FINAL

Programmatic Environmental Assessment

for

Fisheries Research Conducted and Funded by the Northeast Fisheries Science Center

July 2016

Prepared for the National Marine Fisheries Service by:

URS Group

700 G Street, Suite 500

Anchorage, Alaska 99501

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF APPENDICES

(Each appendix will be under separate cover.)

LIST OF TABLES

LIST OF FIGURES

This page intentionally left blank.

LIST ACRONYMS AND ABBREVIATIONS

ACA	Atlantic Coastal Fisheries Cooperative Management Act
ADCP	Acoustic Doppler Current Profiler
ALWTRP	Atlantic Large Whale Take Reduction Plan
ASMFC	Atlantic States Marine Fisheries Commission
ATGTRS	Atlantic Trawl Gear Take Reduction Strategy
BiOp	Biological Opinion
BTS	NEFSC Standard Bottom Trawl Survey
CA	Closed Area
CEQ	Council on Environmental Quality
CETAP	Cetacean and Turtle Assessment Program
CFR	Code of Federal Regulations
cm	centimeter
COASTSPAN	Cooperative Atlantic States Shark Pupping and Nursery
CPUE	catch-per-unit-effort
CRPP	Cooperative Research Partners Program
CTD	Conductivity, Temperature, Depth
CZMA	Coastal Zone Management Act
DAS	days-at-sea
DOI	Department of the Interior
Final PEA	Final Programmatic Environmental Assessment
DPS	Distinct Population Segment
EA	Environmental Assessment
EcoMon	Ecosystem Monitoring
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EFP	exempted fishing permit
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FR	Federal Register
F/V	Fishing Vessel
FWCA	Fish and Wildlife Coordination Act
GB	Georges Bank
GOM	Gulf of Maine
GoMOOS	Gulf of Maine Ocean Observing System
GSC	Great South Channel
HAPC	Habitat Area of Particular Concern
HMS	highly migratory species
hr	hour
Hz	hertz
IMO	International Maritime Organization

IWC	International Whaling Commission
kg	kilogram
kHz	kilohertz
km	kilometers
km/year	kilometer per year
km^2	square kilometers
LME	Large Marine Ecosystems
LNG	Liquefied Natural Gas
LOA	Letters of Authorization
m	meter
MAB	Mid-Atlantic Bight
MAFMC	Mid-Atlantic Fishery Management Council
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MBTA	Migratory Bird Treaty Act
ME-NH	Maine-New Hampshire (inshore trawl program)
MMOs	Marine Mammal Observers
MMPA	Marine Mammal Protection Act
MPA	Marine Protected Areas
mt	metric ton
NAO	NOAA Administrative Order
NEAMAP	Northeast Area Monitoring and Assessment Program
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
nm	nautical mile
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NMS	National Marine Sanctuary
NOAA	National Oceanic and Atmospheric Administration
Research Set-Aside	RSA
RFFAs	Reasonably Foreseeable Future Actions
R/V	Research Vessel
SHPO	State Historic Preservation Office
SNE	Southern New England
sq mi	square mile
TAC	total allowable catch
TEWG	Turtle Export Working Group
TRPs	Take Reduction Plans
TTS	Temporary Threshold Shift
U.S.	United States
USC	United States Code
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

CHAPTER 1 – INTRODUCTION AND PURPOSE AND NEED

The federal government has a responsibility to conserve and protect living marine resources in waters of the United States (U.S.), also referred to as federal waters. These waters generally lie 3 to 200 nautical miles (nm) from the shoreline, and comprise an area known as the Exclusive Economic Zone (EEZ)[1]. The National Oceanic and Atmospheric Administration (NOAA) has the primary responsibility for managing marine finfish and shellfish, certain marine mammal species, sea turtles in marine waters, and their habitats. Within NOAA, the National Marine Fisheries Service (NMFS) has been delegated primary responsibility for the science-based management, conservation, and protection of living marine resources within the U.S. EEZ.

NMFS is fundamentally a science-based agency, with its primary mission being the stewardship of living marine resources through science-based conservation and management. So central is science-based management to NMFS fishery management efforts, it is listed among the ten National Standards set forth in the Magnuson-Stevens Fishery Conservation and Management Act (MSA): "(2) Conservation and management measures shall be based upon the best scientific information available." (16 U.S.C. §§ 1801-1884).

This Final Programmatic Environmental Assessment (Final PEA) evaluates both a primary and a secondary federal action under the National Environmental Policy Act (NEPA). The purpose and need for the primary action is to continue fisheries research activities conducted and funded by the Northeast Fisheries Science Center (NEFSC) to produce scientific information necessary for the management and conservation of living marine resources in the Atlantic Ocean. This research promotes both the recovery of certain species and the long-term sustainability of these resources. It also generates social and economic opportunities and benefits from their use. The information developed from these research activities is essential to the development of a broad array of fisheries, marine mammal, and ecosystem management actions taken not only by NMFS, but also by other federal and state authorities. Each of the research activities requires one or more scientific research permits and the issuance of these permits is a part of the primary federal action covered under this NEPA review. The secondary action is the issuance of proposed regulations and subsequent Letters of Authorization (LOA) under Section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA) of 1972, as amended (MMPA; 16 United States Code [U.S.C.] 1361 et seq.) that would govern the unintentional taking of small numbers of marine mammals incidental to NEFSC fisheries research activities.

Fisheries Science Centers

In order to direct and coordinate the collection of scientific information needed to make informed fishery conservation and management decisions, NMFS established six Regional Fisheries Science Centers[2], each a distinct organizational entity and the scientific focal point within NMFS for region-based federal fisheries-related research in the United States. The Fisheries Science Centers conduct primarily *fisheries-independent* research studies[3] but may also participate in *fisheries-dependent* and *cooperative* research studies. This research is aimed at monitoring fish stock recruitment, survival and biological rates,

---

[1] An Exclusive Economic Zone is an area over which a nation has special rights over the exploration and use of marine resources.

[2] Northeast FSC, Southeast FSC, Southwest FSC, Northwest FSC, Alaska FSC, and Pacific Islands FSC

[3] Fisheries-independent research is designed and conducted independent of commercial fishing activity to meet specific research goals, and includes research directed by NEFSC scientists and conducted on board NOAA- owned and operated vessels or NOAA-chartered vessels. Fisheries-dependent research is research that is carried out in partnership with commercial fishing vessels. The vessel activity is not directed by the NEFSC, but researchers collect data on the commercial catch. Cooperative research programs are those where the NEFSC provides substantial support of the research through funding, equipment supply, or scientific collaboration but which are carried out by cooperating scientists (other agencies, academic institutions, commercial fishing-associated groups, or independent researchers) on board non-NOAA vessels.

abundance and geographic distribution of species and stocks, and providing other scientific information needed to improve our understanding of complex marine ecological processes and promote NMFS strategic goal of ecosystem-based fisheries management.

Northeast Fisheries Science Center Research Activities

The NEFSC is the research arm of NMFS in the Northeast region of the United States. The NEFSC conducts research and provides scientific advice to manage fisheries and conserve protected species along the U.S. Atlantic Coast[4] (Figure 1.1-2). Three regional Fishery Management Councils rely in part on data collected by the NEFSC. The New England Fishery Management Council (NEFMC) is responsible for fisheries occurring in the federal waters off Maine, New Hampshire, Rhode Island, Massachusetts, and Connecticut; the Mid-Atlantic Fishery Management Council (MAFMC) covers federal waters off the shores of New York, New Jersey, Philadelphia, Delaware, Maryland, Virginia, and North Carolina; and the South Atlantic Fishery Management Council (SAFMC) covers federal waters off the shores of South Carolina, Georgia, and part of Florida (Figure 1.1-2). The NEFSC also provides research data and works cooperatively with numerous other domestic and international fisheries management organizations.

In addition to fisheries management organizations, NEFSC generates and communicates scientific information to support the restoration of Atlantic coastal rivers and estuaries, the recovery of protected species, the establishment of marine protected areas, the emergence of marine spatial planning, and to advance scientific understanding of the structure and function of marine ecosystems and the impacts of climate change on these systems.

The specimen archives collected during NEFSC research cruises include some of the world's preeminent collections of plankton, fish, marine invertebrates, and tissue samples for molecular genetics. Sample coverage from different coastal areas is unique in the world because of the long time-series and extensive area from which they have been sampled. These collection archives provide an important record of species diversity, community composition, genetic structure, and an extraordinary record of climate change and other human impacts for current and future studies.

NMFS has prepared this Final PEA to evaluate several alternatives for conducting and funding these fisheries and ecosystem research activities as the primary federal action. NMFS is also evaluating a number of mitigation measures that may be implemented to reduce potential impacts on marine mammals as part of the analysis concerning the secondary action, compliance with the MMPA. Additionally, because the proposed fisheries and ecological research activities occur in areas inhabited by a number of marine mammals, birds, sea turtles, and fishes listed under the Endangered Species Act (ESA) as threatened or endangered, this Final PEA evaluates activities that could result in unintentional impacts on ESA-listed marine species.

CHAPTER 2 – ALTERNATIVES

The National Environmental Policy Act requires federal agencies to consider alternatives to a proposed federal action. The evaluation of alternatives under NEPA assists the decision maker in ensuring that any unnecessary impacts are avoided through an assessment of alternative ways to achieve the underlying purpose of the proposed action that may result in less environmental harm.

---

[4] The Southeast Fisheries Science Center also conducts research along the U.S. Atlantic Coast and provides scientific information for some of the same fisheries management organizations as the NEFSC. There is some spatial overlap with research from the different centers and they work with some of the same research partners. The Southeast Fisheries Science Center is currently preparing a DPEA on its own research programs, covering the same type of authorization processes described for the NEFSC in this Final PEA.

To warrant detailed evaluation under NEPA, an alternative must be reasonable and meet the stated purpose and need for the proposed actions (see Section 1.3). Additionally, NEPA requires consideration of a "no action" alternative, which is Alternative 1 in this Final PEA. For this Final PEA, NMFS has applied the following screening criteria to a range of alternatives to identify which ones should be brought forward for detailed analysis:

Screening Criteria

To be considered "reasonable" for purposes of this Final PEA, an alternative must meet the following criteria:

- The action must not violate any federal statute or regulation.
- The action must be consistent with reasonably foreseeable funding levels.
- The action must be consistent with long-term research commitments and goals to maintain the utility of scientific research efforts, or consider no federal funding availability for fisheries research.

To maintain the utility of scientific research efforts, fisheries and marine ecosystem scientific research should address at least some of the following goals related to fisheries management:

- Methods and techniques should provide standardized and objective data consistent with or complementary to past data sets (time-series) in order to facilitate long-term trend analyses.
- Collected data should adequately characterize living marine resource and fishery populations and the health of their habitats.
- The surveys should enable assessment of population status and provide predictive capabilities required to respond to changing ecosystem conditions and manage future fisheries.
- Research on new methodologies to collect fisheries and ecosystem information (e.g. active and passive acoustic instruments and video surveys of benthic habitats in lieu of dredge gear or bottom trawls) and research oriented toward modifications of fishing gear to address bycatch or other inefficiencies should be conducted under experimental conditions sufficient to allow statistically valid comparisons with relevant alternatives.

NMFS evaluated each potential alternative against these criteria. Based on this evaluation, the No-Action/Status Quo Alternative and two other action alternatives were identified as reasonable and were carried forward for more detailed evaluation in this Final PEA. NMFS also evaluated a second type of no-action alternative that considers no federal funding for fisheries research activities. This has been called the No Research Alternative to distinguish it from the No-Action/Status Quo Alternative. The No-Action/Status Quo Alternative was used as the baseline to compare all of the other alternatives.

Three of the alternatives include a program of fisheries and ecosystem research projects conducted or funded by the NEFSC as the primary federal action. Because this primary action is connected to a secondary federal action (also called a connected action under NEPA), to consider NMFS promulgation of regulations and subsequent issuance of LOAs under Section 101(a)(5)(A) of the MMPA for the incidental, but not intentional, taking of marine mammals, NMFS must identify as part of this evaluation under the MMPA "(t)he means of effecting the least practicable adverse impact on the species or stock and its habitat." As a result, NMFS has identified and evaluated a reasonable range of mitigation measures to minimize impacts to marine mammals that occur in NEFSC research areas. In addition, because this NEPA document has been used to initiate section 7 consultation under the ESA and for compliance with other conservation laws, each of which may recommend or require mitigation measures, the consideration of mitigation measures has been extended to all protected species. These mitigation measures are considered as part of the identified alternatives in order to evaluate their effectiveness to

minimize potential adverse environmental impacts. Protected species include all marine mammals, which are covered under the MMPA, all species listed under the ESA, and bird species protected under the Migratory Bird Treaty Act.

In addition, because the proposed research activities occur partially within the boundaries of National Marine Sanctuaries, and within areas identified as Essential Fish Habitat (EFH), this Final PEA evaluates potential impacts to sanctuary resources and EFH as required under section 304(d) of the National Marine Sanctuaries Act and section 305(b)(2) of the MSA.

Alternative 1 - No-Action/Status Quo Alternative - Conduct Federal Fisheries and Ecosystem Research with Scope and Protocols Similar to Past Effort

The No-Action/Status Quo Alternative includes fisheries research using the same protocols as were implemented from 2008 through 2013. These federal research activities are necessary to fulfill NMFS mission to provide science-based management, conservation, and protection of living marine resources in the areas of the Atlantic Ocean covered by the NEFSC. Under Alternative 1, the NEFSC would use the same scope of research as in recent years and with current mitigation measures for protected species.

Under the Status Quo Alternative, the NEFSC would administer and conduct a wide range of fishery-independent and industry-associated research and survey programs, as summarized in Table 2.2-1 and Table 2.2-2. These surveys generally use fishing gear to capture fish and invertebrates for stock assessment or other research purposes, and also include collection of plankton and larval life stages and oceanographic and acoustic data to characterize the marine environment. The main gear types of concern for potential interactions with protected species include bottom trawls, pelagic trawls (surface and mid-water), bottom and pelagic longline gear, dredge gear, and gillnets. The scope of past research activities is considered as the basis for analysis of future activities under the Status Quo Alternative.

The Status Quo Alternative research activities include a suite of mitigation measures that were developed to minimize the risk of ship strikes and captures or injuries of protected species in fishing gear (i.e., right whale seasonal and dynamic management areas and several marine mammal Take Reduction Plans). The following mitigation measures have been implemented on all NEFSC surveys since at least the end of 2009, although many surveys implemented them earlier:

- Visual monitoring for protected species prior to deployment of gear;
- Use of the “move-on” rule if marine mammals are sighted from the vessel prior to deployment of trawl, longline, dredge, or any other fishing gear that may pose a risk of interactions with protected species and if the animals appear to be at risk of interaction with the gear as determined by the professional judgment of the Chief Scientist or officer on watch; and
- Short tow times and set times to reduce exposure of protected species to research gear.
- Cooperative research projects conducted on commercial fishing vessels with commercial gear used fishing gear modifications required to reduce the risk of marine mammal and sea turtle captures in commercial fisheries (take reduction plans) unless specifically exempted by the terms of scientific research permits or experimental fishing permits.

However, these mitigation measures may not be sufficient to reduce the effects of NEFSC fisheries research activities on marine mammals to the level of least practicable adverse impact, as required under the MMPA (see Alternative 2). Other mitigation measures would be required under the MMPA and ESA processes for the specified research activities conducted by the NEFSC.

Alternative 2 – Preferred Alternative - Conduct Federal Fisheries and Ecosystem Research (New Suite of Research) with Mitigation for MMPA and ESA Compliance

The Preferred Alternative includes a combination of research activities continued from the past and additional, new research surveys and projects as described in Table 2.3-1. In addition, the nature and scope of short-term cooperative research projects (Table 2.3-2) will likely be somewhat different than has occurred in the past. Under this alternative, the NEFSC has applied to NMFS Office of Protected Resources (OPR)[5] to promulgate regulations governing the issuance of LOAs for incidental take of marine mammals under the MMPA. OPR has considered these activities and mitigation measures and has determined that it would be appropriate to promulgate regulations and issue LOAs to the NEFSC. When regulations are promulgated and LOAs are issued, they will prescribe the permissible methods of taking; a suite of mitigation measures intended to reduce the risk of potentially adverse interactions with marine mammals and their habitats during the specified research activities; and require monitoring and reporting that will result in increased knowledge of the species and of the level of taking.

In addition, the NEFSC has engaged in ESA section 7 consultations with NMFS Greater Atlantic Regional Fisheries Office and the U.S. Fish and Wildlife Service for species that are listed as threatened or endangered. These consultations resulted in the development of a Biological Opinion (BiOp) that describe the determinations of the NMFS that the primary and secondary federal actions are not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The BiOp contains incidental take statements that include reasonable and prudent measures along with implementing terms and conditions intended to minimize the number and impact of incidental takes of ESA-listed species during NEFSC research activities (i.e., effect the least practicable adverse impact), and monitoring and reporting requirements.

The NEFSC considers the current suite of monitoring and operational procedures to be necessary to avoid adverse interactions with protected species and still allow the NEFSC and its cooperating partners to fulfill their scientific missions. The Preferred Alternative includes the same suite of mitigation measures as the Status Quo Alternative. However, some mitigation measures such as the move-on rule require judgments about the risk of gear interactions with protected species and the best procedures for minimizing that risk on a case-by-case basis. Ship captains and Chief Scientists are charged with making those judgments at sea. They are all highly experienced professionals but there may be inconsistencies in how those judgments are made across the range of research surveys conducted and funded by the NEFSC. In addition, some of the mitigation measures described in the Status Quo Alternative could also be considered “best practices” for safe seamanship and avoidance of hazards during fishing (e.g., prior surveillance of a sample site before setting trawl gear). At least for some of the research activities considered in this Final PEA, especially those conducted by cooperative research partners, explicit links between the implementation of these best practices and their usefulness as mitigation measures for avoidance of protected species have not been formalized and clearly communicated with all scientific parties and vessel operators. In the case of at least some of the cooperative research projects funded through the NEFSC, scientific procedures and data reporting protocols have been specified in contracts with cooperating research partners but specific procedures to avoid or report interactions with protected species have not been incorporated into contracts. The NEFSC therefore intends to implement a series of improvements to its protected species training, awareness, and reporting procedures under the Preferred Alternative. The NEFSC expects these new procedures will facilitate and improve the implementation of the mitigation measures described under the Status Quo Alternative. The mitigation measures to be

[5] Permits and Conservation Division, Incidental Take Program

implemented in the Preferred Alternative are mandatory, non-discretionary operational requirements of the MMPA authorization process and the ESA section 7 consultation processes.

- Under the Preferred Alternative, the NEFSC will initiate a process for its Chief Scientists and vessel captains to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. As noted in the Status Quo Alternative description of mitigation measures, there are many situations where professional judgment is used to decide the best course of action for avoiding protected species interactions before and during the time research gear is in the water. The intent of this training measure will be to draw on the collective experience of people who have been making those decisions in order to introduce consistency in decision-making, provide a forum for the exchange of information about what went right and what went wrong, and try to determine if there are any rules-of-thumb or key factors to consider that would help in future decisions regarding avoidance practices. The NEFSC will coordinate not only among its staff and vessel captains but also with those from other NMFS Fisheries Science Centers and other institutions with similar experience.
- Another new element of the Preferred Alternative is the development of a formalized protected species training program for all crew members that will be required for all NEFSC-affiliated research projects, including cooperative research partners. Training programs will be conducted on a regular basis and will include topics such as monitoring and sighting protocols, species identification, decision-making factors for avoiding take, procedures for handling and documenting protected species caught in research gear, and reporting requirements. This will be accomplished through participation in protected species training programs developed by the regional commercial fisheries Observer Program, which would typically be the Northeast Fisheries Observer Program (NEFOP) but some NEFSC cooperative partners may receive training through the Southeast Region Fisheries Observer Program. The implementation of this training program will formalize and standardize the information provided to all crew that might experience protected species interactions during research activities.
- For all NEFSC-affiliated research projects and vessels, written cruise instructions and protocols for avoiding adverse interactions with protected species will be reviewed and, if found insufficient, made fully consistent with the NEFOP training materials and any guidance on decision-making that arises out of the two training opportunities described above.
- The NEFSC will incorporate specific language into its contracts that specifies all training requirements, operating procedures, and reporting requirements for protected species that will be required for all charter vessels and cooperating partners.

Alternative 3 - Modified Research Alternative – Conduct Federal Fisheries and Ecosystem Research (New Suite of Research) with Additional Mitigation

Under Alternative 3, the NEFSC would conduct and fund the same scope of fisheries research as described in the Preferred Alternative and would include all of the same mitigation measures considered under the Preferred Alternative. Under this alternative, the NEFSC would also apply for authorizations under the MMPA for incidental take of protected species during these research activities and initiate section 7 consultations regarding ESA-listed species. The difference between Alternative 3 and the Preferred Alternative is that Alternative 3 includes a number of additional mitigation measures derived from a variety of sources including: (1) comments submitted from the public on potential mitigation of commercial fisheries impacts, (2) discussions within NMFS OPR as part of the proposed rulemaking process under the MMPA, and (3) a literature review of past and current research into potential mitigation measures. These measures include changes to visual monitoring methods for protected species (e.g., dedicated Protected Species Observers and technological methods to improve detection under poor

visibility conditions), operational restrictions on where and when research may be conducted, and adoption of alternative methodologies and equipment for sampling.

The NEFSC regularly reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluating new mitigation measures includes assessing their effectiveness in reducing risk to protected species, but measures must also pass safety and practicability considerations, meet survey objectives, allow survey protocols to remain compatible with previous data sets, and be consistent with the purpose and need for NEFSC research activities. Some of the mitigation measures considered under Alternative 3 (e.g., no night fishing or broad spatial/temporal restrictions on research activities) would not allow survey protocols to remain consistent with previous data sets and would essentially prevent the NEFSC from collecting data required to provide for fisheries management purposes under the MSA. Some research surveys necessarily target fish species that are preyed upon by protected species with an inherent risk of interactions during these surveys. The NEFSC acknowledges the inherent risk of these surveys and it has implemented a variety of measures to help mitigate that risk. However, the experimental design of many surveys includes the need to sample "hotspots" of marine life, which often include protected species drawn to concentrations of fish and invertebrates. If these surveys could not sample in areas rich in marine life, as indicated by the presence of marine mammals and sea turtles, even if the protected species did not appear to be at risk of interaction with the research gear, the sampling results would not accurately reflect the variability in abundance for different fish and invertebrate species and the ability of the NEFSC to provide the "best available" scientific data for fisheries management purposes would be compromised. This type of ecological information is also important to agencies and other institutions concerned about the health of the marine environment important to the protected species themselves. The NEFSC currently has no viable alternatives to collecting the data derived from these surveys that meet the research objectives described under Purpose and Need. As a result, NMFS does not propose to implement potential mitigation measures that would preclude continuation of these surveys, such as the elimination of night surveys or use of pelagic trawl gear.

The connected federal action covered under this Final PEA is the issuance of regulations and subsequent LOAs for incidental takes of marine mammals under the MMPA, which requires NMFS to consider a reasonable range of mitigation measures that may reduce the impact on marine mammals among other factors. As described above, some of these measures could prevent the NEFSC from maintaining the scientific integrity of its research programs. These measures would normally be excluded from consideration in the Final PEA for not being consistent with the purpose and need (Chapter 1). However, these additional mitigation measures were considered during the MMPA rulemaking process and/or ESA section 7 consultation and are therefore analyzed in this Final PEA.

Alternative 4 - No Research Alternative - No Fieldwork for Federal Fisheries and Ecosystem Research Conducted or Funded by NEFSC

Under the No Research Alternative, no direct impacts on the marine environment would occur from the primary or secondary federal actions. The NEFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this Final PEA in marine waters of the Atlantic Ocean. This moratorium on fieldwork would not extend to research that is not in scope of this Final PEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents. NMFS would need to rely on other data sources, such as fishery-dependent data (i.e., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its responsibility to manage, conserve and protect living marine resources in the U.S. Under this alternative, organizations that have participated in cooperative research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding. Any non-federal fisheries research would occur without NMFS funding, direct control of program design, or operational oversight. It is unlikely that these non-NMFS fisheries research surveys

would be compatible with the time-series data NMFS has collected over many years (in one case over 50 years), which is the core information supporting NMFS science and management missions and vital to fishery management decisions made by NMFS, the Fishery Management Councils and other marine resource management institutions, leading to greater uncertainty for fishery and other natural resource management decisions.

CHAPTER 3 – AFFECTED ENVIRONMENT

Chapter 3 presents baseline information on the marine environment affected by NEFSC research activities. This information is not intended to be encyclopedic but to provide a foundation for the analysis of environmental impacts of the alternatives and the cumulative effects analysis. Sources of additional information are incorporated by reference.

The marine environment affected by NEFSC research surveys includes sections of two coastal Large Marine Ecosystems (LMEs), including the Northeast U.S. Continental Shelf LME and the Southeast U.S. Continental Shelf LME (Sherman et al. 1996). However, NEFSC fisheries research activities may also be conducted in offshore areas that lie outside of the coastal LME boundaries. There are many areas with special designations to protect various resources and are subject to various levels of conservation and management under a variety of authorities. Classifications of these special resource areas include Essential Fish Habitat, fisheries closure areas, and designated Marine Protected Areas including National Marine Sanctuaries.

