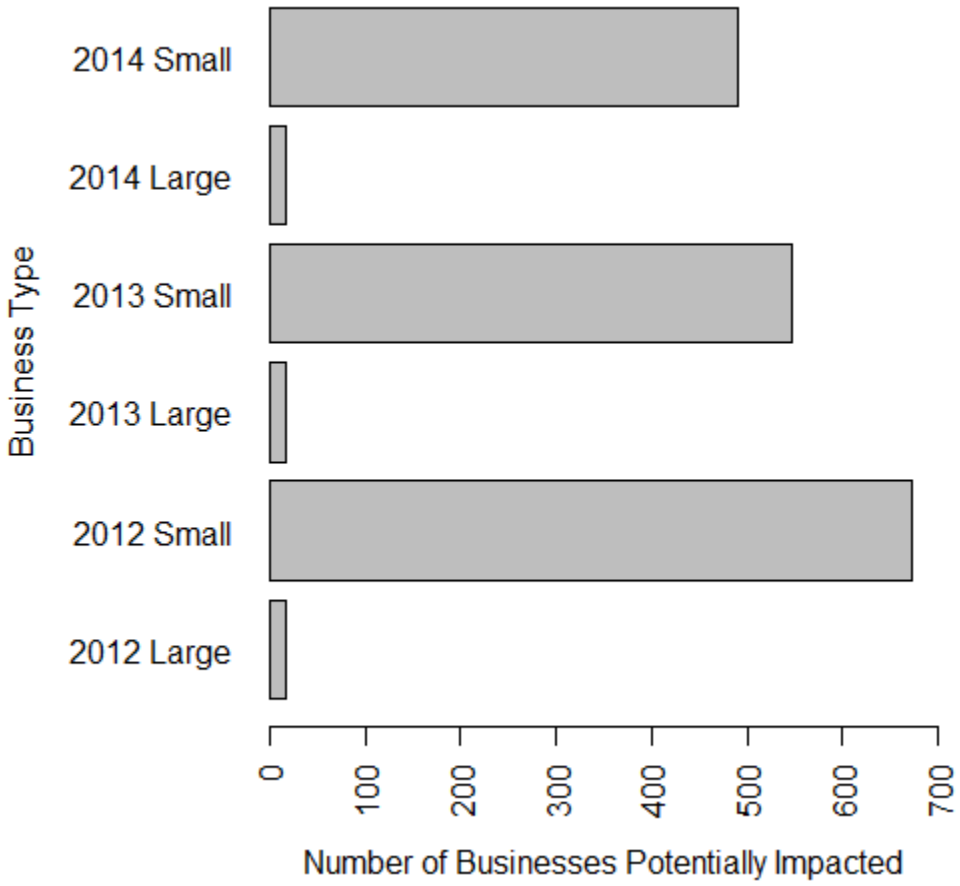
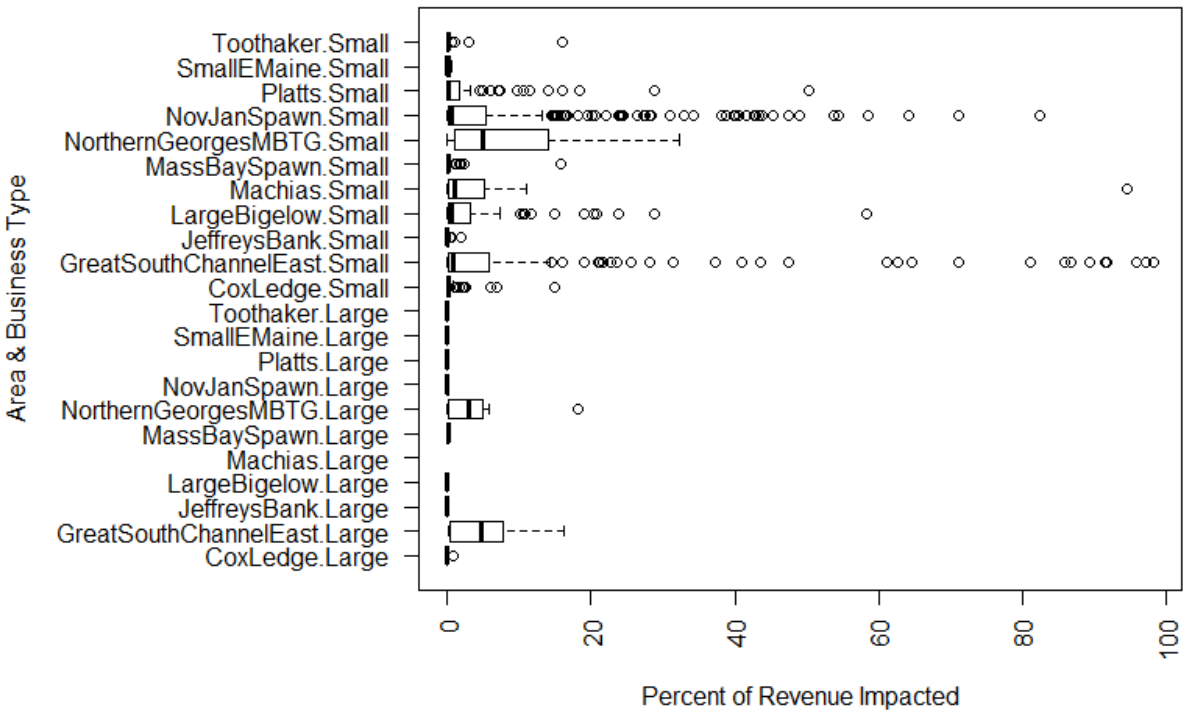


Figure 11 presents an assessment of exposure by area for the more expansive set of management areas, which indicates that the Nov-Jan Spawning (for-hire recreational impacts), Northern Georges MBTG, Machias, and Great South Channel East areas generate the largest proportion of exposure faced by fishing businesses.

Figure 11. Percent of total revenue generated from currently open areas of a mix of alternatives more restrictive to fishing (by area and business type).



7.7.4 Record Keeping and Reporting Requirements

The proposed action does not introduce any new reporting, recordkeeping, or other compliance requirements.

7.7.5 Duplication, Overlap, or Conflict with Other Federal Rules

The proposed action does not duplicate, overlap, or conflict with any other Federal rules, but does alter existing rules.

7.8 Executive Order 12866 (Planning and Coordination)

The purpose of Executive Order 12866 (E.O. 12866, 58 FR 51735, October 4, 1993) 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 a review 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 how 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.

7.8.1 Statement of the problem/goals and objectives

The statement of the problem(s) that this document addresses can be found in the Need and purpose for action section (Volume 1, Section 3.1) and should be referenced for additional information. The goals and objectives of Omnibus Habitat Amendment 2, which are closely related to the need and purpose, are discussed in Volume 1, Section 3.2.

7.8.2 Management alternatives and rationale

A general description, including rationale for development of the proposed action can be found in the alternatives identified in Volume 3, Section 2 as preferred alternatives, while measures that the Council considered but rejected can be found in Volume 3, Section 3.

7.8.3 Description of the fishery

Information about fishery-related businesses and communities potentially affected by the Omnibus Habitat Amendment 2 can be found in Volume 4, Section 4, with a general description of the analysis and assumptions employed presented in Volume 4, Section 4.1. Volume 5, section 2 provides an analysis of the exposed and impacted fisheries at a species/FMP level.

7.8.4 Summary of impacts

The expected effects of each alternative relative to the status quo for the fishery-related businesses and communities are discussed within Volume 4, Section 4. E.O. 12866 requires an assessment of all costs and benefits. Volume 4, Section 4.1 identifies the problems associated with quantifying the full range of costs and benefits associated with the Habitat Omnibus Amendment 2. In this Regulatory Impact Assessment, the cumulative benefits and costs of the proposed action are overviewed, along with a description of the greatest drivers of uncertainty regarding the analysis. Revenue is presented in $2001, in compliance with OMB circular A-4.

The costs of management are heterogeneous across individuals/gears/fisheries and uncertain. For areas currently open to fishing exposure to the management alternatives, in terms of potentially displaced revenue, can be assessed. However, these cannot be considered costs of closure, given that these are gross revenue and not profit estimates, and the behavioral response of fishermen, which would mitigate at least a portion of losses in profits by shifting fishing locations, leasing

quota, fishing for alternate species, or exiting the fishery and finding employment in another sector of the economy, is not factored in. For areas currently closed to fishing, the exposure analysis presents an underestimate of management impacts, due to the fact that these opportunity costs have already been realized. As can be imagined, an individual's outside options are idiosyncratic, and depend on a host of conditions, including what additional permits he or she has access to, the salvage value of vessel and gear, transition costs to alternative fisheries, level of education and length of tenure within the fishery, and myriad other factors. A behavioral model of fishing, such as location choice modeling, would more realistically estimate the costs of management. However, there are substantial technical barriers of such an analysis for these alternatives, including:

1. The sheer number of alternative and options considered;
2. The lack of biological data and historical fishing in currently closed areas from which to infer profitability;
3. The highly qualitative nature of the expected biological impacts for forecasting.

Given this reality, a more qualitative analysis is presented around the core exposure analysis. Figure 12 and Figure 13 respectively present the total exposed revenue and percentage of the overall total revenue generated by each gear type in 2012 – 2014 which has historically occurred within the open waters of the preferred action. In terms of magnitude, the scallop fishery consistently presents the highest exposure to the proposed action. There is substantial variability in the exposure of the scallop fishery chronologically, with an estimated decrease of 30% between 2013 and 2014. This is likely due to the area-based management regime currently employed within the scallop fishery, which can greatly affect the spatial distribution of fishing effort across years. The SAP trawl is exposed at a similar level in terms of percentage of overall revenue generated by each gear type in most years presented. The proposed action presents a one year exemption to the clam dredge fishery in both the Great South Channel and Georges Shoal 2 management areas, in order to allow further consideration of the impact of clam dredges on habitat most susceptible to fishing disturbances. This first exposure analysis is conducted assuming that this exemption continues, but the additional impacts to the clam fishery for changes to the status of this exemption are investigated below. Section 7.7 of this volume identifies the exposure of the proposed action at the individual business level.

Figure 12 – Total revenue potentially displaced under proposed action.

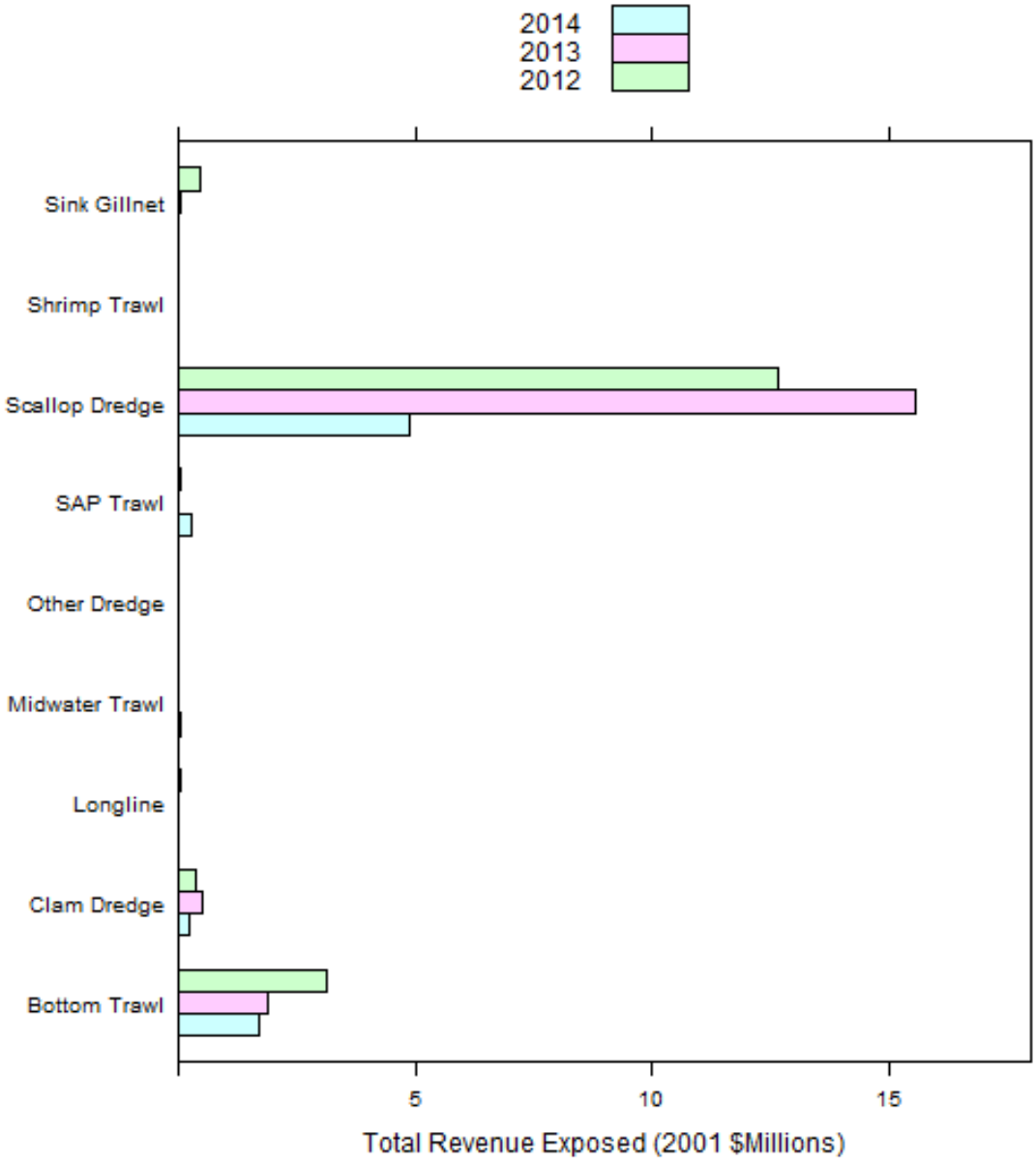


Figure 13 – Percent of revenue exposed for each gear type.

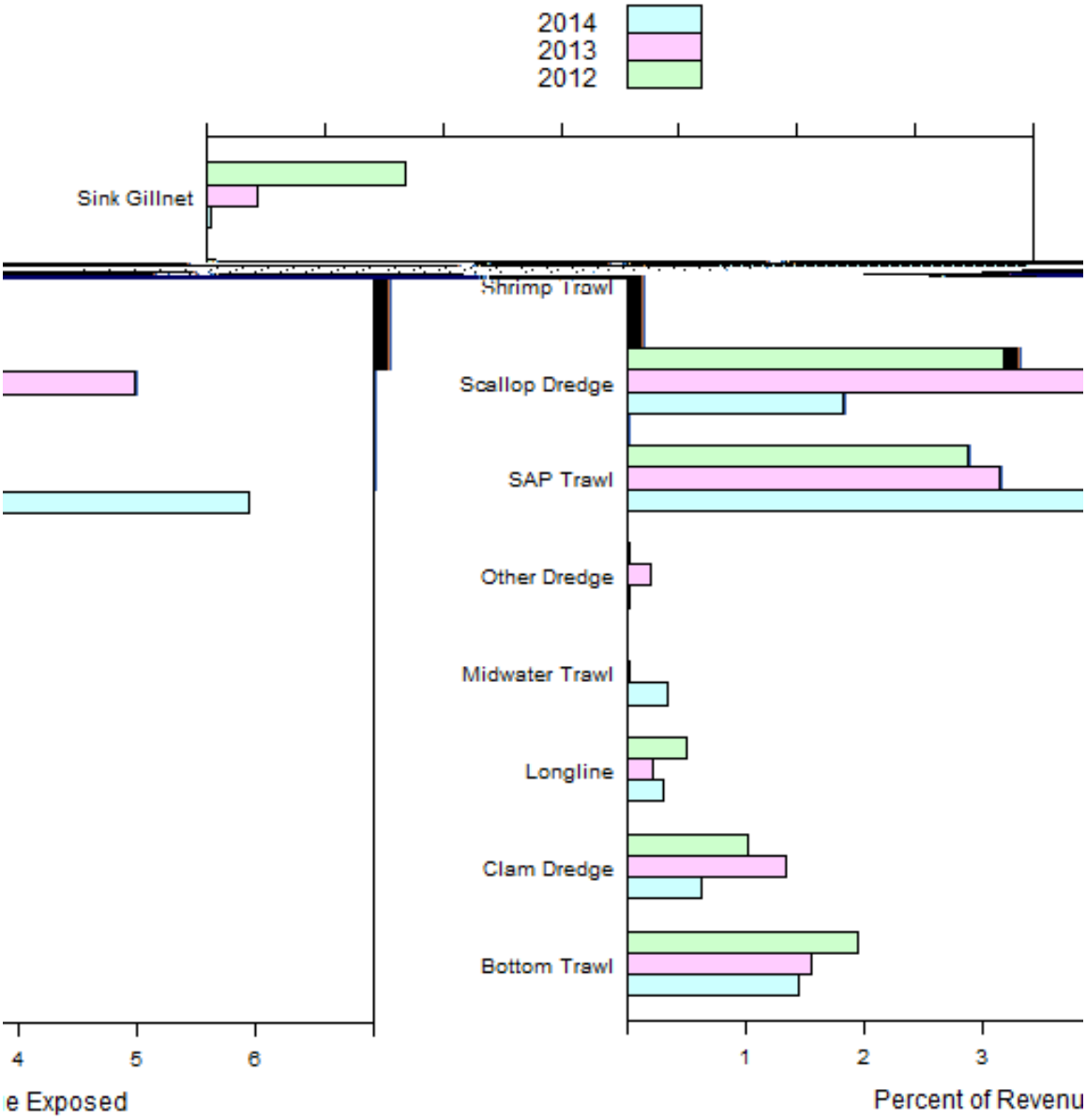


Figure 14 presents the same revenue exposure data binned by FMP generating the revenue streams in question. The sea scallop and groundfish FMPs are the most highly exposed to the currently fished areas of the proposed action.

Figure 14. Average (2012 – 2014) potentially displaced revenue in currently open areas of the proposed action, by FMP.

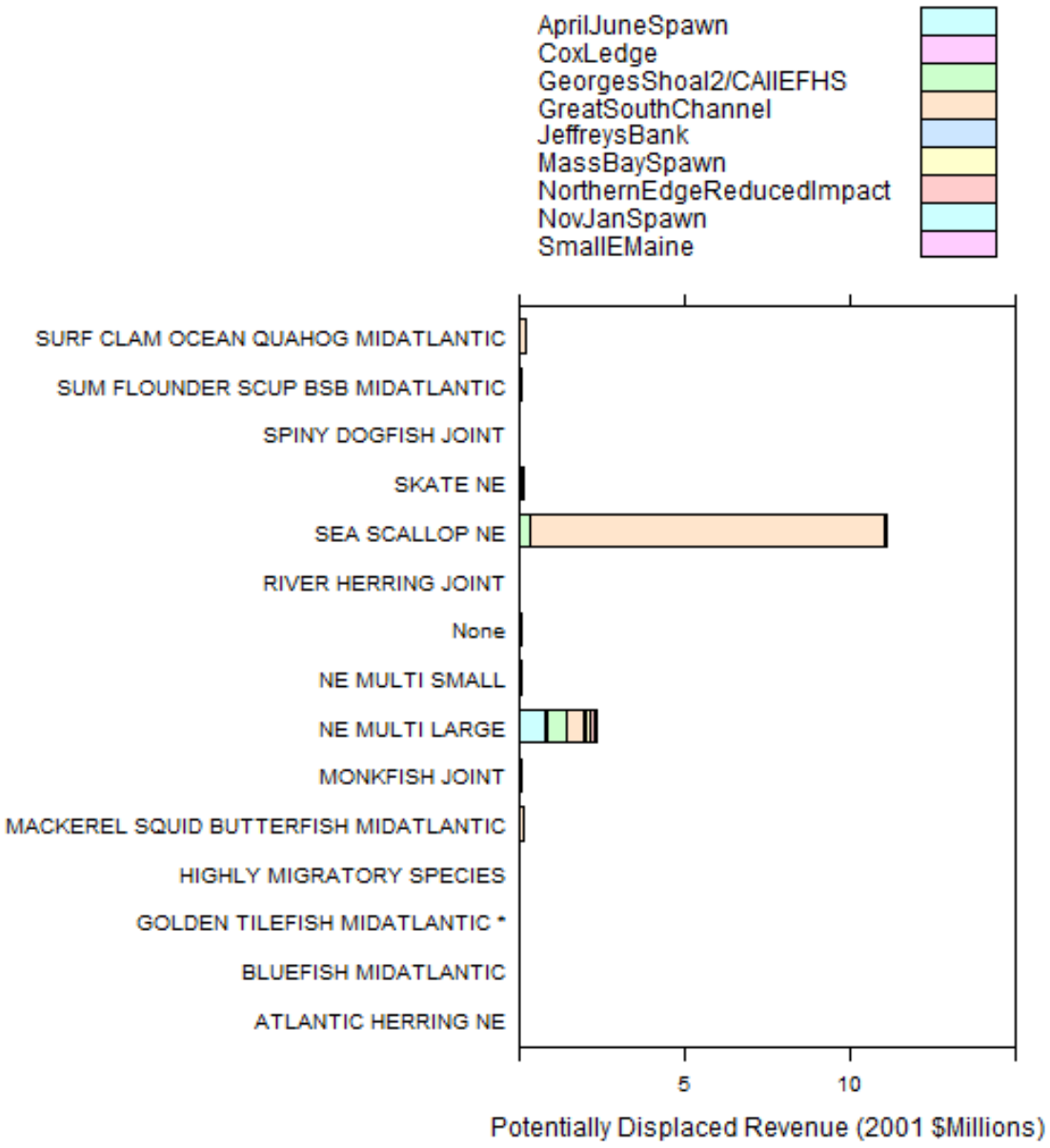
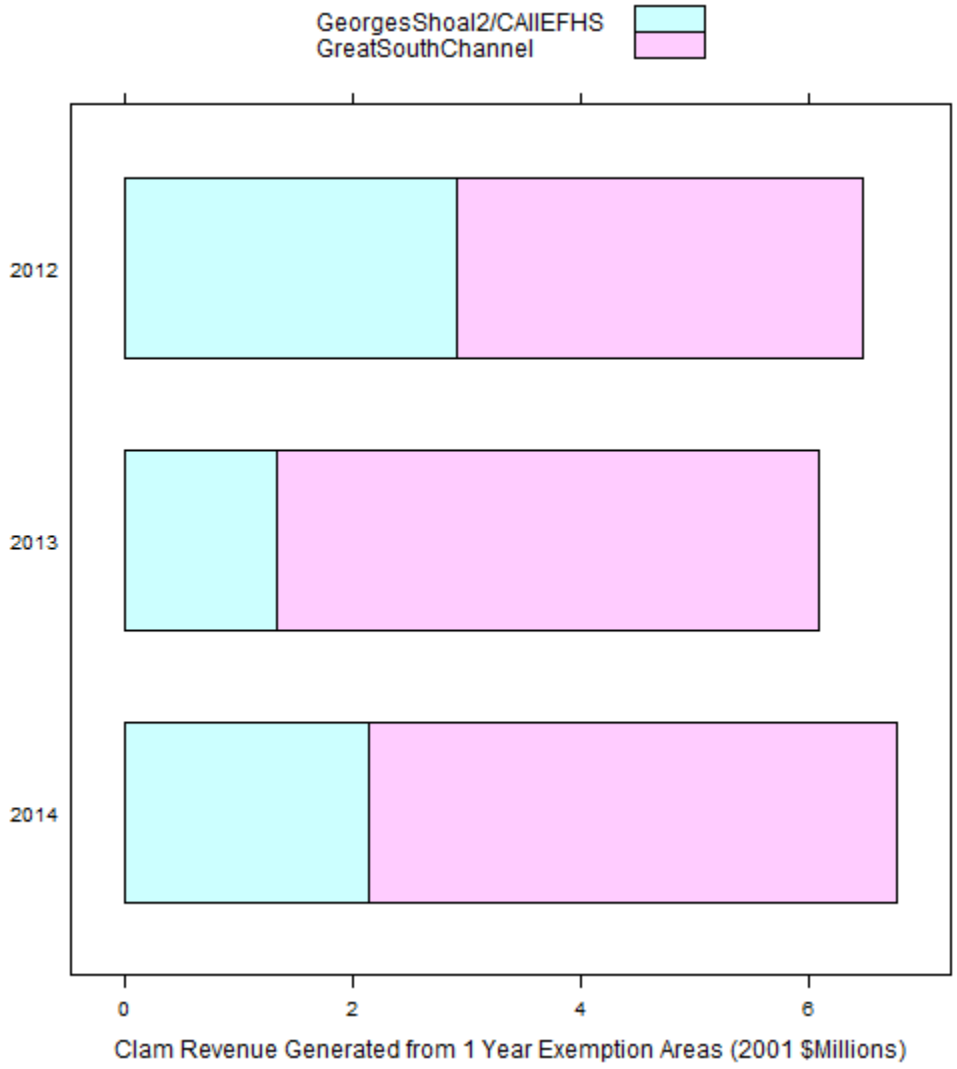


Figure 15 details the recent clam dredge activity in the Great South Channel and Georges Shoal clam dredge exemption areas. Although the proportion of revenue generated from each of the areas varies interannually, the total revenue from these two areas hovers around $6 million annually. This sum represents between 15% and 19% of the total revenue generated annually by the Surf Clam and Ocean Quahog fishery. This would make the Surf Clam and Ocean Quahog fishery the most relatively exposed to the proposed action. The clam exemptions thus mitigate the majority of the impacts that would otherwise accrue to the clam fishery, and generate only neutral to negligibly negative impacts overall for this fishery as compared to the no action alternative.