There are thousands of finfish and shellfish species that occur within the NEFSC research area. Descriptions or lists are provided for ESA-listed species (Atlantic salmon, Atlantic sturgeon, shortnose sturgeon, and smalltooth sawfish), species targeted by commercial fisheries and subject to NEFSC research assessments, highly migratory species, and other species caught frequently in NEFSC surveys.

Marine mammal species that occur in the NEFSC research area are listed in Table 3.2-4 including greater than 30 species of cetaceans (whales, dolphins, and porpoise) and four species of pinnipeds (seals). All of these species are federally protected under the MMPA regardless of where they occur. Six large whale species are listed as endangered under the ESA. Information is presented on marine mammal acoustics and functional hearing ranges for several groups of marine mammals. Marine mammals rely on sound production and reception for social interactions (e.g., reproduction and communication), to find food, to navigate, and to respond to predators.

Two ESA-listed bird species occur in the NEFSC research area. Other common species in these areas that are susceptible to entanglement in fishing gear are listed. All species likely to occur in the U.S. EEZ are protected by the Migratory Bird Treaty Act.

Five species of sea turtles occur within the NEFSC research area, all of which are listed as endangered or threatened under the ESA. Sea turtles are susceptible to damage of onshore nesting habitat, exploitation of eggs, and interactions with research, sport, and commercial fisheries.

There are no ESA-listed invertebrates in the NEFSC research area. The NEFSC conducts substantial research and provides stock abundance and distribution information for management of several commercially valuable invertebrates, including American lobster, Atlantic sea scallops, and longfin squid.

Several components of the social and economic environment are summarized. A number of commercial fisheries harvest marine fish and invertebrates in the waters of the U.S. Atlantic. Complex associations exist between the fishing industry, fisheries management processes, and the social well-being of many communities. Recreational fisheries also play an important role in the well-being of individuals and communities. These fisheries and communities receive scientific and economic benefits from the NEFSC research activities as they contribute to the scientific management of sustainable fisheries. Information is also presented on the basic operating costs of the NEFSC (approximately $60 million annually) and average costs for conducting NEFSC research programs. These expenses include funds for ship time, fuel

and supplies, crew, charter vessels, and other logistic support, which directly and indirectly benefits communities on the U.S. Atlantic coast.

CHAPTER 4 – ENVIRONMENTAL EFFECTS

As indicated earlier, NMFS is fundamentally a science-based agency, with its primary mission being the stewardship of living marine resources through science-based conservation and management. Of the four alternatives evaluated in this Final PEA, three alternatives maintain an active research program (Status Quo, Preferred, and Modified Research Alternatives) that clearly enables collection and development of additional scientific information, and one alternative (No Research) that does not. In NMFS view, the inability to acquire scientific information essential to developing robust fisheries management measures that prevent overfishing and rebuild overfished stocks would ultimately imperil the agency's ability to meet its mandate to promote healthy fish stocks and restore the nation's fishery resources. The scientific information provided by fisheries research programs also allows NMFS to address potential effects of climate change and ocean acidification. Long-term, consistent fisheries and ecosystem research programs contribute substantially to developing effective and timely fisheries management actions and assists in meeting international treaty obligations.

The following discussion summarizes the direct and indirect impacts by resource area associated with the alternatives evaluated in Chapter 4 of this Final PEA. The effects of the alternatives on each resource category were assessed using an impact assessment criteria table to distinguish between major, moderate, and minor effects within the context of each resource category. The analysis shows that the potential direct and indirect impacts on the physical and biological environments under the three research alternatives are similar and would have minor adverse effects. The three research alternatives would also have minor to moderate beneficial effects on the social and economic environment of fishing communities by providing the scientific information needed for sustainable fisheries management and by providing funding, employment, and services. The similarity of impacts among the three research alternatives is due to the fact that the scope of research activities under these alternatives is similar; they differ primarily in the type of mitigation measures included for protected species. The No Research Alternative, in contrast, would eliminate the direct adverse effects of the research alternatives on the marine environment but would have minor to moderate adverse, indirect effects on several biological resources due to increasing uncertainty in future resource management decisions caused by the loss of scientific information on the marine environment from the NEFSC. The No Research Alternative was also considered to have minor to moderate adverse effects on the social and economic environment of fishing communities by having relatively minor to moderate economic impacts on various communities as well as long-term and widespread adverse impacts on sustainable fisheries management. Table ES-1 provides a summary of impact determinations for each resource by alternative.

Table ES-1 Summary of Environmental Effect Conclusions for Each Alternative

Topic	Alternative 1 (Status Quo)	Alternative 2 (Preferred)	Alternative 3 (Modified Research)	Alternative 4 (No Research)
Physical Environment	Minor adverse	Minor *adverse*	Minor *adverse*	Minor *adverse*
Special Resource Areas	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Fish	Minor *adverse*	Minor *adverse*	Minor *adverse*	Moderate *adverse*
Marine Mammals	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*

Topic	Alternative 1 (Status Quo)	Alternative 2 (Preferred)	Alternative 3 (Modified Research)	Alternative 4 (No Research)
Birds	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Sea Turtles	Minor *adverse*	Minor *adverse*	Minor *adverse*	Moderate *adverse*
Invertebrates	Minor *adverse*	Minor *adverse*	Minor *adverse*	Moderate *adverse*
Social and Economic Environment	Minor to Moderate *beneficial*	Minor to Moderate *beneficial*	Minor to Moderate *beneficial*	Minor to Moderate *adverse*

Physical Environment and Special Resource Areas

Under the three research alternatives, direct impacts to benthic habitats would occur through the use of several bottom-contact fishing gears (primarily trawl and dredge gears). The Final PEA includes an analysis of the total footprint of NEFSC-affiliated research on benthic habitat, including EFH, the effects of which are considered small in magnitude, short-term in duration, and localized in geographic scope. An analysis is presented on the proportion of research sampling and biomass removals made within National Marine Sanctuaries in the Atlantic. The numbers of samples taken within Stellwagen Bank National Marine Sanctuary and the removals of fish and invertebrates for scientific purposes are relatively small and would have temporary and minor adverse effects on the Sanctuary.

Under the No Research Alternative, there would be no direct impacts on the physical environment or special resource areas from federal fisheries and ecological research. However, the loss of scientific information generated by NEFSC research would contribute to greater uncertainty about the effects of climate change and ocean acidification on Atlantic marine ecosystems as well as the status of biological resources in marine protected areas. Indirect effects on resource management agencies and conservation plans for protected areas would likely be adverse and minor in magnitude under the No Research Alternative.

Fish

The NEFSC conducts and funds stock assessment and habitat research for many commercially valuable and recreationally important fish species, providing the scientific basis for sustainable fisheries management. NEFSC research also provides critical information on oceanographic conditions and the status of other fish species that are not harvested but which play key roles in the marine food web, providing the scientific basis for NMFS goal of ecosystem-based management, as outlined in NOAA Fisheries Strategic Plan (NOAA 1997). Under the three research alternatives, relatively small impacts to fish populations are expected as a result of on-going research activities. Mortality from captures in surveys is a potential impact for some ESA-listed species (Atlantic sturgeon and Atlantic salmon) but estimated levels of catch in NEFSC-affiliated fisheries research activities are small and considered minor to their respective populations. For most species targeted by commercial fisheries and recreational anglers, mortality due to research surveys and projects is much less than one percent of commercial and recreational harvest and is considered to have minor adverse effects for all species. For a few species which do not have a large commercial market due to various market conditions or past overfishing, the research catch exceeds one percent of commercial catch but is still small relative to the population of each species and is considered minor. Proposed research projects that target stocks that are overfished or where overfishing is occurring are reviewed annually before research permits are issued to determine if they would conflict with rebuilding plans or present other conservation concerns. For highly migratory species

(almost exclusively sharks) and species that are not managed under FMPs, research catch is also relatively small and considered to be minor for all species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities. In contrast to these adverse effects on fish, NEFSC research also provides long-term beneficial effects on target species populations through its contribution to sustainable fisheries management. Data from NEFSC-affiliated research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks.

Under the No Research Alternative, there would be no direct adverse impacts on fish from NEFSC fisheries research. However, the loss of scientific information for fisheries management could have long-term moderate adverse impacts on fish stocks through increasing uncertainty in fisheries management decisions, which could lead to potential overfishing on some stocks, uncertainty about the recovery of overfished stocks, and increasing uncertainty about the efficacy of fishing regulations designed to protect fish stocks and habitat from overfishing.

Marine Mammals

The primary direct effects of the three research alternatives on ESA-listed and non-listed marine mammals include behavioral responses to sound produced through the use of active acoustic sources (Level B harassment under the MMPA), incidental capture or entanglement in fishing gear but released without serious injury (Level A harassment), and incidental capture or entanglement resulting in serious injury or mortality. These all constitute takes of marine mammals under the MMPA. The potential for effects from ship strikes, contamination of the marine environment, and removal of marine mammal prey species was considered minor for all alternatives and species. The MMPA requires applicants for regulations and subsequent LOAs to estimate the number of each species of marine mammal that may be incidentally taken by harassment or serious injury/mortality during the proposed action. The NEFSC LOA application (attached to the Final PEA as Appendix C) includes estimates of marine mammal takes in the NEFSC research area using the scope of research and mitigation measures described in the Preferred Alternative.

The LOA application combines estimated Level A harassment takes with serious injury or mortality takes because the degree of injury resulting from gear interaction cannot be predicted. The estimated take numbers are based on the historical capture of six cetaceans (three short-beaked common dolphins and one each of bottlenose dolphin, harbor porpoise, and minke whale) and two pinnipeds (gray seal and harbor seal) during NEFSC research surveys and NEFOP Observer training trips from 2004 through 2013. Past marine mammal captures have occurred using gill nets (3 captures), mid-water trawls (3 captures), bottom trawl (1 capture), and fyke net (1 capture). Of the eight animals captured, only the minke whale was released alive although it was later determined to be a serious injury.

For the six species that have been taken by entanglement in research gear in the past, the LOA application uses a conservative approach for estimating future takes, using the average annual number of animals caught in different gear types in the past ten years (2004-2013), rounding up to the nearest whole number of animals, and assuming this number of animals could be caught every year during the five-year authorization period. The NEFSC considers this estimation method to be conservative in that it likely overestimates the number of animals that would be caught in the future in order to ensure accounting for a precautionary amount of potential take. The Final PEA uses the estimated takes in the LOA application to assess the impacts on marine mammals. Given the likelihood that these are overestimates, the actual effects from injury, serious injury or mortality could be substantially less than described.

Other species that have not been captured in the past have been included in the LOA application's request for take authorization based on their similarity to species that have been taken by the NEFSC and incidental take in analogous commercial fisheries. Because the scope of research activities under the Status Quo Alternative is very similar to the Preferred Alternative, the estimated take numbers from the

LOA application are used as part of the analysis of effects on marine mammals in this research area under both alternatives.

The Final PEA includes summary tables of the number of estimated Level A harassment/serious injury or mortality takes for each species affected in the NEFSC research area. One of the key elements of the effects analysis is to determine the adverse impact of takes on each species. The Final PEA and LOA application compare estimated future takes for each species with its Potential Biological Removal (PBR) as part of this impact determination. The MMPA defines PBR as, "...the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." PBR was intended to serve as an upper limit guideline for fishery-related mortality for each species. Given the similarity of fisheries research to many commercial fisheries and the role research plays in supporting commercial fisheries, it is appropriate to assess the impacts of incidental takes for fisheries research in a similar manner.

PBR is used as one of the criteria for determining the level of adverse impacts on marine mammals in the Final PEA. For the purposes of this analysis under NEPA, research-related incidental serious injury or mortality less than or equal to 10 percent of PBR for the marine mammal stock is considered minor in magnitude for the population. Serious injury or mortality between 10 percent and 50 percent of PBR is considered moderate in magnitude. Serious injury or mortality greater than or equal to 50 percent of PBR is considered major in magnitude.

For almost all species of marine mammals considered to have potential interactions with NEFSC fisheries research, the requested number of Level A harassment/serious injury and mortality takes would be equal to or less than 10 percent of their respective PBRs. These takes, if they occurred, would likely be rare or infrequent events, be distributed over large geographic areas, and would be considered to have overall minor adverse effects on the population of each species. The potential exceptions are for stocks with very small or unknown PBR values, i.e. one coastal and eight estuarine stocks of bottlenose dolphin, where one or two takes could be moderate or major in magnitude relative to PBR. Given the very limited research effort in nearshore and southern estuarine areas and the mitigation measures in place for the research, the NEFSC considers the chance of taking animals from these small stocks of bottlenose dolphin to be highly unlikely.

Level B harassment takes are estimated based on the acoustic properties of sonars and other acoustic equipment used during research, calculations of the volume of water ensonified to 160 decibels or more (NMFS current recommended threshold for Level B harassment from the active acoustic equipment considered in this Final PEA), estimates of the densities of marine mammals in different areas, and a partitioning of species that typically do not dive deeper than 200 meters and those that do (which affects the size of the ensonified area to which they may be exposed). The Final PEA includes summary tables of the number of estimated Level B harassment takes by acoustic sources of each species affected in the NEFSC research area. It also includes a summary of an assessment of biological effects from NEFSC acoustic equipment used during research (Appendix C, Section 7). Output frequencies of some active acoustic sources (i.e., short range echosounders and Acoustic Doppler Current Profilers) are higher than the functional hearing ranges of marine mammals so no adverse effects are anticipated. Other acoustic sources operate at frequencies within the hearing range of one or more groups of marine mammals and may cause temporary and minor behavioral reactions such as swimming away from an approaching ship. None of the NEFSC acoustic equipment is likely to present risks of hearing loss or injury to any marine mammal.

The Modified Research Alternative includes the same scope of research in the NEFSC research area as the Preferred Alternative but considers a number of other potential mitigation measures that the NEFSC is not proposing to implement in its LOA application. These include a number of alternative methods for monitoring for protected species (e.g., use of dedicated Protected Species Observers and passive acoustic devices), gear modifications such as marine mammal excluder devices for trawl gear, and spatial/temporal

restrictions on where and when research can occur. The NEFSC considers the suite of mitigation measures to be implemented under the Preferred Alternative to represent the most effective and practicable means to reduce the risk of adverse interactions with marine mammals during the conduct of its research program without compromising the scientific integrity of the research program. The potential direct and indirect effects of this alternative on marine mammals would be the same as described for the Preferred Alternative except for the potential of the additional mitigation measures to reduce Level A harassment/serious injury and mortality takes through gear interactions.

Scientists at the NEFSC regularly review their procedures to see if they can do their work more efficiently and with fewer incidental effects on the marine environment, including effects on marine mammals. However, any changes to operational procedures or the equipment used during surveys must also be considered from the standpoint of how they affect the integrity of the scientific data collected, the cost of implementing equipment or operational changes, and the safety of the vessel and crew. It would be speculative to quantify how much any one of these measures (or some combination of them) may reduce the risk of future takes relative to the Status Quo or Preferred Alternatives. The analysis provides a qualitative discussion of the potential for each additional mitigation measure to reduce takes and other effects on marine mammals as well as how each measure may affect practicability, time-series data integrity, and other aspects of the research survey work.

One element of the Modified Research Alternative (e.g., use of Protected Species Observers) would offer mitigation advantages compared to the Status Quo Alternative but is addressed to some extent in the Preferred Alternative. Operational restrictions such as not allowing trawls to be set at night or in poor visibility conditions and spatial/temporal restrictions to avoid high densities of marine mammals would certainly reduce the risk of taking marine mammals. However, such restrictions would have a serious adverse impact on the ability of the NEFSC to collect certain kinds of research data and would have impacts to the cost and scope of research that could be conducted. Some concepts and technologies considered in the Modified Research Alternative are promising as a means to reduce risks to marine mammals and NMFS would continue to evaluate the potential for implementation if they become more practicable.

Under the No Research Alternative, no direct adverse impacts to marine mammals from fisheries and ecological research (i.e., takes by gear interaction and acoustic disturbance) would occur. However, many of the NEFSC research projects that would be eliminated under this alternative contribute valuable ecological information important for marine mammal management, especially for ESA-listed species and species considered depleted under the MMPA. The loss of information on marine mammal habitats would indirectly affect resource management decisions concerning the conservation of marine mammals, especially as time went on and uncertainty about the status of the marine environment increased. There are too many unknown variables to estimate the specific effects this lack of information would mean to any particular stock of marine mammal but the No Research Alternative would likely have minor adverse effects for some species.

Birds

There have been no known adverse interactions with seabirds during NEFSC research activities; there are no records of gear interactions or ship strikes. While commercial fisheries have had adverse interactions with seabirds in the Northeast region, incidental take of seabirds in research gear is unlikely and would not result in any measurable changes to seabird populations. Under the Modified Research Alternative, the NEFSC would deploy streamer lines before longline gear is set to mitigate the risk of catching seabirds. If seabird interactions with longline gear are documented in the future, the NEFSC would revisit whether use of streamer lines is warranted given the tradeoffs between the potential conservation benefit and operational and safety considerations. The adverse effects of the three research alternatives on seabirds are considered minor. Some NEFSC surveys take bird biologists on board when there is bunk space available to conduct transect surveys for bird distribution and abundance in the NEFSC research

area. This information is used by NMFS, the U.S. Fish and Wildlife Service, and other international resource management agencies to help with bird conservation issues and is considered to have indirect beneficial effects on the birds.

Under the No Research Alternative, the risk of direct adverse effects on seabirds from NEFSC research would be eliminated, but there could be potential long-term minor adverse impacts to seabirds because resource management authorities would lose ecological information about the marine environment important to seabird conservation.

Sea Turtles

There have been 75 sea turtles incidentally captured during NEFSC-affiliated research since 2004, all but one of which have been released alive. The Final PEA uses capture rate data from these historical takes, which occurred with different types of fishing gear (bottom trawls, longline gear, and gillnets), to estimate how many sea turtles may be captured given the estimated fishing effort under the three research alternatives. The analysis also includes an estimate of potential mortality for each species based on data from analogous commercial fisheries in the Atlantic. Future incidental captures of sea turtles in these gear types are certain but it is likely that most of these turtles will be released in good condition because of the short tow and set durations of most NEFSC research activities and the presence of trained turtle-handling personnel on many research crews. There is a potential for serious injury and mortality of sea turtles in research gear, especially during some cooperative research activities that have protocols (i.e., long tow durations) similar to commercial fishing conditions, but the estimated level of mortality, if it occurred, would be small relative to overall population size for each species. The overall effects of the research alternatives on ESA-listed sea turtles would likely be small in magnitude, temporary or short-term in duration, limited to small geographic areas, and considered to have minor adverse effects on all species of sea turtles.

As with seabirds and marine mammals, the No Research Alternative would eliminate the risk of direct adverse effects on sea turtles from NEFSC research. However, there could be minor adverse impacts due to the loss of ecological information important to sea turtle conservation. In addition, NEFSC-affiliated research on gears and fishing techniques that might reduce bycatch of sea turtles in commercial fisheries would not occur.

Invertebrates

The NEFSC conducts stock assessment and habitat research for several important invertebrate species (i.e., lobsters and scallops) and, similar to the situation described for commercially valuable fish species, the magnitude of mortality due to research sampling is small relative to commercial harvests. The footprint of bottom-contact gear used in research is also relatively small and impacts to benthic infauna and epifauna would be temporary. The NEFSC conducts research in several areas closed to commercial fishing but much of this effort is conducted using video camera technologies and is the primary means for NMFS to monitor the recovery of scallop stocks, benthic habitat, and the efficacy of fisheries conservation measures. Under the three research alternatives, minor adverse impacts to invertebrates are expected from NEFSC research activities. NEFSC research is important for the scientific and sustainable management of these valuable fisheries, helping to prevent overfishing on the stocks.

Under the No Research Alternative, direct adverse impacts to invertebrates would be eliminated. However, the loss of stock assessment and marine environment information could indirectly result in moderate adverse effects on commercially targeted species through increasing uncertainty in the fishery management environment.

Social and Economic Environment

Under the three research alternatives, long term, beneficial impacts to the social and economic environment are expected from ongoing NEFSC fisheries and ecosystem research activities. NEFSC research provides important scientific information which is the basis for sustainable fisheries management for some of the most valuable commercial and recreational fisheries along the U.S. Atlantic Coast, which benefits commercial and recreational fisheries and the communities that support them. These industries have large economic footprints, generating billions of dollars' worth of sales and thousands of commercial fishing-related jobs, and provide millions of people across the country with highly valued seafood. Millions of recreational fishers also participate and support fishing service industries. NEFSC fisheries research activities would also have minor to moderate beneficial impacts to the economies of fishing communities through direct employment, purchase of fuel, vessel charters, and supplies. Continued NEFSC fisheries research is important to build trust and cooperation between the fishing industry and NMFS scientists and fisheries managers.

The No Research Alternative would likely have minor to moderate adverse impacts on the social and economic environment through greater uncertainty in fisheries management, which could lead to more conservative fishing quotas (i.e., underutilized stocks and lost opportunity) or an increased risk of overfishing, followed by reductions in commercial and recreational fisheries harvests. The lack of scientific information would also compromise efforts to rebuild overfished stocks and monitor the effectiveness of no-fishing conservation areas. These impacts would adversely affect the ability of NMFS to comply with its obligations under the MSA. It would also eliminate research-associated federal spending on charter vessels, fuel, supplies, and support services in various communities. The No Research Alternative would also have long-term adverse impacts on the scientific information the NEFSC contributes to meet U.S. obligations for living marine resource management under international treaties. In these international management organizations, NMFS fisheries conservation and management measures would be compromised and other, potentially competing interests to those of NMFS and the U.S. would have a relatively greater voice.

CHAPTER 5 – CUMULATIVE EFFECTS

Cumulative effects are the net result of all past, present, and reasonably foreseeable future actions on the human environment over time. An individual action may have only minor or moderate impacts, but the cumulative effects of all actions may be major. NEPA requires an analysis of cumulative effects in order to alert decision makers to the full environmental consequences of a proposed action and its alternatives on resource areas of concern. This analysis looks at the overall cumulative impact and the contribution of fisheries research activities to the overall cumulative impact.

In terms of fisheries, understanding how the cumulative impacts from human activities and trends in the natural environment have influenced the marine environment over time is key to understanding the importance of NMFS role in fisheries management. The need for scientific information from NEFSC research activities is in large part the result of past actions that contributed to major adverse impacts on fish stocks from overfishing, pollution of coastal and ocean areas from accidental and intentional discharges, runoff of agricultural and industrial waste, and degradation of habitat from commercial fishing and dam construction, among other activities. Federal efforts within the last 40 years to reduce pollution, restore degraded habitats, and effectively manage commercial and recreational fishery harvests have reversed some of these trends. A number of important fishery stocks have been restored to healthy levels and others are in the rebuilding process.

Similarly, cumulative impacts from human activities and trends in the natural environment over time have contributed major adverse impacts to populations of marine mammals, sea turtles, and other marine species. As a result, the MMPA and ESA were enacted to help address specific conservation concerns and

many human activities are subject to federal management measures to protect marine species and promote recovery of impacted populations.

Climate change and increase in ocean acidification have the potential to impact populations and distributions of many marine species. Fisheries research activities make a negligible contribution to these long-term, global environmental processes through the burning of fossil fuels. However, long-term, systematic marine research provides important scientific information on the changes and trends in marine ecosystems brought about by climatic and oceanic forces.

In addition to NEFSC research efforts, there are many current and reasonably foreseeable activities that may contribute to cumulative impacts on the marine environment, including: conservation efforts, commercial shipping, commercial and recreational fisheries, oil and gas and alternative energy development, military activities, coastal development projects, marine research activities by other agencies and institutions, and other human activities that contribute to global climate change. These actions can produce both adverse and beneficial impacts that directly and indirectly affect ocean resources managed by NMFS and the social and economic environment of fishing communities that rely on them.

This Final PEA generally considers the contribution of the three research alternatives to the cumulative effects on given resources to be very similar and they are often discussed together. The contribution of the No Research Alternative to the cumulative effects on resources is quite different and is discussed separately.

As described in the Chapter 4 summary above, NEFSC research activities would have minor adverse effects on the various resource components of the physical and biological environments. Because NEFSC research activities involve such a small number of vessels compared to other vessel traffic and collect relatively small amounts of biomass compared to commercial and recreational fisheries, the contribution of the three research alternatives to cumulative adverse effects on fish, marine mammal, and other species and resource areas would be small under normal conditions. The proposed NEFSC scientific research activities would also have beneficial contributions to cumulative effects on both biological and socioeconomic resources. The research alternatives contribute substantially to the science that feeds into federal fishery management measures aimed at rebuilding and managing fish stocks in a sustainable manner. It also contributes to understanding the nature of changes in the marine environment and adjusting resource management plans accordingly, and it helps meet international treaty research obligations. The research activities under the three research alternatives help alleviate adverse cumulative impacts on the biological and socioeconomic environments, resulting in long-term beneficial contributions to cumulative effects.

The No Research Alternative would not contribute to direct adverse effects on the marine environment (e.g., research catch of fish and incidental take of marine mammals) but would contribute indirect adverse effects on both the biological and socioeconomic environments based on the lack of scientific information to inform future resource management decisions.

OTHER SECTIONS

In addition to the chapters summarized above, the Final PEA includes a description of the laws applicable to NEFSC research activities in Chapter 6, cited references in Chapter 7, and a list of persons and agencies consulted in Chapter 8. Appendix A provides a description of the fishing gear, other scientific instruments, and vessels used during NEFSC research activities. Appendix B includes tables and figures showing the seasonal distribution of research effort in the NEFSC research area. Appendix C is the NEFSC's application for promulgating regulations and issuing LOAs for incidental take of marine mammals under the MMPA from NMFS OPR. Appendix D contains proposed handling and data collection procedures for marine mammals, sea turtles, and other protected species that are incidentally caught it NEFSC fisheries research activities; these procedures would be implemented after the NEFSC

receives authorization for such incidental takes when the MMPA LOA and ESA consultation processes are completed.

CONCLUSION

Based on the analysis in this Final PEA, NMFS has determined the proposed actions to conduct scientific research activities and issue LOAs would not significantly impact the quality of the human environment. In addition, with implementation of the mitigation measures identified during the analysis and in consultation with NMFS, all beneficial and adverse impacts of the proposed action have been addressed to reach the conclusion of no significant impacts. Accordingly, preparation of an environmental impact statement for this action is not necessary. A final determination on whether potential impacts of the proposed action are significant will be made and documented in the Finding of No Significant Impact (FONSI), which will be noticed in the *Federal Register* and made available to the public.

This page intentionally left blank.

1.1 NOAA'S RESOURCE RESPONSIBILITIES AND ROLE IN FEDERAL FISHERIES RESEARCH

The federal government has a responsibility to protect living marine resources in waters of the United States (U.S.), also referred to as federal waters. These waters generally lay 3 to 200 nautical miles from the shoreline, and comprise the Exclusive Economic Zone (EEZ). To carry out its responsibility over federal waters, Congress has enacted several statutes authorizing certain federal agencies to administer programs to manage and protect living marine resources. Among these federal agencies, the National Oceanographic and Atmospheric Administration (NOAA) has the primary responsibility for protecting marine finfish and shellfish species and their habitats. Within NOAA, the National Marine Fisheries Service (NMFS) has been delegated primary responsibility for the science-based management, conservation, and protection of living marine resources within the U.S. EEZ.

Within the area covered by this Final Programmatic Environmental Assessment (Final PEA), NMFS manages finfish and shellfish harvest under the provisions of several major statutes, including the Magnuson-Stevens Fishery Conservation and Management Act (MSA)[6], the Atlantic Coastal Fisheries Cooperative Management Act (ACA)[7], the Atlantic Striped Bass Conservation Act[8], the Marine Mammal Protection Act (MMPA), and the Endangered Species Act (ESA). Accomplishing the requirements of these statutes requires the close interaction of numerous entities in a sometimes complex fishery management process. In the NMFS Northeast Region, the entities involved include the Northeast Fisheries Science Center, NMFS Greater Atlantic Regional Fisheries Office (formerly named the Northeast Regional Office), NMFS Headquarters, two Fisheries Management Councils, and a Fisheries Commission.

1.1.1 Fisheries Science Centers

Six Regional Fisheries Science Centers direct and coordinate the collection of scientific information needed to make fisheries management decisions. Each Fisheries Science Center is a distinct entity and is the scientific focal point for a particular region (Figure 1.1-1). The Northeast Fisheries Science Center (NEFSC) conducts research primarily in U.S. waters from the Canada border south to Cape Hatteras, North Carolina but also conducts surveys on highly migratory species that extend to Florida. The NEFSC is based out of Woods Hole, Massachusetts and also includes the Orono Field Station (Maine) and four laboratories: the NEFSC Headquarters Laboratory in Woods Hole; Narragansett, Rhode Island Laboratory; Milford, Connecticut Laboratory; and James J. Howard Marine Sciences Laboratory in Sandy Hook, New Jersey (Figure 1.1-2). The National Systematics Laboratory, located in Washington, D.C., is administered by the NEFSC but serves as the taxonomic research arm of NMFS as a whole.

[6] 16 U.S.C. §§ 1801-1884, (MSA 2007).
[7] 16 U.S.C. 5101-5109, (ACFCMA 1993).
[8] 16 U.S.C. 5151-5158, (ASBCA1984).

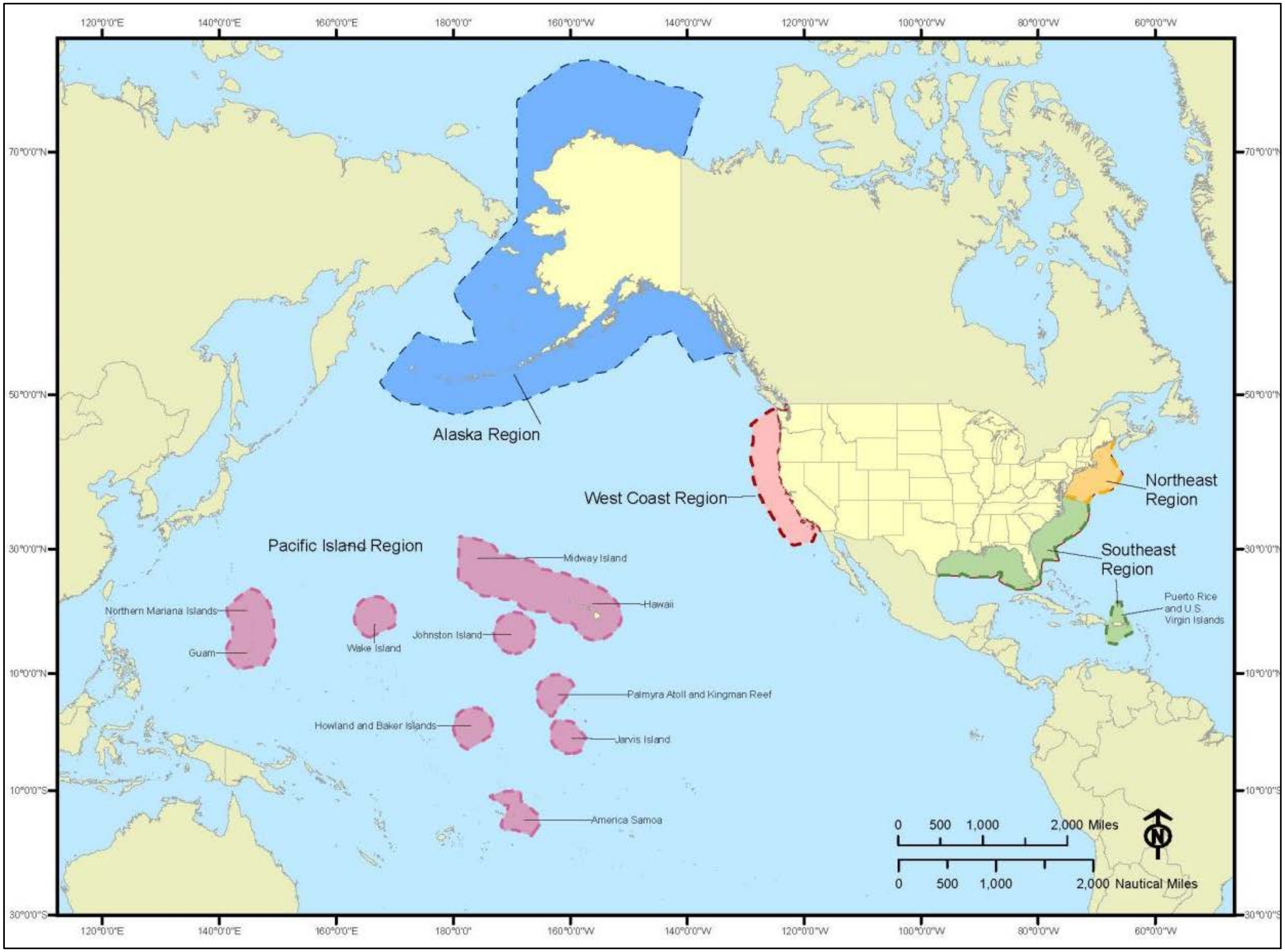


Figure 1.1-1 National Marine Fisheries Service Regions

1.1.2 Fishery Management Councils

In order to encourage a collaborative approach to fisheries management, the MSA established the nation's eight Regional Fishery Management Councils.[9] The councils, which include fishing industry representatives, fishers, scientists, government agency representatives, federal appointees, and others, are designed to provide all resource users and managers a voice in the fisheries management process. Under the MSA, the Councils are charged with developing Fishery Management Plans (FMPs) and management measures for the fisheries occurring within the EEZ adjacent to their constituent states. Data collected by fisheries science centers are often used to inform FMPs, as well as to inform other policies and decisions promulgated by the Fishery Management Councils. Such policies and decisions sometimes affect areas that span the jurisdictions of several Fishery Management Councils, and make use of data provided by multiple fisheries science centers. Three Fishery Management Councils rely on data collected by the NEFSC. The New England Fishery Management Council (NEFMC) is responsible for fisheries occurring in the federal waters off Maine, New Hampshire, Rhode Island, Massachusetts, and Connecticut; the Mid-Atlantic Fishery Management Council (MAFMC) covers federal waters off the shores of New York, New Jersey, Philadelphia, Delaware, Maryland, Virginia, and North Carolina; and the South Atlantic Fishery Management Council (SAFMC) covers federal waters off the shores of South Carolina, Georgia, and part of Florida (Figure 1.1-2).

[9] The eight fisheries management councils are New England, Mid-Atlantic, South Atlantic, Gulf of Mexico, Caribbean, Pacific, North Pacific, and Western Pacific.

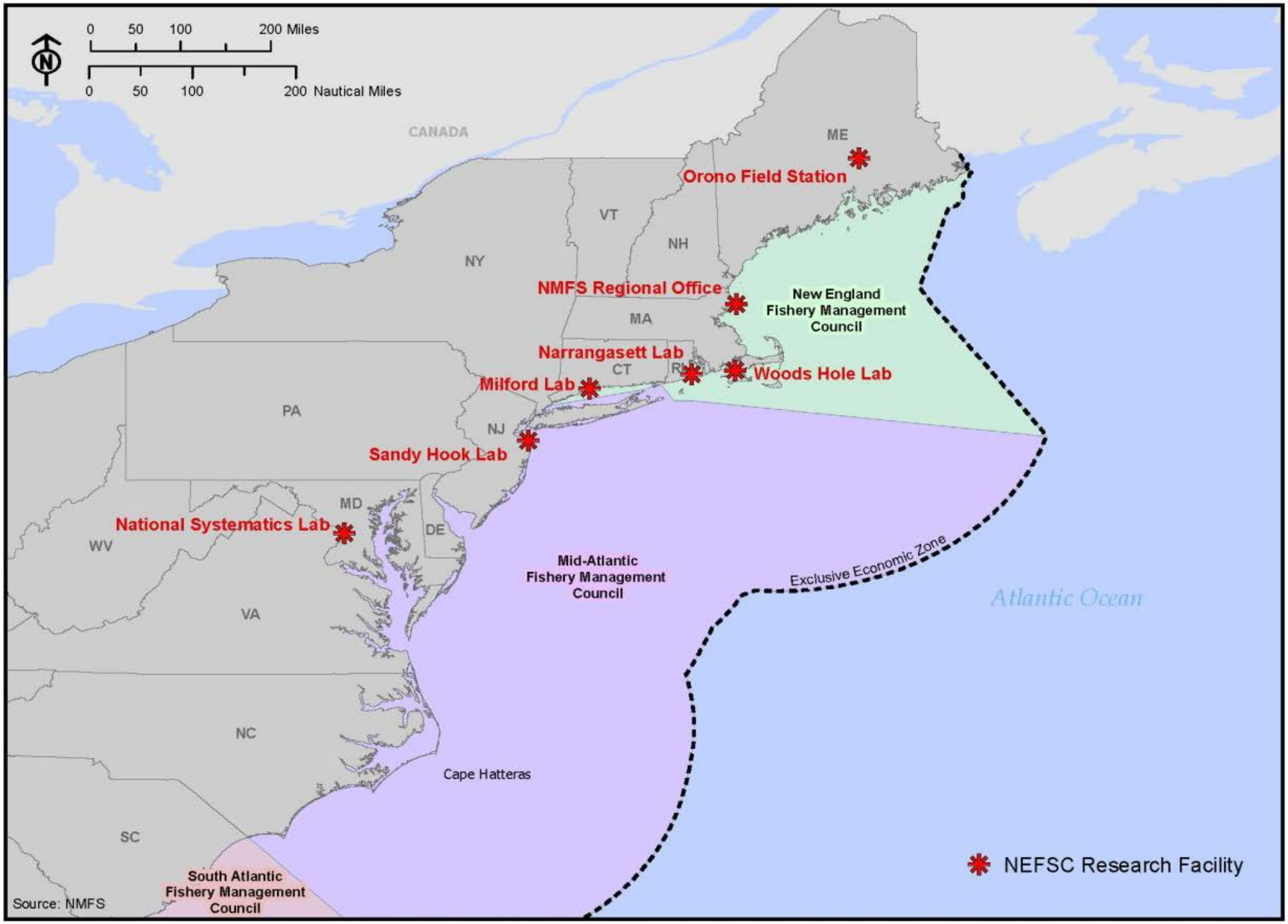


Figure 1.1-2 Northeast Regional Map Showing Fisheries Management Council Boundaries and NEFSC Research Facilities

1.1.3 Marine Fisheries Commissions

Three Interstate Marine Fisheries Commissions were chartered by Congress in recognition that fish do not adhere to political boundaries. The Atlantic States Marine Fisheries Commission (ASMFC) was formed by the 15 Atlantic coast states in 1942. It exists to coordinate the conservation and management of near shore fishery resources shared by member states through the creation of FMPs. For species that have significant fisheries in both state and federal waters (i.e., Atlantic herring, summer flounder, Spanish mackerel), the Commission works cooperatively with the NEFMC, MAFMC, and SAFMC to develop FMPs.

1.1.4 Role of Fisheries Research in Federal Fisheries Management

Fisheries managers use a variety of techniques to manage marine resources, a principal one being the development of FMPs. FMPs articulate fishery goals as well as the methods used to achieve those goals, and their development is specifically mandated under the MSA. The NEFSC provides scientific information and advice to assist with the development of FMPs prepared by the NMFS, the NEFMC, the MAFMC, and the ASMFC.

Through its Regional Fisheries Science Centers, NMFS conducts both *fisheries-dependent* and *fisheries-independent* research on the status of living marine resources and associated habitats, which aids in the development of FMPs. Fisheries-dependent research is research that is carried out in partnership with commercial fishing vessels. The vessel activity is not directed by NEFSC, but researchers collect data on the commercial catch. Fisheries-independent research is designed and conducted independent of commercial fishing activity to meet specific research goals. NMFS role in these activities varies and generally can be described as follows:

- Fishery-independent research directed by NEFSC scientists and conducted on board NOAA-owned and operated vessels (white ships) or NOAA-chartered vessels.
- Fishery-independent research directed by cooperating scientists (other agencies, academic institutions, and independent researchers) conducted on board non-NOAA vessels.
- Fishery-dependent research conducted on board commercial fishing vessels, with or without scientists on board.

All of these activities as carried out in the NEFSC research area are evaluated within this Final PEA (see also Section 1.4, below).

1.2 NEFSC RESEARCH ACTIVITIES

The NEFSC is the research arm of NMFS in the Northeast Region. The NEFSC plans, develops, and manages a multidisciplinary program of basic and applied research to:

- Better understand living marine resources of the Northeast Continental Shelf Large Marine Ecosystem (NE LME) from the Gulf of Maine to Cape Hatteras, and the habitat quality essential for their existence and continued productivity.
- Provide fishery independent survey data for management of sharks in the NE LME as well as the Southeast Continental Shelf Large Marine Ecosystem (SE LME) to encompass the range of the surveyed species.
- Describe and provide to management, industry, and the public, options for the conservation and use of living marine resources, and for the restoration and maintenance of marine environmental quality.

These functions are carried out through the coordinated efforts of research facilities located in Massachusetts, Maine, Rhode Island, Connecticut, New Jersey, and Washington, DC (Figure 1.1-2).

Since 1963, the NEFSC has conducted research surveys from the Gulf of Maine (GOM) south to Cape Hatteras, North Carolina. Additionally, shark longline surveys have been conducted between Florida and Rhode Island in both coastal and estuarine waters to encompass the range of the surveyed species and opportunistic juvenile pelagic shark work is conducted as far north as the Grand Banks off Newfoundland, Canada. These surveys, described in greater detail in Section 2.2 and Appendix A, are conducted to monitor for important indicators of the overall health and status of the Region's fisheries resources, as follows:

- **Monitor Recruitment.** To predict future landings and stock sizes, the survival of fish already large enough to be retained by harvesting gear as well as annual recruitment to the fishery must be estimated. In fisheries management, recruitment refers to the number or amount of new fish entering into a specific fishery that are large enough to be retained by harvesting gear. Depending on the species, research vessel surveys can allow extrapolation of the strength of incoming age groups up to several years before they are allowed to be landed in commercial fisheries.

- **Monitor Abundance and Survival of Harvestable Sizes.** The catch-at-age data collected from the surveys are one important source of information used to estimate survival rates from one year to the next. Research vessel samples generally span the full size and age range of a population on the Northeast Continental Shelf. Although recruitment prediction is one important element of fishery forecasts, it is equally important to calculate the survival rate of the portion of the stock already subjected to fishing. In practice, fishery scientists usually combine catch-at-age data from the surveys with similar data from the commercial fishery catch to improve estimates of fishing mortality and stock sizes. These combined estimates allow calculation of the population that must have existed to yield the catch levels observed during the recent history of the fishery.

  Sampling the abundance of harvestable sizes from research vessel surveys may be the only source of data available for species that have never been fished in the past, or are only fished at very low levels. For example, dredge surveys conducted in the 1960s and 1970s were the only source of information on the abundance of the ocean quahog in the Mid-Atlantic Bight (MAB), Southern New England (SNE), and Georges Bank (GB) areas because until recently quahogs were not fished commercially. Minimum population estimates were made by expanding the average catch-per-square-nautical-mile from the surveys by the number of square nautical miles (nm^2) of sea bottom inhabited by the stock. Similarly, current knowledge of the stock biomass of spiny dogfish and skates is based only on surveys, since catch-at-age based studies using fishery-dependent data have not been undertaken.

- **Monitor the Geographic Distribution of Species.** Some species lead sedentary lives while others are highly migratory. Research vessel surveys conducted over multiple seasons are a major source of data on the movement patterns and geographic extent of stocks. Distribution maps drawn from reports of fishermen may give a biased picture of the stock, emphasizing high-density, fishable populations. Distribution data are important for fishery management and for evaluating population level effects of pollution and environmental change.

- **Monitor Ecosystem Changes.** With few exceptions, surveys conducted by the NEFSC are designed to be multi-purpose. Bottom trawl surveys are not directed at one species, but rather generate data on over 600 species of fish and invertebrates in the Northeast Continental Shelf waters. Many of these species are relatively rare, and have little or no commercial or recreational value. However, when the effect of intensive harvesting on selected species is evaluated, the response of the entire animal community can be observed. The dramatic changes in the system reflect the depletion of several important commercial fishery species, such as haddock, yellowtail flounder, pollock, and Atlantic cod, and an increase in winter skate, spiny dogfish, and other commercial fish. These data suggest ecosystem-level responses to intensive harvesting, which may have important implications for developing harvesting strategies for the community of

species, rather than the individual stocks. A multi-species surveying approach thus provides an important research opportunity in the emerging field of ecosystem-based management.

- **Monitor Biological Rates of Stocks.** Apart from basic information on the abundance and distribution of species, research vessel survey data are collected on a range of biological rates for stocks. These processes include growth rates, sexual maturity rates, and feeding rates. Changes in growth and maturity directly influence assessment calculations related to spawning stock biomass, yield-per-recruit, and percent of maximum spawning potential. Over the past four decades, these parameters have changed dramatically for some species. Faster growth and earlier onset of maturity have been observed for haddock and cod. It is thus important to monitor these rates continuously if stock status is to be accurately determined. Likewise, diet data, collected via examination of stomach contents at sea, will be increasingly important as scientists try to evaluate how harvesting affects species linked by predator-prey relationships.
- **Collect Environmental Data and Support Other Research.** Research vessel surveys are generally conducted 24-hours a day when the vessels are at sea. This presents a superb opportunity to collect environmental information (temperature, salinity, chlorophyll, and nutrient levels, etc.) and to allow other researchers to piggyback on surveys to collect a host of data not directly related to stock assessment. All research vessel surveys conducted by the NEFSC collect and archive an extensive array of environmental measurements and usually have a “shopping list” of samples to be obtained for researchers at academic institutions, other government agencies, and the private sector. On every survey there are scientific berths allocated to cooperating scientists and students in order to foster this cooperative approach to marine science.

1.3 PURPOSE AND NEED

Primary Action: This Final PEA evaluates both a primary and a secondary action under the National Environmental Policy Act (NEPA). The primary action is the proposed continuation of NEFSC fisheries research activities (as described above and in Section 2.2). The purpose of this action is to produce scientific information necessary for the management and conservation of living marine resources in the NMFS Northeast Region in a manner that promotes both the recovery of certain species and the long-term sustainability of these resources, and generates social and economic opportunities and benefits from their use. The information developed from these research activities is essential to the development of a broad array of fisheries, marine mammal, and ecosystem management actions taken not only by NMFS, but also by other federal and state authorities. Each of the research activities requires one or more scientific research permits and the issuance of these permits is a part of the primary federal action covered under this NEPA review.

The ultimate goal of NEFSC fisheries and other research activities is to inform management of the region's marine and anadromous fish and invertebrate populations to ensure they remain at sustainable and healthy levels. In order to achieve this, the NEFSC needs to continue its fisheries research activities through a suite of programs that generate the scientific information necessary for the conservation and management of the region’s living marine resources.

Secondary Action: A secondary, related action—also called a “connected action” under NEPA (Sec. 1508.25)—is the issuance of proposed regulations and subsequent Letters of Authorization (LOA) under Section 101(a)(5)(A) of the MMPA of 1972, as amended (MMPA; 16 United States Code [U.S.C.] 1361 *et seq*.) that would govern the unintentional taking of small numbers of marine mammals incidental to the NEFSC’s research activities.

Sections 101(a)(5)(A) and (D) of the MMPA direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional taking of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and regulations are issued or, if the taking is limited to harassment, a notice of a proposed

authorization is provided to the public for review. Take, under the MMPA means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." The MMPA defines "harassment" as "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; **or (ii) has** the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].

Under the MMPA, any entity conducting activities that may result in the incidental take of marine mammals should request authorization for those incidental takes; this includes research programs conducted by the NMFS science centers. Because the NEFSC's research activities have the potential to take marine mammals by Level A and B harassment, serious injury and/or mortality, the NEFSC is applying to NMFS for an incidental take authorization (ITA) for its research programs. Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s); will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant); and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are set forth.

The purpose of issuing incidental take authorizations (ITAs) is to provide an exemption to the take prohibition in the MMPA and to ensure that the action complies with the MMPA and NMFS implementing regulations. ITAs may be issued as either: (1) regulations and associated Letters of Authorization (LOAs) under Section 101(a)(5)(A) of the MMPA; or (2) Incidental Harassment Authorizations (IHAs) under Section 101(a)(5)(D) of the MMPA. An IHA can only be issued when there is no potential for serious injury and/or mortality or where any such potential can be negated through required mitigation measures. Because there is a potential for lethal takes and takes that may result in serious injury (an injury that is likely to lead to mortality), the NEFSC is requesting rulemaking and the subsequent issuance of LOAs for this action. Because the issuance of regulations and associated LOAs to the NEFSC is a major federal action, NMFS is required to analyze the effects of their issuance on the human environment pursuant to NEPA requirements and NOAA policies.

This Final PEA analyzes the environmental impacts associated with issuance of the requested authorization of the take of marine mammals incidental to the NEFSC's conduct of fisheries research activities in the NEFSC area of responsibility. It also analyzes a reasonable range of mitigation measures that were considered in the MMPA authorization process. The analysis of mitigation measures includes a consideration of benefits to the affected species or stocks and their habitat, and an analysis of the practicability and efficacy of each measure. This analysis of mitigation measures was used to support requirements pertaining to mitigation, monitoring, and reporting specified in MMPA regulations and subsequent LOAs.

Further, because the proposed research activities occur in known habitat areas of species that are listed as threatened or endangered under the ESA, this Final PEA evaluates potential impacts to ESA-listed species that may result from either the primary or secondary action. Likewise, because the proposed research activities occur partially within the boundaries of National Marine Sanctuaries, and within areas identified as Essential Fish Habitat (EFH), this Final PEA evaluates potential impacts to sanctuary resources and EFH as required under section 304(d) of the National Marine Sanctuaries Act and section 305(b)(2) of the MSA respectively. The NEFSC used the Draft PEA as the basis for consultations with the appropriate offices and agencies in compliance with these and other applicable laws (Table 1.6-1).

1.4 SCOPE AND ORGANIZATION OF THIS FINAL PEA

In considering the proposed action, NMFS is responsible for complying with a number of federal statutes, regulations, and executive orders, including NEPA. This Final PEA is intended to provide an

environmental analysis to support the NMFS proposal to continue research activities under all such legal requirements and to encourage and facilitate public involvement in the environmental review process.