Figure 15. Revenue generated from clam dredges in the Great South Channel and Georges Shoal 2 1 year exemption areas.



The analysis of the expected benefits from each area designated by the preferred alternative indicates that the greatest overall driver of benefits associated with the proposed action is the scallop fishery, due to the access of additional biomass in the Great South Channel/Southern

New England (specifically, the current Nantucket Lightship Habitat year-round closure) and Georges Bank (specifically, the current habitat closure along the northern portion of Closed Area II) subregions. These benefits are expected to accrue in both the short and long run. The short-run benefits accruing to the scallop fishery (sum of producer and consumer surplus, see Volume 5, section 6.2.2.2.3) are expected to be on the same order of magnitude as the total gross revenue generated by the groundfish fishery. However, 2018 alone is estimated to generate net benefits of $143 million, an order of magnitude greater than the entire groundfish fishery's revenue, and 18% higher than the no action outcome. Further, area swept is expected to decrease by between 20% and 30% when compared to no action due to scallop fishing on more productive grounds (see Volume 5, section 6.2.2.2.3), which potentially decreases the impact of this gear on critical habitat.

The proposed action also presents a short-term benefit to static gear, such as longline, hand gear, and gillnets, which will be afforded access to areas currently off-limits (seasonal access to all of Closed Area I and Closed Area II, and year-round access to Nantucket Lightship Closed Area), with no new areas closed to their use. Given that the component of the groundfish fishery employing these static gears are relatively small when compared to mobile bottom tending gear, the overall expected benefit for fishermen employing these static gear from additional flexibility of where and when to fish is small. The short-term impacts to non-dredge mobile bottom-tending gear is less certain. This is due to the fact that currently fished areas that would become off-limits under the preferred alternative, such as the Georges Shoal 2 and Great South Channel areas, seem to be important centers of fishing for some individuals (see Figure 6). Given that Special Access Programs allow access to the southern portions of Closed Area II below latitude 41° 30' and the northern portion above latitude 42° 10' for haddock fishing between May 1 and December 31, and May 1 and January 31, respectively, part of the benefits of the proposed action hinge on what additional fishing might occur within Closed Area II between April 16 and May 1 in both of these areas and January 1 – January 31 in the southern portion, as well as potential fishing in Closed Area I and the portion of Closed Area II not described above, but outside of the proposed mobile bottom tending gear closure, between April 16 and January 31. Areas abutting the western edge of Closed Area II between 41° 30' and 42° 10' do not seem to be as heavily fished as areas abutting the northern and southern regions of Closed Area II, although maps of Closed Area I indicates substantial fishing along the line demarcating its northern extent (see section 4.3 of Volume 1). The longer-term benefits are more uncertain, but likely to be negative across the entire groundfish fishery, due to the expected impact of the proposed action on habitat of importance to critical life stages of groundfish (see Volume 5, Sections 2.2.4 and 2.3.2). Neverthless, the benefits to the scallop fishery are likely to greatly outweigh any impacts to the groundfish fishery, given the relative value of each in recent history.

The shift in fishing effort associated with a redefinition of area closures has the potential to increase gear conflicts. This issue has been consistently raised in public comments in regards to lobster pot and mobile bottom tending gear interactions that could occur within the central portion of Closed Area II if it were to reopen to the latter. As discussed in Volume 4, Section 4.2.4.2, the lobster pot/mobile gear interaction is likely to be idiosyncratic, given that there is no manner to ensure due care is taken in avoidance by either groundfish fishermen or lobstermen. However, the preferred alternative (Georges Bank habitat alternative 10) includes a seasonal closure to scallop dredges during the time when the lobster fishery is most active. Given the

current levels of commercial fishing in areas outside of the no action alternative that are being considered, increased gear conflict between the recreational and commercial fisheries are likely to be relatively minor.

Given the highly qualitative nature of the analysis within this FEIS, uncertainty regarding the net benefits associated with the proposed action abounds. Drivers of this uncertainty include the following:

1. The impact of fishing on scallop productivity (Volume 5, Section 6.1)
2. The general productivity link between habitat and fish stocks (Volume 1, Section 4.1)
3. The net effect of area management on habitat impacts, specifically due to:
    a. The potential of shifting effort onto more susceptible habitat not considered in the proposed action (e.g. state waters, Volume 4, Section 3.1.1.7)
    b. The potential increase in impacts due to increased inefficiency of the fisheries under management, due to shifting effort into less productive fishing grounds.
    c. The form of the habitat damage function associated with fishing (Appendix D)
4. The conservation (i.e. non-use) value of area management, including impacts on protected species.
5. The uncertain time horizons at which differential impacts of management begin to accrue.

Unless specifically noted, all of the above are discussed in more detail in Volume 4, Section 4.1.1.

Comparison of proposed action with alternate areas

Given the complexity of the management action under consideration and the number of alternatives presented, it is impossible to compare the full range of potential benefits that could be generated while still meeting the goals and objectives of the action. However, by comparing a suite of alternatives relatively similar to the proposed action, a sense of the relative changes in net benefits, while presumably meeting the goals and objectives of the action, can be assessed. For this purpose, two additional suites of areas are selected. Alternate 1 is composed of a subset of the proposed action, including the preferred spawing alternative and the preferred Cox Ledge, Small Eastern Maine, and Jeffreys Bank MBTG areas, to which are added the Georges Bank Alternative 9 and Great South Channel/Southern New England Alternative 5 habitat areas, including the clam exemptions. Figure 16 indicates the amount of revenue in currently open areas which is exposed by Alternate 1. Alternate 2 is composed of a subset of the proposed action, including the preferred spawing alternative and the preferred Cox Ledge and Jeffreys Bank MBTG areas, to which are added the Georges Bank Habitat Alternative 8, Great South Channel/Southern New England Habitat Alternative 3, and the Large Eastern Maine area, without clam exemptions. Figure 17 presents the total revenue in currently open areas which is exposed by Alternate 2.

Figure 16 – Total Revenue Exposed in Currently Open Areas of Alternate 1.

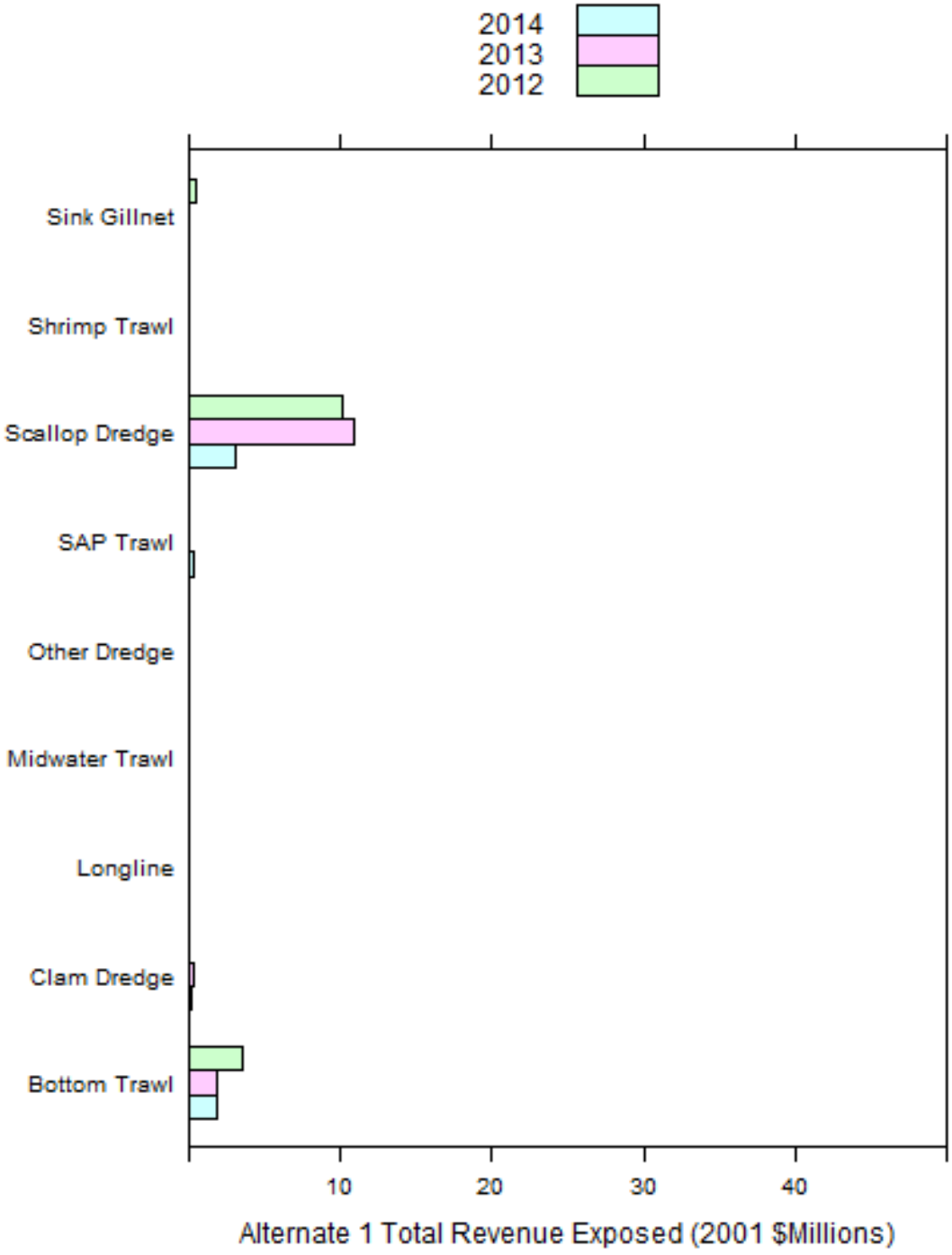


Figure 17. Total Revenue Exposed in Currently Open Areas of Alternate 2.

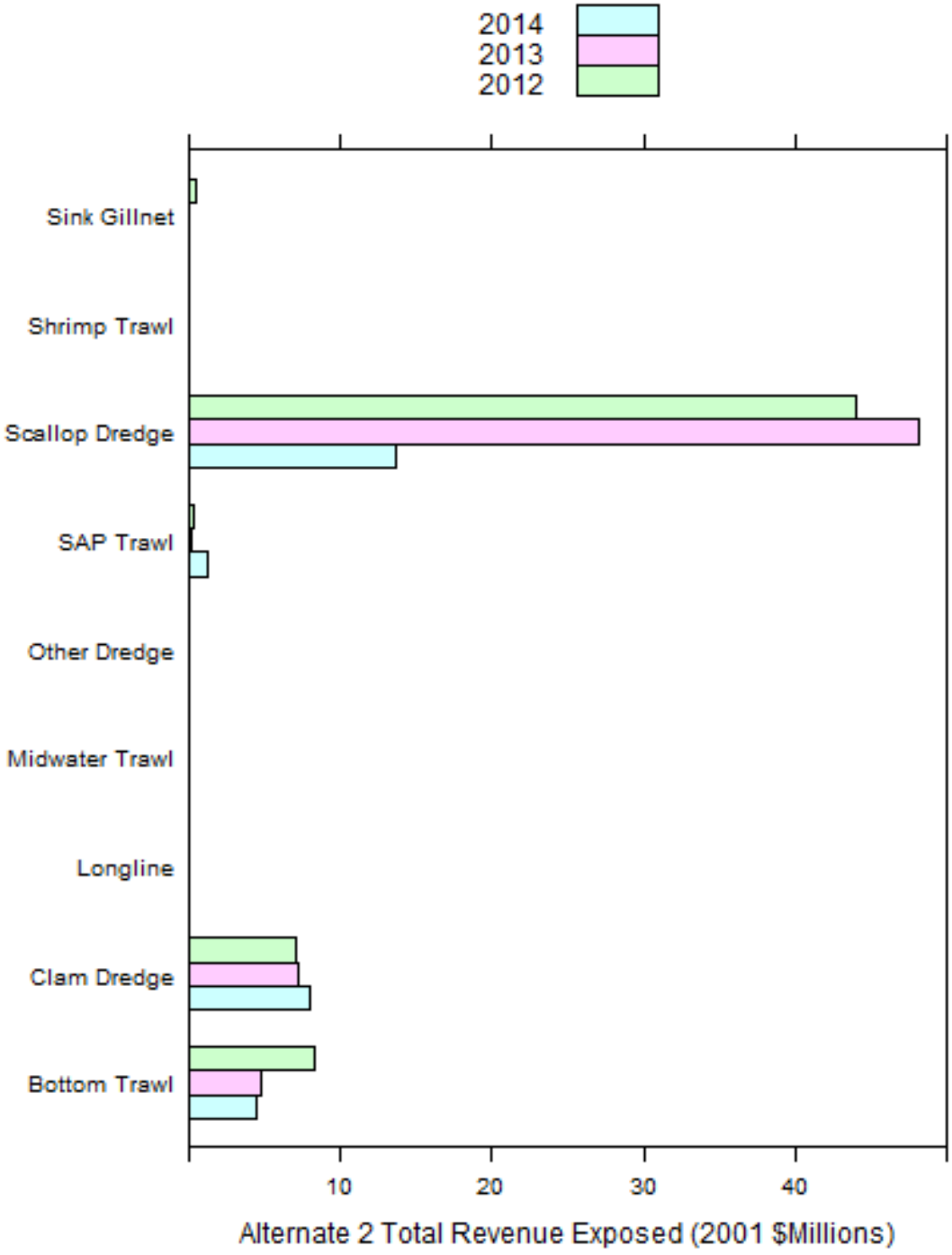


Figure 18 and Figure 19 present the percentage of each gear's total revenue generated within currently open waters of Alternate 1 and 2. From a comparison of these graphs, the difference in magnitude between the scallop fishery and all other exposed fisheries becomes readily apparent, in that although scallop revenue greatly exceeds the revenue generated by other fisheries in Alternate 2, the percentage of the fishery this represents is substantially different.

Figure 18 – Percent of total revenue exposed to Alternate 1, by gear.

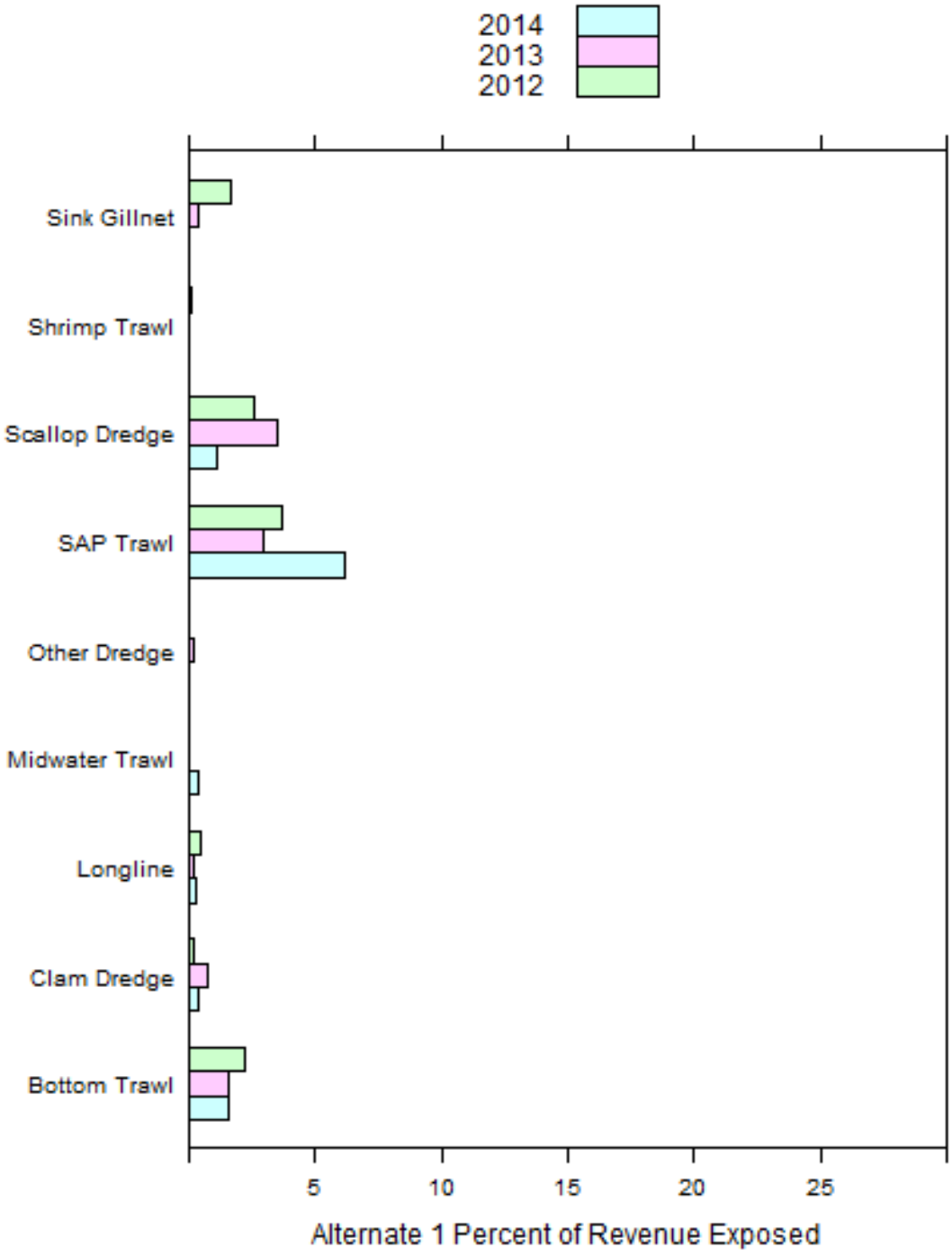


Figure 19 – Percent of total revenue exposed by Alternate 2, by gear.

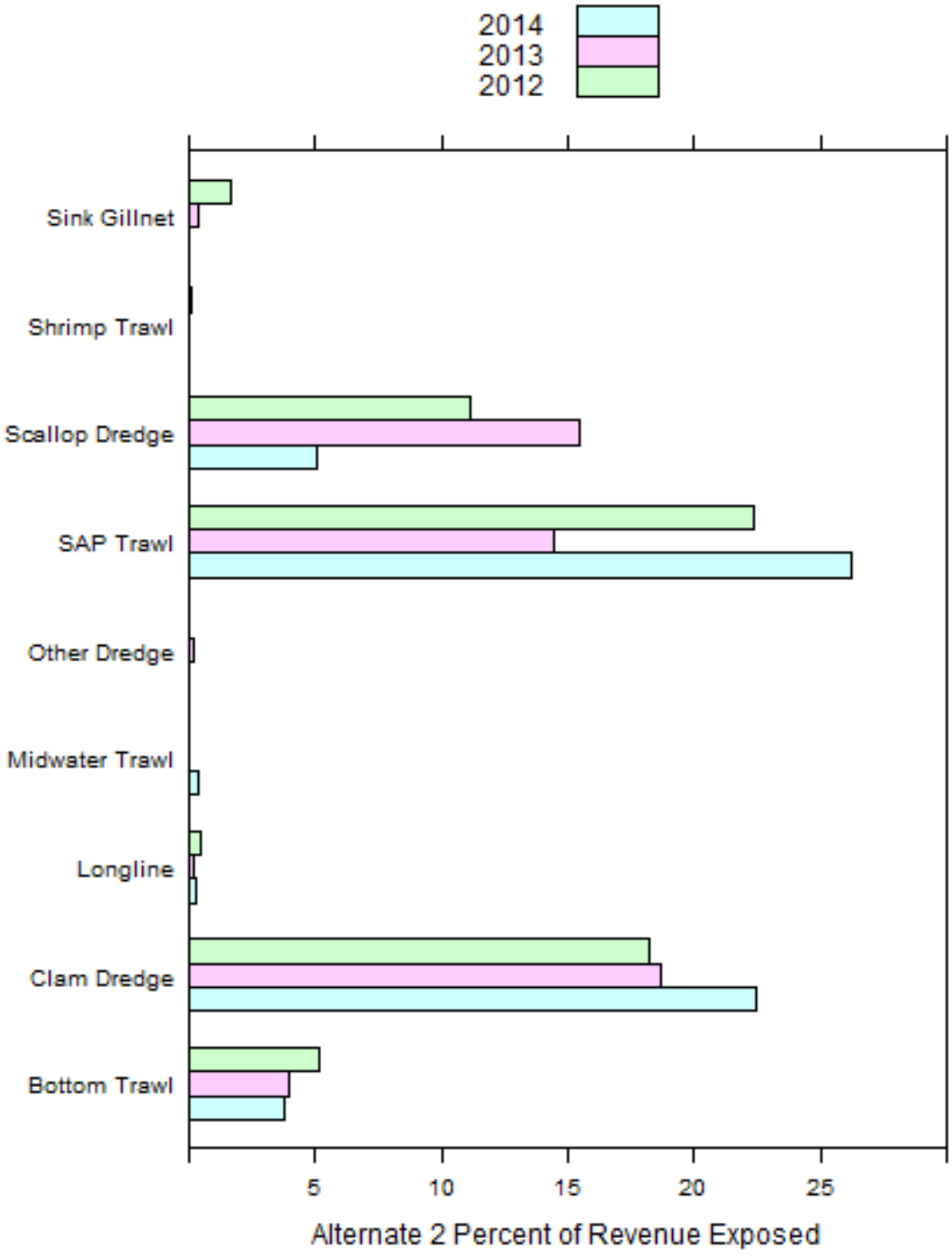


Figure 20 and Figure 21 presents the 2012 – 2014 average annual revenue generated from within the currently open waters associated respectively with Alternates 1 and 2, by FMP. Given the above, the fact that a substantial portion of the revenue is generated from the Scallop FMP in each suite is not suprising.

Figure 20 – 2012 - 2014 Average Revenue within Currenly Open Waters of Alternate 1, by FMP.

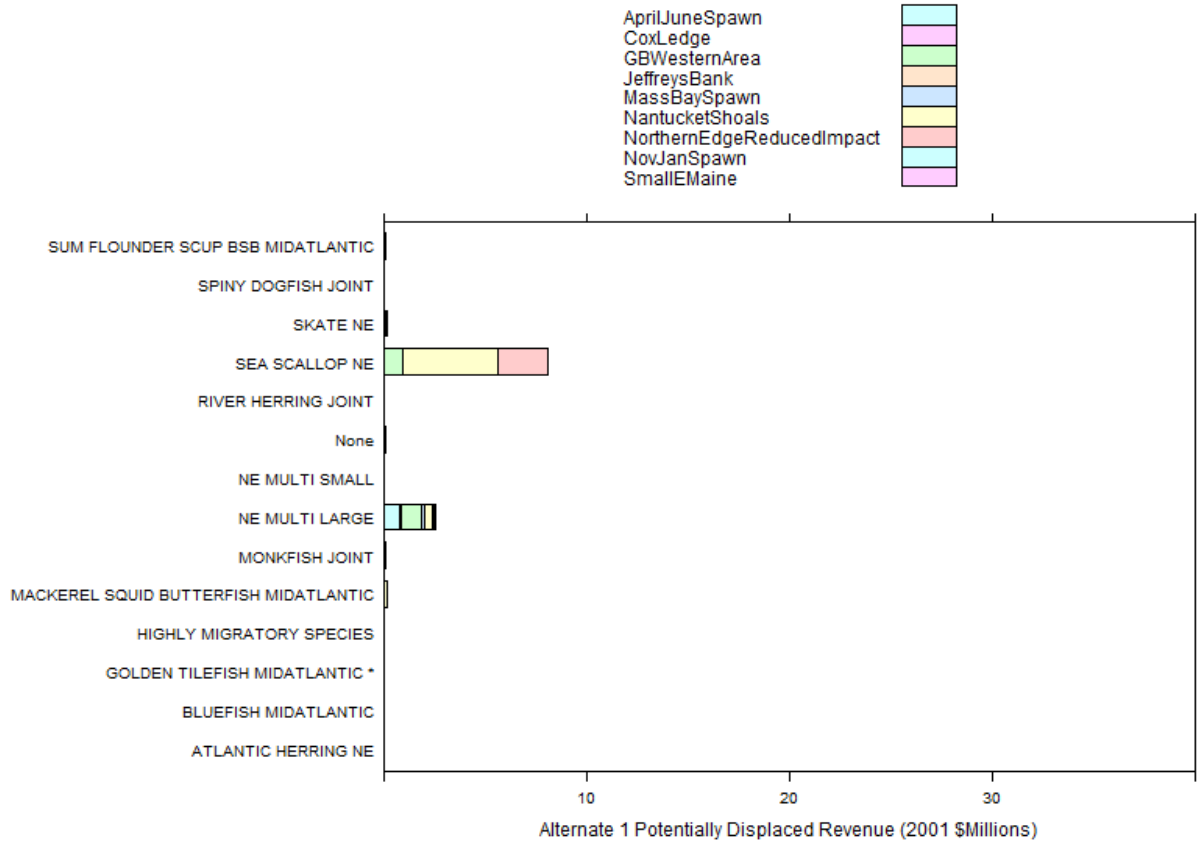
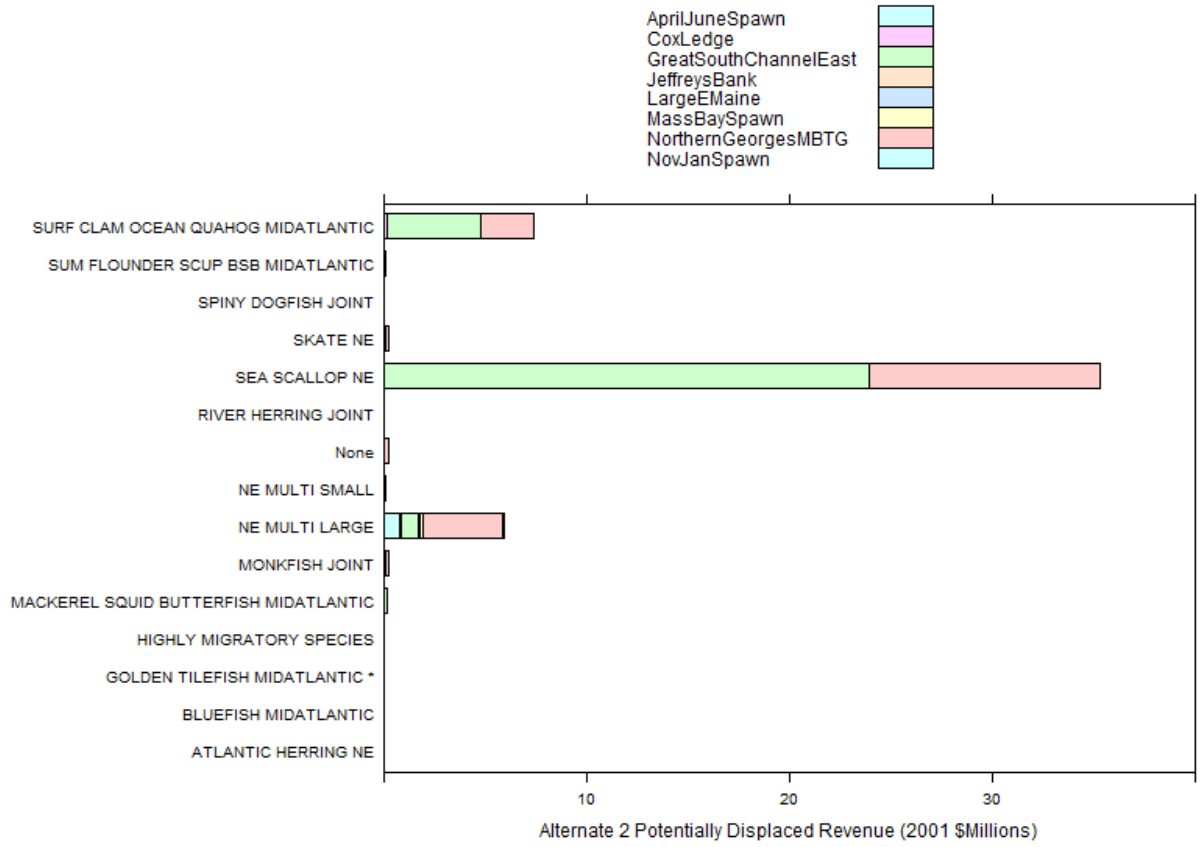


Figure 21 – 2012 - 2014 Average Revenue within Currenly Open Waters of Alternate 2, by FMP.



Volume 5, Table 36 indicates that the combined Northern Georges MBTG and Great South Channel East HMAs of Alternate 2 contains roughly 23% of the short-term and 27% (9%) of the mean (median) long-term scallop yield. For comparison, the no action alternatives on Georges Bank and Great South Channel/Southern New England represent 18% of the short-term and 10% (2.4%) of the mean (median) long-term yield, and generate welfare estimates in the hundreds of millions of dollars less than the proposed action, even over a relatively short 3 – 5 year time time horizon. Conversely, the yield estimated to fall within the Georges Bank Alternative 9 is 13% of the short-term, and 8% (2%) of the mean (median) long-term scallop yield, with negligible yield within the Nantucket Shoals area of Alternate 1. The total impacts of Alternate 1 on the scallop fishery is thus expected to be very similar to the proposed action.

Due to the relative magnitude of each of the fisheries, in terms of value, the net benefits are expected to be dominated by the net benefits accruing to the scallop fishery in the combined subregions of Georges Bank and Great South Channel/Southern New England, in a similar manner to the proposed action. The Large Mesh Multispecies revenue generated from Alternate 2 represents roughly 14% of the total FMP revenue between 2012 and 2014. Given that the majority of this revenue is sourced from the Northern Georges MBTG, and the impact of this area on juvenile habitat and presence which is expected to be neutral to negative when compared to no action (see Volume 5, Section 2.2.4.8), Alternate 2 is expected to have negative impacts for the groundfish fishery overall when compared to No Action/Alternative 1. Of note is that the

relative lack of mobile bottom tending gear fishing in Eastern Maine leads to relatively little difference in terms of exposure between the Large Eastern Maine and Small Eastern Maine areas, respectively, of the proposed action and Alternate 2. The Surf Clam and Ocean Quahog fishery is also expected to face negative impacts from Alternate 2, with roughly 2/3 of the exposed revenue sourced from the Great South Channel East area, and 1/3 from the Northern Georges MBTG area. Summed, this revenue represents 22% of the Surf Clam and Ocean Quahog fishery's average annual revenue between 2012 and 2014.

The impact of Alternate 1 on non-scallop fisheries is expected to be more nuanced. The clam dredge exemption would mitigate the majority of the impacts to the Surf Clam and Ocean Quahog fishery, in a similar manner to the proposed action. However, the proposed action areas have generated roughly 30% more Surf Clam and Ocean Quahog revenue in the 2012 – 2014 period when compared to Alternate 1, primarily stemming from much higher revenue in the Georges Shoals 2 vs. Georges Bank West areas, which indicates substantially different impacts if the exemption was to expire. The proposed action and Alternate 1 also present similar exposure to the sink gillnet, SAP trawl, and Bottom Trawl revenue, again primarily generated from the Large Mesh Multispecies FMP. Volume 5, Sections 2.2.4.9 and 2.2.4.10 compare the potential impacts of the Georges Bank Alternative 9 (Alternate 1 here) and 10 (preferred action here), which indicates that Alternate 1 would be expected to provide higher protection for juvenile groundfish than the proposed action on Georges Bank, although both provides for less protection than the No Action alternative. However, across species the amount of protection afforded varies across alternatives. Conversely, the proposed action's Great South Channel HMA is expected to afford greater protection for juvenile groundfish than both Alternate 1's Nantucket Shoals and the No Action alternative for the Great South Channel/Southern New England subregion (see Volume 5, Section 2.2.5). However, this assessment is highly uncertain, particularly given the decreasing quantity of survey trawl data available moving from Great South Channel towards Nantucket. Thus, the relative impacts between the proposed action and Alternate 1 are highly uncertain and spatially mixed for the groundfish fishery.

In summation, the net benefits of any suite of alternatives are dominated by the impacts, either positive or negative, expected to accrue to the scallop fishery due to the vast differential in value of the fisheries under management. However, impacts on other fisheries are highly uncertain and heterogenous both spatially and between species, gears, and fisheries, making any partial assessment of benefits problematic.

7.9 Executive Order 12898 (Environmental Justice)

OHA2 actions do not create substantial adverse impacts on the human health and environment for minority and low-income communities. The persons largely affected by this action are those individuals and businesses that operate within the fishing industry either directly or indirectly (i.e. harvesters, processors, dealers, vessel service businesses). These fishing communities directly impacted by Federal action taken in response to proposed OHA2 measures are not characterized as low income or minority communities. For these reasons, OHA2 is compliant with Executive Order 12898.

7.10 Executive Order 13132 (Federalism)

This E.O. established nine fundamental federalism principles for Federal agencies to follow when developing and implementing actions with federalism implications, with the objective to guarantee the Constitution's division of governmental responsibilities between the federal government and the states. The E.O. also lists a series of policy making criteria to which federal agencies must adhere when formulating and implementing policies that have federalism implications. This action does not contain policies with federalism implications sufficient to warrant preparation of an assessment under E.O. 13132. The affected states have been closely involved in the development of the proposed management measures through their representation on the Council (all affected states are represented as voting members of at least one Regional Fishery Management Council) and coordination with the Atlantic States Marine Fisheries Commission and the Mid-Atlantic Fishery Management Council. Vessels operating exclusively within state waters (0-3 nautical miles from the coastline) are exempt from fishing restrictions proposed under OHA2.

7.11 Executive order 13158 (Marine Protected Areas)

Executive Order 13158 applies to Marine Protected Areas, and 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 extent practicable, avoid harm to the natural and cultural resources that are protected by an MPA. The E.O. defines a Marine Protected Area as "any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." The E.O. requires that the Departments of Commerce and the Interior jointly publish and maintain such a list of MPAs. Marine Protected Areas within the New England Fishery Management Council's jurisdiction include: Stellwagen Bank National Marine Sanctuary, Lydonia Canyon Gear Restricted Area, Oceanographer Canyon Gear Restricted Area, and Veatch Canyon Gear Restricted Area; all other areas within the Northeast are not located within the EEZ. Fishing restrictions associated with the Western Gulf of Maine habitat and groundfish closures overlap Stellwagen Bank National Marine Sanctuary, and are maintained via the preferred action. The four canyon gear restricted areas prohibit the use of mobile bottom-tending gears to protect tilefish habitats. These restrictions are not affected by measures in OHA2. Therefore, OHA2 is compliant with Executive Order 13158.

8 References

8.1 Glossary

A: Refers to the area swept by a piece of fishing gear, adjusted for contact of gear with the seabed (contact index). *A* is added to the SASI model in annual time steps.

Adverse effect: An impact to EFH that is 'more than minimal and not temporary in nature' Any impact that reduces quality and/or quantity of EFH. May include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include sites-specific of habitat wide impacts, including individual, cumulative, or synergistic consequences of actions.

Adult stage: One of several marked phases or periods in the development and growth of many animals. In vertebrates, the life history stage where the animal is capable of reproducing, as opposed to the juvenile stage.

Aggregation: A group of animals or plants occurring together in a particular location or region.

Amendment: a formal change to a fishery management plan (FMP). The Council prepares amendments and submits them to the Secretary of Commerce for review and approval. The Council may also change FMPs through a "framework adjustment procedure" (see below). The Commission prepares amendments and submits them to the Commission's Atlantic Herring Section for approval. Implementing regulations are adopted by the states.

Amphipods: A small crustacean of the order Amphipoda, such as the beach flea, having a laterally compressed body with no carapace.

Anadromous species: fish that spawn in fresh or estuarine waters and migrate to ocean waters

Anemones: Any of numerous flowerlike marine coelenterates of the class Anthozoa, having a flexible cylindrical body and tentacles surrounding a central mouth.

Bay: An inlet of the sea or other body of water usually smaller than a gulf; a small body of water set off from the main body; e.g. Ipswich Bay in the Gulf of Maine.

Benthic community: Benthic means the bottom habitat of the ocean, and can mean anything as shallow as a salt marsh or the intertidal zone, to areas of the bottom that are several miles deep in the ocean. Benthic community refers to those organisms that live in and on the bottom.

Biological feature: Any living seabed structure assumed to be used for shelter by managed species of fish or their prey

Biota: all the plant and animal life of a particular region.

Benthic community: *Benthic* means the bottom habitat of the ocean, and can mean anything as shallow as a salt marsh or the intertidal zone, to areas of the bottom that are several miles deep in the ocean. *Benthic community* refers to those organisms that live in and on the bottom. (*In* meaning they live within the substrate; e.g., within the sand or mud found on the bottom. See *Benthic infauna*, below)

Benthic infauna: See *Benthic community*, above. Those organisms that live *in* the bottom sediments (sand, mud, gravel, etc.) of the ocean. As opposed to *benthic epifauna*, that live *on* the surface of the bottom sediments.

Benthivore: Usually refers to fish that feed on benthic or bottom dwelling organisms.

Berm: A narrow ledge typically at the top or bottom of a slope; e.g. a berm paralleling the shoreline caused by wave action on a sloping beach; also an elongated mound or wall of earth.

Biogenic habitats: Ocean habitats whose physical structure is created or produced by the animals themselves; e.g., coral reefs.

Biomass: The total mass of living matter in a given unit area or the weight of a fish stock or portion thereof. Biomass can be listed for beginning of year (Jan-1), Mid-Year, or mean (average during the entire year). In addition, biomass can be listed by age group (numbers at age * average weight at age) or summarized by groupings (e.g., age 1^+, ages 4+ 5, etc.). See also spawning stock biomass, exploitable biomass, and mean biomass.

B_{MSY}: The stock biomass that would produce MSY when fished at a fishing mortality rate equal to F_{MSY}. For most stocks, B_{MSY} is about ½ of the carrying capacity. The proposed overfishing definition control rules call for action when biomass is below ¼ or ½ B_{MSY}, depending on the species.

$B_{threshold}$: 1) A limit reference point for biomass that defines an unacceptably low biomass i.e., puts a stock at high risk (recruitment failure, depensation, collapse, reduced long term yields, etc.). 2) A biomass threshold that the SFA requires for defining when a stock is overfished. A stock is overfished if its biomass is below $B_{threshold}$. A determination of overfished triggers the SFA requirement for a rebuilding plan to achieve B_{target} as soon as possible, usually not to exceed 10 years except certain requirements are met. In Amendment 9 control rules, $B_{threshold}$ is often defined as either $1/2B_{MSY}$ or $1/4\ B_{MSY}$. $B_{threshold}$ is also known as $B_{minimum}$.

B_{target}: A desirable biomass to maintain fishery stocks. This is usually synonymous with B_{MSY} or its proxy.

Biomass weighted F: A measure of fishing mortality that is defined as an average of fishing mortality at age weighted by biomass at age for a ranges of ages within the stock (e.g., ages 1^+ biomass weighted F is a weighted average of the mortality for ages 1 and older, age 3^+ biomass weighted is a weighted average for ages 3 and older). Biomass weighted F can also be calculated using catch in weight over mean biomass. See also fully-recruited F.

Biota: All the plant and animal life of a particular region.

Bivalve: A class of mollusks having a soft body with plate-like gills enclosed within two shells hinged together; e.g., clams, mussels.

Bottom roughness: The inequalities, ridges, or projections on the surface of the seabed that are caused by the presence of bedforms, sedimentary structures, sedimentary particles, excavations, attached and unattached organisms, or other objects; generally small scale features.

Bottom tending mobile gear: All fishing gear that operates on or near the ocean bottom that is actively worked in order to capture fish or other marine species. Some examples of bottom tending mobile gear are otter trawls and dredges.

Bottom tending fixed gear: All fishing gear that operates on or near the ocean bottom that I snot actively worked; instead, the effectiveness of this gear depends on species moving to the gear which is set in a particular manner by a vessel, and later retrieved. Some examples of bottom tending static gear are gillnets, traps, and pots.

Boulder reef: An elongated feature (a chain) of rocks (generally piled boulders) on the seabed.

Bryozoans: Phylum aquatic organisms, living for the most part in colonies of interconnected individuals. A few too many millions of these individuals may form one colony. Some bryozoans encrust rocky surfaces, shells, or algae others form lacy or fan-like colonies that in some regions may form an abundant component of limestones. Bryozoan colonies range from millimeters to meters in size, but the individuals that make up the colonies are rarely larger than a millimeter. Colonies may be mistaken for hydroids, corals or seaweed.

Burrow: A hole or excavation in the sea floor made by an animal (as a crab, lobster, fish, burrowing anemone) for shelter and habitation.

Bycatch: (v.) the capture of nontarget species in directed fisheries which occurs because fishing gear and methods are not selective enough to catch only target species; (n.) fish which are harvested in a fishery but are not sold or kept for personal use, including economic discards and regulatory discards but not fish released alive under a recreational catch and release fishery management program.

Continental shelf waters: waters overlying the continental shelf, which extends seaward from the shoreline and deepens gradually to the point where the sea floor begins a slightly steeper descent to the deep ocean floor; the depth of the shelf edge varies, but is approximately 200 meters in many regions.

Crustaceans: invertebrates characterized by a hard outer shell and jointed appendages and bodies. They usually live in water and breathe through gills. Higher forms of this class include lobsters, shrimp and crawfish; lower forms include barnacles.

Capacity: the level of output a fishing fleet is able to produce given specified conditions and constraints. Maximum fishing capacity results when all fishing capital is applied over the maximum amount of available (or permitted) fishing time, assuming that all variable inputs are utilized efficiently.

Catch: the sum total of fish killed in a fishery in a given period. Catch is given in either weight or number of fish and may include landings, unreported landings, discards (bycatch), and incidental deaths.

Contact index: The proportion of a gear component that is assumed to touch the seabed during fishing

Coarse sediment: Sediment generally of the sand and gravel classes; not sediment composed primarily of mud; but the meaning depends on the context, e.g. within the mud class, silt is coarser than clay.

Commensalism: See *Mutualism*. An interactive association of two species where one benefits in some way, while the other species is in no way affected by the association.

Continental shelf waters: The waters overlying the continental shelf, which extends seaward from the shoreline and deepens gradually to the point where the sea floor begins a slightly steeper descent to the deep ocean floor; the depth of the shelf edge varies, but is approximately 200 meters in many regions.

Control rule: A pre-determined method for determining fishing mortality rates based on the relationship of current stock biomass to a biomass target. Amendment 9 overfishing control rules define a target biomass (B_{MSY} or proxy) as a management objective. The biomass threshold ($B_{threshold}$ or B_{min}) defines a minimum biomass below which a stock is considered overfished.

Cohort: see year class.

Crustaceans: Invertebrates characterized by a hard outer shell and jointed appendages and bodies. They usually live in water and breathe through gills. Higher forms of this class include lobsters, shrimp and crawfish; lower forms include barnacles.

Data Poor Working Group (DPWG): A standing assessment panel assembled to address stocks with limited or poor data.

Days-at-sea (DAS): the total days, including steaming time that a boat spends at sea to fish. Amendment 13 categorized DAS for the multispecies fishery into three categories, based on each individual vessel's fishing history during the period fishing year 1996 through 2001. The three categories are: Category A: can be used to target any groundfish stock; Category B: can only be used to target healthy stocks; Category C: cannot be used until some point in the future. Category B DAS are further divided equally into Category B (regular) and Category B (reserve).

Demersal species: Most often refers to fish that live on or near the ocean bottom. They are often called benthic fish, groundfish, or bottom fish.