Under NEPA, an Environmental Assessment (EA) is prepared to determine if any significant environmental impacts are likely to be caused by a proposed action. If the Final PEA does not identify significant impacts, a Finding of No Significant Impact (FONSI) is prepared to document the decisionmaker's determination and to approve the proposed action. If at any time during preparation of the Final PEA it appears that significant impacts would result from the proposed action, the agency would halt development of the Final PEA and begin preparation of an Environmental Impact Statement (EIS) to more thoroughly evaluate the potential impacts and potential ways to reduce or mitigate those impacts. Thus, while the Final PEA objectively evaluates the full extent of potential impacts of a proposed action (from minor to major, adverse or beneficial, short-term to long-term – see discussion below), the FONSI provides the decision maker’s rationale with regard to the significance of those impacts.

This Final PEA provides a programmatic-level assessment of the potential impacts on the biological and human environments associated with the proposed NEFSC research programs. A programmatic approach is used when initiating or reevaluating a federal program for NEPA compliance. It takes a broad look at issues and alternatives (compared to a document for a specific project or action), and provides a baseline for future management actions. Programmatic documents are often intended to provide NEPA compliance for management and other activities over a certain period before a formal review is again initiated.

This Final PEA assesses not only the potential direct and indirect impacts of the alternatives presented to the physical, biological and socioeconomic systems in the NEFSC area of responsibility, but also the potential impacts to the management processes that are used to monitor the health of the resources, develop plans to manage the resources to balance recovery goals and socioeconomic goals, and ensure the sustainability of the resources and affected fishing communities.

The chapters that follow describe the proposed research activities and potential alternatives considered (Chapter 2), the affected environment as it currently exists (Chapter 3), the probable direct and indirect consequences on the human environment that may result from the implementation of the proposed research activities and their alternatives (Chapter 4), and the potential contribution to cumulative impacts from the proposed activities and their alternatives (Chapter 5).

The scope of this Final PEA covers research activities conducted by the NEFSC or its research partners that:

- Contribute to fishery management and ecosystem management responsibilities of NMFS under U.S. law and international agreements.
- Take place in marine waters of the Atlantic Ocean.
- Involve the transiting of these waters in research vessels, the deployment of fishing gear and scientific instruments into the water in order to sample and monitor living marine resources and their environmental conditions, and/or use active acoustic devices for navigation and remote sensing purposes.
- Have the potential to interact adversely with marine mammals and protected species of fish, turtles, birds, and invertebrates. However, the research activities covered under this Final PEA involve only *incidental* interactions with protected species, not *intentional* interactions with those species. The primary focus of this Final PEA is on fisheries-related research but several other types of surveys are also included because they deploy fishing gear and other instruments similar to those used in fisheries research in order to monitor the environment important to protected species and therefore involve the same potential risks of incidental interactions with protected species.

- The Final PEA covers both short-term and long-term NEFSC fisheries research projects of limited size and magnitude and where cumulative effects are deemed negligible. Therefore, information within the Final PEA would inform the issuance of a scientific research permit to conduct NEFSC fisheries research. However, any information not included in this programmatic Final PEA may need to be captured in a supplemental EA.

This Final PEA does NOT cover:

- Directed research on protected species, such as studies involving intentional pursuit or capture of marine mammals or sea turtles for tagging, tissue sampling, or other intentional takes under the MMPA or ESA which require special research permits. Directed research on protected species is covered by other environmental review processes, consultations, and permits under applicable regulations.
- The potential effects of research conducted by scientists in other NMFS Science Centers.
- Other activities of the NEFSC that do not involve the deployment of vessels or gear in marine waters, such as evaluations of socioeconomic impacts related to fisheries management decisions, taxonomic research in laboratories, fisheries enhancements such as hatchery programs, and educational outreach programs.
- Implementation of the Northeast Fisheries Observer Program (other than a small number of observer training cruises with different gear types). The impacts of the Fisheries Observer Program are considered under Fishery Management Plan NEPA processes.
- Other fisheries research programs conducted and funded by other agencies, academic institutions, non-governmental organizations, and commercial fishing industry research groups.

In the future, additional research activities may propose to use methods that were not considered in the evaluation of impacts in this Final PEA. Some of these proposed projects may require further environmental impact assessment or satisfaction of other consultation, approval, or permitting requirements before being allowed to proceed (see also Section 2.2). In particular, proposed future projects that may impact NMFS trust resources and require permits under the ESA, MSA, NMSA, or the MMPA may require individual NEPA analyses and decisions tiered off this Final PEA. As the details of any such studies are presently unavailable, they cannot be assessed here. After new projects are sufficiently well defined and their potential environmental consequences are better understood, specific impacts would be evaluated as necessary. If the proposed new research activities are not within or similar to the range of alternatives addressed in the programmatic document and may have adverse environmental impacts that are not within the scope of the analysis in this Final PEA, additional NEPA review would be required.

In developing this Final PEA, NMFS adhered to the procedural requirements of NEPA; the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations (CFR) 1500-1508), and NOAA's procedures for implementing NEPA[10].

The following definitions are used to characterize the nature of the various impacts evaluated with this Final PEA:

Short-term or long-term impacts. These characteristics are determined on a case-by-case basis and do not refer to any rigid time period. In general, short-term impacts are those that would occur only with

[10] NOAA Administrative Order 216-6, Environmental Review Procedures for Implementing the National Environmental Policy Act.

respect to a particular activity or for a finite period. Long-term impacts are those that are more likely to be persistent and chronic.

Direct or indirect impacts. A direct impact is caused by a proposed action and occurs contemporaneously at or near the location of the action. An indirect impact is caused by a proposed action and might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action. For example, a direct impact of erosion on a stream might include sediment-laden waters in the vicinity of the action, whereas an indirect impact of the same erosion might lead to lack of spawning and result in lowered reproduction rates of indigenous fish downstream.

Minor, moderate, or major impacts. These relative terms are used to characterize the magnitude of an impact. Minor impacts are generally those that might be perceptible but, in their context, are not amenable to measurement because of their relatively minor character. Moderate impacts are those that are more perceptible and, typically, more amenable to quantification or measurement. Major impacts are those that, in their context and due to their intensity (severity), have the potential to meet the thresholds for significance set forth in CEQ regulations (40 CFR 1508.27) and, thus, warrant heightened attention and examination for potential means for mitigation to fulfill the requirements of NEPA.

Adverse or beneficial impacts. An adverse impact is one having adverse, unfavorable, or undesirable outcomes on the manmade or natural environment. A beneficial impact is one having positive outcomes on the manmade or natural environment. A single act might result in adverse impacts on one environmental resource and beneficial impacts on another resource.

Cumulative impacts. CEQ regulations implementing NEPA define cumulative impacts as "impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time within a geographic area.

The proposed NEFSC research activities are not reasonably expected to result in the spread or introduction of non-indigenous species. The research involves movement of vessels between water bodies. However, ballast water management and other discharge processes for NOAA and charter vessel operations are bound by federal laws, regulations and Executive Orders (EO) that are in place in order to prevent or minimize the potential for spread or introduction of non-indigenous species, including the Clean Water Act, National Invasive Species Act, Nonindigenous Aquatic Nuisance Prevention and Control Act, and EO13112. The proposed NEFSC research activities are also not expected to result in impacts to public health or safety. These issues are not considered further in this assessment.

1.5 PUBLIC REVIEW AND COMMENT

Public participation is a cornerstone of the NEPA process. In preparing EAs, federal agencies must involve environmental agencies, applicants, and the public to the extent practicable (40 CFR Sec. 1501.4 [b]). Following guidance for public review of EAs in NOAA Administrative Order 216-6 (Sections 5.02b.1 and 5.03e.2), this Draft PEA and the associated LOA application were made available for public review on the internet and a notice of the availability for these documents was published in the *Federal Register* on December 29, 2014 (79 FR 78061). Notice of the availability of the proposed MMPA regulations was published in the Federal Register on July 9, 2015 (80 FR 39542).Public comments received on the Draft PEA and proposed rule are addressed here and in the FONSI..

Comments on the Draft PEA and LOA application included the following:

- A combined comment letter from the Humane Society of the U.S. (HSUS) and Whale and Dolphin Conservation (WDC) raised several substantive issues. The HSUS/WDC letter expressed concern that NMFS (as opposed to the NEFSC) had inappropriately restricted the scope of the Draft PEA by not discussing or analyzing the impacts of research programs conducted by other

research entities, particularly conservation engineering studies and an active acoustic system that had impacts on marine mammals.

- o The Draft PEA and LOA application clearly describe the scope of the documents as pertaining to fisheries and ecosystem research conducted or funded by the NEFSC (not NMFS as an agency) and state explicitly that they do not cover research conducted or funded by other entities. The NEFSC has no control over the protocols used by other research entities, including what mitigation measures are used or how they are implemented, or other aspects of the MMPA authorization process such as monitoring and reporting requirements, and therefore cannot take responsibility for the impacts of those other research activities on marine mammals. The particular research projects described in the HSUS/WDC letter as being inappropriately omitted have no connection to the NEFSC and are therefore properly excluded from the NEFSC PEA and LOA application.

- The HSUS/WDC letter claims that NMFS (as opposed to the NEFSC) underestimates the potential takes of bottlenose dolphins based on an incomplete accounting of fisheries research-related takes in the past. The comment includes citations from recent stock assessment reports (SARs) indicating research takes of specific stocks were not considered in the PEA or LOA.

  - o The NEFSC has accounted for all the marine mammal takes in its past fisheries research activities and bases its potential future take estimates on that historical data (in part). Takes of other animals described in the SARs were the result of fisheries research conducted or funded by the Southeast Fisheries Science Center (SEFSC) and other entities not connected to the NEFSC. The SEFSC is in the process of developing its own PEA and submitting its own LOA application concerning fisheries research under its responsibility. As stated above, the NEFSC has no control over research activities conducted and funded by other entities and such activities are properly excluded from the NEFSC PEA and LOA application.

  - o The NEFSC considered HSUS/WDC's public comments on the likelihood of their research activities affecting certain stocks of bottlenose dolphins and reanalyzed the locations of their activities relative to the ranges of coastal bottlenose dolphin stocks in the Atlantic coast region. Based on that reanalysis and consideration of public comments, the NEFSC determined that the spatial footprint of their coastal research activities within the Southeast U.S. LME was smaller than the information presented in the original 2015 application for an LOA and the Draft PEA.

    The NEFSC's revised analysis revealed that the Apex Predators Bottom Longline Coastal Shark Survey intersected with the estimated ranges of three stocks of bottlenose dolphins: the WNA Offshore, the WNA Northern Migratory Coastal, and the WNA Southern Migratory Coastal stocks. This survey generally samples in water depths greater than 20 m (66 ft) and does not intersect with the remaining three coastal stocks in question: the WNA South Carolina-Georgia Coastal, the WNA Northern Florida Coastal, and the WNA Central Florida Coastal.

    The primary habitat of the coastal morphotype of bottlenose dolphins extends from Florida to New Jersey during summer months in waters less 20 m (66 ft) deep (Waring et al., 2015) and other studies indicate that in waters less than 10 m (33 ft) depth, 70 percent of the bottlenose dolphins consist of the coastal morphotype. Between 10- and 20-m (33 and 66 ft) depths, the percentage of animals of the coastal morphotype dropped precipitously and at depths greater than 40 m (131 ft) nearly all (greater than 90 percent) animals were of the offshore morphotype.

In assessing the spatiotemporal overlap between the observed patterns of occurrence for the three coastal stocks in question (less than 10 m [33 ft] depth) and the Apex Predators Bottom Longline Coastal Shark Survey's extent the NEFSC determined that a take request was not warranted based on the following factors including: (1) the efficacy of the planned mitigation measures in reducing the effects of the specified activity to the level of least practicable adverse impact; (2) the survey's location (offshore in water depths greater than 20 m [66 ft] depth); (3) the total survey effort (less than 50 days annually); (4) seasonality (spring); and (5) survey frequency (conducted every two to three years).

With respect to the estuarine stocks of bottlenose dolphins in North Carolina, South Carolina, Georgia, and Florida, the NEFSC did not request take due to limited survey effort in estuarine waters. The NEFSC notes in their final PEA that the Southeast Fisheries Science Center's (SEFSC) research activities could also potentially interact with the same stocks in the Atlantic coast region.

The SEFSC is currently developing a Draft PEA and LOA application concerning fisheries research under its responsibility within the Atlantic coast region. The SEFSC's LOA application and Draft PEA will include consideration of the remaining coastal and estuarine bottlenose dolphin stocks within their future LOA application. Thus, NMFS will be able to consider the combined impacts of incidental take related to NEFSC and SEFSC research activities on all bottlenose dolphin stocks within the Atlantic coast region.

- The HSUS/WDC letter expresses concern about potential impacts on marine mammals from short-term conservation engineering research projects using gillnets and cod pots, especially concerning additional vertical lines that may entangle large whales, and how the NEFSC would assess the potential effects of future research projects.
    - The NEFSC funds a wide variety of cooperative research projects and has considered the potential impacts of such research using the gears described in the PEA. The potential impacts from these short-term research projects on different marine mammal stocks have been incorporated into the NEFSC take requests in the LOA application. Note that the LOA application does not include take requests for all types of research gear – only those gears and potential interactions considered by the NEFSC to represent reasonable risks of adverse interactions with marine mammals. The PEA also describes the fact that short-term research projects are often developed as fishery issues emerge and are subject to annual granting application processes. The purpose, protocols, location, and seasonality of such projects are often not fully determined until they are funded. The PEA describes how the NEFSC will examine the proposed research projects on an annual basis as they come before the NEFSC for funding review or requests for logistical support. During those annual reviews the NEFSC will determine whether the scope of the proposed research is consistent with the description of research activities and potential impacts of research as described in the PEA. Proposed projects that target species of concern or are likely to have adverse interactions with protected species could be subject to additional NEPA and MMPA reviews, as warranted, which would include public review opportunities. In addition, the MMPA authorization includes requirements for monitoring and reporting of marine mammal interactions. These reports will be used by OPR and NEFSC to provide "adaptive management" of mitigation measures or other research protocols if future research results in higher levels of adverse interactions than anticipated in the LOA application.

- The HSUS/WDC letter expresses concern that Alternative 3, the Modified Research Alternative, includes a mix of clearly untenable mitigation measures and some measures that would be reasonable for the NEFSC to implement. The perception is that the alternative is designed to be an "all or nothing" choice and the measures they consider to be reasonable are therefore unjustly excluded from consideration.
    - Alternative 3 is not intended to be an all or nothing choice. It was included to facilitate the MMPA and ESA permitting processes by analyzing mitigation measures other than those proposed to be implemented by the NEFSC in the Preferred Alternative. NMFS protected species biologists have considered each of these additional measures on its own merits when determining what mitigation measures and conditions would be reasonable and necessary requirements of the MMPA regulations and the BiOp Incidental Take Statement.
- The HSUS/WDC letter requests that NMFS update the marine mammal species accounts in Chapter 3 of the Draft PEA with the latest SARs.
    - The NEFSC used the most recent SARs available at the time the Draft PEA was written. The SARs are constantly in revision as new information becomes available so it is not possible for a document to be "up to date" throughout a long regulatory process. However, the MMPA and ESA permitting processes are designed to provide opportunities for adaptive management; if the status of a stock changes substantially in the future or the relative impacts of NEFSC fisheries research become a concern, NMFS can review the conditions of the MMPA authorization during the annual issuance of LOAs and may re-initiate ESA section 7 consultation at any time. An example of this adaptive management process is that the NEFSC incidentally caught a gray seal in a bottom trawl survey in April 2015 and submitted an addendum to its LOA application to account for this take as well as to update or correct several other issues (see Appendix E in this Final PEA). OPR published corrections to its proposed rule in the *Federal Register* on August 6, 2015 (80 FR 46939) and August 17, 2015 (80 FR 49196) to account for these changes. Both of these modifications of the proposed rule included opportunities for public comment.
- The HSUS/WDC letter questions the methodology used in the LOA to calculate densities of marine mammals, especially of bottlenose dolphins, and therefore the estimates of Level B harassment takes due to active acoustic sources.
    - The NEFSC used the best available information to estimate densities of marine mammals and described the limitations of that data in the LOA. The limitations included the seasonality of stock assessment efforts (aerial flights and vessel transects conducted primarily in summer) versus the seasonality of NEFSC research (all year) and the complex distribution patterns of actual populations versus the need to assume a uniform distribution for acoustic take estimates. The need to simplify the bottlenose dolphin stock estimates was based on the inability to differentiate animals from different stocks based on aerial survey data. In addition, acoustic take estimates are only made for surveys that use active acoustic gear as part of their research protocols, which are a subset of all research projects, and limits the geographic extent of potential impacts to waters north of Cape Hatteras. The NEFSC believes the methodology it used to estimate acoustic takes is appropriate and conservative in that it likely overestimates the number of animals potentially affected.
- The Virginia Department of Environmental Quality and the Virginia Marine Resources Commission did not find any issues with the structure or analysis provided in the Draft PEA as it relates to Virginia or the state's fisheries.

Comments on the proposed MMPA regulations included a comment letter from HSUS/WDC with the same concerns as described above and a comment letter from the Marine Mammal Commission (MMC).

- The MMC indicated that NMFS has not been consistent regarding the type of marine activities, other than NEFSC fisheries research, that should seek authorization for Level B harassment of marine mammals with active acoustic gear. The MMC recommends that, "NMFS develop criteria (e.g., based on source level, peak frequency, bandwidth, signal duration and duty cycle, affected species or stocks) and guidance for determining when prospective applicants should request taking by Level B harassment from the use of subbottom profilers, echosounders, and other sonars."
- The MMC believes NMFS is using an outdated and incorrect behavior threshold for Level B harassment when subbottom profilers, echosounders, and other sonars are proposed for use. The MMC recommends that, "NMFS formulate a strategy for updating the behavior thresholds for all types of sound sources (i.e., impulsive and non-impulsive, which can be both intermittent or continuous) and incorporate new data regarding behavior thresholds as soon as possible…"
- The MMC requests NMFS to re-estimate numbers of marine mammals that may be taken by Level B harassment through use of NEFSC acoustic research equipment based on the 120 dB re 1 μPa threshold for continuous sources rather than the 160 dB re 1 μPa threshold for non-impulsive intermittent sound sources.
    - The issues regarding criteria and thresholds for Level B harassment have been raised by the MM in contexts other than fisheries research so they are not unique to this PEA or the proposed rule. NMFS Office of Protected Resources disagrees that the thresholds used are inappropriate or that the take estimates should be re-calculated, although it does continue to work on updating its marine mammal acoustic exposure criteria and impact thresholds based on emerging research.
- The MMC describes recent research that indicates Category 1 acoustic sources that emit at frequencies above 180 kHz may be audible to some marine mammals, contrary to what is stated in the PEA and proposed rule, and may elicit behavioral responses at substantial distances. The MMC recommends that, "NMFS incorporate the findings of the recent scientific literature on acoustic sources with frequencies above 180 kHz into its criteria and guidance for determining when prospective applicants should request authorization for taking by Level B harassment from the use of echosounders, sonars, and subbottom profilers."

1.6 REGULATORY REQUIREMENTS

NMFS is the lead federal agency for the proposed research activities evaluated in this Final PEA. These activities trigger a broad range of regulatory issues because they may cause adverse impacts to public resources regulated by various statutes, and contribute to reducing impacts caused by other activities, such as fishing, that are also regulated by those same statutes. Chapters 4 and 5 assess the impacts of the research activities on protected species and habitat. Because these research activities are necessary for NMFS to carry out its regulatory mandates, Chapters 4 and 5 also describe potential impacts to NMFSs ability to effectively monitor and manage fishery resources under the alternatives evaluated. Descriptions of the relevant statutory requirements are provided in Chapter 6, "*Applicable Laws*."

Table 1.6-1, below, presents a brief summary of some of the applicable laws and treaties. This information is provided to aid the reader in understanding the material presented later in the Final PEA and is not intended to be a complete listing of all applicable statutes, orders, or regulations applicable to the proposed action and alternatives.

Table 1.6-1 Applicable Laws and Treaties

Law	Description
National Environmental Policy Act (NEPA)	Requires federal agencies to evaluate potential environmental effects of any major planned federal action and promotes public awareness of potential impacts by requiring federal agencies to prepare an environmental evaluation for any major federal action affecting the human environment.
Magnuson-Stevens Fishery Conservation and Management Act (MSA)	Authorizes the U.S. to manage fishery resources in an area from a state's territorial sea (extending 3 nautical miles [nm] from shore) to 200 nm off its coast (termed as the Exclusive Economic Zone [EEZ]). Includes 10 national standards to promote domestic commercial and recreational fishing under sound conservation and management principles, and provide for the preparation and implementation of fishery management plans (FMPs).
Marine Mammal Protection Act (MMPA)	Prohibits the take of marine mammals in U.S waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the U.S. Allows, upon request, the "incidental," but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing or directed research on marine mammals).
Endangered Species Act (ESA)	Provides for the conservation and recovery of endangered and threatened species of fish, wildlife, and plants. Prohibits the take of endangered species and some threatened species as well. Administered jointly by NMFS and the USFWS.
Atlantic Tunas Convention Act	Allows for an advisory committee to be established to provide advice and recommendations on the conservation and management of any highly migratory species covered by obligations of the International Convention for the Conservation of Atlantic Tunas that that was signed in Rio de Janeiro on May 14, 1966.
Migratory Bird Treaty Act (MBTA)	Protects approximately 836 species of migratory birds from any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof, unless permitted by regulations.
Fish and Wildlife Coordination Act (FWCA)	Requires USFWS and NMFS to consult with other state and federal agencies in a broad range of situations to help conserve fish and wildlife populations and habitats in cases where federal actions affect natural water bodies.
National Marine Sanctuaries Act (NMSA)	Authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries. Section 304(d) of the NMSA requires interagency consultation between the NOAA Office of National Marine Sanctuaries (ONMS) and federal agencies taking actions that are "likely to destroy, cause the loss of, or injure a sanctuary resource."
National Historic Preservation Act (NHPA)	Section 106 requires review of any project funded, licensed, permitted, or assisted by the federal government for impact on significant historic properties.
Executive Order (EO) 12989, Environmental Justice	Directs federal agencies to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law.
Executive Order 13158, Marine Protected Areas	The purpose of this order is to strengthen and expand the Nation's system of marine protected areas (MPAs). It encourages federal agencies to use science-based criteria and protocols to identify and prioritize natural and cultural resources in the marine environment that should be protected to secure valuable ecological services and to monitor and evaluate the effectiveness of MPAs. Each federal agency whose actions affect the natural or cultural resources that are protected by an MPA shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA.
Coastal Zone Management Act (CZMA)	Encourages and assists states in developing coastal management programs. Requires any federal activity affecting the land or water use or natural resources of a state's coastal zone to be consistent with that state's approved coastal management program.

This page intentionally left blank.

2.1 INTRODUCTION

The Council on Environmental Quality (CEQ) is responsible for the development and oversight of regulations and procedures implementing the National Environmental Policy Act (NEPA). The CEQ regulations provide NEPA procedural requirements that apply to all federal agencies (40 Code of Federal Regulations [CFR] Part 1500). National Oceanic and Atmospheric Administration (NOAA) has also prepared environmental review procedures for implementing NEPA, NOAA Administrative Order (NAO) 216-6, May 20, 1999, as preserved by NAO 216-6A, "Compliance with the National Environmental Policy Act, Executive Orders 12114, Environmental Effects Abroad of Major Federal Actions; 11988 and 13690, Floodplain Management; and 11990, Protection of Wetlands," requires all proposed projects to be reviewed with respect to environmental consequences on the human environment.. Section 5.03b of NAO 216-6 states: "An Environmental Assessment [EA] must consider all reasonable alternatives, including the preferred action and the no action alternative."

To warrant detailed evaluation by the National Marine Fisheries Service (NMFS), an alternative must be reasonable[11] and meet the purpose and need (see Section 1.3). Screening criteria are used to determine whether an alternative is reasonable and should be considered further or whether it is not reasonable to consider in detail in the Final PEA. Section 2.6 describes potential alternatives that were considered but rejected because they do not meet the purpose and need of the proposed action.

Screening Criteria – To be considered 'reasonable' for the purposes of this Draft Programmatic Environmental Assessment (Final PEA), an alternative must meet the following criteria:

1. The action must not violate any federal statute or regulation.
2. The action must be consistent with reasonably foreseeable funding levels.
3. The action must be consistent with long-term research commitments and goals to maintain the utility of scientific research efforts, or consider no federal funding availability for fisheries research.