Discards: animals returned to sea after being caught; see Bycatch

Echinoderms: A member of the Phylum Echinodermata. Marine animals usually characterized by a five-fold symmetry, and possessing an internal skeleton of calcite plates, and a complex water vascular system. Includes echinoids (sea urchins), crinoids (sea lillies) and asteroids (starfish).

Egg stage: One of several marked phases or periods in the development and growth of many animals. The life history stage of an animal that occurs after reproduction and refers to the developing embryo, its food store, and sometimes jelly or albumen, all surrounded by an outer shell or membrane. Occurs before the *larval* or *juvenile stage*.

Embayment: A bay or an indentation in a coastline resembling a bay.

Environmental Impact Statement (EIS): an analysis of the expected impacts of a fishery management plan (or some other Proposed Action) on the environment and on people, initially prepared as a "Draft" (DEIS) for public comment. After an initial EIS is prepared for a plan, subsequent analyses are called "Supplemental" (i.e., DSEIS, FSEIS).

Epifauna: Animals that live on the surface of the substrate, and are often associated with surface structures such as rocks, shells, vegetation, or colonies of other animals.

Exclusive Economic Zone (EEZ): for the purposes of the Magnuson-Stevens Fishery Conservation and Management Act, the area from the seaward boundary of each of the coastal states to 200 nautical miles from the baseline.

Essential Fish Habitat (EFH): Those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

Estuarine area: The area of an estuary and its margins; an area characterized by environments resulting from the mixing of river and sea water.

Estuary: A water passage where the tide meets a river current; especially an arm of the sea at the lower end of a river; characterized by an environment where the mixing of river and seawater causes marked variations in salinity and temperature in a relatively small area.

Eutrophication: A set of physical, chemical, and biological changes brought about when excessive nutrients are released into the water.

Euphotic zone: The zone in the water column where at least 1% of the incident light at the surface penetrates.

Exclusive Economic Zone (EEZ): a zone in which the inner boundary is a line coterminous with the seaward boundary of each of the coastal States and the outer boundary is line 200 miles away and parallel to the inner boundary

Exempt fisheries: Any fishery determined by the Regional Director to have less than 5 percent regulated species as a bycatch (by weight) of total catch according to 50 CFR 648.80(a)(7).

Exploitable biomass: The biomass of fish in the portion of the population that is vulnerable to fishing.

Fathom: A measure of length, containing six feet; the space to which a man can extend his arms; used chiefly in measuring cables, cordage, and the depth of navigable water by soundings.

FMP (fishery management plan): also referred to as a "plan," this is a document that describes a fishery and establishes measures to manage it. The New England Fishery Management Council prepares FMPs and submits them to the Secretary of Commerce for approval and implementation. The Atlantic States Marine Fisheries Commission prepares FMPs and implementing regulations are adopted by the States.

Fishing mortality (F): A measurement of the rate of removal of fish from a population caused by fishing. This is usually expressed as an instantaneous rate (F) and is the rate at which fish are harvested at any given point in a year. Instantaneous fishing mortality rates can be either fully recruited or biomass weighted. Fishing mortality can also be expressed as an exploitation rate (see exploitation rate) or less commonly, as a conditional rate of fishing mortality (m, fraction of fish removed during the year if no other competing sources of mortality occurred. Lower case m should not be confused with upper case M, the instantaneous rate of natural mortality).

Fishing effort: the amount of time and fishing power used to harvest fish. Fishing power is a function of gear size, boat size and horsepower.

Framework adjustments: adjustments within a range of measures previously specified in a fishery management plan (FMP). A change usually can be made more quickly and easily by a framework adjustment than through an amendment. For plans developed by the New England Council, the procedure requires at least two Council meetings including at least one public hearing and an evaluation of environmental impacts not already analyzed as part of the FMP.

GARM: Groundfish Assessment Review Meeting; peer reviewed assessment of groundfish stock managed by the Northeast Multispecies Fishery Management Plan.

Geological feature: Any non-living seabed structure assumed to be used for shelter by managed species of fish or their prey

Glacial moraine: A sedimentary feature deposited from glacial ice; characteristically composed of unsorted clay, sand, and gravel. Moraines typically are hummocky or ridge-shaped and are located along the sides and at the fronts of glaciers.

Glacial till: Unsorted sediment (clay, sand, and gravel mixtures) deposited from glacial ice.

Grain size: the size of individual sediment particles that form a sediment deposit; particles are separated into size classes (e.g. very fine sand, fine sand, medium sand, among others); the classes are combined into broader categories of mud, sand, and gravel; a sediment deposit can be composed of few to many different grain sizes.

Habitat complexity: Describes or measures a habitat in terms of the variability of its characteristics and its functions, which can be biological, geological, or physical in nature. Refers to how complex the physical structure of the habitat is. A bottom habitat with *structure-forming organisms*, along with other three dimensional objects such as boulders, is more complex than a flat, featureless, bottom.

Highly migratory species: tuna species, marlin, oceanic sharks, sailfishes, and swordfish

Hydroids: Generally, animals of the Phylum Cnidaria, Class Hydrozoa; most hydroids are bush-like polyps growing on the bottom and feed on plankton, they reproduce asexually and sexually.

Individual Fishing Quota (IFQ): federal permit under a limited access system to harvest a quantity of fish, expressed by a unit or units representing a percentage of the total allowable catch of a fishery that may be received or held for exclusive use by an individual person or entity

Juvenile stage: One of several marked phases or periods in the development and growth of many animals. The life history stage of an animal that comes between the *egg* or *larval stage* and the *adult stage*; juveniles are considered immature in the sense that they are not yet capable of reproducing, yet they differ from the larval stage because they look like smaller versions of the adults.

Landings: The portion of the catch that is harvested for personal use or sold.

Larvae stage: One of several marked phases or periods in the development and growth of many animals. The first stage of development after hatching from the *egg* for many fish and invertebrates. This life stage looks fundamentally different than the juvenile and adult stages, and is incapable of reproduction; it must undergo metamorphosis into the juvenile or adult shape or form.

Limited-access permits: permits issued to vessels that met certain qualification criteria by a specified date (the "control date").

Maturity ogive: A mathematical model used to describe the proportion mature at age for the entire population. A_{50} is the age where 50% of the fish are mature.

Meter: A measure of length, equal to 39.37 English inches, the standard of linear measure in the metric system of weights and measures. It was intended to be, and is very nearly, the ten millionth part of the distance from the equator to the North Pole, as ascertained by actual measurement of an arc of a meridian.

Metric ton: A unit of weight equal to a thousand kilograms (1kgs = 2.2 lbs.). A metric ton is equivalent to 2,205 lbs. A thousand metric tons is equivalent to 2.2 million lbs.

Molluscs: Common term for animals of the phylum Mollusca. Includes groups such as the bivalves (mussels, oysters etc.), cephalopods (squid, octopus etc.) and gastropods (abalone, snails). Over 80,000 species in total with fossils back to the Cambrian period.

Multispecies: the group of species managed under the Northeast Multispecies Fishery Management Plan. This group includes whiting, red hake and ocean pout plus the regulated species (cod, haddock, pollock, yellowtail flounder, winter flounder, witch flounder, American plaice, windowpane flounder, white hake and redfish).

Natural disturbance: A change caused by natural processes; e.g. in the case of the seabed, changes can be caused by the removal or deposition of sediment by currents; such natural processes can be common or rare at a particular site.

Natural mortality: A measurement of the rate of death from all causes other than fishing such as predation, disease, starvation, and pollution. Commonly expressed as an instantaneous rate (M). The rate of natural mortality varies from species to species, but is assumed to be M=0.2 for the five critical stocks. The natural mortality rate can also be expressed as a conditional rate (termed n and not additive with competing sources of mortality such as fishing) or as annual expectation of natural death (termed v and additive with other annual expectations of death).

Northeast Shelf Ecosystem: The Northeast U.S. Shelf Ecosystem has been described as including the area from the Gulf of Maine south to Cape Hatteras, extending from the coast seaward to the edge of the continental shelf, including the slope sea offshore to the Gulf Stream.

Observer: any person required or authorized to be carried on a vessel for conservation and management purposes by regulations or permits under the Magnuson-Stevens Act

Open access: describes a fishery or permit for which there is no qualification criteria to participate. Open-access permits may be issued with restrictions on fishing (for example, the type of gear that may be used or the amount of fish that may be caught).

Opportunistic species: Species that colonize disturbed or polluted sediments. These species are often small, grow rapidly, have short life spans, and produce many offspring.

Optimum Yield (OY): the amount of fish which A) will provide the greatest overall benefit to the nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems; B) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery

Overfished: A conditioned defined when stock biomass is below minimum biomass threshold and the probability of successful spawning production is low.

Overfishing: A level or rate of fishing mortality that jeopardizes the long-term capacity of a stock or stock complex to produce MSY on a continuing basis.

Pelagic gear: Mobile or static fishing gear that is not fixed, and is used within the water column, not on the ocean bottom. Some examples are mid-water trawls and pelagic longlines.

Phytoplankton: Microscopic marine plants (mostly algae and diatoms) which are responsible for most of the photosynthetic activity in the oceans.

Polychaetes: Polychaetes are segmented worms in the phylum Annelida. Polychaetes (poly-chaetae = many-setae) differ from other annelids in having many setae (small bristles held in tight bundles) on each segment.

Pre-recruits: Fish in size or age groups that are not vulnerable to the fishery (including discards).

Prey availability: The availability or accessibility of prey (food) to a predator. Important for growth and survival.

Primary production: The synthesis of organic materials from inorganic substances by photosynthesis.

Plan Development Team (PDT): a group of technical experts responsible for developing and analyzing management measures under the direction of the Council.

Prey feature: One of six benthic invertebrate taxa commonly consumed by managed species in the Northeast Region

Recruitment: the amount of fish added to the fishery each year due to growth and/or migration into the fishing area. For example, the number of fish that grow to become vulnerable to fishing gear in one year would be the recruitment to the fishery. “Recruitment” also refers to new year classes entering the population (prior to recruiting to the fishery).

Recruitment overfishing: fishing at an exploitation rate that reduces the population biomass to a point where recruitment is substantially reduced.

Regulated groundfish species: cod, haddock, pollock, yellowtail flounder, winter flounder, witch flounder, American plaice, windowpane flounder, white hake and redfish. These species are usually targeted with large-mesh net gear.

Realized: Refers to an area swept data layer that is intended to realistically represent actual fishing effort, where gear dimensions, fishing locations, and number of trips/tows/sets are based

on observer, trip report, or other data sources. Realized area swept is aggregated on an annual basis.

Recovery, R: Recovery is defined as the time in years that would be required for the functional value of that habitat feature to be restored.

SASI model: The combination of vulnerability assessment and geo-referenced fishing effort and habitat data used to estimate the magnitude and location of the adverse effects of fishing on habitat

Simulated: Refers to an area swept data layer that is intended to allow for spatial visualization the underlying seabed vulnerability, independent of the magnitude of area swept. Simulated area swept might be uniformly distributed, or non-uniformly distributed.

Substrate classes: Mud, sand, granule-pebble, cobble, and boulder, as defined by the Wentworth particle grade scale

Susceptibility, S: Susceptibility is defined as the percentage of total habitat features encountered by fishing gear during a hypothetical single pass fishing event that have their functional value reduced.

Structured grid: A regular grid of consisting of 100 km^2 cells to which area swept estimates are inferred.

Sea whips: A coral that forms long flexible structures with few or no branches and is common on Atlantic reefs.

Sea pens: An animal related to corals and sea anemones with a featherlike form.

Sediment: Material deposited by water, wind, or glaciers.

Sediment suspension: The process by which sediments are suspended in water as a result of disturbance.

Sedimentary bedforms: Wave-like structures of sediment characterized by crests and troughs that are formed on the seabed or land surface by the erosion, transport, and deposition of particles by water and wind currents; e.g. ripples, dunes.

Sedimentary structures: Structures of sediment formed on the seabed or land surface by the erosion, transport, and deposition of particles by water and wind currents; e.g. ripples, dunes, buildups around boulders, among others.

Sediment types: Major combinations of sediment grain sizes that form a sediment deposit, e.g. mud, sand, gravel, sandy gravel, muddy sand, among others.

Spawning adult stage: See *adult stage*. Adults that are currently producing or depositing eggs.

Spawning stock biomass (SSB): the total weight of fish in a stock that sexually mature, i.e., are old enough to reproduce.

Species assemblage: Several species occurring together in a particular location or region

Species composition: A term relating the relative abundance of one species to another using a common measurement; the proportion (percentage) of various species in relation to the total on a given area.

Species diversity: The number of different species in an area and their relative abundance

Species richness: See *Species diversity*. A measurement or expression of the number of species present in an area; the more species present, the higher the degree of species richness.

Status Determination: A determination of stock status relative to $B_{threshold}$ (defines overfished) and $F_{threshold}$ (defines overfishing). A determination of either overfished or overfishing triggers a SFA requirement for rebuilding plan (overfished), ending overfishing (overfishing) or both.

Stock: A grouping of fish usually based on genetic relationship, geographic distribution and movement patterns. A region may have more than one stock of a species (for example, Gulf of Maine cod and Georges Bank cod). A species, subspecies, geographical grouping, or other category of fish capable of management as a unit.

Stock assessment: determining the number (abundance/biomass) and status (life-history characteristics, including age distribution, natural mortality rate, age at maturity, fecundity as a function of age) of individuals in a stock

Structure-forming organisms: Organisms, such as corals, colonial bryozoans, hydroids, sponges, mussel beds, oyster beds, and seagrass that by their presence create a three-dimensional physical structure on the bottom. See *biogenic habitats*.

Surficial sediment: Sediment forming the sea floor or land surface; thickness of the surficial layer may vary.

Ten-minute- "squares" of latitude and longitude (TMS): Are a measure of geographic space. The actual size of a ten-minute-square varies depending on where it is on the surface of the earth, but in general each square is approximately 70-80 square nautical miles in this region. This is the spatial area that EFH designations, biomass data, and some of the effort data have been binned into for analysis purposes in various sections of this document.

Topography: The depiction of the shape and elevation of land and sea floor surfaces.

Total Allowable Catch (TAC): The amount (in metric tons) of a stock that is permitted to be caught during a fishing year. In the Multispecies FMP, TACs can either be "hard" (fishing ceases

when the TAC is caught) or a "target" (the TAC is merely used as an indicator to monitor effectiveness of management measures, but does not trigger a closure of the fishery).

Unstructured grid: An irregular grid based on the distribution of substrate data points. High or low energy and a suite of features are inferred to each unstructured grid cell

Vulnerability: The combination of a feature's susceptibility to fishing gear impact and its ability to recover from fishing gear impact

Voronoi tessellation: A mathematical procedure used to develop the unstructured substrate grid based on point data

Valued Ecosystem Component: A resource or environmental feature that is important (not only economically) to a local human population, or has a national or international profile, or if altered from its existing status, will be important for the evaluation of environmental impacts of industrial developments, and the focusing of administrative efforts.

Wentworth: A size-based sediment classification scheme

Yield-per-recruit (YPR): the expected yield (weight) of individual fish calculated for a given fishing mortality rate and exploitation pattern and incorporating the growth characteristics and natural mortality.

Yearclass: also called cohort. Fish that were spawned in the same year. By convention, the "birth date" is set to January 1st and a fish must experience a summer before turning 1. For example, winter flounder that were spawned in February-April 1997 are all part of the 1997 cohort (or year-class). They would be considered age 0 in 1997, age 1 in 1998, etc. A summer flounder spawned in October 1997 would have its birth date set to the following January 1 and would be considered age 0 in 1998, age 1 in 1999, etc.

Zooplankton: Small, often microscopic animals that drift in currents. They feed on detritus, phytoplankton, and other zooplankton. They are preyed upon by fish, shellfish, whales, and other zooplankton.

***Z*:** A measure of the adverse effect of fishing effort on seabed habitat features, measured in km^2 units. Z is area swept (A) that has been adjusted for susceptibility (S) and recovery (R). Z is considered a "stock" effect that accumulates over time based on the amount of adverse effect entering the fishery in any particular time step (Y), and the amount of adverse effect deemed to have recovered in that time step (X), such that $Z = X – Y$.

***Z_∞*:** (Vulnerability) The asymptotically stable equilibrium level of Z. Z_∞ is reached when a constant annual level of fishing area swept is applied to the all grid cells in the model for a length of time just slightly greater than the greatest terminal year of recovery estimated for all features in the Vulnerability Assessment.

$Z_{realized}$: The actual distribution of Z by gear type based on past area swept estimates. Annual $Z_{realized}$ estimates for each 100 km^2 grid cell include the current year Z summed across all area swept in the cell, adjusted for feature susceptibility, plus *Z* accumulated from fishing events in past years that has not yet decayed.

8.2 Literature cited

NOAA Fisheries Navigator, November 2013. Supplement to Commercial Fisheries News, http://fish-news.com/cfn/noaa-fisheries-navigator/.

Abernathy, S. A. (1989). Description of the Mid-Atlantic environment. Minerals Management Serv., Vienna, VA (USA). Atlantic OCS Reg.

Able, K. W. and M. P. Fahay (1998). The first year of life in estuarine fishes in the Middle Atlantic Bight. Rutgers, NJ, Rutgers University Press. 342pp.

Aguilar, A. (2002). Fin whale, *Balaenoptera physalus*. Encyclopedia of Marine Mammals. Perrin, W. F., B. Würsig and G. M. Thewissen. San Diego, Academic Press**:** 435-438.

Ames, E. P. (1997). Cod and haddock spawning grounds of the Gulf of Maine from Grand Manan to Ipswich Bay. The Implications of Localized Fishery Stocks, Portland, ME.

Ames, E. P. (2004). Atlantic Cod Stock Structure in the Gulf of Maine. Fisheries 29(1): 10-28.

Anderson, S. and R. S. Gregory (2000). Factors regulating survival of northern cod (NAFO 2J3KL) during their first 3 years of life. ICES J. Mar. Sci. 57: 349-359.

Arrow, K., M. Cropper, et al. (2013). Determining benefits and costs for future generations. Science 341(349-350).

Arsenault, D. J. and J. H. Himmelman (1998). Spawning of the Iceland scallop (*Chlamys islandica* Muller, 1776) in the northern Gulf of St. Lawrence and its relationship to temperature and phytoplankton abundance. The Veliger 41(2): 180-185.

ASMFC American Lobster Stock Assessment Subcommittee (2009). American Lobster Stock Assessment Report for Peer Review. Stock Assessment Report No. 09-01 (Supplement) of the Atlantic States Marine Fisheries Commission. Conducted on March 17-20, 2009, Boston, Massachusetts. Prepared by the ASMFC American Lobster Stock Assessment Subcommittee. 316pp.

ASMFC American Lobster Stock Assessment Subcommittee (2015). American Lobster Benchmark Stock Assessment and Peer Review Report. Conducted on June 8-11, 2015, Woods Hole, Massachusetts. Prepared by the ASMFC American Lobster Stock Assessment Review Panel. 438pp.

ASMFC Northern Shrimp Technical Committee (2012). Assessment Report for Gulf of Maine Northern Shrimp – 2012. Prepared November 21, 2012 by the Atlantic States Marine Fisheries Commission's Northern Shrimp Technical Committee. 81pp.

--- (2013). Assessment Report for Gulf of Maine Northern Shrimp – 2013. Prepared November 21, 2013 by the Atlantic States Marine Fisheries Commission's Northern Shrimp Technical Committee. 92pp.

Atlantic States Marine Fisheries Commission (2011). Species profile: Northern shrimp. Excerpted from ASMFC Fisheries Focus, Vol. 20, Issue 5.

Atlantic States Marine Fisheries Commission Technical Committee (2007). Special Report to the Atlantic Sturgeon Management Board: Estimation of Atlantic sturgeon bycatch in coastal Atlantic commercial fisheries of New England and the Mid-Atlantic. 95pp.

Atlantic Sturgeon Status Review Team (2007). Status review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). National Marine Fisheries Service. February 23, 2007. 175pp.

Atlantic Wolffish Biological Review Team (2009). Status review of Atlantic wolffish (*Anarhichas lupus*). Report to the National Marine Fisheries Service, Northeast Regional Office. 161pp.

Auster, P. and R. Langton (1999). The effects of fishing on fish habitat. Fish habitat: essential fish habitat and rehabilitation. American Fisheries Society, Symposium 22. Benaka, L. Bethesda, MD, American Fisheries Society**:** 150-187.

Auster, P. J. (2002). Representation of biological diversity of the Gulf of Maine region at Stellwagen Bank National Marine Sanctuary (Northwest Atlantic): patterns of fish diversity and assemblage composition. Managing Protected Areas in a Changing World, Wolfville, Nova Scotia.

Auster, P. J. (2005). Are deep-water corals important habitats for fishes? Cold-water Corals and Ecosystems. Freiwald, A. and J. M. Roberts. Berlin, Springer-Verlag Berlin Heidelberg**:** 747-760.

Auster, P. J., K. Joy and P. C. Valentine (2001). Fish species and community distributions as proxies for seafloor habitat distributions: the Stellwagen Bank National Marine Sanctuary example (Northwest Atlantic, Gulf of Maine). Environmental Biology of Fishes 60(4): 331-346.

Auster, P. J., M. Kilgour, et al. (2013). Octocoral gardens in the Gulf of Maine (NW Atlantic). Biodiversity: 1-2.

Auster, P. J. and J. Lindholm (2005). The ecology of fishes on deep boulder reefs in the western Gulf of Maine. Diving for Science 2005, Proceedings of the American Academy of Underwater Sciences, Connecticut Sea Grant, Groton: 89-107.

Auster, P. J., J. Lindholm, et al. (2003a). Use of sand wave habitats by silver hake. Journal of Fish Biology 62(1): 143-152.

Auster, P. J., J. Lindholm and P. C. Valentine (2003b). Variation in habitat use by juvenile Acadian redfish, *Sebastes fasciatus*. Environmental Biology of Fishes 68(4): 381-389.

Auster, P. J., R. J. Malatesta and C. L. S. Donaldson (1997). Distributional responses to small-scale habitat variability by early juvenile silver hake, *Merluccius bilinearis*. Environmental Biology of Fishes 50(2): 195-200.

Auster, P. J., R. J. Malatesta, et al. (1996). The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (northwest Atlantic): Implications for conservation of fish populations. Rev. Fish. Sci. 4(2): 185-202.

Auster, P. J., R. J. Malatesta and S. C. LaRosa (1995). Patterns of microhabitat utilization by mobile megafauna on the Southern New England (USA) continental shelf and slope. Mar. Ecol. Prog. Ser. 127: 77-85.

Auster, P. J., R. J. Malatesta, et al. (1991). Microhabitat utilization by the megafaunal assemblage at a low relief outer continental shelf site -- Middle Atlantic Bight, USA. Journal of Northwest Atlantic Fishery Science 11: 59-69.

Auster, P. J., C. Michalopoulos, et al. (1998). Delineating and monitoring habitat management units in a temperate deep-water marine protected area. Science and Management of Protected Areas**:** 169-185.

Auster, P.J., D. Packer, R. Waller, S. Auscavitch, M.J. Kilgour, L. Watling, M.S. Nizinski, I. Babb, D. Johnson, J. Pessutti, A. Drohan, and B. Kinlan. Imaging surveys of select areas in the Northern Gulf of Maine for deep-sea corals and Sponges during 2013-2014. Report to the New England Fishery Management Council - 30 October 2014.

Babb, I. and M. De Luca (1988). Benthic Productivity and Marine Resources of the Gulf of Maine. National Undersea Research Program Research Report 88-3. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Oceanic and Atmospheric Research, Office of Undersea Research, 292pp.

Backus, R. H. (1987). Georges Bank. Cambridge, MA, Massachusetts Institue of Technology Press. 593pp.

Baillon, S., J.-F. Hamel, et al. (2012). Deep cold-water corals as nurseries for fish larvae. Frontiers in Ecology and the Environment 10(7): 351-356.

Barnhardt, W. A., J. T. Kelley, et al. (1998). Mapping the Gulf of Maine with Side-Scan Sonar: A New Bottom-Type Classification for Complex Seafloors. Journal of Coastal Research 14(2): 646-659.

Barbeau, M. A., B. G. Hatcher, et al. (1996). Dynamics of juvenile sea scallop (Placopecten magellanicus) and their predators in bottom seeding trials in Lunenburg Bay, Nova Scotia. Canadian Journal of Fisheries and Aquatic Sciences 53(11): 2494-2512.

Beardsley, R. C., B. Butman, et al. (1996). Physical oceanography of the Gulf of Maine: an update. Proceedings of the Gulf of Maine Ecosystem Dynamics Scientific Symposium and Workshop. Wallace, G. T. and E. F. Braasch, Regional Association for Research on the Gulf of Maine. 97-1**:** 39-52.

Berlinsky, D. L. (2009). Genetic Identification of Atlantic Cod Spawning Stocks in U.S. Waters using Microsatellite and SNP DNA Markers. Northeast Consortium Cooperative Interim Final Report, Award Number 111A20.

Berrien, P. and J. Sibunka (1999). Distribution patterns of fish eggs in the United States northeast continental shelf ecosystem, 1977-1987. NOAA Technical Report NMFS 145. pp.

Best, P. B., J. L. Bannister, et al. (2001). Right whales: worldwide status. J. Cetacean Research and Management Special issue 2: 309.

Biesiot, P. M. and H. M. Perry (1995). Biochemical composition of the deep-sea red crab *Chaceon quinquedens* (Geryonidae): organic reserves of developing embryos and adults. Mar. Biol. 124: 407-416.

Bigelow, H. B. and W. C. Schroeder (1953). Fishes of the Gulf of Maine. U.S. Fish and Wildlife Service Fishery Bulletin 53: 577pp.

Blumenthal, J.M., J.L. Solomon, C.D. Bell, T.J. Austin, G. Ebanks-Petrie, M.S. Coyne, A.C. Broderick, and B.J. Godley. 2006. Satellite tracking highlights the need for international cooperation in marine turtle management. Endangered Species Research 2:51-61.

Boesch, D. F. (1979). Benthic ecological studies: macrobenthos. Final report Bur. Land Manage. Contract No. AA550-CT6062. 301pp.

Bologna, P. A. X. and R. S. Steneck (1993). Kelp beds as habitat for American lobster *Homarus americanus*. Mar. Ecol. Prog. Ser. 100: 127-134.

Bonardelli, J. C., J. H. Himmelman and K. Drinkwater (1996). Relation of spawning of the giant scallop, *Placopecten magellanicus*, to temperature fluctuations during downwelling events. Mar. Biol. 124(4): 637-649.

Borg, A., L. Pihl and H. Wennhage (1997). Habitat choice by juvenile cod (*Gadus morhua* L.) on sandy soft bottoms with different vegetation types. Helgol. Meeresunters 51(2): 197-212.

Bowen, B. W., A. L. Bass, et al. (2004). Natal homing in juvenile loggerhead turtles (*Caretta caretta*). Mol. Ecol. 13: 3797-3808.

Bowering, W. R. and W. B. Brodie (1991). Distribution of commerical flatfishes in the Newfoundland-Labrador region of the Canadian northwest Atlantic and changes in certain biological parameters since exploitation. Neth. J. Sea Res. 27: 407-422.

Brander, K. and P. C. F. Hurley (1992). Distribution of Early-Stage Atlantic Cod (*Gadus morhua*), Haddock (*Melanogrammus aeglefinus*), and Witch Flounder (*Glyptocephalus cynoglossus*) Eggs on the Scotian Shelf: A Reappraisal of Evidence on the Coupling of Cod Spawning and Plankton Production. Can. J. Fish. Aquat. Sci. 49(2): 238-251.

Braun, J., and S.P. Epperly. 1996. Aerial surveys for sea turtles in southern Georgia waters, June 1991. Gulf of Mexico Science 1996(1): 39-44.

Braun-McNeill, J. and S. P. Epperly (2004). Spatial and temporal distribution of sea turtles in the western North Atlantic and the U.S. Gulf of Mexico from Marine Recreational Fishery Statistics Survey (MRFSS). Mar. Fish. Rev. 64(4): 50-56.

Braun-McNeill, J., C.R. Sasso, S.P.Epperly, C. Rivero. 2008. Feasibility of using sea surface temperature imagery to mitigate cheloniid sea turtle–fishery interactions off the coast of northeastern USA. Endangered Species Research 5: 257–266.

Brodziak, J. K. T. (2005). Essential Fish Habitat Source Document: Haddock, *Melanogrammus aeglefinus*, Life History and Habitat Characteristics, Second Edition. NOAA Technical Memorandum NMFS-NE-196. 78pp.

Brooks, D. A. (1996). Physical oceanography of the shelf and slope seas from Cape Hatteras to Georges Bank: A brief overview.

Brown, M. B., O. C. Nichols, et al. (2002). Surveillance of North Atlantic right whales in Cape Cod Bay and adjacent waters. Final report to the Division of Marine Fisheries, Commonwealth of Massachusetts. 29pp.

Burdge, R. J. (2004). The Concepts, Process, and Methods of Social Impact Assessment. Middleton, WI, Social Ecology Press. 307pp.

Burdge, R. J. and F. Vanclay (1995). Social impact assessment. Environmental and Social Impact Assessment. Vanclay, F. and D. A. Bronstein, Wiley**:** 31-66.

Burnett, J., M. R. Ross and S. H. Clark (1992). Several biological aspects of the witch flounder (*Glyptocephalus cynoglossus* (L.)) in the Gulf of Maine-Georges Bank region. J. Northw. Atl. Fish. Sci. 12: 15-25.

Butman, B., R. C. Beardsley, et al. (1982). Recent Observations of the Mean Circulation on Georges Bank. Journal of Physical Oceanography 12(6): 569-591.

Caddy, J. F. (2008). The Importance of Cover in the Life Histories of Demersal and Benthic Marine Resources: A Neglected Issue in Fisheries Assessment and Management. Bulletin of Marine Science 83(1): 7-52.

Caddy, J. F. (2013). Why do assessments of demersal stocks largely ignore habitat? ICES J. Mar. Sci. doi:10.1093/icesjms/fss199, 13pp.

Cargnelli, L. M., S. J. Griesbach, et al. (1999). Essential Fish Habitat Source Document: Pollock, *Pollachius virens*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-131. 38pp.

Casas, J. M. and J. Paz (1994). Diet of Flemish Cap cod with particular reference to predation on redfish: 1988-93. Northwest Atl. Fish. Organ. Sci. Counc. Res. Doc. No. 94-24. 21pp.

Cetacean and Turtle Assessment Program (1982). Final report or the cetacean and turtle assessment program, University of Rhode Island, to Bureau of Land Management, U.S. Department of the Interior. Ref. No. AA551-CT8-48. 568pp.

Chang, S., W. W. Morse and P. L. Berrien (1999). Essential Fish Habitat Source Document: White Hake, *Urophycis tenuis*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-136. 32pp.

Chen, C., H. Huang, et al. (2011). Tidal dynamics in the Gulf of Maine and New England Shelf: An application of FVCOM. Journal of Geophysical Research: Oceans 116(C12): C12010.

Chen, C., H. Liu and R. C. Beardsley (2003). An Unstructured Grid, Finite-Volume, Three-Dimensional, Primitive Equations Ocean Model: Application to Coastal Oceans and Estuaries. Journal of Atmospheric and Oceanic Technology 20: 159-186.

Chen, Y., C. Zhang, M. Kersula, A. Dority, P. Shepard (2014). Eastern Gulf of Maine Sentinel Survey 2010-2013, Draft Report. School of Marine Sciences, University of Maine, Orono, ME, and Penobscot East Resource Center, Stonington, ME. 31pp.

Chute, A. S., D. Hennen, et al. (2013). Stock Assessment Update for Ocean Quahogs (*Arctica islandica*) through 2011. Northeast Fisheries Science Center Reference Document 13-17. 156pp.

Clapham, P. (2002). Humpback whale, *Megaptera novaeangliae*. Encyclopedia of Marine Mammals. Perrin, W. F., B. Würsig and G. M. Thewissen. San Diego, Academic Press**:** 589-592.

Clapham, P. J., S. B. Young and R. L. Brownell (1999). Baleen whales: Conservation issues and the status of the most endangered populations. Mammal Rev. 29(1): 35-60.

Collette, B. B. and G. Klein-MacPhee (2002). Fishes of the Gulf of Maine. Washington, DC, Smithsonian Institution Press. 748pp.

Collie, J. S., G. Escanero, et al. (1996). Scallop dredging on Georges Bank: photographic evaluation of effects on benthic epifauna. ICES Committee Meeting.

Collie, J. S., G. A. Escanero and P. C. Valentine (1997). Effects of bottom fishing on the benthic megafauna of Georges Bank. Mar. Ecol. Prog. Ser. 155: 159-172.

Collins, J. W. (1887). Historical notes and incidents of the fresh-halibut fishery. In G.B. Goode ed. The fisheries and fishery industries of the United States. Section II: A geographical review of the fisheries industries and fishing communities for the year 1880. Govt. Print. Office, Washington, DC, pp.

Collins, M. R. and T. I. J. Smith (1997). Distribution of shortnose and Atlantic sturgeons in South Carolina. North American Journal of Fisheries Management. 17: 995-1000.

Colton, J. B. (1972). Temperature trends and the distribution of groundfish in continental shelf waters, Nova Scotia to Long Island. Fish. Bull. 70(3): 637-657.

Colton, J. B. and R. R. Marak (1969). Guide for identifying the common planktonic fish eggs and larvae of continental shelf waters, Cape Sable to Block Island. Bureau of Commercial Fisheries Biological Laboratory, Woods Hole, MA, 43pp.

Colton, J. B., W. Smith, et al. (1979). Principal spawning areas and times of marine fishes, Cape Sable to Cape Hatteras. Fish. Bull. 76: 911-915.

Colton, J. B., Jr. and R. F. Temple (1961). The Enigma of Georges Bank Spawning. Limnology and Oceanography 6(3): 280-291.

Colvocoresses, J. and J. Musick (1984). Species associations and community composition of Middle-Atlantic Bight continental shelf demersal fishes. Fish. Bull. 82: 295-313.

Conant, T. A., P. H. Dutton, et al. (2009). Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service, August 2009. 222pp.

Cook, S. K. (1988). Physical oceanography of the Middle Atlantic Bight. NOAA Tech. Memo. NMFS-F/NEC-56. 1-50pp.

Cooper, R. A. and J. R. Uzmann (1980). Ecology of juvenile and adult American, *Homarus americanus*, and European, *Homarus gammarus*, lobsters. Biology of Lobsters. Cobb, S. J. and B. F. Phillips. New York, NY, Academic Press**:** 97-141.

Cooper, R. A. and J. R. Uzmann (1980). Georges Bank and submarine canyon living resources and habitat baselines in oil and gas drilling areas. Manned Undersea Research and Technology Program, FY 1980 Northeast Monitoring Program Report. Northeast Fisheries Center, National Marine Fisheries Service, Woods Hole, MA, 34pp.

Cooper, R. A., P. C. Valentine, et al. (1987). Submarine canyons. Georges Bank. Backus, R. H. Cambridge, MA, MIT Press**:** 52-63.

Cowles, G. W., S. J. Lentz, et al. (2008). Comparison of observed and model-computed low frequency circulation and hydrography on the New England Shelf. J. Geophys. Res. Oceans 113: C09015.

Dadswell, M. (2006). A review of the status of Atlantic sturgeon in Canada, with comparisons to populations in the United States and Europe. Fisheries 31: 218-229.

Dalley, E. L. and J. T. Anderson (1997). Age-dependent distribution of demersal juvenile Atlantic cod (*Gadua morhua*) in inshore/offshore northeast Newfoundland. Can. J. Fish. Aquat. Sci. 54(Suppl. 1): 168-176.

Dalyander, P. S., B. Butman, et al. (2013). Characterizing wave- and current- induced bottom shear stress: U.S. middle Atlantic continental shelf. Cont. Shelf Res. 52(0): 73-86.

Davidson, L.-A., M. Lanteigne and M. Niles (1993). Timing of the gametogenic development and spawning period of the giant scallop *Placopecten magellancius* (Gmelin) in the southern Gulf of St. Lawrence. Can. Tech. Rep. Fish. Aquat. Sci. 1935. 14pp.

Davies, K. T. A., W. C. Gentleman, et al. (2014). Semi-annual spawning in marine scallops strengthens larval recruitment and connectivity on Georges Bank: a model study. Marine Ecology Progress Series 516: 209-227.

Dean, M. J., W. S. Hoffman, et al. (2014). Fine-scale diel and gender-based patterns in behaviour of Atlantic cod (*Gadus morhua*) on a spawning ground in the Western Gulf of Maine. ICES J. Mar. Sci.

DeCelles, G. R. and S. X. Cadrin (2010). Movement patterns of winter flounder (*Pseudopleuronectes americanus*) in the southern Gulf of Maine: observations with the use of passive accoustic telemetry. Fish. Bull. 108: 408-419.

Deese, H. (2005). Appendix A to final report: Utilizing Genetics Techniques to Discriminate Atlantic Cod Spawning Stocks in U.S. waters: a Pilot Project. 14pp.

Diaz, R. J., G. R. Cutter and K. W. Able (2003). The importance of physical and biogenic structure to juvenile fishes on the shallow inner continental shelf. Estuaries 26(1): 12-20.

Dodge, K.L., B. Galuardi, T. J. Miller, and M. E. Lutcavage (2014). Leatherback Turtle Movements, Dive Behavior, and Habitat Characteristics in Ecoregions of the Northwest Atlantic Ocean. PLOS ONE 9 (3) e91726: 1-17.

Dodge, K.L, B. Galuardi, M.E. Lutcavage (2015) Orientation behaviour of leatherback sea turtles within the North Atlantic subtropical gyre. Proc. R. Soc. B 282: 20143129. http://dx.doi.org/10.1098/rspb.2014.3129

Dorsey, E. M. (1988). Geological overview of the seafloor of New England. Effects of fishing gear on the seafloor of New England. Dorsey, E. M. and J. Pederson, MIT SeaGrant Pub. 98-4**:** 8-14.

Dovel, W. L. and T. J. Berggren (1983). Atlantic sturgeon of the Hudson River estuary, New York. New York Fish and Game Journal 30: 140-172.

Dunton, K. J., A. Jordaan, et al. (2010). Abundance and distribution of Atlantic sturgeon (*Acipenser oxyrinchus*) within the Northwest Atlantic Ocean determined from five fishery-independent surveys. Fish. Bull. 108: 450-465.

DuPaul, W. D., J. E. Kirkley and A. C. Schmitzer (1989). Evidence of a semiannual reproductive cyle for the sea scallop, *Placopecten magellanicus* (Gmelin, 1791), in the mid-Atlantic reigon. J. Shellfish Res. 8: 173-178.

Eckert, S.A., D. Bagley, S. Kubis, et al (2006). Internesting and postnesting movements of foraging habitats of leatherback sea turtles (*Dermochelys coriacea*) nesting in Florida. Chel. Cons. Biol. 5(2): 239-248.

Ecosystem Assessment Program (2012). Ecosystem Status Report for the Northeast Shelf Large Marine Ecosystem - 2011. Northeast Fish Sci Cent Ref Doc. 12-07. Woods Hole, MA, 33pp.

Elklund, A.-M. (1988). Fishes inhabiting hard bottom reef areas in the Middle-Atlantic Bight: seasonality of species composition, catch rates, and reproduction. Coll. Mar. Studies, Univ. of Delaware, Lewes, DE, 98pp.

Epperly, S.P., J. Braun, and A.J. Chester (1995a). Aerial surveys for sea turtles in North Carolina inshore waters. Fishery Bulletin 93:254-261.

Epperly, S.P., J. Braun, A.J. Chester, et al. (1995b). Winter distribution of sea turtles in the vicinity of Cape Hatteras and their interactions with the summer flounder trawl fishery. Bulletin of Marine Science 56(2):547-568.

Epperly, S.P., J. Braun, and A. Veishlow (1995c). Sea turtles in North Carolina waters. Conservation Biology 9(2):384-394.

Erdman, R. B., N. J. Blake, et al. (1991). Comparative reproduction of the deep-sea crabs *Chaceon fenneri* and *C. quinquedens* (Brachyura: Geryonidae) from the northeast Gulf of Mexico. Invertebrate Reproduction and Development 19: 175-184.

Erickson, D. L., A. Kahnle, M. J. Millard, et al. (2011). Use of pop-up satellite archival tags to identify oceanic-migratory patterns for adult Atlantic Sturgeon, Acipenser oxyrinchus oxyrinchus Mitchell, 1815. J. Appl. Ichthyol. 27: 356–365.

Fahay, M. P. (1974). Occurrence of silver hake, *Merluccius bilinearis,* eggs and larvae along the Middle Atlantic continental shelf during the 1966 period. Fish. Bull. 72: 813-834.

Fahay, M. P. and K. W. Able (1989). White hake, *Urophycis tenuis*, in the Gulf of Maine: spawning seasonality, habitat use, and growth in young of the year and relationships to the Scotian Shelf population. Canadian Journal of Zoology 67(7): 1715-1724.

Fairchild, E.A., L. Siceloff, W.H. Howell, B. Hoffman, and M.P. Armstrong. 2013. Coastal spawning by winter flounder and a reassessment of essential fish habitat in the Gulf of Maine. Fish. Res. 141:118-129.

Fay, C., M. Bartron, et al. (2006). Status Review for Anadromous Atlantic Salmon (*Salmo salar*) in the United States, Report to the National Marine Fisheries Service and U.S. Fish and Wildlife Service. 294pp.

Feely, R.A., S.C. Doney, and S.R. Cooley. (2009). Ocean Acidification: Present Conditions and Future Changes in a High-CO_2 World. Oceanography 22(4): 36-47.

Fitz, E. S. and F. C. Daiber (1963). An introduction to the biology of *Raja eglanteria* Bosc 1802 and *Raja erinacea* Mitchill 1825 as they occur in Delaware Bay. Bull. Bingham Oceanogr. Collect., Yale Univ. 18(3): 69-97.

Gabriel, W. L. (1992). Persistence of demersal fish assemblages between Cape Hatteras and Nova Scotia, Northwest Atlantic. Journal of Northwest Atlantic Fishery Science 14: 29-46.

Garman, G. C. (1983). Observations on Juvenile Red Hake Associated with Sea Scallops in Frenchman Bay, Maine. Transactions of the American Fisheries Society 112(2A): 212-215.

Gaskin, D. E. (1977). Harbour porpoise, *Phocoena phocoena* (L.), in the western approaches to the Bay of Fundy 1969-75. Rep. Int Whal. Comm 27: 487-792.

Gell, F. R. and C. M. Roberts (2003). Benefits beyond boundaries: the fishery effects of marine reserves. Trends in Ecology & Evolution 18(9): 448-455.

Genovese, S. J. and J. D. Witman (1999). Interactive effects of flow speed and particle concentration on growth rates of an active suspension feeder. Limnology and Oceanography 44(4): 1120-1131.

Georgianna, D., A. Cass and P. Amaral (1999). The cost of fishing for sea scallops in the United States. University of Massachusetts Dartmouth, National Oceanic and Atmospheric Administration Cooperative Marine Education and Research Award, Contract Number NA67FEO420. pp.

Gilbert, C. S., W. C. Gentleman, et al. (2010). Modelling dispersal of sea scallop (*Placopecten magellanicus*) larvae on Georges Bank: The influence of depth-distribution, planktonic duration and spawning seasonality. Prog. Oceanography 87(1–4): 37-48.

Gotceitas, V. and J. A. Brown (1993). Substrate selection by juvenile Atlantic cod (*Gadus morhua*): Effects of predation risk. Oecologia 93(1): 31-37.

Gotceitas, V., S. Fraser and J. A. Brown (1995). Habitat use by juvenile Atlantic cod (*Gadus morhua*) in the presence of an actively foraging and non-foraging predator. Marine Biology 123(3): 421-430.

Gottschall, K., M. W. Johnson and D. G. Simpson (2000). The distribution and size composition of finfish, American lobster and long-finned squid in Long Island Sound based on the Connecticut Fisheries Division bottom trawl survey, 1984-1994. NOAA Technical Report NMFS 148. 1999pp.

Grabowski, J. H., J. Gaudette, et al. (In preparation). Identifying habitat associations of early juvenile cod in nearshore Gulf of Maine waters.

Grabowski, J. H., M. Bachman, et al. (2014). Assessing the Vulnerability of Marine Benthos to Fishing Gear Impacts. Reviews in Fisheries Science & Aquaculture: 142-155.

Graham, J. J., S. B. Chenoweth and C. W. Davis (1972). Abundance, distribution, movements, and lengths of larval herring along the western coast of the Gulf of Maine. Fish. Bull. 70(2): 307-321.

Grannis, B. M. (2005). Impacts of mobile fishing gear and a buried fiber-optic cable on soft-sediment benthic community structure. Master of Science in Oceanography, University of Maine.

Greenstreet, S. P. R., H. M. Fraser and G. J. Piet (2009). Using MPAs to address regional-scale ecological objectives in the North Sea: modeling the effects of fishing effort displacement. ICES J. Mar. Sci. 66: 90-100.

Gregory, R. S. and S. Anderson (1997). Substrate selection and use of protective cover by juvenile Atlantic cod Gadus morhua in inshore waters of Newfoundland. Mar. Ecol. Prog. Ser. 146: no.

Griffin, D.B., S. R. Murphy, M. G. Frick, et al. (2013). Foraging habitats and migration corridors utilized by a recovering subpopulation of adult female loggerhead sea turtles: implications for conservation. Mar. Biol. 160: 3071–3086.

Grimm, S. K. (1983). Changes in time and location of herring (*Clupea harengus* L.) spawning relative to bottom temperatures in Georges Bank and Nantucket Shoals areas, 1971-77. NAFO Sci. Coun. Stud. 6. 15-34.

Gulf of Maine Research Institute (2012). Workshop on Proactive Conservation Planning for Northwest Atlantic Cusk. December 7-8, 2011. Gulf of Maine Research Institute, Portland, Maine. Funded by and held in coordination with NMFS.

Hacunda, J. S. (1981). Trophic relationships among demersal fishes in a coastal area of the Gulf of Maine. Fish. Bull. 79: 775-788.