To maintain the utility of scientific research efforts, fisheries and marine ecosystem scientific research activities should address at least some of the following goals related to fisheries management:

1. Methods and techniques should provide standardized and objective data consistent with or complementary to past data sets (time-series) in order to facilitate long-term trend analyses.
2. Collected data should characterize living marine resource and fishery populations and the health of their habitats.
3. The surveys should enable assessment of population status and provide predictive capabilities required to respond to changing ecosystem conditions and manage future fisheries.
4. Research on new methodologies to collect fisheries and ecosystem information (e.g. active and passive acoustic instruments and video surveys of benthic habitats in lieu of dredge gear or bottom trawls), and research oriented toward modifications of fishing gear to address bycatch or

[11] "Section 1502.14 (NEPA) requires the EA/Environmental Impact Statement (EIS) to examine all reasonable alternatives to the proposal. In determining the scope of alternatives to be considered, the emphasis is on what is 'reasonable' rather than on whether the proponent or applicant likes or is itself capable of carrying out a particular alternative. Reasonable alternatives include those that are *practical or feasible from the technical and economic standpoint and using common sense*, rather than simply desirable from the standpoint of the applicant." (40 Questions) (emphasis added)

other inefficiencies should be conducted under experimental conditions sufficient to allow statistically valid comparisons with relevant alternatives.

NMFS evaluated each potential alternative against these criteria and requirements. Based on this evaluation, the No-Action/Status Quo alternative and two other action alternatives were identified as reasonable and are carried forward for more detailed evaluation in this Final PEA. NMFS also evaluates a second type of no-action alternative that considers no federal funding for fisheries research activities. This alternative is called the No Research Alternative to distinguish it from the No-Action/Status Quo Alternative.

The No-Action/Status Quo Alternative is used as the baseline for comparison of the other alternatives. Three of the alternatives include fisheries and ecosystem research projects conducted or funded by the Northeast Fisheries Science Center (NEFSC) as the primary federal action. These three alternatives also include suites of mitigation measures intended to minimize potentially adverse interactions with protected species. Protected species include all marine mammals, which are covered under the Marine Mammal Protection Act (MMPA), all species listed under the Endangered Species Act (ESA), and bird species protected under the Migratory Bird Treaty Act (MBTA).

The three alternatives involving research activities in the marine environment trigger marine mammal protection requirements under the MMPA. For this reason, NMFS must evaluate the alternatives to ensure that they would fulfill the purpose and need of NMFS issuing regulations and subsequent Letters of Authorization (LOA) under Section 101(a)(5)(A) of the MMPA to the NEFSC, which is the secondary federal action considered in this Final PEA. The LOA, if issued, would provide an exception to the NEFSC from the take prohibitions for marine mammals under the MMPA, incidental to the conduct of the NEFSC's research activities, namely: (1) the issuance of an LOA for the take of marine mammals by Level A and Level B harassment, and by serious injury or mortality incidental to the NEFSC's conduct of research activities for a specified period; and (2) compliance with the MMPA which sets forth specific findings (e.g. no unmitigable adverse impact on the availability of a species or stock for subsistence uses and negligible impact on a species or stock) and prescriptions (mitigation, monitoring, and reporting requirements) that must be made in order for NMFS to issue an LOA. In order to authorize incidental take of marine mammals under the MMPA, NMFS must identify and evaluate a reasonable range of mitigation measures to minimize impacts to marine mammals to the level of least practicable adverse impact. A range of mitigation measures has been incorporated as part of the identified alternatives in order to evaluate their ability to minimize potential adverse environmental impacts. The efficacy and practicability of all potential mitigation measures are assessed in Chapter 4.

Further, because the proposed research activities occur in known habitat areas of species that are listed as threatened or endangered under the ESA, this Final PEA evaluates potential impacts to ESA-listed species that may result from either the primary or secondary action. Likewise, because the proposed research activities occur partially within the boundaries of National Marine Sanctuaries, and within areas identified as Essential Fish Habitat (EFH), this Final PEA evaluates potential impacts to sanctuary resources and EFH as required under section 304(d) of the National Marine Sanctuaries Act and section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA).

2.2 ALTERNATIVE 1 – NO-ACTION/STATUS QUO ALTERNATIVE - CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH WITH SCOPE AND PROTOCOLS SIMILAR TO PAST EFFORT

As discussed in Chapter 1, the NEFSC collects a wide array of information necessary to evaluate the status of fishery resources and the marine environment. NEFSC scientists conduct fishery-independent research onboard NOAA owned and operated vessels or on chartered vessels in the Northeast U.S. Continental Shelf Large Marine Ecosystem (LME) and the Southeast U.S. Continental Shelf LME, an area of the Atlantic Ocean stretching from the U.S.-Canada border to Florida. Under the Status Quo Alternative, the NEFSC would administer and conduct a wide range of fishery-independent and industry-associated research and survey programs as they have been in the recent past, as summarized in Table 2.2-1 and Table 2.2-2. Appendix A provides an illustrated description of the fishing gear and scientific instruments used during NEFSC research.

2.2.1 Long-term Research Activities

Table 2.2-1 summarizes the long-term fisheries research programs conducted or funded by the NEFSC. Some of these projects are conducted by cooperative research partners as noted.

Table 2.2-1 Summary Description of Long-Term NEFSC-Affiliated Research Activities Conducted under the Status Quo Alternative

Many surveys use more than one gear type; each survey/research project is listed under one predominant gear type to avoid duplication or splitting projects into multiple components in the table. See Appendix A for descriptions of the different gear types and vessels used. Appendix B includes figures showing the spatial/temporal distribution of fishing gears used during NEFSC research. Mitigation measures are described in Section 2.2.1. Units of measurement are presented in the format data was collected. Abbreviations used in the table: ADCP = Acoustic Doppler Current Profiler; CTD = Conductivity Temperature Depth; DAS = days at sea; cm^2 = square centimeter; freq = frequency; ft = feet; GB = Georges Bank; GOM = Gulf of Maine; hr = hour; in = inch; kHz = kilohertz; km = kilometer; kts = knots; L = liter; m = meter; m^3 = cubic meter; MAB = Mid-Atlantic Bight; max = maximum; MHz = megahertz; mi = miles; min = minutes; mm = millimeter; NA = Not Available or Not Applicable; nm = nautical miles; SNE = Southern New England; TBD = to be determined; v = volt; yr = year; ~ = approximately.

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
NORTHEAST US CONTINENTAL SHELF LME								
Projects using bottom trawl gear								
Benthic Habitat Survey	The objective of this project is to assess habitat distribution and condition, including disturbance by commercial fishing and changes as the benthic ecosystem recovers from chronic fishing impacts. Also serves to collect data on seasonal migration of benthic species, collect bottom data for mapping, and provide indications of climate change through species shifts.	GB	Summer or Fall, Annually 20 DAS	R/V *H.B. Bigelow*, R/V *Gordon Gunter*, or R/V *Pisces*	4-seam, 3-bridle bottom trawl	Net size: 31 m long x 19 m wide x 5 m high Tow speed: 3.0 kts Duration: 30 min at target depth	54 tows (maximum)	**Standard Avoidance:** Vessel captains and crew watch for marine mammals and sea turtles while underway, especially where concentrations of protected species are observed, and take action to avoid collisions if possible (see Section 2.2.3). **Move-on Rule:** Vessel captains and Chief Scientists take action to avoid setting gear at times and places where concentrations of protected species are observed to avoid potential interactions with gear (see Section 2.2.4).
					Conductivity Temperature Depth (CTD) profiler and rosette water sampler	Tow Speed: 0 Duration: 5-15 min	217 casts (maximum)	
					Brooke Ocean Moving Vessel CTD Profiler	Tow speed: 10 kts	Continuous	
					Van Veen Sediment Grab aboard SeaBoss	Samples a 100 cm^2 area Tow speed: 0 Duration: 1 min	128 casts (maximum)	
					Plankton Light Trap	Size: 0.027 m^3 Tow speed: 0 Duration: 30 min	10 casts (maximum)	
					Beam trawl	Net size: 2 m wide Tow speed : 2.0 kts Duration: 20 min at depth	50 tows	
					Naturalists dredge	1 m wide Tow speed: 2-3 kts Duration: 1 min at depth	3 casts	
					SeaBoss Benthic Camera Vehicle	Still and video cameras, strobe & continuous lighting, CTD Tow Speed: 0.5 kt Duration: 30 min	128 tows (maximum)	
					Reson 7125 swath sonar	Output freq: 200/400 kHz	Continuous	
					Klein 5500 side scan sonar	Output freq: 450 kHz	Continuous	
					Odum CV200 Single beam sonar	Output freq: 200 kHz	Continuous	
					Split Beam Sonar	Output freq: 18 kHz, 38 kHz, 120 kHz	Continuous	

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Changes in the Community Structure of Benthic Fishes	The objective of this project is to quantify the abundance and distribution of benthic associated fishes of the Hudson River Estuary ecosystem.	Hudson River Estuary, New York.	Summer 20 DAS	R/V *Nauvoo*	16 ft bottom trawl	Net size: 16 ft wide bottom trawl Tow speed: 2.5 kts Duration: 5 min	176 trawls	Standard Avoidance and Move-on Rule
					YSI (electronic water chemistry sensor)	YSI 6000		
					Hydroacoustic instrument	38 and 120 kHz split-beam		
					Kemmerer bottle	2.2 L		
Fish Collection for Laboratory Experiments	Trawling/hook and line collection operations undertake to capture high quality fish for laboratory experiments.	New York Bight, Sandy Hook Bay, New Jersey	Annually, as needed throughout year 10 DAS	R/V *Nauvoo*, R/V *Harvey*, R/V *Chemist*	Simple Memphis net and twine shrimp trawl	Net size: 16 ft wide bottom trawl Tow speed: 2.5 kts Duration: 10 min	Varies depending on scientific need, typically enough trawls to capture 10-60 specimens	Standard Avoidance and Move-on Rule
					Simple Memphis net and twine shrimp trawl	Net size: 30 ft wide bottom trawl Tow speed: 2.5 kts Duration: 10 min		
					Fishing poles	Fishing poles		
Habitat Characterization	The key objective of this project is to characterize and map coastal marine habitats and living marine resources, particularly in waters and wetlands of New York and New Jersey. The research is conducted under the terms of a Memorandum of Understanding with the NJ Sea Grant Consortium.	Sandy Hook Bay Barnegat Bay, New York and New Jersey	Annually 30 DAS	R/V *Nauvoo*, R/V *Resolute*	Simple Memphis net and twine shrimp trawl	Net size: 16 ft wide bottom trawl Tow speed: 2.5 kts Duration: 10 min	Max. 60 trawls per year with 16 ft net and 20 trawls per year with 30 ft net	Standard Avoidance and Move-on Rule
					Simple Memphis net and twine shrimp trawl	Net size: 30 ft wide bottom trawl Tow speed: 2.5 kts Duration: 10 min		
					Video Sled	Sea Cam 5000 12v video cam		
					CTD	Sea Bird CTD		
					YSI	YSI 6000		
					Tucker plankton net	1.4 m x 1 m trawl		
					Acoustic Doppler Current Profiler (ADCP)	Output freq. 600 kHz		
					Hydroacoustic instrument	38 and 120 kHz split-beam		
					Ponar grab	6 in x 6 in		
					Kemmerer bottle	2.2 L		
Habitat Mapping Survey	This project maps shallow reef habitats of fisheries resource species, including warm season habitats of black sea bass, and locate sensitive habitats (e.g. shallow temperate coral habitats) for habitat conservation.	Ocean shelf off Maryland Coast	Summer, Annually 11 DAS	R/V *F.R. Hassler*	4-seam, 3-bridle bottom trawl	Net size: 31 m x 19 m x 5 m Tow speed: 3.0 kts Duration: 30 min at target depth	54 tows (max)	Standard Avoidance and Move-on Rule
					CTD Profiler	Tow Speed: 0 Duration: 5-15 min	217 casts (max)	
					Brooke Ocean Moving Vessel CTD Profiler	Tow speed 10 kts	Continuous	
					Van Veen Sediment Grab aboard SeaBoss	Samples 100 cm^2 area Tow speed: 0 Duration: 1 min	128 casts (max)	
					Plankton Light Trap (optional)	Size: 0.027 m^3 Tow speed: 0 Duration: 30 min	10 casts (max)	

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
					Beam trawl,	Net size: 2 m wide Tow speed: 2.0 kts Duration: 20 min at depth	50 tows	
					Naturalists dredge	1 m wide Tow speed: 2-3 kts Duration: 1 min at depth	3 casts	
					SeaBoss Benthic Camera Vehicle	Still and video cameras, strobe & continuous lighting, CTD Tow Speed: 0.5 kt Duration: 30 min	128 tows (max)	
					Reson 7125 swath sonar	Output freq: 200/400 kHz	Continuous	
					Klein 5500 side scan sonar	Output freq: 450 kHz	Continuous	
					Odum CV200 Single beam sonar	Output freq: 200 kHz	Continuous	
					Split Beam Sonar	Output freq: 18 kHz, 38 kHz, 120 kHz	Continuous	
Living Marine Resources Center Survey	This project undertakes to determine the distribution, abundance, and recruitment patterns for multiple species.	Cape Hatteras to New Jersey	Winter, Annually 11 DAS	R/V *H.B. Bigelow*, R/V *Gordon Gunter*, or R/V *Pisces*	4-seam, 3-bridle bottom trawl	Net size: 31 m x 19 m x 5 m Tow speed: 3.8 kts Duration: 30 min at depth	25 tows	Standard Avoidance and Move-on Rule
					Beam trawl	Net size: 2 m wide Tow speed: 2.0 kts Duration: 20 min at depth	30 tows	
					Van Veen sediment grab	Samples 100 cm^2 area Duration: 1 min	29 casts	
					CTD Profiler	Tow Speed: 0 Duration: 15-120 min	30 casts	
					Split Beam Sonar	Output freq: 18, 38,120 kHz	Continuous	
Massachusetts Division of Marine Fisheries Bottom Trawl Surveys	The objective of this project is to track mature animals and determine juvenile abundance.	Territorial waters from Rhode Island to New Hampshire borders	Spring and Fall 30-36 DAS	R/V *G. Michelle*	Otter Trawl	Net size: 39 ft headrope, 51 ft footrope Tow speed: 2.5 kts Duration: 20 min	In Gulf of Maine (GOM), 56 tows in spring and 56 tows in fall. In Southern New England (SNE), 47 tows in spring and 47 tows in fall. 206 tows total/yr	Standard Avoidance and Move-on Rule

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Northeast Area Monitoring and Assessment Program (NEAMAP) Near Shore Trawl Program	This project provides data collection and analysis in support of single and multispecies stock assessments in the Mid-Atlantic. It includes the Maine/New Hampshire inshore trawl program, conducted by Maine Department of Marine Resources (MDMR) in the northern segment, and the NEAMAP Mid-Atlantic to Southern New England survey, conducted by Virginia Institute of Marine Science, College of William and Mary (VIMS) in the southern segment.	Near shore Maine to North. Carolina Northern segment: U.S.-Canada border to New Hampshire-Massachusetts border from shore to 300 ft depth. Southern segment: Montauk, New York to Cape Hatteras, North. Carolina from 20 to 90 ft depth.	Spring (Apr.–June) and Fall (Oct.–Dec.) approximately 30-50 DAS per season for each segment.	F/V *Robert Michael* from Maine to New Hampshire (northern segment) F/V *Darana R* from Massachusetts to North Carolina (southern segment)	Northern segment: modified GOM shrimp otter trawl net typically used by commercial otter trawlers in Maine and New Hampshire. Southern segment: 4-seam, 3-bridle net bottom trawl (same net used by NEFSC Standard Bottom Trawl Survey).	Northern segment: Net size: 58 ft headrope, 70 ft footrope, 24 ft siderope, 1 in poly stretch mesh, with #7.5 Bison doors Tow speed: 2.2-2.5 kts Duration: 20 min at target depth Southern segment: Net size: 31 m x 19 m x 5 m Tow speed: 3 kts Duration: 20 min at target depth	Northern segment: 100 tows per season, 200 tows per year, approx. 1 station per 36 square nm. Southern segment: 150 tows per season, 300 tows per year, approx. 1 station per 30 square nm	Daytime tows only in both northern and southern NEAMAP segments. In northern segment, each tow station is surveyed for lobster gear prior to setting out mobile trawl gear, during which the bridge crew also observe for protected species. Move-on Rule.
Northeast Observer Program (NEFOP) Observer Bottom Trawl Training Trips	Certification training for new NEFOP Observers is provided by this operation.	Maine to North Carolina	Annually, one-day trips throughout year as needed. 18 DAS	Contracted commercial fishing vessels	Contracted vessels trawl gear	Net size: various Tow speed: various Duration: 20-45 min per tow	6 tows per trip 108 tows total	Continuous watch for marine mammals and sea turtles by vessel crew and NEFOP staff while underway and take action to avoid setting gear at times and places where concentrations of protected species are observed.
Northern Shrimp Survey	The objective of this project is to determine the distribution and abundance of northern shrimp and collect related data.	GOM	Annually 22 DAS	R/V *G. Michelle*	4-seam modified commercial shrimp bottom trawl. Positional sensors, mini-log, and CTD attached to net gear.	Net size: 25 m x 17 m x 3 m Tow speed: 2 kts Duration: 15 min	82 tows	Standard Avoidance and Move-on Rule
NEFSC Standard Bottom Trawl Surveys (BTS)	This project tracks mature animals and determines juvenile abundance over their range of distribution.	Cape Hatteras to Western Scotian Shelf	Spring & fall 120 DAS	R/V *H.B. Bigelow*	4-seam, 3-bridle net bottom trawl	Net size: 31 m x 19 m x 5 m Tow speed: 3 kts Duration: 20 min at target depth	GOM: 110 tows each season (220 total) Georges Bank (GB): 90 tows each season (180 total) SNE: 90 tows each season (180 total) Mid-Atlantic Bight (MAB): 110 tows each season (220 total)	Standard Avoidance and Move-on Rule
					CTD Profiler	Tow speed: 0 Duration: 2-5 hr	800 tows	
					ADCP	300 or 150 kHz	Continuous	
					Bongo net equipped with CTD	61 cm diameter Tow type: oblique Tow speed: 1.5 kts Duration: max 20 min	240 tows	
					Split beam and multi-beam acoustics	Output freq: 18 kHz, 38 kHz, 70 kHz, 120 kHz, 200 kHz	Continuous	

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Projects using pelagic trawl gear								
Atlantic Herring Survey	This operation collects fisheries-independent herring spawning biomass data and also includes survey equipment calibration and performance tests.	GOM and Northern GB	Fall 34 DAS	R/V *H.B. Bigelow*, R/V *Gordon Gunter*, or R/V *Pisces*	4-seam, 3-bridle bottom trawl	31 m x 19 m x 5 m Tow Speed: 3 kts Duration 10-20 min on bottom	20 tows	Standard Avoidance and Move-on Rule
					Hydroacoustic Midwater Rope Trawl	Net size: 15 m x 30 m Tow speed : 4 kts Duration: 5-30 min at depth	70 tows	
					Split beam and multi-beam acoustics	Output Freq: 18 kHz, 38 kHz, 70 kHz, 120 kHz, 200 kHz	Continuous	
Atlantic Salmon Trawl Survey	This is a targeted research effort to evaluate the marine ecology of Atlantic salmon.	Inshore and offshore GOM	Spring - annually as funding allows Approx. 21 DAS	Contracted commercial vessels	Modified mid-water trawl that fishes at the surface via pair trawling	Net size: 50 m from wing to wing, 10 m from headrope to footrope Tow speed: 2-6 kts Duration: 30-60 min	Approximately 130 tows	Standard Avoidance and Move-on Rule
Deepwater Biodiversity	This project collects fish, cephalopod and crustacean specimens from 500 to 2000 m for tissue samples, specimen photos, and documentation of systematic characterization.	Western North Atlantic	Annually 16 DAS	R/V *H.B. Bigelow* or R/V *Pisces*	Superior Midwater trawl	Net size: 92 m x 35 m x 31 m Tow speed : 1.5-2.5 kts Duration: 60 min at depth	16 tows	Standard Avoidance and Move-on Rule
					4-seam, 3-bridle bottom trawl	Net size: 31 m x 19 m x 5 m Tow speed : 1.5-2.5 kts Duration: 60 min at depth	9 tows	
					Split beam and multi-beam acoustics	Output Freq: 18 kHz, 38 kHz, 70 kHz, 120 kHz, 200 kHz	Continuous	
Penobscot Estuarine Fish Community and Ecosystem Survey	The objective of this project is fish and invertebrate sampling for biometric and population analysis of estuarine and coastal species.	Penobscot Estuary and Bay, Maine	Year round, even coverage across seasons. 12 DAS	Contracted commercial vessels	Mamou shrimp trawl modified to fish at surface	Net size: 12 m x 6 m trawl mouth opening Tow speed: 2-4 kts Duration: 20 min	50 trawls per season (200 trawl total)	Standard Avoidance and Move-on Rule
Projects using longline gear								
Apex Pelagic Shark (***Survey not continued in the Preferred Alternative***)	The NEFSC conducts a bi-annual fishery-independent survey of Atlantic pelagic sharks in U.S. waters from Maryland to Canada. The objectives are to: 1) monitor the species composition, distribution, and abundance of sharks in the coastal Atlantic; 2) tag sharks for migration and age validation studies; 3) collect biological samples for age and growth, feeding ecology, and reproductive studies; and 4) collect morphometric data for other studies. The time-series of abundance from this survey is critical to the evaluation of pelagic Atlantic shark species.	Maryland to Canada	Biannual in spring 30 DAS Daytime sets only	Charter Vessel	Yankee longline gear and current pelagic longline gear	Both: Mainline length: 2-11 mi Hooks per set: 100-400 Bait: spiny dogfish Soak time: 3-5 hr Yankee: Gangion length: 24 ft Gangion spacing: 170 ft Hook size and type: Non-stainless Japanese #40 tuna hook or non-stainless circle hook Commercial: Gangion length: 33 ft Gangion spacing: 183 ft Hook size and type: Non-stainless circle hook 16/0 or 18/0	25 sets per survey	Prior to setting the gear, the area for the set is visually examined for the presence of sea turtles and marine mammals for at least 30 minutes. If any sea turtles or marine mammals are seen and they appear to be at risk of interactions with the longline gear, the station is moved at least one mile away (Move-on Rule for longline research). During the soak the line is run and if a sea turtle or marine mammal is sighted the line is pulled immediately. In addition, the Chief Scientist, at a minimum, is a NEFOP trained sampler and tagger for sea turtles for the NEFSC.

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Apex Predators Bottom Longline Coastal Shark	The NEFSC conducts a bi-annual fishery-independent survey of Atlantic large and small coastal sharks in U.S. waters from Florida to Delaware. The objectives are to: 1) monitor the species composition, distribution, and abundance of sharks in the coastal Atlantic; 2) tag sharks for migration and age validation studies; 3) collect biological samples for age and growth, feeding ecology, and reproductive studies; and 4) collect morphometric data for other studies. The time-series of abundance from this survey is critical to the evaluation of coastal Atlantic shark species.	Rhode Island to Florida within 40 fathoms	Biannual in spring 47 DAS	Charter Vessel	Florida style bottom longline	Mainline length: 4 mi Gangion length: 12 ft Gangion spacing: 60 ft Hook size and type: Mustad #349703 3/0 non-stainless J hook Hooks per set: 300 Bait: spiny dogfish Soak time: 3 hr	29 sets (max) in MAB	Move-on Rule (this survey uses a one nautical mile radius around the vessel to guide the decision on whether the animals are at risk of interactions). During the soak the line is run and if any sea turtles or marine mammals are sighted the line is pulled immediately. In addition, the Chief Scientist, at a minimum, is a NEFOP trained sampler and tagger for sea turtles for the NEFSC.
Apex Predators Pelagic Nursery Grounds Shark	This project is an opportunistic sampling on board a commercial swordfish longline vessel to: 1) monitor the species composition, distribution, and abundance of sharks in the coastal Atlantic; 2) tag sharks for migration and age validation studies; 3) collect biological samples for age and growth, feeding ecology, and reproductive studies; and 4) collect morphometric data for other studies. Data from this survey are critical to the evaluation of juvenile pelagic Atlantic shark species. The project determines the location of shark nurseries, species composition, relative abundance, distribution, and migration patterns.	GB to Grand Banks off Newfoundland, Canada	Annually, fall 21-55 DAS	F/V *Eagle Eye II*	Standard commercial pelagic longline gear. Configured according to NMFS HMS Regulations	Mainline length: 35 mi Gangion length: 33 ft Gangion spacing: 183 ft Hook size and type: Non-stainless 18/0 10 degree offset circle Hooks per set: 1008 Bait: spiny dogfish Soak time: 8 hr	Average 21 sets	Move-on Rule. As per required for commercial longline vessels, Captain is trained in NMFS/Highly Migratory Species Protected Species Safe Handling, Release, and Identification Workshops to review mitigation methods required by various take reduction plans as well as methods to release protected species safely.
Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) Longline and Gillnet Surveys	This project determines the location of shark nurseries, species composition, relative abundance, distribution, and migration patterns. It is used to identify and refine essential fish habitat and provides standardized indices of abundance by species used in multiple species specific stock assessments. NEFSC conducts surveys in Delaware, New Jersey, and Rhode Island estuarine and coastal waters. Other areas are surveyed by cooperating institutions and agencies. In the NE LME, cooperating partners are Stony Brook University (SBU) in NY and Virginia Institute of Marine Science (VIMS).	Florida to Rhode Island	Annually, summer. 25 DAS for NEFSC conducted surveys. 40 DAS for cooperating institutions and agencies. Daytime sets only	R/V *C.E. Stillwell* and cooperating partner vessels	Bottom longline gear	Small juvenile gear / Large juvenile-adult shark gear Mainline length: 1000 ft / 1000 ft Gangion length: 5 ft / 8 ft Gangion spacing: 20 ft / 40 ft Hook size and type: 12/0 / 16/0 Mustad circle hooks Hooks per set: 50 / 25 Bait: finfish (mackerel or herring) Soak time: 30 min / 2 hr	NEFSC: 20 sets off coast of RI (SNE), 110 sets off coasts of DE and NJ (MAB). SBU: 30 sets off coast of NY. VIMS: 100 sets off coast of VA.	Move-on Rule. The gear is monitored during the soak; if any sea turtles or marine mammals are sighted during the soak and is considered to be at risk of interacting with the gear then the line is pulled immediately.
					Anchored Sinking Gillnet	325 ft x 10 ft, single panel of 4 in stretch mesh made of #177 (20 lb test) nylon monofilament 3 hr soak time while continuously running the net to tag and release targeted species and release all other species.	12 sets (max) in Delaware Bay (NEFSC)	

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Projects using dredge gear								
Annual Assessments of Sea Scallop Abundance and Distribution in Selected Closed/Rotational Areas	These Atlantic Sea Scallop Research Set-Aside rotational area surveys endeavor to monitor scallop biomass and derive estimates of Total Allowable Catch (TAC) for annual scallop catch specifications. Additionally, the surveys monitor recruitment, growth, and other biological parameters such as meat weight, shell height and gonadal somatic indices.	Dredge and drop camera samples in GB, Closed Areas I & II, Hudson Canyon, DELMarVA, Nantuckett, GOM and Mid-Atlantic areas. Drop camera also samples in GOM: Fippennies Ledge, Cashes Ledge, Platts Bank and Jeffreys Ledge	Dredge surveys conducted Apr. through Sept. HABCAM and drop camera surveys generally occur in Summer months (June – Sept.) Not all rotational areas are sampled each year. Typically, between 2 to 4 areas are selected for dredge surveys and 2-3 areas for HABCAM or drop camera surveys are selected each year.	Dredge surveys: F/V *Celtic*, F/V *Pursuit*, F/V *Nordic Pride*, F/V *Kathy Ann*, F/V *Stephanie B II*, F/V *Regulus*, F/V *Carolina Boy* HABCAM : F/V *Kathy Marie* SMAST Drop Camera: F/V *Endeavor*, F/V *Guidance*, F/V *Karen Nicole*, F/V *Kathryn Marie*, F/V *Resolution*, F/V *Liberty*, F/V *Ranger*, F/V *Incentive*	Commercial and standardized NMFS scallop dredges, towed simultaneously.	NMFS New Bedford survey dredge: 8 ft width, 2 in rings, 4 in diamond twine top, and 1.5 in diamond mesh liner. Commercial gear: 15 ft Coonamessett Farm Turtle Deflector Dredge (CFTDD) with 4 in rings, 10 in diamond mesh twine top and no liner. Turtle chains are used in configurations as dictated by the area surveyed and current regulations. Tow speed: 3.8-4.0 kts Duration: 15 min	100 dredge tows in each rotational area when sampled using that method. Average number of dredge tows per year is about 200 in all areas.	Standard Avoidance and Move-on Rule
					Both a towed photographic and sonar hydroacoustic imaging system (HABCAM) and a drop camera and underwater video system is used to conduct the SMAST Video Survey Pyramid deployed from commercial scallop vessels.	HABCAM photographic system has 1 m field of view in each photograph, 5–10 frames per second with >50% overlap at 5 kts towing speed. Photo system coupled with two Imagenix side scan sonars or Teledyne Benthos C3D side scan sonars.	Between 350 and 690 nm of transects using digital photography by HABCAM each year. Drop camera typically samples over 400 stations on a 1.57 km sampling grid.	
NEFOP Observer Scallop Dredge Training Trips	This program provides certification training for NEFOP observers.	Maine to North Carolina	Annually, one-day trips throughout year as needed. 6 DAS	Contracted commercial fishing vessels	Contracted vessels scallop gear	Dredge type: Turtle Deflector Dredge Duration: 1 hr	2-3 tows per trip 12-18 tows total	All gear compliant with current commercial fishing regulations under the MSA. Continuous watch for marine mammals and sea turtles by vessel crew and NEFOP staff while underway and take action to avoid setting gear at times and places where concentrations of protected species are observed.
Sea Scallop Survey	The objective of this project is to determine distribution and abundance of sea scallops and collect related data for Ecosystem Management from concurrent stereo-optic images. It is conducted by the NEFSC.	North Carolina to GB	Summer, Annually 36 DAS	R/V *H. R. Sharp*	New Bedford type dredge	8 ft width, 2 in rings, 4 in diamond twine top, and 1.5 in diamond mesh liner. Tow speed: 3.8 kts Duration: 15 min at depth	225 dredge tows	Standard Avoidance and Move-on Rule.
					HabCam	2,500 lb towed metal frame 3 ft x 10 ft x 4 ft. Carries a payload of two digital cameras, 4 strobes, and two cylinders containing an array of oceanographic data towed with an electro-optic cable.	18 days of continuous stereo-optic camera towing	
Surfclam and Ocean Quahog Dredge Survey	The objective of this project is to determine distribution and abundance of Surfclam/ocean quahog and collect related data.	Southern Virginia to GB	One third of resource sampled per year over three year period. 15 DAS	Commercially contracted vessel (varies annually)	Hydraulic-jet dredge	12.5 ft cutting blade Tow speed: 1.5 kts Duration: 5 min at depth	150 tows	Minimal bottom time and construction of gear mitigate interactions with sea turtles

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Projects using other gears								
Beach Seine Survey, Maine	The project is a fish community survey at fixed locations.	Penobscot Bay and estuary, Maine	Annually, Apr.-Nov.	R/V *Silver Smolt*	45 m beach seine	5 mm nylon mesh	100 sets	Observe for marine mammals before and continuously during sampling. Net is not deployed if marine mammals are spotted. Scientists look as far as field of view permits from the beach in the general sampling area before the net is fished.
Beach Seine Survey, New Jersey	The project is a fish community survey at fixed locations.	Sandy Hook Bay and Navesink River, New Jersey	Summer	NA, conducted from shore	45 m beach seine	5 mm nylon mesh	90 sets	Observe for marine mammals before and continuously during sampling. Net is not deployed if marine mammals are spotted. Scientists look as far as field of view permits from the beach in the general sampling area before the net is fished.
Coastal Maine Telemetry Network	The objective of this project is to monitor tagged animals entering the Penobscot Bay System and exiting the system into the Gulf of Maine.	Penobscot River, estuary and bay, GOM	Deployed continuously year round in GOM and Apr.-Nov. in nearshore areas 10 DAS for data retrieval and maintenance.	Contract commercial Vessel	Fixed position acoustic telemetry array receivers on moorings spaced 250-400 m apart.	69 kHz receivers moored with buoys attached to 10 to 100 m lines	30 to 120 moorings, continuous in GOM, continuous from Apr.–Nov. in nearshore areas	Follow Take Reduction Plan gear restrictions for Penobscot Bay (i.e., sinking lines with 600 lb weak links on moored equipment).
Deep-sea Coral Survey	The objective of this program is to determine the species diversity, community composition, distribution and extent of deep sea coral and sponge habitats.	Continental shelf margin, slope, and submarine canyons and deep basins: GOM to Virginia	Annually, summer 16 DAS	R/V *H.B. Bigelow*	ROV (tethered)	Continuous and strobe lights, cameras, CTD, manipulator arm for sampling Speed: 3 kts Duration: 24 hr	10 dives	Standard Avoidance and Move-on Rule
					Towed Camera system	Strobe lights, camera, CTD Speed: 0.25 kt Duration: 8 hr	18 dives	
					CTD Profiler with Niskin 12-bottle rosette water sampler	Tow speed: 0 Duration: 1-5 hr	30 casts; 360 water samples (maximum)	
					ADCP	300 or 150 kHz	Continuous	
					Split beam and multi-beam acoustics	Output frequency: 18 kHz, 38 kHz, 70 kHz, 120 kHz, 200 kHz	Intermittent	
Diving Operations	The objective of this project is to collect growth data on hard clams, oysters and bay scallops.	Long Island Sound	Year round 20 DAS	R/V *V. Loosanoff*, R/V *Milford 17*, R/V *Milford 22*	Wire mesh cages, lantern nets	1.5 in square wire mesh cages 60 in x 24 in x 18 in staked to the seabed	30 cages deployed for 1-36 months	Standard Avoidance and Move-on Rule
						Lantern nets 18 in diameter x 72 in long anchored to the seabed with 4 cinder blocks with the net oriented vertically	30 nets deployed for 1-36 months	
Ecology of Coastal Ocean Seascapes	This project is designed to provide information required for a next generation spatially and temporally explicit population simulation model for commercially important stocks such as summer flounder.	New York Bight	Annually, spring, summer, and fall 35 DAS	R/V *Nauvoo*, R/V *Resolute*	ADCP	600 kHz	80 tows	Standard Avoidance and Move-on Rule
					Hydroacoustic	120/38 kHz		
					Video sled	Sea Cam 5000 12v video cam towed at 1 kt for 300 m.		
					CTD	Sea Bird CTD		
					YSI	1.4 m x 1 m Tucker trawl		
					Plankton net	YSI 6000		

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
					Multi-nutrient analyzer	EcoLAB 2		
					Kemmerer bottle	2.2 L		
Ecosystem Monitoring ***(Replaced by expanded version in the Preferred Alternative, renamed "Northeast Integrated Pelagic Survey")***	This project assesses changing biological and physical properties including ichthyoplankton and zooplankton composition, abundance and distribution. Seabird / marine mammal observers survey birds, mammals, and sea turtles from the flying bridge on transits between stations during daylight hrs.	Cape Hatteras to Western Scotian Shelf	Quarterly 80 DAS	R/V *H.B. Bigelow*, R/V *Pisces*, R/V *G. Gunter*	Isaacs-Kidd midwater plankton trawl	Net size: 3 m Tow type: oblique Tow speed: 2.5 kts Duration: max 30 min	80 tows	Standard Avoidance and Move-on Rule
					Bongo net equipped with CTD	61 cm diameter Tow type: oblique Tow speed: 1.5 kts Duration: 20 min (max)	600 casts	
					Baby bongo: added to subset of Bongo tows	20 cm diameter, attached above standard Bongo	80 casts	
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 1 hr (max)	250 casts	
					ADCP on vessel	300 kHz or 150 kHz	Continuous	
Estuarine Habitat Dynamics and Telemetered Movements ***(Survey not continued in the Preferred Alternative)***	The objective of this project is to establish an estuarine observatory for the tracking of acoustically tagged bluefish (adults and young-of-the-year), weakfish and striped bass in the Navesink River.	Shrewsbury and Navesink Rivers Sandy Hook Bay, New Jersey	Spring, summer, and fall 10 DAS	R/V *Nauvoo*, R/V *Harvey*	Acoustic tags and receivers	VR2 Vemco V8 Coded	N/A	Standard Avoidance and Move-on Rule
					Gillnets	50 ft x 8 ft gill net	4 sets	
Finfish Nursery Habitat Study	This project is designed to collect fish eggs, larvae, and juvenile fish from the seabed to identify essential habitats. The project tracks fish to determine habitat use.	Long Island Sound, New York	May-Oct. 10 DAS	R/V *V. Loosanoff*, R/V *Milford 17*, R/V *Milford 22*	Epibenthic Sled	1 m x 333 cm opening towed on the seabed Tow speed: 1.5 kts Duration: 5 min	20 tows	Standard Avoidance and Move-on Rule
					Bongo plankton net	Two 0.5 m diameter nets attached side by side towed at 0.5 kts at varying depths between the surface and bottom	20 tows	
					Neuston plankton net	1 m x 0.5 m opening towed at 1 kt at the surface	20 tows	
					Acoustic fish tags	70 kHz implanted tags	30 tags with 14-month life	
Gear Effects on Amphipod Tubes	The purpose of this project was to survey the abundance of amphipod tubes and examine the effects of bull raking and crab dredging.	Sandy Hook Bay, Barnegat Bay, and Great South Bay, New Jersey	Annually, July and Aug. 20 DAS Daytime sampling only.	R/V *Nauvoo*, R/V *Resolute*, R/V *Harvey*	Plankton net		Varies	Standard Avoidance and Move-on Rule
					YSI			
					Ponar sediment sampling grab (clam shell type)	Sample area: 152 mm x 152 mm Volume: 2.4 L		
Gulf of Maine Ocean Observing System Mooring Cruise	This project services oceanographic moorings operated by the University of Maine.	GOM and Northern GB	Spring 12 DAS	R/V *H.B. Bigelow*, R/V *Pisces*, R/V *G. Gunter*	ADCP on vessel	300 kHz	Continuous 600 km/year	Standard Avoidance and Move-on Rule
					ADCP on moorings	300 kHz, 75 kHz	Continuous	
Hydroacoustic Surveys	This project consists of mobile transects conducted throughout the estuary and bay to study fish biomass and distribution.	Penobscot Bay and estuary	25 DAS	R/V *Silver Smolt* or charter vessel	Split-beam and DIDSON	38 and 120 kHz split-beam 1.1 and 1.1 MHz DIDSON	Continuous 50 km per survey	Standard Avoidance

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Marine Estuaries Diadromous Survey	This project is a fish community survey at fixed locations.	Penobscot estuary and bay, Maine	Annually, Apr.–Nov. 100 DAS	R/V *Silver Smolt*	1 m and 2 m fyke nets	2 m fyke: 2 m x 2 m (1.9 cm main/0.6 cm mesh) 1 m fyke: 1 m x 1 m (0.6 cm mesh) Duration: 24 hr	100 sets	Nets deployed on low tide in intertidal areas, retrieved every 12 to 24 hours Mammal excluder on 2 m fyke net (14 cm gap opening) Small throat opening on 1 m fyke (12.7 cm round)
NEFOP Observer Gillnet Training Trips	This program provides certification training for NEFOP Observers.	Maine to North Carolina	Annually 10 DAS	Contracted commercial fishing vessels	Contracted vessels gillnet gear	String: 3-5 nets each Soak duration: 12-24 hr	4 sets per trip 40 sets total	Acoustic pingers used on all gillnet gear in compliance with commercial requirements. Continuous watch for marine mammals and sea turtles by vessel crew and NEFOP staff while underway and take action to avoid setting gear at times and places where concentrations of protected species are observed
Nutrients and Frontal Boundaries	The objective of this project is to characterize nutrient patterns associated with distinct water masses and their boundaries off of coastal New Jersey and Long Island in association with biological sampling.	MAB	Quarterly; Feb., May-June, Aug., and Nov. 10 DAS, sampling day and night	R/V *Resolute*	ADCP	600 kHz	Varies	Standard Avoidance and Move-on Rule
					Hydroacoustic	120/38 kHz		
					CTD	Sea Bird CTD		
Ocean Acidification	The objective of this project is to develop baseline pH measurements in the Hudson River water.	Hudson River Coastal waters	Quarterly 10 DAS, sampling day and night.	R/V *Resolute*	YSI	YSI 6000	Varies	Standard Avoidance and Move-on Rule
					Multi-nutrient analyzer	EcoLAB 2		
					Kemmerer bottle	2.2 L		
					CTD	Sea Bird CTD		
Pilot Studies	This program provides gear and platform testing.	Massachusetts state waters, GB	Annually, June 5 DAS Daylight	R/V *G Michelle*	AUV	Remus 100	4-8 hr missions	Standard Avoidance and Move-on Rule
Rotary Screw Trap (RSTs) Survey	This project is designed to collect abundance estimates of Migrating Atlantic salmon smolts and other anadromous species.	Estuaries on coastal Maine rivers	Apr. 15-June 15 60 sampling days	NA	Rotary Screw Trap	4 ft, 5 ft and 8 ft traps – aluminum construction, current propelled sampling devices.	Continuous (Apr.–June)	Daily tends of sampling device; adjustments in frequency if protected species likely to occur. If protected species are observed in the sampling area, sampling is suspended temporarily. If capture occurs, animal is temporarily retained in live tank and released as soon as possible.
Seabed Habitat Classification Survey	The objective of this project is to determine the composition of the surface layer of the seabed utilizing hydroacoustic equipment.	Long Island Sound	Year round 20 DAS Sampling occurs during daylight hours within two hours of high tide.	R/V *V. Loosanoff*, R/V *Milford 17*, R/V *Milford 22*	Quester Tangent seabed classification equipment	50/200 kHz transducer, Transducer fixed to hull operated at 4.5 kts	100 hr	Standard Avoidance and Move-on Rule
					Drop camera	24 in x 24 in x 24 in water filled box with a 12v DC video camera inside and two 60 watt 12v DC lights. Deployed 2 m or less from the seabed directly below the support vessel.	20 20-min sessions	
Trawling to Support Finfish Aquaculture Research	The objective of this project is to collect broodstock for laboratory spawning and rearing and experimental studies.	Long Island Sound	May through Aug. 30 DAS	R/V *V. Loosanoff*, R/V *Milford 17*, R/V *Milford 22*	Combination bottom trawl	Net size: 40 ft head rope, 40 ft sweep, 7 ft rise Tow speed: 2.5 kts Duration: 30 min	~50 tows to collect 100 adult scup	Standard Avoidance and Move-on Rule

Project Name	Project Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
					Shrimp trawl	Net size: 16 ft head rope, 16 ft foot rope, 2 ft rise Tow speed: 1.5 kts Duration: 30 min	~50 tows to collect 400 young-of-year scup	
					Rod and Reel	I/O circle and J hooks	12 hooks fished for ~100 hr to collect 50 adult black sea bass	
					Gill net	150 ft x 8 ft tied down gill net with 4 in stretch mesh, 24 hr sets	15 sets	
U.S. Army Corps of Engineers Bottom Sampling	This program provides habitat assessments monitoring.	Woods Hole, Massachusetts	Every two years 1 DAS	R/V *G Michelle*	Grab sampler	Peterson Grab	6 grabs	Standard Avoidance and Move-on Rule
SOUTHEAST US CONTINENTAL SHELF LME								
Projects using longline gear								
Apex Predators Bottom Longline Coastal Shark	The NEFSC conducts a bi-annual fishery-independent survey of Atlantic large and small coastal sharks in U.S. waters from Florida to Delaware to: 1) monitor the species composition, distribution, and abundance of sharks in the coastal Atlantic; 2) tag sharks for migration and age validation studies; 3) collect biological samples for age and growth, feeding ecology, and reproductive studies; and 4) collect morphometric data for other studies. The time-series of abundance indices (CPUE) from this survey is critical to the evaluation of coastal Atlantic shark species.	Florida to Rhode Island within 40 fathoms	Biannual, in spring 47 DAS	Charter Vessel	Florida style bottom longline	Mainline length: 4 mi Gangion length: 12 ft Gangion spacing: 60 ft Hook size and type: Mustad #349703 3/0 non stainless J hook Hooks per set: 300 Bait: spiny dogfish Soak time: 3 hr	71 sets (max.)	Move-on Rule. During the soak the line is run and if any sea turtles or marine mammals are sighted the line is pulled immediately. In addition, the Chief Scientist, at a minimum, is a NEFOP trained sampler and tagger for sea turtles for the NEFSC.
COASTSPAN Longline and Gillnet Surveys	This program determines location of shark nurseries, species composition, relative abundance, distribution, and migration patterns. Data are used to identify and refine essential fish habitat and provides standardized indices of abundance by species used in multiple species specific stock assessments. This component of COASTSPAN is conducted by cooperating institutions and agencies (South Carolina Department of Natural Resources [SCDNR], Georgia Department of Natural Resources [GDNR], and University of North Florida [UNF]).	Florida to Rhode Island.	Annually, summer. 85 DAS Daytime sets only	Cooperating institution and agency vessels	Bottom longline gear	Small juvenile gear / Large juvenile/adult shark gear Mainline length: 1000 ft / 1000 ft Gangion length: 5 ft / 8 ft Gangion spacing: 20 ft / 40 ft Hook size and type: 12/0 / 16/0 Mustad circle hooks Hooks per set: 50 / 25 Bait: finfish (mackerel or herring) Soak time: 30 min / 2 hr	SCDNR: 150 sets GDNR: 150 sets UNF: 150 sets	Move-on Rule.The gear is monitored during the soak; if any sea turtles or marine mammals are sighted during the soak and is considered to be at risk of interacting with the gear then the line is pulled immediately.
					Anchored sinking gillnet	325 ft x 10 ft Single panel of 4 in stretch mesh made of #177 (20 lb test) nylon monofilament 3 hr soak time while continuously running the net to tag and release targeted catch and release all bycatch	SCDNR: 20 sets UNF: 20 sets	

This page intentionally left blank.

2.2.2 Short-term Research Activities

In addition to the research activities summarized in Table 2.2-1, the Status Quo Alternative includes a set of fisheries and ecosystem research activities which fall predominately within a category of activities known as Cooperative Research, which in the Northeast Region is made up of several major programs summarized below: Cooperative Research Partners Program, Northeast Consortium Cooperative Research Program, Commercial Fisheries Research Foundation, and the Research Set-Aside Program. The specific projects funded through these programs vary on an annual basis as needs arise for information to support particular fisheries or address emerging conservation concerns. Table 2.2-2 provides a summary of the projects that have been supported by the NEFSC from 2008 through 2012, which is taken as a period representing the Status Quo baseline.

- ***Cooperative Research Partners Program –*** In Fiscal Year (FY) 1999, NMFS Northeast Regional Office (now called the Greater Atlantic Regional Fisheries Office) developed the Cooperative Research Partners Program (CRPP), formerly known as the Cooperative Research Partners Initiative, to formalize and expand collaborative research among New England's commercial fishing industry, marine science and fishery management communities. The goal of this initiative is to enhance the data upon which fishery management decisions are made as well as to facilitate communication and collaboration among New England commercial fishermen, scientists, and fishery managers. Through this initiative, CRPP partners are collaborating with the New England Fishery Management Council (NEFMC) in setting research priorities to meet management and fishing industry needs.
- ***Northeast Consortium Cooperative Research Program –*** The Northeast Consortium administers nearly $5 million annually from the NEFSC for collaborative research on a broad range of topics that are consistent with the mission of the NEFSC, including gear selectivity, fish habitat, stock assessments, and socioeconomics. The funding is appropriated to NMFS and administered by the University of New Hampshire on behalf of the Northeast Consortium. Potential research projects are solicited through an annual Request for Proposals and funds are distributed through an open competition after scrutiny of research protocols by an institutional board of review. All projects must involve partnership between commercial fishermen and scientists, be designed to minimize any negative impacts to ecosystems or marine organisms, and be consistent with accepted ethical research practices.
- ***Commercial Fisheries Research Foundation –*** The Commercial Fisheries Research Foundation is designed to support 1-2 year research projects that address a range of topics: gear engineering aimed at bycatch reduction and compliance with protected species regulations; reproductive capabilities and discard mortality rates for key species; and evaluation of the socio-economic impacts of fishery management regulations. The Commercial Fisheries Research Foundation administers the program based on the “Strategic Plan for Collaborative Fisheries Research in Southern New England” (CFRF 2011). The research projects are conducted primarily by academic institutions. Future funding will be devoted to supporting collaborative research projects in the areas of improved stock assessments, bycatch reduction (particularly in the winter flounder fishery), understanding of changing ecosystem dynamics as they relate to the rebuilding of fisheries stocks important to Rhode Island and southern New England, and the socio economic impacts of fishery regulations.
- ***Research Set-Aside Programs –*** Research Set-Aside programs (RSAs) were developed by the NEFMC and the Mid-Atlantic Fishery Management Council (MAFMC) as part of the fishery management plan (FMP) process, and are administered by NMFS. RSA programs encourage cooperative research among fisheries participants, marine scientists, and fishery managers. The goals of the RSA programs are to further the understanding of our nation’s fisheries, enhance

information used in fisheries management decision-making, and foster collaborations among marine fisheries interests. RSA programs are implemented in accordance with individual FMPs. Some FMPs set aside a portion of the annual fishery-wide quota or Total Allowable Catch (TAC) to be harvested for the purpose of funding research. FMPs such as those for sea scallops and Atlantic herring in New England, and summer flounder, scup, black sea bass, tilefish, spiny dogfish, *Illex* squid, *Loligo* squid, butterfish, Atlantic mackerel, and bluefish in the Mid-Atlantic reserve up to two or three percent of the TAC, depending on the fishery, for research funding. The monkfish FMP sets aside a portion of the days-at-sea (DAS) allocated for fishing to establish an annual pool of research DAS. A vessel that participates in an approved research project may apply for research DAS instead of using valuable fishing time to participate in cooperative monkfish research. Currently, RSA programs have been implemented for Atlantic Sea Scallops, Mid-Atlantic multi-species, Monkfish, and Atlantic Herring FMPs.

Table 2.2-2 Short-term Cooperative Research Projects Funded From 2008-2012

This table indicates the scope and type of short-term research projects conducted under the status quo. The projects are organized by general purpose and gears used. No specific mitigation measures for protected species were contractually required for these types of projects under the status quo but they have been conducted by experienced researchers and fishermen using good seamanship practices (e.g., bridge watches to avoid collisions and not setting gear when animals are around the vessel) to reduce the risk of incidental interactions with protected species. All vessels used for these projects are commercial fishing vessels or chartered vessels capable of deploying the commercial fishing gears used in these types of projects.