Haedrich, R. L., G. T. Rowe and P. T. Polloni (1975). Zonation and faunal composition of epibenthic populations on the continental slope south of New England. J. Mar. Res. 33: 191-212.

Haefner, P. A. J. (1977). Reproductive biology of the female deep-sea red crab, *Geryon quinquedens*, from the Chesapeake Bight. Fish. Bull. 75: 91-102.

Halpern, B. S., S. D. Gaines and R. R. Warner (2004). Confounding effects of the export of production and the displacement of fishing effort from marine reserves. Ecological Applications 14(4): 1248-1256.

Harris, B. P., G. W. Cowles and K. D. E. Stokesbury (2012). Surficial Sediment Stability on Georges Bank in the Great South Channel and on eastern Nantucket Shoals. Cont. Shelf Res. 49: 65-72.

Harris, B. P. and K. D. E. Stokesbury (2010). The spatial structure of local surficial sediment characteristics on Georges Bank, USA. Cont. Shelf Res. 30: 1840-1853.

Harrison, G. W. and E. E. Rutstrom (2008). Experimental evidence on the existence of hypothetical bias in value elicitation methods. Handbook of Experimental Economics Results. Plott, C. R. and V. L. Smith. 1**:** 1-5.

Hart, D. R. (2006). When do marine reserves increase fishery yield? Canadian Journal of Fisheries and Aquatic Sciences 63(7): 1445-1449.

Hart, D. R. and A. S. Chute (2009). Verification of Atlantic sea scallop (*Placopecten magellanicus*) shell growth rings by tracking cohorts in fishery closed areas. Canadian Journal of Fisheries and Aquatic Sciences 66(5): 751-758.

Hart, D. R., L. D. Jacobson and J. Tang (2013). To split or not to split: Assessment of Georges Bank sea scallops in the presence of marine protected areas. Fisheries Research 144: 74-83.

Hart, D. R. and P. J. Rago (2006). Long-term dynamics of U.S. Atlantic sea scallop *Placopecten magellanicus* populations. N. Am. J. Fish. Manage. 26(2): 490-501.

Hartley, D., A. Whittingham, J. Kenney, et al. (2003). Large Whale Entanglement Report 2001. Report to the National Marine Fisheries Service, updated February 2003.

Haug, T. (1990). Biology of the Atlantic Halibut, *Hippoglossus hippoglossus* (L., 1758). Advances in Marine Biology. Blaxter, J. H. S. and A. J. Southward, Academic Press. Volume 26**:** 1-70.

Hawkes, L.A., A.C. Broderick, M.S. Coyne, et al. (2006). Phenotypically linked dichotomy in sea turtle foraging requires multiple conservation approaches. Current Biology 16: 990-995.

Hawkes, L.A., M.J. Witt, A.C. Broderick, et al. (2011). Home on the range: spatial ecology of loggerhead turtles in Atlantic waters of the USA. Diversity and Distributions 17:624–640.

Heck, K. L., K. W. Able, et al. (1989). Fishes and decapod crustaceans of Cape Cod eelgrass meadows: Species composition, seasonal abundance patterns and comparison with unvegetated substrates. Estuaries 12(2): 59-65.

Hecker, B. (1990). Variation in megafaunal assemblages on the continental margin south of New England. Deep Sea Research (Part I, Oceanographic Research Papers) 37(1A): 37-57.

Hecker, B. (2001). Polygons BH1-4 (Veatch, Hydrographer, Oceanographer, and Lydonia Canyons). Natural Resources Defense Council, Washington, DC, 32-36.

Hecker, B. and G. Blechschmidt (1979). Final Historical Coral Report for the Canyon Assessment Study in the Mid- and North-Atlantic Areas of the U.S. Outer Continental Shelf. U.S. Department of Interior, Bureau of Land Management, Washington, D.C..

Hecker, B., G. Blechschmidt and P. Gibson (1980). Final report - canyon assessment study in the Mid- and North Atlantic areas of the U.S. outer continental shelf. Contract No. BLM-AA551-CT8-49. U.S. Dept. Interior, Bureau of Land Management, Washington, D.C., 456pp.

Hecker, B., D. T. Loban, et al. (1983). Megafaunal assemblages in Lydonia Canyon, Baltimore Canyon, and selected slope areas. Pages 1-140 in Canyon and slope processes study, Vol. III, biological processes. Final report for U.S. Department of Interior, M. M. S. No. 14-12-001-29178.

Hennen, D. R. and D. R. Hart (2012). Shell Height-To-Weight Relationships for Atlantic Sea Scallops (Placopecten magellanicus) in Offshore U.S. Waters. Journal of Shellfish Research 31(4): 1133-1144.

Hilborn, R., K. Stokes, et al. (2004). When can marine reserves improve fisheries management? Ocean Coast. Manage. 47(3–4): 197-205.

Hill, M. F., J. D. Witman and H. Caswell (2002). Spatio-temporal variation in Markov chain models of subtidal community succession. Ecology Letters 5(5): 665-675.

Hirth, H. F. (1997). Synopsis of the biological data of the green turtle, *Chelonia mydas* (Linnaeus 1758). USFWS Biological Report 97(1): 1-120.

Holland, B. F. J. and G. F. Yelverton (1973). Distribution and biological studies of anadromous fishes offshore North Carolina. N.C. Dep. Nat. Econ. Res. Spec. Sci. Rep. 24. 132pp.

Horwood, J. (2002). Sei whale, *Balaenoptera borealis*. Encyclopedia of Marine Mammals. Perrin, W. F., B. Würsig and G. M. Thewissen. San Diego, Academic Press**:** 1069-1071.

Howe, A. B., S. J. Correia, et al. (2002). Spatial Distribution of Ages 0 and 1 Atlantic Cod (*Gadus morhua*) off the Eastern Massachusetts Coast, 1978-1999, Relative to 'Habitat Area of Special Concern'. Massachusetts Division of Marine Fisheries Technical Report TR-12. Massachusetts Division of Marine Fisheries, Department of Fisheries, Wildlife, and Environmental Law Enforcement, Executive Office of Environmental Affairs, Commonwealth of Massachusetts, 39pp.

Howell, W. H., M. Morin, et al. (2008). Residency of adult Atlantic cod (*Gadus morhua*) in the western Gulf of Maine. Fisheries Research 91: 123-132.

Howland, J., S. Gallager, et al. (2006). Development of a towed survey system for deployment by the fishing industry. Oceans 2006 MTS/IEEE. Institute of Electrical and Electronics Engineers (IEEE). Boston, Massachusetts, September 18-21 2006, Curran Associates, Inc.

Huret, M., Runge, J.A., et al. (2007). Dispersal modeling of fish early life stages: sensitivity with application to Atlantic cod in the western Gulf of Maine. Mar. Ecol. Prog. Ser. 347: 261-274.

Hutchings, J. A., T. D. Bishop and C. R. McGregor-Shaw (1999). Spawning behavior of Atlantic cod, *Gadus morhua*: evidence of mate competition and mate choice in a broadcast spawner. Can. J. Fish. Aquat. Sci. 56: 97-104.

Interorganizational Committee on Principles and Guidelines for Social Impact Assessment (1994). Guidelines and Principles for Social Impact Assessment. Impact Assessment 12(2): 107-152.

--- (2003). Principles and Guidelines for Social Impact Assessment in the USA. Impact Assessment and Project Appraisal 21(3): 233-250.

IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

James, M. C., R. A. Myers and C. A. Ottenmeyer (2005). Behaviour of leatherback sea turtles, *Dermochelys coriacea*, during the migratory cycle. Proceedings of the Royal Society of London, Biological Sciences 272: 1547-1555.

James, M. C., C. A. Ottenmeyer and R. A. Myers (2005). Identification of high-use habitat and threats to leatherback sea turtles in northern waters: new directions for conservation. Ecology Letters 8: 195-201.

James, M.C., C.A. Ottenmeyer, S.A. Eckert, and R.A. Myers (2006a). Changes in diel diving patterns accompany shifts between northern foraging and southward migration in leatherback sea turtles. Can. J. Zool. (84): 754-765.

James, M.C., S.A. Sherrill-Mix, K. Martin, and R. A. Myers (2006b). Canadian waters provide critical foraging habitat for leatherback sea turtles. Biological Conservation 133: 347-357.

Jamieson, G. S. and A. Campbell (1985). Sea scallop fishing impact on American lobsters in the Gulf of St. Lawrence. Fish. Bull. 83(4): 575-586.

Jepson, M. and L. L. Colburn (2013). Development of Social Indicators of Fishing Community Vulnerability and Resilience in the U.S. Southeast and Northeast Regions. NOAA Technical Memorandum NMFS-F/SPO-129. 64pp.

Johnson, A. J., G. S. Salvador, J. F. Kenney, et al. (2005). Fishing gear involved in entanglements of right and humpback whales, Mar. Mammal Sci. 21(4): 635-645.

Johnson, D. L. (2004). Essential Fish Habitat Source Document: American Plaice, *Hippoglossoides platessoides*, Life History and Habitat Characteristics, Second Edition. NOAA Technical Memorandum NMFS-NE-187. 83pp.

Johnson, D. L., W. W. Morse, et al. (1999). Essential Fish Habitat Source Document: Yellowtail Flounder, *Limanda ferruginea*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-140. 38pp.

Jury, S. H., J. D. Field, et al. (1994). Distribution and abundance of fishes and invertebrates in North Atlantic estuaries. ELMR Rep. No. 13. NOAA/NOS Strategic Environmental Assessments Division, Silver Spring, MD, 221pp.

Katona, S. K., V. Rough and D. T. Richardson (1993). A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. Washington, D.C., Smithsonian Institution Press. 316pp.

Keats, D. W. (1991). American plaice, Hippoglossoides platessoides (Fabricius), predation on green sea urchins, *Strongylocentrotus droebachiensis* (O. F. Muller), in eastern Newfoundland. Journal of Fish Biology 38(1): 67-72.

Keats, D. W., G. R. South and D. H. Steele (1985). Reproduction and egg guarding by Atlantic wolffish (*Anarhichas lupus*: Anarhichidae) and ocean pout (*Macrozoarces americanus*: Zoarcidae) in Newfoundland waters. Canadian Journal of Zoology 63(11): 2565-2568.

Keinath, J. A., J. A. Musick and R. A. Byles (1987). Aspects of the biology of Virginia's sea turtles: 1979-1986. Virginia J. of Science 38(4): 329-336.

Kelley, J. T. (1988). Mapping the surficial geology of the western Gulf of Maine. Effects of fishing gear on the seafloor of New England. Dorsey, E. M. and J. Pederson, MIT SeaGrant Pub. 98-4**:** 15-19.

Kellner, J. B., I. Tetreault, et al. (2007). Fishing the line near marine reserves in single and multispecies fisheries. Ecological Applications 17(4): 1039-1054.

Kenney, R. D. (2002). North Atlantic, North Pacific, and Southern hemisphere right whales Encyclopedia of Marine Mammals. Perrin, W. F., B. Würsig and G. M. Thewissen. San Diego, Academic Press**:** 806-813.

Kenney, J., and D. Hartley (2001). Draft Large Whale Entanglement Summary 1997-2001. Report to the National Marine Fisheries Service, updated October 2001.

Kerr, L. A., S. X. Cadrin, et al. (2012). Evaluating the impact of closed areas in the Gulf of Maine and Georges Bank on groundfish productivity**:** 29.

Klein-MacPhee, G. (2002). Atlantic cod/*Gadus morhua* Linnaeus 1758. Bigelow and Schroeder's Fishes of the Gulf of Maine. 3rd Edition. Collette, B. B., Klein-MacPhee, G., editors. Washington, DC, Smithsonian Institution Press**:** 228-235.

--- (2002). Cods, Family Gadidae. Bigelow and Schroeder's Fishes of the Gulf of Maine. 3rd Edition. Collette, B. B., Klein-MacPhee, G., editors. Washington, DC, Smithsonian Institution Press**:** 223-261.

--- (2002). Righteye Flounders, Family Pleuronectidae. Bigelow and Schroeder's Fishes of the Gulf of Maine. 3rd Edition. Collette, B. B., Klein-MacPhee, G., editors. Washington, DC, Smithsonian Institution Press**:** 217-222.

--- (2002). Silver hakes, family Merlucciidae. Bigelow and Schroeder's Fishes of the Gulf of Maine. 3rd Edition. Collette, B. B., Klein-MacPhee, G., editors. Washington, DC, Smithsonian Institution Press**:** 560-587.

Klein-MacPhee, G. and B. B. Collette (2002). Eelpouts, Family Zoarcidae. Bigelow and Schroeder's fishes of the Gulf of Maine. 3rd Edition. Collette, B. B., Klein-MacPhee, G., editors. Washington, DC, Smithsonian Institution Press**:** 466-474.

Kocik, J., C. Lipsky, et al. (2013). An Atlantic Sturgeon Population Index for ESA Management Analysis. Northeast Fish Sci Cent Ref Doc. 13-06. 36pp.

Kocik, J. F. and T. F. Sheehan. (2006). Status of fishery resources off the northeastern U.S. Atlantic salmon (*Salmo salar*). http://www.nefsc.noaa.gov/sos/spsyn/af/salmon/.

Kocik, J., C. Lipsky, et al. (2013). An Atlantic Sturgeon Population Index for ESA Management Analysis. Northeast Fisheries Science Center Reference Document 13-06. 44pp.

Kocik, J.F., S.E. Wigley, and D. Kircheis. 2014. Annual Bycatch Update Atlantic Salmon 2013 U.S. Atlantic Salmon Assessment Commission Working Paper 2014:05. Old Lyme, CT. 6 pp. (cited with permission of authors).

Kraus, S. D., J. H. Prescott and G. S. Stone (1983). Harbour porpoise, *Phocoena phocoena*, in the U.S. coastal waters of the Gulf of Maine: A survey to determine seasonal distribution

and abundance. Report to the Director, National Marine Fisheries Service, 166 Water St., Woods Hole, MA. 15pp.

Kropp, R., R. Diaz, et al. (2000). 1999 Outfall Benthic Monitoring Report. Massachusetts Water Resources Authority, Boston, 230pp.

Kulka, D. W., M. R. Simpson and R. G. Hooper (2004). Changes in distribution and habitat associations of wolffish (Anarhichidae) in the Grand Banks and Labrador Shelf. Canadian Science Advisory Secretariat Research Document 2004/113. Fisheries and Oceans Canada, 48pp.

Kynard, B. and M. Horgan (2002). Ontogenetic behavior and migration of Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus*, and shortnose sturgeon, *A. brevirostrum*, with notes on social behavior. Environmental Behavior of Fishes 63: 137-150.

Lacroix, G. L., D. Knox and M. J. W. Stokesbury (2005). Influence of tidal flow on Atlantic salmon post-smolt migration and behaviour in coastal habitat. J. Fish Biology 66: 485-498.

Laney, R. W., J. E. Hightower, et al. (2007). Distribution, habitat use, and size of Atlantic sturgeon captured during cooperative winter tagging cruise, 1988-2006. American Fisheries Society Symposium 56**:** 167-182.

Lang, K. L., F. P. Almeida, et al. (1996). The use of otolith microstructure in resolving issues of first year growth and spawning seasonality of white hake, *Urophycis tenuis*, in the Gulf of Maine-Georges Bank region. Fish. Bull. 94: 170-175.

Langton, R. W., P. J. Auster and D. C. Schneider (1995). A spatial and temporal perspective on research and management of groundfish in the northwest Atlantic. Reviews in Fisheries Science 3(3): 201-229.

Langton, R. W. and R. E. Bowman (1981). Food of eight northwest Atlantic pleuronectiform fishes. NOAA NMFS SSRF-749. 16pp.

Langton, R. W., W. E. Robinson and D. Schick (1987). Fecundity and reproductive effort of sea scallops *Placopecten magellanicus* from the Gulf of Maine. Mar. Ecol. Prog. Ser. 37: 19-25.

Lazzari, M. A., S. Sherman and J. K. Kanwit (2003). Nursery use of shallow habitats by epibenthic fishes in Maine nearshore waters. Estuarine, Coastal and Shelf Science 56(1): 73-84.

Lazzari, M. A. and B. Z. Stone (2006). Use of submerged aquatic vegetation as habitat by young-of-the-year epibenthic fishes in shallow Maine nearshore waters. Estuarine, Coastal and Shelf Science 69(3–4): 591-606.

Lee, M. A. and E. M. Thunberg (2013). An inverse demand system for New England groundfish: welfare analysis of the transition to catch share management. Am. J. Agr. Econ. 95(5): 1178-1195.

Leichter, J. J. and J. D. Witman (1997). Water flow over subtidal rock walls: relation to distributions and growth rates of sessile suspension feeders in the Gulf of Maine Water flow and growth rates. J. Experimental Marine Biology and Ecology 209(1–2): 293-307.

Lesser, M. P., J. D. Witman and K. P. Sebens (1994). Effects of flow and seston availability on scope for growth of benthic suspension-feeding invertebrates from the Gulf of Maine. Biol. Bull. 187: 319-335.

Lilley, R. J. and R. K. Unsworth (2014). Atlantic Cod (*Gadus morhua*) benefits from the availability of seagrass (*Zostera marina*) nursery habitat. Global Ecol. Conserv. 2: 367-377.

Lilly, G. R. and D. G. Parsons (1991). Distributional patterns of the northern shrimp (*Pandalus borealis*) in the Northwest Atlantic as inferred from stomach contents of cod (*Gadus morhua*). ICES Meeting, 26 Sept-4 Oct 1991. LaRochelle, France.

Lindholm, J. and P. J. Auster (2003). Site utilization by Atlantic cod (*Gadus morhua*) in off-shore gravel habitat as determined by acoustic telemetry: implications for the design of marine protected areas. Marine Technology Society Journal 37: 27-34.

Lindholm, J., P. J. Auster and A. Knight (2007). Site fidelity and movement of adult Atlantic cod *Gadus morhua* at deep boulder reefs in the western Gulf of Maine, USA. Mar. Ecol. Prog. Ser. 342: 239-247.

Lindholm, J. B., P. J. Auster and L. S. Kaufman (1999). Habitat-mediated survivorship of juvenile (0-year) Atlantic cod *Gadus morhua*. Mar. Ecol. Prog. Ser. 180: 247-255.

Lindholm, J. B., P. J. Auster, et al. (2001). Modeling the Effects of Fishing and Implications for the Design of Marine Protected Areas: Juvenile Fish Responses to Variations in Seafloor Habitat. Conserv. Biol. 15(2): 424-437.

Linehan, J. E., R. S. Gregory and D. C. Schneider (2001). Predation risk of age-0 cod (Gadus) relative to depth and substrate in coastal waters. J. Exp. Mar. Biol. and Ecol. 263(1): 25-44.

Link, J. S., K. Bolles and C. G. Milliken (2002). The feeding ecology of flatfish in the northwest Atlantic. J. Northw. Atl. Fish. Sci. 30: 1-17.

Link, J. S., L. P. Garrison and F. P. Almeida (2002). Ecological Interactions between Elasmobranchs and Groundfish Species on the Northeastern U.S. Continental Shelf. I. Evaluating Predation. N. Amer. J. Fish. Mgmt. 22(2): 550-562.

List, J. A. and C. A. Gallet (2001). What Experimental Protocol Influence Disparities Between Actual and Hypothetical Stated Values? Evidence from a Meta-Analysis. Environmental and Resource Economics 20: 241-254.

Lough, R. G. (2010). Juvenile cod (Gadus morhua) mortality and the importance of bottom sediment type to recruitment on Georges Bank. Fisheries Oceanography 19(2): 159-181.

Lough, R. G. and G. R. Bolz (1989). The movement of cod and haddock larvae onto the shoals of Georges Bank. Journal of Fish Biology 35: 71-79.

Lough, R. G., L. O'Brien and L. J. Buckley (2008). Differential Egg Mortality of Georges Bank Cod and Haddock Inferred from Two Independent Estimates of Seasonal Egg Production. J. Northw. Atl. Fish. Sci. 41: 119-128.

Lough, R. G. and D. C. Potter (1993). Vertical distribution patterns and diel migrations of larval and juvenile haddock *Melanogrammus aeglefinus* and Atlantic cod *Gadus morhua* on Georges Bank. Fish. Bull. 91(2): 281-303.

Lough, R. G., P. C. Valentine, et al. (1989). Ecology and distribution of juvenile cod and haddock in relation to sediment type and bottom currents on eastern Georges Bank. Mar. Ecol. Prog. Ser. 56(1-2): 1-12.

Lux, F. E., A. R. Ganz and W. F. Rathjen (1982). Marking studies on the red crab *Geryon quinquedens* Smith off southern New England. J. Shellfish Res. 2(1): 71-80.

MacDonald, B. A. and R. J. Thompson (1985). Influence of temperature and food availability on the ecological energetics of the giant scallop *Placopecten magellanicus*. II. Reproductive output and total production. Mar. Ecol. Prog. Ser. 25: 295-303.

MacDonald, B. A. and R. J. Thompson (1988). Intraspecific variation in growth and reproduction in latitudinally differentiated populations of the gaint scallop *Placopecten magellanicus* (Gmelin). Biol. Bull. 175: 361-371.

MacDonald, J. S., M. J. Dadswell, et al. (1984). Fishes, fish assemblages, and their seasonal movements in the lower Bay of Fundy and Passamaquoddy Bay, Canada. Fish. Bull. 82(1): 121-139.

Magurran, A. E. (2004). Measuring Biological Diversity, Blackwell Science, Ltd. 264pp.

Mahon, R., S. K. Brown, et al. (1998). Assemblages and biogeography of demersal fishes of the east coast of North America. Can. J. Fish. Aquat. Sci. 55(7): 1704-1738.

Mandelman, J. W., A. M. Cicia, et al. (2013). Short-term post-release mortality of skates (family Rajidae) discarded in a western North Atlantic commercial otter trawl fishery. Fisheries Research 139(0): 76-84.

Mansfield, K.L., V.S. Saba, J. Keinath, and J.A. Musick. 2009. Satellite telemetry reveals a dichotomy in migration strategies among juvenile loggerhead sea turtles in the northwest Atlantic. Mar. Biol. 156:2555-2570.

Markle, D. F., D. A. Methven and L. J. Coates-Markle (1982). Aspects of spatial and temporal cooccurrence in the life history stages of the sibling hakes, *Urophycis chuss* (Walbaum 1792) and *Urophycis tenuis* (Mitchill 1815) (Pisces: Gadidae). Canadian Journal of Zoology 60(9): 2057-2078.

Martin, F. D. and G. E. Drewry (1978). Development of fishes of the Mid-Atlantic Bight: An atlas of egg, larval, and juvenile stages. Vol 6: Stromateidae through Ogcocephalidae. U.S. Fish Wildl. Serv. Biol. Serv. Prog. FWS/OBS 78/12. 416pp.

McClellan, C.M., and A.J. Read. 2007. Complexity and variation in loggerhead sea turtle life history. Biology Letters 3:592-594

McCracken, F. D. (1958). On the Biology and Fishery of the Canadian Atlantic Halibut, *Hippoglossus hippoglossus* L. Journal of the Fisheries Research Board of Canada 15(6): 1269-1311.