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
SURVEY PROJECTS						
Projects using trawl gear						
An industry-based survey for winter flounder in Southern New England	SNE, West of Closed Area (CA) I and north of Nantucket Lightship CA	5 survey cruises completed June-Oct. 2010	F/V *Seel*, F/V *Sasha Lee*, F/V *Sea Siren*, F/V *Iberia II*, F/V *United States*	Flat fish otter trawl	Bottom trawl. 60 ft head rope length x 80 ft ground rope length. Otter trawl survey net designed by Reider's Inc. 21 in rock hopper disks on sweep, tapered to 18 in and 16 in on wings, 20 fathoms bridle, 2-seam flat net using 4 mm Euro twine, 4.5 in mesh	288 tows at 20 to 30 min per tow
An industry-based survey for yellowtail flounder in Southern New England	SNE, Rhode Island Bight, Vineyard Sound, Long Island, NY	Aug.-Sept. 2011 (9 total trips were taken)	F/V *Heather Lynn*, F/V *Travis and Natalie*, F/V *Mary Elena*	Flat fish otter trawl	Bottom trawl. 360 x 6 in 2-seam flatfish otter trawl net, 3 in cookies, 135 ft sweep, 3 in codend mesh size	263 total tows at 20 to 30 min per tow
Cookie versus rock hopper sweep comparison	Paired trawl experiment: GOM, GB, SNE. Twin trawl experiment: SNE Fishing in 30 to 50 meter depth.	Twin trawl experiment: fall of 2009, 2 cruises lasting 5 days each, 10 DAS. Paired trawl experiment: fall of 2009, 6 cruises of 10 days each, 60 DAS	Twin trawl: F/V *Karen Elizabeth* Paired trawl: F/V *Endurance*, F/V *Moragh Kay*, F/V *Mary Kay*	Otter trawls with different sweeps (cookie and rock hopper)	Bottom trawl. Bigelow 4-seam 3-bridle net: two exact same nets with different sweeps (one cookie and one rock hopper)	Twin trawls: 100 tows, 20 min at 3 kts Paired tow experiment: 527 tows, 20 min at 3 kts

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
Projects using dredge gear						
Scallop survey transition and calibration tows from NMFS R/V ***Albatross*** **to the University of Delaware's** R/V ***Hugh R. Sharpe***	Entire range of Atlantic scallop resources, i.e., GOM, GB, SNE, MAB	Spring and fall survey periods, 2008	R/V *Albatross*, R/V *Hugh R. Sharpe*	Standard scallop survey dredge.	8 ft scallop dredge rigged with turtle chains, bag liner. Twin dredges towed simultaneously.	491 paired tows total.
Projects using hook and line gear						
Penobscot East bottom longline and jig fishing survey	GOM, up to 30 nm offshore between Vinehaven and Grand Manan Channel	July-Oct. 2013 and spring and fall 2014 pending funding, 20 DAS	F/V *Andanamra and* F/V *Tricia Clarke*	Longline and jig gear	Longline: 2000 hooks per set, ground line #7 with 1 fathom between hooks, #550 green gangion, #12 mustad semi-circle easy baiter hooks. Sets are soaked for 2 hr each. Jig: 80 pound power pro spectra with line on reel 40 pound braid. 3 hook setup (9/0 hook on bottom, 8/0 hooks on top and middle), 16-36 ounce diamond jig.	44 longline sets distributed among three depth strata, 88 total soak-hr 48 stratified random jigging stations, 5 lines per station, 5 min soak time.
Video hook-and-line survey to further knowledge of cusk (*Brosme brosme*) distribution and habitat preferences.	Statistical area 514 (western GOM, Old Scantum and New Scantum)	Aug.-Sept. 2011 and May-June 2012 (10 trips of approx. 4 hr)	F/V *Too Far*	Hook and line fishing gear and video equipment	Hook-and-line, drop camera (deep sea camera mounted on towed body)	10 trips, average of 4 rod-hours per trip
Projects using pot gear						
Application of broadband sonar technology for fisheries assessment and research	GOM – Coast wide in Maine waters	Year round sampling during 2009 commercial fishing season.	F/V *Jennifer and Emily*	Lobster boats equipped with acoustic sonar	Hydroacoustic sampling gear: Simrad ES70 single beam, dual-frequency systems.	Samples or numbers of lobster boat cruises not available

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
Cooperative industry/university/government based scup and sea bass survey utilizing fixed gear	Scup: bays offshore MA and RI. Black sea bass: Four zones along East Coast (MA, RI, NJ, and VA).	Scup: 5 cycles, June 15-Oct. 15, 2010 Black sea bass: 16 locations sampled monthly Apr.-Oct. depending on the region. Southern sites sampled in the spring, northern sites in summer and fall.	F/V *Drake*, F/V *Evangeline*, F/V *Captain Robert*, others	Pot gear Black sea bass: 10 individual pots per set. 30 sets on random hard bottom areas.	Scup: unvented 2 ft x 2 ft x 2 ft pots constructed of 1.5 in mesh fished for 1-2 days. Black sea bass pots: 43.5 in x 23 in x 16 in pots constructed with 1.5 in coated wire mesh, fished for 1 day.	Scup: 30 pots at each of 15 sites every 4 weeks. Total 2700 pot hauls. Black sea bass: 30 pots at each of 16 sites sampled monthly. Total 3360 pot hauls.
CONSERVATION ENGINEERING PROJECTS						
Projects using trawl gear						
A method to reduce butterfish retention in the offshore *Loligo* squid fishery through the use of a bycatch reduction device (BRD) adapted to pre-existing gear.	SNE and MAB (Hudson Canyon region)	Nov.-Dec. 2010 and Jan.-Mar. 2011, 4 trips of 6-day durations.	F/V *Karen Elizabeth*	Otter trawl (twin trawl with experimental and standard squid nets).	Bottom trawl. Comparisons between the standard legal codend mesh size of 1 7/8 in to larger mesh sizes (2.5 in) test of economic viability and butterfish escapement.	1 hr tows, 7 tows per day. 84 tows total.
A method to reduce winter flounder retention through the use of avoidance gear; adaptations in the small mesh trawl fishery within the Southern New England/Mid-Atlantic winter flounder stock area	SNE and MAB	July 2010 10 DAS	Trawl vessel	Trawl gear	Bottom trawl. Side by side parallel tows, 1 fishing experimental and one fishing the regular commercial trawl.	1 hr tows at 3.2 kts, 4-6 tows per day, 40-60 paired tows total

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
Collaborative network approach to reduce bycatch in the Southern New England/Mid-Atlantic squid trawl fishery (SQUIDNET)	SNE, MAB out to EEZ, Hudson Canyon and MAB	Fall 2010. Day and night sampling with 3 to 4 depth strata. 10-12 DAS	F/V *Karen Elizabeth*	Standard Bigelow net with acoustic equipment on net	Bottom trawl. 4-seam Bigelow net, Ecoview acoustic data to estimate density entering net or escapement, thus catchability. Same protocols as NEAMAP and Bigelow.	20 min tows. 40 day v. 40 night samples for comparisons.
Design and test of an innovative large mesh whiting trawl to reduce spiny dogfish bycatch in the Southern New England whiting fishery	SNE between Block Island and Nantucket Island	Aug.-Sept. 2010 10 DAS	Two whiting trawl vessels	Semi-pelagic trawl	Mid-water trawl. Side by side parallel tows, 1 fishing experimental and one fishing the regular commercial trawl.	1 hr tows at 3.2 kts, 4-6 paired tows per day, 40-60 paired tows total.
Design and test of a squid trawl with raised footrope rigging and a grid device to reduce winter flounder, scup and butterfish bycatch (SQUIDGRID)	Nantucket Sound (Statistical Block Numbers 99, 100, 101, 102, 115, 116)	June 1-Oct. 30, 2010 10 DAS per vessel	Two 70 ft squid trawlers	Experimental squid trawl	Bottom trawl. Paired tows with experimental and standard squid gear.	1 hr tows, 6 tows per day, 60 paired tows total.
Development and introduction of a low impact semi-pelagic (LISP) trawl.	Various areas, anticipated to occur in GOM, GB, and SNE	Two trips of 5-10 days each, trips may occur anytime during 2013.	F/V *Teresa Marie III*, F/V *Teresa Marie IV*, F/V *Harmony*, F/V *Nobska*, F/V *Morue*	2-seam otter trawl with 6 in mesh size, semi-pelagic doors.	Mid-water trawl. Netmind system to measure door spread and monitor door height off bottom, Gopro U/W camera to visually monitor doors and net.	2-4 hr tows, anticipated to complete 25 hauls per trip, 50 hauls total.
Eliminating flounder in the cod fishery with the use of a rigid escape vent behind the first bottom belly of the trawl.	Likely in SNE, Rhode Island Bight and GB	2013, 4 one-day trips	F/V *Lightening Bay*	Otter trawl	Bottom trawl. 360 ft x 60 ft 2-seam otter trawl with flounder escape vent and camera to observe fish response to gear.	1.5 hr tows, estimated 5 tows per day, 20 tows total.

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
Evaluation of a (modified) turtle excluder device (TED) design in the Southern New England and Mid-Atlantic summer flounder trawl fisheries	Coastal waters of SNE and MAB	June- Sept. 2008	Commercial trawl	Trawl	Bottom trawl. Experimental trawl with TED.	1.5 hr tows at 3 kts, 40 tows in SNE, 40 tows in MAB
Exploring bycatch reduction of summer, winter, yellowtail, and windowpane flounders using 12 in drop chain trawl net design in the small mesh fishery	Block Island Sound and Rhode Island Sound	May-Nov. 2010 12 DAS total	Two commercial trawlers	Bottom trawl	Side-by-side tow method comparing the control net with the experimental net, nets changed between vessels every 3 trips.	40 min tows, 4 to 5 tows per day, 48-60 paired tows total
Fishing efficiency and bottom contact effects of trawling with low-contact ground cables	GOM, Statistical Area 513	May–June 2013	F/V *Ellen Diane*, F/V *Sandi Lynn*	Demersal otter trawl	2-seam 6 in mesh, low contact ground cables. Tow speed approximately 2-3 kts.	Sample size unknown at this time.
Fuel saving in the topless trawl	GOM, Statistical area 514	May–June 2013	F/V *Mystic*	2-seam demersal otter trawl	6 in mesh size, head rope much longer than ground cable, topless configuration.	Sample size unknown at this time.
Groundfish net modified into topless flounder trawl	GOM, Statistical Area 133	May-June 2013	F/V *Stormy Weather*	Otter trawl modified to topless trawl	Standard 2-seam demersal trawl, 6 in trawl body and 6.5 in square mesh codend.	60 tows, 29-99 min at 2-3 kts
Reduce catch of white hake while targeting other groundfish species such as flounders in deep water habitat	GOM	May-June 2013	F/V *Jocka*	Demersal 2-seam otter trawl	6 in mesh, modified to topless trawl and rigged for deep water trials. Towed at 2-3 kts.	Sample size unknown at this time.
Reduction of butterfish and scup bycatch in the inshore *Loligo* squid fishery	Rhode Island Sound and Block Island Sound, Stat area 539	May-June and Sept.-Oct. 2009 10 DAS for each vessel	Two commercial bottom trawl vessels	Bottom trawl	Comparison of experimental and standard shrimp trawl gears	45-60 min tows at 3 kts, 120 tows total

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
Rigid mesh belly escapement panel for SNE winter flounder in the small mesh *Loligo* trawl fishery	Off Long Island, New York	June–Oct. 2010, 16 trips	F/V *Rianda S*	Avoidance Gear Adaptations (AGA) otter trawl	Bottom trawl. Comparison of experimental and standard trawl gears	45 tows each for the control and experimental nets, 90 tows total.
Squid mesh study and field staff	Between Montauk, NY and Ocean City, MD at depths ranging between 60 m and 134 m	Sept.–Oct. 2008	F/V *Karen Elizabeth*	Twin otter trawl methods (demersal)	Comparison of experimental and standard trawl gears. High-opening *Loligo* nets, two-seam, two- bridle “rope trawls” with detachable codends (3.4 m diameter).	70 paired tows, 1 hr tows at 3 kts
Testing of new Reidar's haddock trawl on Georges Bank	GB	Likely June-Aug. 2013	F/V *Sao Paulo*	Demersal otter trawl	6 to 8 in mesh sizes	40 estimated tows, towed at 2-3 kts for 120 min
Testing of 6 in mesh-sized square and top belly on large mesh haddock trawl	GB, Statistical area 522	Year round but will be completed in June 2013, one 7-day trip	F/V *Sao Paulo*	Demersal otter trawl targeting haddock	6 in mesh size with large mesh panel in the top of the belly	As many tows as possible, 1 hr tows
Topless trawl in Southern New England and Mid-Atlantic summer flounder trawl fishery to reduce sea turtle interactions.	Panama City, FL, SNE, and MAB	June 15-Aug. 15, 2010 14 DAS, 7 on each vessel	Two commercial vessels	Topless trawl	Bottom trawl. Comparison of experimental topless trawl and standard trawl gear	90 min tows, 3 paired tows per day, 40 paired tows total.
Projects using dredge gear						
Testing of a sea scallop dredge designs: mesh size twine top for finfish bycatch reduction	GB Closed Areas I & II, SNE Nantucket Light Ship and Rhode Island Bight, Elephant Trunk Access Area, MAB DelMarVa Access Area	This has been an on-going research initiative since 2002. Most recent work done in 2009–2010. Most work was conducted Aug. 2009–Jan. 2010	F/V *Westport*, F/V *Kathy Ann*, F/V *Tradition*, F/V *Celtic*, F/V *Diligence*	Scallop dredge (modified turtle dredge, twin top, bag design) using various mesh sizes and graduation of mesh configurations and chain mat designs.	Standard New Bedford and modified turtle deflector scallop dredges (4-5 meters wide), using twine top mesh sizes ranging from 6–12 in and hung at ratios from 2:1 and with various numbers of meshes across the apron.	52-239 tows at 4-4.5 kts per experiment. Total number of tows for project was 1675.

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
Projects using hook and line gear						
Evaluating the practicality and economic viability of a pilot redfish jig fishery	Offshore banks in the GOM - Platts Bank and Jeffreys Bank	June-Aug. 2010 10 day-trips, 10 DAS total	Hook-and-Line vessel	Jig	3 jig lines from the vessel, 10 hr fishing time	30 line hr per trip, 300 line hr total
Projects using gillnets						
Application of up to three styles of gillnets to assess species selectivity and avoidance of low allocation species	GOM, Statistical area 513	June-July 2013, 4 trips	F/V *Karen Lynn*, F/V *Miss Maura*, F/V *Capt. Al*, F/V *Sweet Misery*	Sink gillnet	Three styles of nets: 2 ft raised footrope, 7 in mesh and 6.5 in mesh with larger twine. 100 ft long gillnet panels.	At least 12 sets each of three different gillnets
Bycatch Reduction Engineering Program (BREP) monkfish gillnet - sturgeon	New Jersey water in Statistical areas 612, 614 and 615	Nov.–Dec. 2010 and 2011	F/V *Dana Christine*, F/V *Traveller II*	Sink gillnet	Control nets: 12 meshes by 12 in mesh size with 48 in tie downs spaced 24 ft apart. Experimental nets: 6 meshes by 12 in mesh size with 48 in. tie downs spaced 12 ft apart. Gillnets configured in 10-panel strings totaling 3,000 ft long. Soak time: 96 hr or less.	120 total hauls with 60 replicates each year.
Projects using other gear						
Are Norwegian cod pots an effective and economically viable gear type for catching cod in New England?	GOM near Cape Cod, MA in statistical areas 537, 526, and 525	May-June 2013.	F/V *Illusion*, F/V *Rose Marie*, F/V *Heritage*, F/V *Evan Christine*, F/V *James and Matthew*	Norwegian cod pots in conjunction with standard commercial otter trawls.	Gear specifics not available at this time.	Sample size unknown at this time.
Reducing juvenile alewife, blueback, and American shad bycatch in the coastal poundnet and floating fish trap fisheries	GOM inshore waters - Bailey's Island	2009	Commercial vessels	Floating fish traps and pound nets	Large fish pound nets that are stationary. Catch is gathered up using large dip nets after pursing the pound net to concentrate the fish.	Sample size unknown at this time.

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
Sea turtle-scallop fishery interaction study	MAB and coastal waters off NJ and MD out to edge of shelf	Oct. 2011-Aug. 2012. Two research trips completed in 2011 (tagging) and follow-up cruise to conduct transects for turtle observing.	Commercial scallop dredgers, F/V *Kathy Ann*, F/V *Ms. Manya*, F/V *Celtic*	ROV equipped with underwater video, radio tagging of turtles	Ultra-Miniature Digital Scanning Sonar (model 852-000-100) designed by Imagenex Technology Corporation mounted on ROV and operated at a frequency of 675/850 kHz to scan a full 360° with a range of 150 mm up to 50 m. 10 Satellite Relay Data Loggers (SRDL) with Argos Fastloc GPS tags.	Transects run at 4 kts until turtles spotted. Then turtle following mode implemented with ROV.
TAGGING PROJECTS						
Projects using trawl gear						
Movement and migration patterns of winter flounder (*Pseudopleuronectes americanus*) tagged along the Maine coast	Throughout inshore waters from NH to Eastport, ME	Mid-Mar. and July 2011 32 DAS	Two commercial trawl vessels	Maine shrimp net	Mid-water trawl. 15- 20 min tows at 2.5 kts	Up to 10 tows made daily by each vessel, 650 total tows
Northeast cooperative research dogfish tagging program	GOM, GB, SNE	Feb. 2011 to Dec. 2012	F/V *Lisa Ann II*, F/V *Sao Paulo*, F/V *Heather Lynn*	Commercial otter trawl	Bottom trawl. 20 to 30 min tows	34,604 individual fish were tagged
Projects using hook and line gear						
Is Cape Cod a natural delineation for migratory patterns in U.S. and Canadian spiny dogfish stocks?	North and south of Cape Cod	3 periods in 2011, spring (early June), summer (Aug.), and Fall (Oct.).	Commercial longline and gillnet vessels	Longline and gillnet	Longline gear deployed for 30 min; Gillnets: 10 min sets	Longline: 5 sets per trip, 15 sets total Gillnets: 5 sets per trip, 15 sets total
Tagging - Halibut	Coastal waters of Maine (2-24 nm offshore)	May–July 2007 and 2008	Commercial vessels	Longline gear	1800 ft of ground line with 3 ft gangions, 300 hooks per set. Circles hooks of numbers and (sizes): 33 (12/0), 33 (14/0) and 34 (16/0) were randomly assigned on a center point.	51 stations. Soak time was between 5 and 24 hr.

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
Projects using gillnets						
Tagging to assess monkfish (*Lophius americanus*) movements and stock structure in the Northeastern U.S. and age validation of monkfish in the Gulf of Maine	GOM, SNE and MAB (two sample sites each in Southern and Northern Management Areas)	Sept. 2007 to Jan. 2008, 18 separate DAS	F/V *C.W. Griswold*, F/V *Gertrude H.*	Commercial gillnets	8 to 12 in mesh gillnets, soak times ranged from 2-5 days	Sample size unknown at this time.
LIFE HISTORY PROJECTS						
Projects using trawl gear						
Defining Atlantic wolffish aggregations in Massachusetts Bay	Massachusetts Bay, Stellwagen Bank National Marine Sanctuary Stat area 514	May 22-June 30, 2011 10 DAS	Trawl vessels	Bottom trawl.	<30 min tows at 2.8 kts	5 tows per day, 50 tows total
Synoptic acoustic and trawl surveys to characterize biomass and distribution of the spring spawning aggregations of Atlantic cod in Ipswich Bay	Ipswich Bay, Statistical area 133	Single nights: late March, mid-May, mid-June, and mid-July of 2011; 8 DAS total	Two bottom trawlers	Bottom trawl and echosounder	10 min tows at 2 kts	10 pre-planned, and 5 adaptive tows per vessel per day, 4 days towing each, 120 tows total
Temporal aspects of habitat utilization and interspecies competition: defining the ecological impacts of spiny dogfish in structuring ecosystem dynamics of Southern New England	Off the coast of Rhode Island (Block Island)	May-Aug. 2009, 1 day per month	Commercial trawlers F/V *Proud Mary*, F/V *Elizabeth Helen*	Bottom trawl, midwater trawl	30 min tows for vessel at 2.5 –3 kts. Codend 15.2 cm mesh – 5.1 cm liner, sweep 23.7 m, spread 10.7 m.	5 tows each per day, 50 tows total

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
Projects using pot gear						
Examining settlement dynamics of postlarval American lobster, (*Homarus americanus*), in Lobster Management Area 2	Buzzards Bay, Rhode Island Sound, and Narragansett Bay (Statistical areas 538, 537, and 539)	May-Oct. 2009	Lobster vessels	Settlement collectors, satellite drifters	Settlement collectors will be deployed for about 90 days.	Varies
Expansion of the coastwide ventless lobster trap survey in Southern New England	Buzzards Bay, Rhode Island Bight, Block Island Sound, Long Island Sound.	June-Sept. 2010	F/V *Sherri & Deke*, F/V *Aaron Cebula*, F/V *Andrea C*, F/V *Jarrett Drake*, F/V *Cynthia Lee*	Standardized lobster pots	Alternating vented /ventless lobster pots, 21 in x 40 in x 14 in. 3-5 days soak time.	2 hauls per month, 8 hauls total
Exploratory fixed gear survey in the inshore Gulf of Maine, utilizing trap gear and targeting Atlantic wolffish	GOM, focusing on Boothbay Harbor, ME	Mid-Apr. to mid-June 2010, 2011, and 2012 6 DAS	Commercial lobster boat	Lobster pots with modified trap gear	Soak time depends on results	10 pots per sample, sample once per week
The Buzzards Bay lobster resource: are changes in reproduction having a negative impact on the fishery?	Buzzards Bay, MA, Lobster Management Area 2, Statistical area 538.	30 days in June-July, and one week in Nov. 2009 and 2010 6 DAS total	Lobster vessels	Lobster pots	24 to 48 hr soaks, pots set in June, retrieved in July, re-set in Nov., retrieved the end of Nov.	Total of 120 traps, 20 trawls (strings) grouped in 4 locations, 5 trawls per location, total of 40 vertical buoy lines
The use of settlement collectors to investigate the early life history of Atlantic wolffish (*Anarhichas lupus*) and Cusk (*Brosme brosme*) in the Gulf of Maine	Closed Area on Jeffery's Ledge	Nov. 2012-Aug. 2013, 8 trips total	F/V *Lady Victoria*	Lobster pots filled with cobble.	60 cm x 91 cm x 15 cm pots	32 pots total, 3-4 per month

Survey Name/Description	General Area of Operation	Season, Frequency, Annual DAS	Vessel Used	Gear Used	Gear Details	Number of Samples
Projects using other gear						
A fisherman-scientist collaboration to re-assess lobster nurseries in Narragansett Bay after two decades of environmental change	Narragansett Bay, Rhode Island	July 1, 2011– June 30, 2013	Commercial vessel. Also, cobble-filled collectors deployed by lobstermen.	Scuba divers and cobble collectors	Scuba divers using visual and suction sampling of 1 m^2 sampling units at 5 m and 10 m deep. Lobstermen place cobble collectors (2 ft x 4 ft mesh baskets filled with cobble)	20 quadrats per site, 4-5 sites per day. Visual counts and suction sampling at all sites.
An assessment of quahog larval supply and distribution in the Upper Narragansett Bay with a focus on spawning sanctuaries and alternative area management strategies	Narragansett Bay, Rhode Island	Sept.-June 2011-2013 (on-going - no final report	Not available	Not available	Not available	Sample size unknown at this time.
Studying the population of the channeled whelk (*Busycotypus canaliculatus*) fishery	Nantucket Sound, Vineyard Sound	June 2011-Oct. 2012 – varies but mostly during summer	Commercial vessels	Standard commercial whelk traps	Traps and bait used are variable. Typically about 22 in x 22 in x 10 in with 12 in x 12 in openings, weighted down with concrete blocks and deployed in strings of up to 10 pots.	Sample at least 200 individual animals
HABITAT PROJECTS						
Projects using other gear						
High resolution video survey of the sea scallop resource, recruitment patterns and habitat of Closed Areas relative to scallop and groundfish management	GB- Closed Area	2013	Commercial scallop vessel	Drop camera, towed vehicle coupled with dredge sampling	Commercial scallop dredge	Sample size unknown at this time.

This page intentionally left blank.

2.2.3 Mitigation Measures for Protected Species

Many of the research activities included in this Final PEA are conducted by NEFSC scientists but the NEFSC also funds or has substantial participation in many long-term and short-term research projects conducted by cooperating agencies and institutions, which are also included in the Final PEA (Tables 2.2-1 and 2.2-2). The fisheries and ecosystem research activities included in this Final PEA are conducted in all seasons but are more frequent in spring and fall (about 35 percent of surveys in each season), with summer surveys accounting for about 25 percent of the total and winter surveys the remaining 5 percent. Most of the NEFSC-affiliated research surveys are conducted within the Northeast U.S. Continental Shelf LME. In addition, two long-term surveys are conducted by NEFSC personnel and cooperating agencies in the Southeast U.S. Continental Shelf LME. The gear types fall into several categories: bottom-contact gear includes dredges, bottom trawls, lobster and crab pots, and bottom longlines; pelagic gear (used at various levels in the water column) includes pelagic longlines, various trawls, and gillnets; various gears used to sample small fish in estuary and coastal areas such as fyke nets, beach seines, and rotary screw traps: and many types of other scientific sampling gear and instruments (various fine-meshed plankton nets, active and passive acoustic instruments, video recording equipment, Conductivity Temperature Depth [CTD] profilers, etc.).