McEachran, J. D. (1970). Egg capsules and reproductive biology of the skate *Raja garmani* (Pisces: Rajidae). Copeia: 197-199.

--- (2002). Skates, Family Rajidae. Bigelow and Schroeder's Fishes of the Gulf of Maine. 3rd Edition. Collette, B. B., Klein-MacPhee, G., editors. Washington, DC, Smithsonian Institution Press**:** 60-75.

McEachran, J. D. and J. A. Musick (1975). Distribution and relative abundance of seven species of skates (Pisces: Rajidae) which occur between Nova Scotia and Cape Hatteras. Fish. Bull. 73: 110-136.

McGonigle, C., J. H. Grabowski, et al. (2011). Detection of deep water benthic macroalgae using image-based classification techniques on multibeam backscatter at Cashes Ledge, Gulf of Maine, USA. Estuarine, Coastal and Shelf Science 91(1): 87-101.

McMullen, K. Y., L. J. Poppe, et al. (2014). Sea-Floor Geology in Northwestern Block Island Sound, Rhode Island. Open-File Report 2014-1018. U.S. Geological Survey, Reston, VA.

McMullen, K. Y., L. J. Poppe, et al. (2013). Sea-Floor Geology in Northeastern Block Island Sound, Rhode Island. Open-File Report 2013-1003. U.S. Geological Survey, Reston, VA.

McMullen, K. Y., L. J. Poppe, et al. (2011). Surficial Geology of the Sea Floor in Central Rhode Island Sound Southeast of Point Judith, Rhode Island. Open-File Report 2011-1005. U.S. Geological Survey, Reston, VA.

Methratta, E. T. and J. S. Link (2006). Associations between Surficial Sediments and Groundfish Distributions in the Gulf of Maine–Georges Bank Region. N. Amer. J. Fish. Mgmt. 26(2): 473-489.

Methratta, E. T. and J. S. Link (2006). Seasonal variation in groundfish habitat associations in the Gulf of Maine-Georges Bank region. Mar. Ecol. Prog. Ser. 326: 245-256.

Methratta, E. T. and J. S. Link (2007). Ontogenetic variation in habitat associations for four flatfish species in the Gulf of Maine-Georges Bank region. Journal of Fish Biology 70(6): 1669-1688.

Michalopoulos, C. (1990). A field study on the ecology and behavior of the winter skate (*Raja ocellata*) and little skate (*Raja erinacea*) off outer Cape Cod, Massachussetts. M.S., Southeastern Mass. Univ.

Miller, J. M., J. S. Burke and G. R. Fitzhugh (1991). Early life history patterns of Atlantic North American flatfish: Likely (and unlikely) factors controlling recruitment. Neth. J. Sea Res. 27(3–4): 261-275.

Mitchell, G.H., R.D. Kenney, A.M. Farak, and R.J. Campbell (2003). Evaluation of occurrence of endangered and threatened marine species in naval ship trial areas and transit lanes in the Gulf of Maine and offshore of Georges Bank. NUWC-NPT Technical Memo 02-121A. March 2003. 113pp.

Moffitt, E.A., J.W. White, and L.W. Botsford. (2013). Accurate assessment of marine protected area success depends on metric and spatiotemporal scale of monitoring. Mar. Ecol. Prog. Ser. 489: 17-28.

Morgan, M. J. (2000). Interactions between substrate and temperature preference in adult American plaice *(Hippoglossoides platessoides).* Mar. Fresh. Behav. Physiol. 33: 249-259.

Morin, M. (2000). Movement of Atlantic Cod (*Gadus morhua*) in and among the Western Gulf of Maine Rolling Closures as determined through mark and recapture. Master of Science, University of New Hampshire.

Morreale, S. J., C. F. Smith, et al. (2005). Assessing health, status, and trends in northeastern sea turtle populations. Interim report -Sept. 2002 - Nov. 2004. National Marine Fisheries Service, Northeast Regional Office, Gloucester, Massachusetts.

Morreale, S. J. and E. A. Standora (2005). Western North Atlantic waters: crucial developmental habitat for Kemp's ridley and loggerhead sea turtles. Chelonian Conservation and Biology 4(4): 872-882.

Mountain, D., R. Langton and L. Watling (1994). Oceanic processes and benthic substrates: influences on demersal fish habitats and benthic communities. NOAA Tech. Memo. NMFS-NE-106. 20-25pp.

Murawski, S. A., S. E. Wigley, et al. (2005). Effort distribution and catch patterns adjacent to temperate MPAs. ICES J. Mar. Sci. 62: 1150-1167.

Murphy T, Kitts A, Demarest C, Walden J (2015). 2013 Final report on the performance of the northeast multispecies (groundfish) fishery (May 2013 -April 2014). US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-02; 106 p. doi: 10.7289/V5XS5SB9

Murphy, T.M., S.R. Murphy, D.B. Griffin, and C. P. Hope (2006). Recent occurrence, spatial distribution and temporal variability of leatherback turtles (Dermochelys coriacea) in nearshore waters of South Carolina, USA. Chel. Cons. Biol. 5(2): 216-224.

Murray, K. T. (2006). Estimated average annual by-catch of Loggerhead Sea Turtles (*Caretta caretta*) in U.S. Mid-Atlantic bottom otter trawl gear, 1996-2004. Northeast Fish. Sci. Cent. Ref. Doc. 06-19. 26pp.

--- (2009). Characteristics and magnitude of sea turtle bycatch in US mid-Atlantic gillnet gear. Endangered Species Research 8: 211-224.

--- (2011). Interactions between sea turtles and dredge gear in the U.S. sea scallop *(Placopecten magellanicus*) fishery, 2001-2008. Fisheries Research 107:137-146.
--- (2013). Estimated loggerhead and unidentified hard-shelled turtle interactions in mid-Atlantic gillnet gear, 2007-2011. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NM-225. 20 pp. http://www.nefsc.noaa.gov/publications/tm/.
--- (2015a). Estimated Loggerhead (*Caretta caretta*) interactions in the mid-Atlantic scallop dredge fishery, 2009-2014. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-20; 15 p.
--- (2015b). The importance of location and operational fishing factors in estimating and reducing loggerhead turtle (*Caretta caretta*) interactions in U.S. bottom trawl gear. Fisheries Research 172: 440–451
Musick, J. A. and C. J. Limpus (1997). Habitat utilization and migration in juvenile sea turtles. The Biology of Sea Turtles. Lutz, P. L. and J. A. Musick. Boca Raton, Florida, CRC Press**:** 137-164.
Murray, K.T. and C.D. Orphanides (2013). Estimating the risk of loggerhead turtle Caretta caretta bycatch in the U.S. mid-Atlantic using fishery-independent and –dependent data. Marine Ecology Progress Series. 477:259-270.
Naidu, K. S. (1970). Reproduction and breeding cycle of the giant scallop *Placopecten magellanicus* (Gmelin) in Port au Port Bay, Newfoundland, Can. J. Zool. 48: 1003-1012.
National Marine Fisheries Service (1991). Final recovery plan for the humpback whale (*Megaptera novaeangliae*). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 105pp.
--- (1991). Final recovery plan for the North Atlantic right whale (*Eubalaena glacialis*). Prepared by the Right Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. pp.
--- (1998). Final recovery plan for the shortnose sturgeon *(Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 104pp.
--- (2002). Biological Opinion. Implementation of the Deep-Sea Red Crab, *Chaceon quinquedens*, Fishery Management Plan. February 6, 2002.NMFS
--- (2005). Recovery Plan for the North Atlantic right whale (*Eubalaena glacialis*). 137pp.
--- (2006). Bottlenose Dolphin Take Reduction Plan Final Environmental Assessment. Prepared by NMFS Southeast Region, St. Petersburg, Florida. 240pp.
--- (2007). Guidelines for social impact assessment. National Marine Fisheries Service instruction 01-111-02. Effective date Dec. 24 2007 (Appendix 2g to the NMFS Operational Guidelines – Fishery Management Process).
--- (2009). Correspondence between ENTRIX, Inc and the Northeast Fisheries Science Center regarding impacts to sea turtles from fishing gear.
--- (2009). Endangered and Threatened Species; Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic Salmon. Federal Register 74: 29344.
--- (2009). Endangered Species Act Section 7 Consultation on the Atlantic Sea Scallop Fishery Management Plan. Biological Opinion. February 5, 2009.
--- (2009). Harbor Porpoise Take Reduction Plan Final Environmental Assessment. Prepared by NMFS Northeast Region, Gloucester, Massachusetts. 170pp.

--- (2009). Hawksbill Turtle *(Eretmochelys imbricata).* Available at: http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.htm.
--- (2011). 2012 List of Fisheries. Available at: http://www.nmfs.noaa.gov/pr/interactions/lof/final2012.htm
--- (2012). 2013 List of Fisheries. Available at: http://www.nmfs.noaa.gov/pr/interactions/lof/final2012.htm.
--- (2012). Endangered Species Act Section 7 Consultation on the Atlantic Sea Scallop Fishery Management Plan. Prepared by NMFS Northeast Region, Gloucester, Massachusetts. 256pp.
--- (2012a). Reinitiation of Endangered Species Act Section 7 Consultation for the Atlantic Sea Scallop Fishery Management Plan. Biological Opinion. July 12, 2012.
--- (2012b). Section 7 Consultation for Continued Authorization of the Tilefish, Herring, Red Crab and Atlantic Surfclam and Ocean Quahog Fishery Management Plans Due to Listing of New Species. Memo issued April 23, 2012.
--- (2013). Atlantic Large Whale Take Reduction Plan Draft Environmental Impact Statement. Prepared by NMFS Northeast Region, Gloucester, Massachusetts.
--- (2013). Endangered Species Act Section 7 Consultation on the Northeast Multispecies, Monkfish, Spiny Dogfish, Atlantic Bluefish, Northeast Skate Complex, Mackerel/Squid/Butterfish, and Summer Flounder/Scup/Black Sea Bass Fishery Management Plans. Prepared by NMFS Northeast Region, Gloucester, Massachusetts. 434pp.
--- (2014). Endangered Species Act Section 7 Consultation on the Continued Implementation of Management Measures for the American Lobster Fishery. Issued July 31, 2014.
--- (2014). Fishing Year 2014 Northeast Multispecies Sector Operations Plans and Contracts Draft Environmental Assessment. Prepared by NMFS Greater Atlantic Region, Gloucester, Massachusetts. 344pp.
National Marine Fisheries Service Northeast Fisheries Science Center Fisheries Statistics Branch (NMFS NEFSC FSB). 2015. Northeast Fisheries Observer Program: Incidental Take Reports. Omnibus data request and supplemental data for 2014 from http://www.nefsc.noaa.gov/fsb/take_reports/nefop.html.
National Marine Fisheries Service Greater Atlantic Region (2014). Atlantic Large Whale Take Reduction Plan Environmental Impact Statement. Gloucester, Massachusetts.
National Marine Fisheries Service Northeast Region (2013). Endangered Species Act Section 7 Consultation on the Continued Implementation of Management Measures for the Northeast Multispecies, Monkfish, Spiny Dogfish, Atlantic Bluefish, Northeast Skate Complex, Mackerel/Squid/Butterfish, and Summer Flounder/Scup/Black Sea Bass Fisheries. Consultation No. F/NER/2012/01956. 440pp.
National Marine Fisheries Service and U.S. Fish and Wildlife Service (1991). Recovery plan for U.S. population of Atlantic green turtle. 58pp.
--- (1991). Recovery plan for U.S. population of loggerhead turtle. 64pp.
--- (1992). Recovery plan for leatherback turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. 65pp.
--- (1995). Status reviews for sea turtles listed under the Endangered Species Act of 1973. 139pp.
--- (1998a). Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle (*Dermochelys coriacea*). Silver Spring, Maryland: National Marine Fisheries Service. 65 pp.

--- (1998b). Recovery Plan for U.S. Pacific Populations of the Green Turtle (*Chelonia mydas*). Silver Spring, Maryland: National Marine Fisheries Service. 84 pp.
--- (2005). Recovery plan for the Gulf of Maine distinct population segment of the Atlantic salmon (*Salmo salar*). National Marine Fisheries Service, Silver Spring, MD.
--- (2007). Green sea turtle (*Chelonia mydas*) 5 year review: summary and evaluation. 102pp.
--- (2007). Kemp's ridley sea turtle (*Lepidochelys kempii*) 5 year review: summary and evaluation. 50pp.
--- (2007). Leatherback sea turtle (*Dermochelys coriacea*) 5 year review: summary and evaluation. 79pp.
--- (2007). Loggerhead sea turtle (*Caretta caretta*) 5 year review: summary and evaluation. 65pp.
--- (2008). Recovery plan for the Northwest Atlantic population of the loggerhead turtle (*Caretta caretta*), Second revision. 325pp.
--- (2013). Hawksbill sea turtle (*Eretmochelys imbricata*) 5 year review: summary and evaluation. Silver Spring, Maryland: National Marine Fisheries Service. 89 pp.
--- (2015). Kemp's ridley sea turtle (*Lepidochelys kempii*) 5 year review: summary and evaluation. Silver Spring, Maryland: National Marine Fisheries Service. 62 pp.
National Marine Fisheries Service, U.S. Fish and Wildlife Service, and SEMARNAT (2011). Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), 2nd revision. National Marine Fisheries Service. Silver Spring, MD. 156 pp. + appendices.
National Marine Fisheries Service Southeast Fisheries Science Center (2001). Stock assessments of loggerheads and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. U.S. NOAA Technical Memorandum NMFS-SEFSC-455. 343pp.
National Research Council (1990). Decline of the Sea Turtles: Causes and Prevention. Washington, D.C., National Academy Press. 259pp.
Neilson, J. D., J. F. Kearney, et al. (1993). Reproductive Biology of Atlantic Halibut (*Hippoglossus hippoglossus*) in Canadian Waters. Can. J. Fish. Aquat. Sci. 50(3): 551-563.
Nelson, G. A. and M. R. Ross (1992). Distribution, growth and food habits of the Atlantic wolffish (*Anarhichas lupus*) from the Gulf of Maine-Georges Bank region. Journal of Northwest Atlantic Fishery Science 13: 53-61.
Nenadovic, M. (2009). The effects of bottom-tending mobile fishing gear and fiber-optic cable burial on soft-sediment benthic community structure. Master of Science in Marine Biology, University of Maine.
New England Fishery Management Council (2011). The Swept Area Seabed Impact (SASI) approach: a tool for analyzing the effects of fishing on Essential Fish Habitat. 257pp.
--- (2015). Framework Adjustment 53 to the Northeast Multispecies Fishery Management Plan. Submitted March 16, 2015. 391pp. plus appendices.
Nickerson, J. T. R. (1978). The Atlantic halibut and its utilization. Mar. Fish. Rev. 40(7): 21-25.
Nordeide, J. T. and I. Folstad (2000). Is cod lekking or a promiscuous group spawner? Fish and Fisheries 1: 90-93.
Northeast Data Poor Stocks Working Group (2009). The Northeast Data Poor Stocks Working Group Report, December 8-12, 2008 Meeting. Part A. Skate species complex, deep sea red crab, Atlantic wolffish scup, and black sea bass. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 09-02. 373pp.

Northeast Fisheries Science Center (2006). 42nd Northeast Regional Stock Assessment Workshop (42nd SAW) Stock Assessment Report. Part A: Silver hake, Atlantic Mackerel, & Northern Shortfin Squid. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-09a. 284pp.

--- (2007). 44th Northeast Regional Stock Assessment Workshop (44th SAW) Stock Assessment Report. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 07-10. pp.

--- (2008). Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, MA, August 4-8, 2008. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 08-15. 884pp.

--- (2010). 50th Northeast Regional Stock Assessment Workshop (50th SAW): Assessment Report. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 10-17. 848pp.

--- (2011). 52nd Northeast Regional Stock Assessment Workshop (52nd SAW), Assessment Report. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 11-17. 962pp.

--- (2012a). 54th Northeast Regional Stock Assessment Workshop (54th SAW), Assessment Report. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 12-18. 604pp.

--- (2012b). 54th Northeast Regional Stock Assessment Workshop (54th SAW), Assessment Summary Report. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 12-14. 45pp.

--- (2012c). Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 12-06. 789pp.

--- (2013a). 55th Northeast Regional Stock Assessment Workshop (55th SAW) Assessment Report. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 13-11. 845pp.

--- (2013b). 56th Northeast Regional Stock Assessment Workshop (56th SAW) Assessment Report. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 13-10. 872pp.

--- (2013c). 2013 Monkfish Operational Assessment. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 13-23. 133pp.

--- (2014). 58th Northeast Regional Stock Assessment Workshop (58th SAW), Assessment Summary Report. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 14-03. 51pp.

Nye, J.A., Link, J.S., et al. (2009). Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Mar. Ecol. Prog. Ser. 393: 111-129.

O'Brien, L. (2010). Status of Fishery Resources off the Northeastern US: Cusk (*Brosme brosme*). NMFS Northeast Fisheries Science Center Resource Evaluation and Assessment Division.

Ogren, L., J. Chess and J. Lindberg (1968). More notes on the behavior of young squirrel hake, *Urophycis chuss*. Underwater Naturalist 5(3): 38-39.

Overholtz, W. J. (1985). Seasonal and age-specific distribution of the 1975 and 1978 year-classes of haddock on Georges Bank. NAFO Sci. Coun. Studies 8: 77-82.

--- (1987). Factors relating to the reproductive biology of Georges Bank haddock (*Melanogrammus aeglefinus*) in 1977-1983. J. Northw. Atl. Fish. Sci. 7: 145-154.
Overholtz, W. J. and A. V. Tyler (1985). Long-term responses of the demersal fish assemblages of Georges Bank. Fish. Bull. 83(4): 507-520.
Palakovich Carr, J. and L. Kaufman (2009). Estimating the importance of maternal age, size, and spawning experience to recruitment of Atlantic cod (*Gadus morhua*). Biological Conservation 142(3): 477-487.
Palka, D. (1995). Abundance estimate of the Gulf of Maine harbor porpoise. Rep. Int Whal. Comm 16: 27-50.
--- (1995). Influences on spatial patterns of Gulf of Maine harbor porpoises. Whales, seals, fish, and man. Blix, A. S., L. Walløe and Ø. Ulltang. Amsterdam, The Netherlands, Elsevier Science**:** 69-75.
--- (2000). Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. NOAA-NMFS-NEFSC Ref. Doc. 00-07. 29pp.
Palmer, M. C. and S. E. Wigley (2007). Validating the stock apportionment of commercial fisheries landings using positional data from vessel monitoring systems. Northeast Fisheries Science Center Reference Document 07-22. 44pp.
--- (2009). Using positional data from vessel monitoring systems to validate the logbook-reported area fished and the stock allocation of commercial fisheries landings. N. Amer. J. Fish. Mgmt. 29(4): 928-942.
Pereira, J., E. Schultz and P. Auster (2012). Geospatial analysis of habitat use in yellowtail flounder *Limanda ferruginea* on Georges Bank. Mar. Ecol. Prog. Ser. 468: 279-290.
Perkins, H. C., S. B. Chenoweth and R. W. Langton (1997). The Gulf of Maine Atlantic cod complex, patterns of distribution and movement of the Sheepscot Bay substock. Bulletin of the National Research Institute of Aquaculture 3 (Supplement): 101-107.
Perrin, W. F., B. Wursig and J. G. M. Thewissen (2002). Encyclopedia of Marine Mammals, Academic Press, California. 1414pp.
Perry, S. L., D. P. DeMaster and G. K. Silber (1999). The great whales: History and status of six species listed as endangered under the U.S. Endangered Species Act of 1973. Mar. Fish. Rev. 61(1, Special Edition): 59-74.
Pierdomenico, M., V.G. Guida, et al. 2015. Sedimentary facies, geomorphic features and habitat distribution at the Hudson Canyon head from AUV mutlibeam data. Deep Sea Res. II 121: 112-125.
Pita, C., H. Dickey, et al. (2010). Willingness for mobility amongst European fishermen. J. of Rural Studies 26(3): 308-319.
Pomeroy, R., M. Mascia and R. Pollnac (2007). Marine protected areas, the social dimension. FAO Expert Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations, FAO, Rome**:** 149-275.
Poppe, L. J., W. W. Danforth, et al. (2012). Sea-Floor Character and Sedimentary Processes of Block Island Sound, Offshore Rhode Island. Open-File Report 2012-1005. U.S. Geological Survey, Reston, VA, pp.
Posgay, J. A. (1976). Population assessment of the Georges Bank sea scallop stocks. ICES C.M. 1976/34. 8pp.
Posgay, J. A. and K. D. Norman (1958). An observation on the spawning of the sea scallop, *Placopecten magellanicus* (Gmelin), on Georges Bank. Limnology and Oceanography 3: 478.

Powles, P. M. (1967). Atlantic wolffish (*Anarhichas lupus* L.) eggs off southern Nova Scotia. Journal of the Fisheries Research Board of Canada 24(1): 207-208.

Powles, P. M. and A. C. Kohler (1970). Depth Distributions of Various Stages of Witch Flounder (*Glyptocephalus cynoglossus*) off Nova Scotia and in the Gulf of St. Lawrence. Journal of the Fisheries Research Board of Canada 27(11): 2053-2062.

Pratt, S. (1973). Benthic fauna. Univ. R.I. Mar. Pub. Ser. 2:5-1-5-70.

Rangeley, R. W. and D. L. Kramer (1995). Use of rocky intertidal habitats by juvenile pollock *Pollachius virens*. Mar. Ecol. Prog. Ser. 126: 9-17.

Rangeley, R. W. and D. L. Kramer (1998). Density-Dependent Antipredator Tactics and Habitat Selection in Juvenile Pollock. Ecology 79(3): 943-952.

Rasmussen, L. E. L., D. L. Hess and C. A. Luer (1999). Alterations in serum steroid concentrations in the clearnose skate, *Raja eglanteria*: Correlations with season and reproductive status. Journal of Experimental Zoology 284(5): 575-585.

Records, D. and C. Demarest (2013). Producing high resolution spatial estimates of fishing effort using a VMS-based statistical model (draft working paper). Woods Hole, MA, Northeast Fisheries Science Center**:** 35.

Regional Sediment Resource Management Workgroup (2014). Work Group Report: 2014 Massachusetts Ocean Management Plan Update. 57pp.

Reid, R. N. and F. W. Steimle, Jr. (1988). Benthic macrofauna of the Middle Atlantic continental shelf. NOAA Tech. Memo. NMFS-F/NEC-56. 125-160pp.

Richards, A., J. Grabowski and G. Sherwood (2012). Archival Tagging Study of Monkfish, *Lophius americanus*. Northeast Consortium Final Report 09-042. 35pp.

Richards, S. W., D. Merriman and L. H. Calhoun (1963). Studies on the marine resources of southern New England. IX. The biology of the little skate *Raja erinacea* Mitchill. Bull. Bingham Oceanogr. Collect. Yale Univ. 18(3): 5-68.

Rona, P., V.G. Guida, et al. 2015. Hudson submarine canyon head offshore New York and New Jersey: A physical and geochemical investigation. Deep Sea Res. II 121: 213-232.

Rose, C., E. Munk, et al. (2010). Feature: Cooperative Research to Reduce the Effects of Bering Sea Flatfish Trawling on Seafloor Habitat and Crabs. Alaska Fisheries Science Center Quarterly Research Reports, Jan-Feb-Mar 2010. 6pp.

Rose, C. S., J. R. Gauvin and C. F. Hammond (2009). Effective herding of flatfish by cables with minimal seafloor contact. Fish. Bull. 108(2): 136-144.

Rountree, R. A. (2002). Wolffishes; Family Anarhichadidae. Bigelow and Schroeder's Fishes of the Gulf of Maine, 3rd. edition. Collette, B. B. and G. Klein-MacPhee. Washington and London, Smithsonian Inst. Press**:** 485-496.

Scharf, F. S., J. P. Manderson and M. C. Fabrizio (2006). The effects of seafloor habitat complexity on survival of juvenile fishes: Species-specific interactions with structural refuge. J. Exp. Mar. Biol. and Ecol. 335: 167-176.

Schmitz, W. J., W. R. Wright and N. G. Hogg (1987). Physical oceanography. The marine environment of the U.S. Atlantic continental slope and rise. Milliman, J. and W. Wright. Boston, MA, Jones and Bartlett Publishers**:** 27-56.

Schmitzer, A. C., W. D. DuPaul and J. E. Kirkley (1991). Gametogenic cycle of sea scallops (Placopecten magellanicus (Gmelin, 1791)) in the mid-Atlantic Bight. J. Shellfish Res. 10: 211-228.

Schultz, E., J.J. Pereira, and P.J. Auster (2007). Determining winter flounder spawning sites in two Connecticut estuaries. Final report submitted to the Connecticut Department of Marine Fisheries.

Scott, J. S. (1982). Depth, temperature, and salinity preferences of common fishes of the Scotian Shelf. J. Northw. Atl. Fish. Sci. 3: 29-39.

--- (1982). Selection of Bottom Type by Groundfishes of the Scotian Shelf. Can. J. Fish. Aquat. Sci. 39(7): 943-947.

Scott, W. B. and M. G. Scott (1988). Atlantic fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731.

Sea Turtle Disentanglement Network (STDN, 2014). Northeast Region Sea Turtle Disentanglement Network Summary of Entanglement/Disentanglement Data from 2002-2013. Unpublished report compiled by NMFS NERO.

Sears, R. (2002). Blue whale, *Balaenoptera musculus*. Encyclopedia of Marine Mammals. Perrin, W. F., B. Würsig and G. M. Thewissen. San Diego, Academic Press**:** 112-116.

Shepard AN, Theroux RB, et al. (1986). Ecology of Ceriantharia (Coelenterata, Anthozoa) of the Northwest Atlantic from Cape Hatteras to Nova Scotia. Fish. Bull. 84: 625-646

Shepard, A. N., N. F. Marshall, et al. (1979). Currents in submarine canyons and other sea valleys. Am. Assn. Petrol. Geol., Studies in Geol. No. 8.

Sherman, K., N. A. Jaworski and T. J. Smayda (1996). The northeast shelf ecosystem - assessment, sustainablity, and management. Cambridge, MA, Blackwell Science. 564pp.

Shoop, C. R. and R. D. Kenney (1992). Seasonal distributions and abundance of loggerhead and leatherback sea turtles in waters of the northeastern United States. Herpetological Monographs 6: 43-67.

Siceloff, L. and W. H. Howell (2013). Fine-scale temporal and spatial distributions of Atlantic cod (*Gadus morhua*) on a western Gulf of Maine spawning ground. Fish. Res. 141: 31-43.

Simpson, A. W. and L. Watling (2006). An investigation of the cumulative impacts of shrimp trawling on mud-bottom fishing grounds in the Gulf of Maine: effects on habitat and macrofaunal community structure. ICES J. Mar. Sci. 63(9): 1616-1630.

Smith, E. M. and P. T. Howell (1987). The effects of bottom trawling on American lobsters, *Homarus americanus*, in Long Island Sound. Fish. Bull. 85(4): 373-744.

Smith, M. D., J. H. Grabowski and P. O. Yund (2008). The role of closed areas in rebuilding monkfish populations in the Gulf of Maine. ICES J. Mar. Sci. 65(7): 1326-1333.

Smith, S. J. and P. Rago (2004). Biological reference points for sea scallops (*Placopecten magellanicus*): the benefits and costs of being nearly sessile. Canadian Journal of Fisheries and Aquatic Sciences 61(8): 1338-1354.

Smith, W. G. and W. W. Morse (1985). Retention of larval haddock *Melanogrammus aeglefinus* in the Georges Bank region, a gyre-influence spawning area. Mar. Ecol. Prog. Ser. 24: 1-13.

--- (1993). Larval distribution patterns: Early signals for the collapse/recovery of Altantic herring *Clupea harengus* in the Georges Bank area. Fish. Bull. 91(2): 338-347.

Smith, W. G., J. D. Sibunka and A. Wells (1975). Seasonal distributions of larval flatfishes (Pleuronectiformes) on the continental shelf between Cape Cod, Massachusetts, and Cape Lookout, North Carolina, 1965-66. NOAA Tech. Rep. NMFS SSRF-691. 68pp.

--- (1975). Seasonal distributions of larval flatfishes (Pleuronectiformes) on the continental shelf between Cape Cod, Massachusetts, and Cape Looookout, North Carolina, 1965-66. NOAA Tech. Rep. NMFS SSRF-691. 66pp.

Smolowitz, R., K. Goetting, et al. (2012). Optimizing the Georges Bank Scallop Fishery by Maximizing Meat Yield and Minimizing Bycatch. Final Report Prepared for the 2011 Sea Scallop Research Set-Aside. Coonamessett Farm Foundation, East Falmouth, MA, 245pp.

Sparholt, H. (1990). An estimate of the total biomass of fish in the North Sea. ICES J. Mar. Sci. 46: 200-210.

Stanley, D. J. (1971). Fish-produced markings on the outer continental margin east of the middle Atlantic states. J. Sediment. Res. 41(1): 159-170.

Steele, D. H. (1963). Pollock (*Pollachius virens* (L.)) in the Bay of Fundy. J. Fish. Res. Board Can. 20: 1267-1314.

Steimle, F. W., W. W. Morse, et al. (1999). Essential Fish Habitat Source Document: Ocean Pout, *Macrozoarces americanus*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-129. 34pp.

Steimle, F. W. and C. Zetlin (2000). Reef Habitats in the Middle Atlantic Bight: Abundance, Distribution, Associated Biological Communities, and Fishery Resource Use. Marine Fisheries Review 62(2): 24-42.

Stein, A. B., K. D. Friedland and M. Sutherland (2004a). Atlantic sturgeon marine bycatch and mortality on the continental shelf of the Northeast United States. N. Amer. J. Fish. Mgmt. 24: 171-183.

--- (2004b). Atlantic sturgeon marine distribution and habitat use along the northeastern coast of the United States. Trans. Am. Fish. Soc. 133: 527-537.

Steinbeck, S. R. and E. M. Thunberg (2006). Northeast Region Commercial Fishing Input-Output Model. NOAA Technical Memorandum NMFS-NE-188. 64pp.

Steiner, W. W., J. J. Luczkovich and B. L. Olla (1982). Activity, shelter usage, growth and recruitment of juvenile red hake Urophycis chuss. Mar. Ecol. Prog. Ser. 7: 125-135.

Steneck, R. S. (1997). Fisheries-induced biological change to the structure and function of the Gulf of Maine Ecosystem. Proceedings of the Gulf of Maine Ecosystem Dynamics: A Scientific Symposium and Workshop. Regional Association for Research on the Gulf of Maine, Hanover NH.

Steneck, R. S. and J. T. Carlton (2001). Human alterations of marine communities: Students Beware! Marine Community Ecology. Bertress, S., S. D. Gaines and M. Hay. Sunderland, MA, Sinauer Press**:** 445-468.

Steneck, R. S., J. Vavrinec and A. V. Leland (2004). Accelerating Trophic-level Dysfunction in Kelp Forest Ecosystems of the Western North Atlantic. Ecosystems 7(4): 323-332.

Stevenson, D., L. Chiarella, et al. (2004). Characterization of fishing practices and marine benthic ecosystems of the northeast US shelf, and and evaluation of potential effects of fishing on Essential Fish Habitat. Gloucester, MA, 179pp.

Steves, B. P. and R. K. Cowen (2000). Settlement, growth, and movement of silver hake *Merluccius bilinearis* in nursery habitat on the New York Bight continental shelf. Mar. Ecol. Prog. Ser. 196: 279-290.

Stobo, W. T., J. D. Neilson and P. G. Simpson (1988). Movements of Atlantic Halibut (*Hippoglossus hippoglossus*) in the Canadian North Atlantic. Can. J. Fish. Aquat. Sci. 45(3): 484-491.

Stokesbury, K. D. E., J. D. Carey, et al. (2010). High Densities of Juvenile Sea Scallop (*Placopecten magellanicus*) on Banks and Ledges in the Central Gulf of Maine. J. Shellfish Res. 29(2): 369-372.

Stone, S. L., T. A. Lowery, et al. (1994). Distribution and abundance of fishes and invertebrates in Mid- Atlantic estuaries. ELMR Rep. No. 12. NOAA/NOS Strategic Environmental Assessments Division, Silver Spring, MD, 280pp.

Stumpf, R. P. and R. B. Biggs (1988). Surficial morphology and sediments of the continental shelf of the Middle Atlantic Bight. NOAA Tech. Memo. NMFS-F/NEC-56. 51-72pp.

Sulikowski, J. A., S. Elzey, et al. (2007). The reproductive cycle of the smooth skate, *Malacoraja senta*, in the Gulf of Maine. Marine and Freshwater Research 58(1): 98-103.

Sulikowski, J. A., P. C. Tsang and W. H. Howell (2004). An annual cycle of steroid hormone concentrations and gonad development in the winter skate, *Leucoraja ocellata*, from the western Gulf of Maine. Mar. Biol. 144: 845-853.

Sullivan, M. C., R. K. Cowen, et al. (2000). Spatial scaling of recruitment in four continental shelf fishes. Mar. Ecol. Prog. Ser. 207: 141-154.

Sullivan, M. C., R. K. Cowen, et al. (2006). Applying the basin model: Assessing habitat suitability of young-of-the-year demersal fishes on the New York Bight continental shelf. Cont. Shelf Res. 26(14): 1551-1570.

Suuronen, P., P. Jounela and V. Tschernij (2010). Fishermen responses on marine protected areas in the Baltic cod fishery. Marine Policy 34(2): 237-243.

Swingle, W. M., S. G. Barco, et al. (1993). Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Mar. Mammal Sci. 9: 309-315.

Tallack, S. (2008). Movements of Atlantic cod relative to closed areas: Observations from the Northeast Regional Cod Tagging Program. Gulf of Maine Research Institute, Portland, ME, 45pp.

Tamsett, A., K. B. Heinonen, et al. (2010). Dynamics of Hard Substratum Communities Inside and Outside of a Fisheries Habitat Closed Area in Stellwagen Bank National Marine Sanctuary (Gulf of Maine, NW Atlantic). ONMS-10-05. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Ocean and Coastal Resource Management, Office of National Marine Sanctuaries, Silver Spring, MD, 53pp.

Templeman, W. (1982). Development, occurrence and characteristics of egg capsules of the thorny skate, *Raja radiata*, in the Northwest Atlantic. J. Northw. Atl. Fish. Sci. 3(1): 47-56.

--- (1986). Some biological aspects of Atlantic wolffish (*Anarhichas lupus*) in the Northwest Atlantic. J. Northw. Atl. Fish. Sci. 7: 57-65.

Theroux, R. B. and M. D. Grosslein (1987). Benthic fauna. Georges Bank. Backus, R. H. and D. W. Bourne. Cambridge, MA, MIT Press**:** 283-295.

Theroux, R. B. and R. L. Wigley (1998). Quantitative Composition and Distribution of the Macrobenthic Invertebrate Fauna of the Continental Shelf Ecosystems of the Northeastern United States. 240pp.

Thoma, J. N., E. Pante, et al. (2009). Deep-sea octocorals and antipatharians show no evidence of seamount-scale endemism in the NW Atlantic. Mar. Ecol. Prog. Ser. 397: 25-35.

Tian, R. C., C. Chen, et al. (2009). Dispersal and settlement of sea scallop larvae spawned in the fishery closed areas on Georges Bank. ICES J. Mar. Sci. 66(10): 2155-2164.

Timoshkin, V. P. (1968). Atlantic sturgeon (*Acipenser sturio* L.) caught at sea. Prob. Ichthyol. 8(4):598.

Townsend, D. W. (1992). An overview of the oceanography and biological productivity of the Gulf of Maine. NOAA Coastal Ocean Prog. Reg. Synth. Ser. 1. 5-26pp.

Transboundary Resource Assessment Committee (2006). Gulf of Maine-Georges Bank Herring Stock Complex. TRAC Status Report 2006/01. Fisheries and Oceans Canada, 6pp.

--- (2009). Gulf of Maine-Georges Bank Herring Stock Complex, Status Report 2009/04. Fisheries and Oceans Canada, 6pp.

--- (2012). Eastern Georges Bank Cod, Revised Status Report 2012/02. Fisheries and Oceans Canada, 11pp.

--- (2012). Eastern Georges Bank Haddock, Revised Status Report 2012/03. Fisheries and Oceans Canada, 6pp.

--- (2012). Georges Bank Yellowtail Flounder, Revised Status Report 2012/01. Fisheries and Oceans Canada, 8pp.

Tremblay, M. J. and M. Sinclair (1985). Gulf of St. Lawrence Cod: Age-Specific Geographic Distributions and Environmental Occurrences from 1971 to 1981. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1387. Department of Fisheries and Oceans, Halifax, Nova Scotia, 48pp.

Tripple, E. A., O. S. Kjesbu and P. Solemdal (1997). Effects of adult age and size structure on reproductive output in marine fishes. Early Life History and Recruitment in Fish Populations. Chambers, R. C. and E. A. Tripple. London, Chapman & Hall**:** 63-102.

Tucholke, B. E. (1987). Submarine geology. The marine environment of the U.S. Atlantic continental slope and rise. Milliman, J. and W. Wright. Boston, MA, Jones and Bartlett Publishers**:** 53-113.

Tupper, M. and R. G. Boutilier (1995). Effects of habitat on settlement, growth, and postsettlement survival of Atlantic cod (*Gadus morhua*). Can. J. Fish. Aquat. Sci. 52(9): 1834-1841.

Turtle Expert Working Group (1998). An assessment of the Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-409. 96pp.

--- (2000). Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the Western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-444. 115pp.

--- (2007). An assessment of the leatherback turtle population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-555. 116pp.

--- (2009). An assessment of the loggerhead turtle population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-575. 131pp.

Twichell, D. C., B. Butman and R. S. Lewis (1987). Shallow structure, surficial geology, and the processes currently shaping the bank. Georges Bank. Backus, E. H. and D. W. Bourne. Cambridge, MA, Massachusetts Institute of Technology Press**:** 31-37.

Tyler, A. V. (1971). Periodic and Resident Components in Communities of Atlantic Fishes. J. Fish. Res. Board Can. 28(7): 935-946.

Valentine, P. and R. G. Lough (1991). The sea floor environment and the fishery of Eastern Geoges Bank. The influence of geologic and oceanographic environmental factors on the abundance and distribution of fisheries resources of the northeastern United States continental shelf. Open file report 91-439. Department of Interior, U.S. Geological Survey, 25pp.

Valentine, P. C., J. L. Baker, et al. (2005). Sea floor image maps showing topography, sun-illuminated topography, backscatter intensity, ruggedness, slope, and the distribution of boulder ridges and bedrock outcrops in the Stellwagen Bank National Marine Sanctuary region off Boston, Massachusetts. USGS Scientific Investigations Map: 2840.

Valentine, P. C. and C. A. Schmuck (1995). Geological mapping of biological habitats on Georges Bank and Stellwagen Bank, Gulf of Maine Region, in *Applications of Side-Scan Sonar and Laser-Line Systems in Fisheries Research*, Special Publication of Alaska Department of Fish and Game, Juneau. pp.

Valentine, P. C. U., Joseph R.; Cooper, Richard A. (1980). Geologic and biologic observations in Oceanographer submarine canyon; descriptions of dives aboard the research submersibles Alvin (1967, 1978) and Nekton Gamma (1974). 80-76.

Vallin, L. and A. Nissling (2000). Maternal effects on egg size and egg buoyancy of Baltic cod, Gadus morhua: Implications for stock structure effects on recruitment. Fish. Res. 49(1): 21-37.

Vanclay, F. (2002). Conceptualizing social impacts. Environ. Impact Asses. 22(3): 183-211.

Vitaliano, J., D. Packer, et al. (2013). Broad-scale, dense amphipod tube aggregations on the sea bed: implications for resource species that utilize benthic habitats. Fish. Oceanogr. 22(1): 61-67.

Vladykov, V. D. (1936). Capsules d'oeufs de raies de l'Atlantique Canadien appartenant au genre *Raja*. Natur. Can. 63: 211-231.

Wahle, R. A. and R. S. Steneck (1991). Recruitment habitats and nursery grounds of the American lobster *Homarus americanus*: a demographic bottleneck? Mar. Ecol. Prog. Ser. 69: 231-243.

Wahle, R. A. and R. S. Steneck (1992). Habitat restrictions in early benthic life: experiments on habitat selection and in situ predation with the American lobster. J. Exp. Mar. Biol. and Ecol. 157(1): 91-114.

Waldman, J. R., J. T. Hart and I. I. Wirgin (1996). Stock composition of the New York Bight Atlantic sturgeon fishery based on analysis of mitochondrial DNA. Trans. Am. Fish. Soc. 125: 364-371.

Wallmo, K. and S. Edwards (2008). Non-market Values of Marine Protected Areas: A Latent Class Modeling Approach. Mar. Res. Econ. 23(3): 301-323.

Warden, M.L. (2011a). Modeling loggerhead sea turtle (*Caretta caretta*) interactions with US Mid-Atlantic bottom trawl gear for fish and scallops, 2005–2008. Biological Conservation 144: 2202–2212.

Warden, M.L. (2011b). Proration of loggerhead sea turtle (*Caretta caretta*) interactions in US Mid-Atlantic bottom otter trawls for fish and scallops, 2005-2008, by managed species landed. NEFSC Reference Document 11-04; 8pp. http://www.nefsc.noaa.gov/publications/crd/.

Waring, G. T., E. Josephson, et al. (2011). U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2010. NOAA Tech Memo NMFS NE 219. 595pp.

--- (2012). U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2011. NOAA Tech Memo NMFS NE 221. 319pp.

--- (2013). U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2012. NOAA Tech Memo NMFS NE 223. 419pp.

--- (2014). U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2013. NOAA Tech Memo NMFS- NE-228. 475pp.

--- (2015). U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2014. http://www.nmfs.noaa.gov/pr/sars/pdf/atl2014_final.pdf

Watling, L. and P. Auster (2005). Distribution of deep-water Alcyonacea off of the Northeast coast of the United States. Pages 279-296 in Cold-Water Corals and Ecosystems, edited by A. Friewald and J. M. Roberts. Berlin, Heidelberg, Springer-Verlag.

Watling, L. and C. Skinder (2007). Video analysis of megabenthos assemblages in the central Gulf of Maine. Geological Association of Canada Special Paper 47. 369-377pp.

Wentworth, C. K. (1922). A grade scale and class terms for clastic sediments. J. Geol. 30: 377-392.

Whitehead, H. (2002). Sperm whale, *Physeter macrocephalus*. Encyclopedia of Marine Mammals. Perrin, W. F., B. Würsig and G. M. Thewissen. San Diego, Academic Press**:** 1165-1172.

Whittingham, A., D. Hartley, J. Kenney, et al (2005a). Large Whale Entanglement Report 2002. Report to the National Marine Fisheries Service, updated March 2005.

Whittingham, A., M. Garron, J. Kenney, and D. Hartley (2005b). Large Whale Entanglement Report 2003. Report to the National Marine Fisheries Service, updated June 2005.

Wicklund, R. (1966). Observations on the nursery grounds of young squirrel hake, *Urophycis chuss*. Underwater Naturalist 4(1): 33-34.

Wiebe, P. H., E. H. Backus, et al. (1987). Biological oceanography. The marine environment of the U.S. Atlantic continental slope and rise. Milliman, J. and W. Wright. Boston, MA, Jones and Bartlett Publishers**:** 140-201.

Wigley, R. L., T. R.B. and H. E. Murray (1975). Deep-sea red crab, *Geryon quinquedens*, survey off Northeastern United States. Mar. Fish. Rev. 37(8): 1-21.

Wigley, R. L. and R. B. Theroux (1981). Atlantic continental shelf and slope of the United States -- macrobenthic invertebrate fauna of the Middle Atlantic Bight region -- faunal composition and quantitative distribution. United States Department of the Interior, Geological Survey.

Wigley, S.E., and J.M. Burnett. (2003). Preliminary Estimates of Biological and Yield Characteristics of Deep-water Witch Flounder (*Glyptocephalus cynoglossus*) in the Georges Bank - Mid-Atlantic Bight Region J. Northw. Atl. Fish. Sci. 31: 181-194.

Wigley, S. E. and F. M. Serchuk (1992). Spatial and temporal distribution of juvenile Atlantic cod *Gadus morhua* in the Georges Bank-southern New England region. Fish. Bull. 90: 599-606.

Wilber, D.H., D.G. Clarke, J. Gallo, C.J. Alcoba, A.M. Dilorenzo, and S.E. Zappala (2013). Identification of winter flounder (*Pseudopleuronectes americanus*) estuarine spawning habitat and factors influencing egg and larval distributions. Estuaries Coasts 36:1304-1318.

Wiley, D. N., R. A. Asmutis, et al. (1995). Stranding and mortality of humpback whales, *Megaptera novaeangliae*, in the Mid-Atlantic and southeast United States, 1985-1992. Fish. Bull. 93: 196-205.

Witman, J. D. and K. P. Sebens (1988). Benthic community structure at a subtidal rock pinnacle in the central Gulf of Maine (in Benthic Productivity and Marine Resources in the Gulf of Maine). 67-104pp.

--- (1992). Regional variation in fish predation intensity: a historical perspective in the Gulf of Maine. Oecologia 90(3): 305-315.

Worthington, L. V. (1976). On the North Atlantic Circulation. Johns Hopkins Ocean. Stud. No. 6. Baltimore, MD, Johns Hopkins Univ. Press**:** 110pp.

Wright, W. R. and L. V. Worthington (1970). The water masses of the North Atlantic Ocean: a volumetric census of temperature and salinity. Serial Atlas of the Marine Environment, Folio 19, American Geographical Society: 8pp, 7 plates.

Wynne, K. and M. Schwartz (1999). Guide to marine mammals and turtles of the U.S. Atlantic and Gulf of Mexico. Rhode Island Sea Grant, Narragansett, RI, 120pp.

Zemeckis, D. R., M. J. Dean and S. X. Cadrin (2014). Spawning Dynamics and Associated Management Implications for Atlantic Cod. N. Amer. J. Fish. Mgmt. 34(2): 424-442.

9 Index

O

P

R

S

T

V

W