The Status Quo Alternative is to perform fisheries research as it was conducted from through 2013 as described in Table 2.2-1 and Table 2.2-2 (see also Appendix A for an illustrated description of different gear types used and Appendix B for a summary of the spatial/temporal distribution of research efforts). The Status Quo also includes mitigation measures that were developed by the NEFSC in consultation with marine mammal and sea turtle scientists and other protected species experts and are currently implemented on NEFSC surveys (e.g., standard avoidance procedures and the move-on rule). The long-term projects conducted by cooperating agencies and institutions also implement the same mitigation measures. For short-term projects conducted by cooperating partners (Table 2.2-2), no specific mitigation measures were contractually required for these types of projects under the Status Quo. However, they have been conducted by experienced researchers and fishermen using good seamanship and fishing practices to avoid hazardous situations (e.g., reconnaissance of trawl or dredge sites with sonar and visual observations to look for commercial fishing gear or underwater obstacles prior to setting the research gear). If any marine mammals or sea turtles had been seen during the reconnaissance period and were considered at risk of interaction with the gear, they would have been treated as a “hazard” and the sets would have been delayed or moved. The mitigation measures described below are anticipated to be required under Letters of Authorization (LOA) that would be issued under the Preferred Alternative for the specified research activities conducted by the NEFSC. However, these mitigation measures may not be sufficient to reduce the effects of NEFSC activities on marine mammals to the level of least practicable adverse impact (see Alternative 2), so additional mitigation may be required under the proposed action by the LOA.

The procedures described here are based on protocols used during previous NEFSC-conducted research surveys and the long-term cooperative research surveys described in Table 2.2-1. These procedures are the same whether the survey is conducted on board a NOAA vessel or charter vessel. At least some of the short-term cooperative research projects (Table 2.2-2) may not have followed all of these specific procedures. The NEFSC regularly reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluations of new mitigation measures include assessments of their effectiveness in reducing risk to protected species. Implementation of any such measures must also be subject to safety and practicability considerations, allow survey results to meet research objectives, and maintain consistency with previous data sets.

2.2.3.1 Ship Strikes

NEFSC-affiliated research vessels adhere to several mitigation measures which were implemented to minimize the risk of vessel collisions with right whales. Other species also benefit from these measures. The compliance guide for the right whale ship strike reduction rule (NMFS 2008b) states that all vessels 65 feet in overall length or greater must slow to speeds of 10 knots or less in seasonal management areas. Northeast U.S. Seasonal Right Whale Management Areas include: Cape Cod Bay (January 1 to May 15), Off Race Point (March 1 to April 30) and Great South Channel (April 1 to July 31). Mid-Atlantic Seasonal Management Areas include several port or bay entrances from November 1 to April 30.

When research vessels are actively sampling, cruise speeds are less than five knots, a speed at which the probability of collision and serious injury or mortality of large whales is low. When transiting between sampling stations, research vessels can travel at speeds of up to 14 knots. However, when NEFSC vessels are operating in right whale Seasonal Management Areas, Dynamic Management Areas, or at times and locations when whales are otherwise known to be present, they operate at speeds no greater than 10 knots. In addition, NEFSC research vessel captains and crew watch for marine mammals while underway during daylight hours and take necessary actions to avoid them. There are currently no Marine Mammal Observers (MMOs) aboard the vessels dedicated to watching for marine mammals to minimize the risk of collisions, although the large NOAA vessels operated by the NOAA Corps (e.g., R/V *Henry B. Bigelow*) include one bridge crew dedicated to watching for obstacles at all times, including marine mammals. At any time during a survey or in transit, any bridge personnel that sights protected species that may intersect with the vessel course immediately communicates their presence to the helm for appropriate course alteration or speed reduction as possible to avoid incidental collisions, particularly with large whales (e.g., North Atlantic right whales).

The Right Whale Sighting Advisory System (RWSAS) is a NOAA Fisheries program run by the NEFSC which was designed to reduce collisions between ships and the critically endangered North Atlantic right whale by alerting mariners to the presence of the right whales. These reports are obtained from a variety of sources including aerial surveys, shipboard surveys, whale watch vessels, and opportunistic sources (U.S. Coast Guard, commercial ships, fishing vessels, and the general public). All NOAA research vessels operating in North Atlantic right whale habitat participate in RWSAS.

2.2.3.2 Take Reduction Plans

Incidental take of marine mammals in commercial fisheries has been and continues to be a serious issue in the Northeast region. In compliance with section 118 of the MMPA, NMFS has developed and implemented several Take Reduction Plans (TRP) to reduce serious injuries and mortality of strategic marine mammal stocks that interact with certain commercial fisheries. Strategic stocks are those species listed as threatened or endangered under the ESA, those species listed as depleted under the MMPA, and those species with human-caused mortality that exceeds the Potential Biological Removal (PBR) for the species. The immediate goal of TRPs is to reduce serious injury and mortality for each species below PBR. The long-term goal is to reduce incidental serious injury and mortality of marine mammals from commercial fishing operations to insignificant levels approaching a zero serious injury and mortality rate, taking into account the economics of the fishery, the availability of existing technology, and existing state or regional fishery management plans. Although there are substantial differences between NEFSC research protocols and typical commercial fishing practices, most of the NEFSC fisheries research programs, including short-term cooperative research projects, comply with the gear requirements and operational limits consistent with the following TRPs. Some projects may have exceptions to these requirements specified in Scientific Research Permits or Experimental Fishing Permits if they interfere with research objectives or if elements of the TRP are the subject of the research.

The Atlantic Large Whale Take Reduction Plan (ALWTRP) was developed to reduce serious injury and mortality of North Atlantic right, humpback, fin, and minke whales in the Northeast/Mid-Atlantic lobster

trap/pot, Atlantic blue crab trap/pot, Atlantic mixed species trap/pot, Northeast sink gillnet, Northeast anchored float gillnet, Northeast drift gillnet, Mid-Atlantic gillnet fishery, Southeastern U.S. Atlantic shark gillnet, and Southeastern Atlantic gillnet fisheries (NMFS 2010b). A final rule was published in 1999 (64 FR 7529) and numerous amendments and revisions have been made since. The ALWTRP is continually evolving as more is learned about why whales become entangled and how fishing practices can be modified to reduce entanglement risks (NMFS 2013a). The most recent revisions were finalized in June 2014 (79 FR 36586). Universal gear modification requirements and restrictions apply to all lobster traps/pots and anchored gillnets, including: no floating buoy line at the surface; no wet storage of gear (all gear must be hauled out of the water at least once every 30 days); fishermen are encouraged, but not required, to maintain knot-free buoy lines; and all groundlines must be made of sinking line. Additional gear modification requirements and restrictions vary by location, date, and gear type. Additional requirements may include the use of weak links, and gear marking and configuration specifications. Detailed requirements may be found in the regional guides to gillnet and pot/trap gear fisheries available at http://www.nero.noaa.gov/Protected/whaletrp/.

The intent of the Bottlenose Dolphin Take Reduction Plan (BDTRP) is to reduce serious injuries and mortalities of coastal bottlenose dolphins incidental to the North Carolina inshore gillnet, Southeast Atlantic gillnet, Southeastern U.S. shark gillnet, U.S. Mid-Atlantic coastal gillnet, Atlantic blue crab trap/pot, Mid-Atlantic haul/beach seine, North Carolina long haul seine, North Carolina roe mullet stop net, and Virginia pound net fisheries (71 FR 24776). The following general requirements were implemented: spatial/temporal gillnet restrictions, gear proximity (fishermen must stay within a set distance of gear), gear modifications, non-regulatory conservation measures, and a revision to the large mesh gillnet size restriction (NMFS 2006a).

The Harbor Porpoise Take Reduction Plan (HPTRP) was developed to reduce interactions between harbor porpoises and commercial gillnet gear fisheries in the New England and the Mid-Atlantic areas. Management includes seasonal time and area closures that correspond with peak seasonal abundances of harbor porpoises and gear modification requirements such as the use of pingers, floatline length, twine size, tie downs, net size, net number, and numbers of nets per string (NMFS 2010d).

The Pelagic Longline Take Reduction Plan (PLTRP) addresses incidental serious injury and mortality of long-finned and short-finned pilot whales and Risso's dolphins in commercial pelagic longline fishing gear in the Atlantic. Regulatory measures include limiting mainline length to 20 nautical miles or less within the Mid-Atlantic Bight (MAB) and posting an informational placard on careful handling and release of marine mammals in the wheelhouse and on working decks of the vessel (NMFS 2009a).

The Atlantic Trawl Gear Take Reduction Strategy is a non-regulatory effort to address incidental serious injury and mortality of long-finned and short-finned pilot whales, short-beaked common dolphins, and white-sided dolphins incidental to the Mid-Atlantic mid-water trawl and other Atlantic trawl fisheries. Because estimates of annual human-caused serious injury and mortality were below PBR levels for these species, a take reduction plan was unwarranted. Voluntary mitigating measures include reducing the numbers of turns made by the fishing vessel and tow times while fishing at night and increasing between-vessel radio communications about marine mammal presence and/or incidental take to alert other fishermen of the potential for interactions in the area (NMFS 2009b).

2.2.4 Mitigation Measures for Protected Species during Research with Trawl Gear

2.2.4.1 Monitoring methods

- The officer on watch (or other designated member of the Scientific Party), and crew standing watch on the bridge visually scan for marine mammals, sea turtles, and other ESA-listed species (protected species) during all daytime operations. Bridge binoculars are used as necessary to survey the area upon arrival at the station, during visual and sonar reconnaissance of the trawl

line to look for potential hazards (e.g., commercial fishing gear, unsuitable bottom for trawling, etc.), and while the gear is deployed. If any marine mammals or sea turtles are sighted by the bridge or deck crew prior to setting the gear or at any time the gear is in the water, the bridge crew and/or Chief Scientist are alerted immediately. Environmental conditions (e.g., lighting, sea state, precipitation, fog, etc.) often limit the distance for effective visual monitoring of protected species.

2.2.4.2 Operational procedures

- "Move-on" Rule. If any marine mammals or sea turtles are sighted around the vessel before setting the gear, the vessel may be moved away from the animals to a different section of the sampling area if the animals appear to be at risk of interaction with the gear at the discretion of the officer on watch. Small moves within the sampling area can be accomplished without leaving the sample station. After moving on, if marine mammals or sea turtles are still visible from the vessel and appear to be at risk, the officer on watch may decide to move again or to skip the station. The officer on watch consults with the Chief Scientist or other designated scientist (identified prior to the voyage and noted on the cruise plan) and other experienced crew as necessary to determine the best strategy to avoid potential takes of these species. Strategies are based on the species encountered, their numbers and behavior, their position and vector relative to the vessel, and other factors. For instance, a whale transiting through the area and heading away from the vessel may not require any move, or may require only a short move from the initial sampling site, while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or possibly cancellation of the station if the dolphins follow the vessel. In most cases, trawl gear is not deployed if marine mammals or sea turtles have been sighted near the ship unless those animals do not appear to be in danger of interactions with the trawl, as determined by the judgment of the Chief Scientist or officer on watch. The efficacy of the "move-on" rule is limited during night time or other periods of limited visibility; research gear is deployed as necessary when visibility is poor, although operational lighting from the vessel illuminates the water in the immediate vicinity of the vessel during gear setting and retrieval.
- Once the trawl net is in the water, the officer on watch and/or crew standing watch continue to monitor the waters around the vessel and maintain a lookout for marine mammals and sea turtles. If these species are sighted before the gear is fully retrieved, the most appropriate response to avoid incidental take is determined by the professional judgment of the officer on watch, in consultation with the Chief Scientist or other designated scientist and other experienced crew as necessary. These judgments take into consideration the species, numbers, and behavior of the animals, the status of the trawl net operation (net opening, depth, and distance from the stern), the time it would take to retrieve the net, and safety considerations for changing speed or course. Consideration is also given to the increase in likelihood of marine mammal interactions during retrieval of the net, especially when the trawl doors have been retrieved and the net is near the surface and no longer under tension. In some situations, risk of adverse interactions may be diminished by continuing to trawl with the net at depth until the marine mammals and/or sea turtles have left the area before beginning haul-back operations. In other situations, swift retrieval of the net may be the best course of action. The appropriate course of action to minimize the risk of incidental take of protected species is determined by the professional judgment of the officer on watch and appropriate crew based on all situation variables, even if the choices compromise the value of the data collected at the station.
- If trawling operations have been delayed because of the presence of marine mammals or sea turtles, the vessel resumes trawl operations (when practical) only when these species have not

been sighted near the vessel or otherwise determined to no longer be at risk. This decision is at the discretion of the officer on watch and is situationally dependent.

- Care is taken when emptying the trawl, including opening the cod end as close as possible to the deck of the checker (or sorting table) in order to avoid damage to protected species that may be caught in the gear but are not visible upon retrieval. The gear is emptied as quickly as possible after retrieval in order to determine whether or not protected species are present.
- On Observer Training cruises, all Northeast Fisheries Observer Program (NEFOP) protocols are followed as per current NEFOP Observer Manual and NEFOP Biosampling Manual. In addition, the Lead Instructor for each training cruise advises the vessel Captain to refrain from deploying gear if any marine mammals or sea turtles are sighted around the vessel and appear to be at risk of interaction with the gear. A time delay or slight location change may be made in order to avoid interactions and allow for trawl operations to continue.

2.2.4.3 Tow duration

- Standard tow durations for all long-term bottom trawl surveys (Table 2.2-1) have been reduced to 20-30 minutes or less at targeted depth, excluding deployment and retrieval time, to reduce the likelihood of attracting and incidentally taking protected species. These short tow durations decrease the opportunity for curious marine mammals to find the vessel and investigate. The resulting tow distances are typically one to two nautical miles or less, depending on the survey and trawl speed. Short tow times reduce the likelihood that captured marine mammals or sea turtles would drown.
- A few mid-water trawl projects and the NEFOP trawl training cruises (Table 2.2-1) and short-term cooperative research projects (Table 2.2-2) may have longer tows (up to two hours). These exceptions to the short tow duration protocols are necessary to meet their research or training objectives.

2.2.5 Mitigation Measures for Protected Species during Research with Longline Gear

2.2.5.1 Monitoring methods

- The officer on watch, Chief Scientist (or other designated member of the Scientific Party), and/or crew standing watch on the bridge or deck visually scan for sea turtles, marine mammals and other ESA-listed species (protected species) during all daytime operations. In addition, for the Apex Predators Bottom Longline Coastal Shark Survey, the entire setting area is traversed prior to setting the gear to look for potential hazards and the officer on watch visually scans the waters surrounding the vessel for protected species at least 30 minutes before the longline gear is deployed. This typically occurs during transit through the setting area and then returning back to the starting point.

2.2.5.2 Operational procedures

- Prior to setting longline gear, the “move-on” rule is implemented if any protected species are sighted around the vessel in the 30 minutes prior to setting the gear and appear to be at risk of interactions with the longline gear, as determined by the professional judgment of the Chief Scientist or officer on watch. This decision is based on several factors including the species, behavior, and travel vector of the animals. The Apex Predators Bottom Longline Coastal Shark Survey uses a one nautical mile radius around the vessel as a guide for this decision. Small moves within the sampling area can be accomplished without leaving the sample station. The efficacy of the “move-on” rule is limited during night time or other periods of limited visibility when visual

monitoring is limited or ineffective; research gear is deployed as necessary when visibility is poor.

- After a sample site is moved due to the presence of marine mammals or sea turtles, if marine mammals or sea turtles are still visible from the vessel and appear to be at risk, the officer on watch will inform the Chief Scientist who may decide to move again or to skip the station. The officer on watch will consult with the Chief Scientist or other designated scientist (identified prior to the voyage and noted on the cruise plan) and other experienced crew as necessary to determine the best strategy to avoid potential takes of these species. Strategies are based on the species encountered, their numbers and behavior, their position and vector relative to the vessel, and other factors. Longline gear is always the first equipment or fishing gear to be deployed after the vessel arrives on station. However, there is usually a delay in when the vessel arrives on station and when the longline gear is deployed. For the larger scale longline surveys (e.g., various Apex Predators surveys), the sample site (set line) is visually and acoustically inspected for hazards (e.g., the presence of other fishing gear, snags on the bottom, etc.) For small-scale longline operations (e.g., COASTSPAN surveys that deploy 25-50 hooks), the small crew usually must first bait the line before it can be deployed. In all cases, the time between the vessel arriving on station and the deployment of gear allows for at least 30 minutes of monitoring time for protected species prior to setting the gear.
- If sea turtles or marine mammals are detected while longline gear is in the water, the officer on watch and/or crew standing watch in conjunction with the Chief Scientist exercise professional judgment and discretion to avoid incidental take of these species with the longline gear. The species, number, and behavior of the protected species are considered along with the status of the ship and gear, weather and sea conditions, and crew safety factors. The same judgment and discretion is used to minimize the risk of potentially adverse interactions with protected species during all aspects of longline survey activities.
- If sea turtles or marine mammals are detected during setting operations and are considered to be at risk, immediate retrieval or halting of the setting operations may be warranted. If setting operations have been halted due to the presence of these species, setting does not resume until no sea turtles or marine mammals are sighted near the vessel or these species are otherwise determined to no longer be at risk. Additionally, for large scale longline surveys, setting operations will not resume until there are no observations within one nautical mile of the vessel for at least 30 minutes. If sea turtles or marine mammals are detected while longline gear is in the water and are considered to be at risk, haul-back is postponed until it is safe to proceed. Adverse interactions with marine mammals, such as hooking and entanglement, are typically observed during retrieval of the longline gear when hooks are close to the surface.
- Hooks vary in size depending on the type of longline operation and target species. No stainless steel hooks are used in the NEFSC surveys so that in the event the hook cannot be removed, it will corrode. For swordfish (Pelagic Nursery Ground Studies), 18/0, 10^{o} offset circle hooks are used. To provide comparison to previous surveys a #40 Japanese tuna hook is used in the Pelagic Shark Survey. For the Bottom Longline Coastal Shark Survey, 3/0 Mustad #349703 J hooks were used when the survey was started in 1995 in order to have consistency with the gear used by commercial shark fisheries at that time. J hooks continue to be used in order to provide continuity with the time-series data set, which is essential for ongoing stock assessment purposes. If the hook type were changed to circle hooks to minimize sea turtle hookings, the time-series data on shark abundance would be invalidated and the survey would not meet its scientific objectives.
- For COASTSPAN large juvenile and adult surveys a 16/0 Mustad circle hook is used and for the small juvenile survey a 12/0 Mustad circle hook is used.

- NEFSC shark longline sets are conducted with either bottom (anchored) or pelagic (drifting) gear marked at both ends with buoys (Appendix A). Typical bottom sets for the Bottom Longline Coastal Shark Survey have a 3 hour soak time, pelagic sets vary from two to four hours, and COASTSPAN bottom longline sets have a two hour soak time for the large juvenile/adult gear and a 30 minute soak time for the small juvenile gear. Spiny dogfish are used as bait for the Apex Predators Bottom Longline Coastal Shark Survey. Circle hooks and finfish bait (mackerel or herring) are used with pelagic and COASTSPAN bottom longline gear where possible to minimize sea turtle bycatch.
- In all pelagic shark surveys, gear configuration allows a potentially hooked sea turtle or marine mammal the ability to reach the surface (i.e., gangions are 110 percent as long as the set is deep).
- NEFSC longline protocols specifically prohibit chumming (releasing additional bait to attract target species to the gear). Bait is removed from hooks during retrieval and retained on the vessel until all gear is removed from the area. The crew members do not discard offal or spent bait while longline gear is in the water to reduce the risk of protected species detecting the vessel or being attracted to the area.
- For all large scale longline surveys, as is required for commercial longline vessels, the Chief Scientist (at a minimum) is trained in NMFS/Highly Migratory Species Protected Species Safe Handling, Release, and Identification Workshops. Participants review mitigation methods required under various commercial fisheries whale and sea turtle take reduction plans as well as methods to release protected species safely (sea turtles, marine mammals, and smalltooth sawfish).
- In addition, for all large scale longline surveys, the Chief Scientist (at a minimum) is a NEFOP trained handler and tagger for sea turtles. Incidentally caught sea turtles are handled, tagged (only if a trained and duly authorized researcher is present), and released according to standard procedures (Appendix D).

2.2.6 Mitigation Measures for Protected Species during Research with Dredge Gear

2.2.6.1 Monitoring methods

- The monitoring procedures for dredge gear are the same as described for trawl gear.

2.2.6.2 Operational procedures

- The “move-on” rule and other decisions regarding the best course of action to avoid potentially adverse interactions with protected species are similar to those as described for trawl gear.
- Care is taken when emptying the dredge, including flipping the ring bag as close to the sorting table as possible in order to avoid damage to protected species that may be caught in the gear but are not visible upon retrieval. The gear is emptied as quickly as possible after retrieval in order to determine whether or not protected species are present.
- On Observer Training cruises, in-house training trip protocols are followed. Vessel crew and NEFOP staff continually watch for marine mammals and sea turtles while underway. Action is taken to avoid setting gear at times and places where concentrations of protected species are observed.

2.2.6.3 Tow duration

- Standard dredge durations are 15 minutes or less, excluding deployment and retrieval time, to reduce the likelihood of attracting and incidentally taking protected species. The resulting tow

distances are typically one nautical mile. Short tow times reduce the likelihood that captured marine mammals or sea turtles would drown.

2.2.6.4 Gear modifications

- The small size of the scallop dredge (eight feet wide) and clam dredge (13 feet wide) and the fishing orientation of the opening during most of the dredge haul (downward against the seabed) minimize the need for marine mammal and turtle excluding devices.
- On Observer training cruises, Turtle Deflector Dredges are used on all training cruises to prevent turtles resting on or near the bottom from being run over by the dredge. All gear is compliant with current commercial fishing regulations.

2.2.7 Mitigation Measures for Protected Species during Research with Gill Net Gear

2.2.7.1 Monitoring methods

- The monitoring procedures for gill nets are similar to those described for trawl gear.

2.2.7.2 Operational procedures

- Gill nets are not deployed if sea turtles or marine mammals have been sighted on arrival at the sample site. The exception is for animals that, because of their behavior, travel vector or other factors, do not appear to be at risk of interaction with the gillnet gear.
- If no sea turtles or marine mammals are present, the gear is set and monitored during the soak. If a sea turtle or marine mammal is sighted during the soak and appears to be at risk of interaction with the gear, then the gear is pulled immediately.
- On Observer Training cruises, acoustic pingers and weak links are used on all gill nets consistent with the regulations and TRPs for commercial fisheries. All NEFOP in-house training trip protocols are followed. Soak duration time is 12-24 hours in order to reduce possible gear interaction with protected species. Communication with the NEFOP Training Lead and the vessel Captain occurs within 24-48 hours prior to setting of gear. During these communications, it is decided on when to set the gear, specifically taking into account any possible weather delays to avoid a long soak period. Gear is not deployed if a significant weather delay is expected that would increase the preferred soak duration greater than 24 hours. In those situations, the gear set times will be delayed.
- On COASTSPAN gillnet surveys, gillnets are continuously monitored during the three hour soak time by under-running it, pulling it across the boat while leaving the net ends anchored. All animals, algae and other objects are removed with each pass as the net is reset into the water. This practice maximizes survival, minimizes bycatch mortality, and insures the best shark condition for tagging. If after the first two passes there are no sharks in the net, the net is left to soak for the time remaining before retrieval. The boat remains with the gear for the entire soak time to monitor it for potential protected species bycatch when it is not being under-run across the boat.

2.2.8 Mitigation Measures for Protected Species during Research with Pot and Trap Gear

2.2.8.1 Gear modifications

- There are no long-term research activities that use pot or trap gear (Table 2.2-1) but there have been a number of short-term cooperative research projects that have used pot/trap gear under the Status Quo (Table 2.2-2). These types of projects have been conducted by groups affiliated with the commercial fishing industry and have been conducted on commercial vessels using standard

industry gear unless modifications to the gear were part of the research design. Unless specifically exempted as part of their experimental fishing permits, the gears used in these projects would be in compliance with regional gear modifications and seasonal restrictions required under the Atlantic Large Whale Take Reduction Plan (see Section 2.2.3.2).

2.2.9 Mitigation Measures for Protected Species during Research with Fyke Net Gear

2.2.9.1 Monitoring methods

- Marine mammals are noted during transit to the site and prior to deployment. Typically the gear is set at low tide and therefore on emerged intertidal area.

2.2.9.2 Operational procedures

- Fyke net sets are deployed in specific locations and remain in place for 12 to 24 hours, at which time the net is retrieved and resultant catch sampled and released.

2.2.9.3 Gear modifications

- A harbor seal was taken in a 2-meter fyke net in 2010 (see Section 4.2.4) using the protocols described above. Subsequent to that incidental take, and excluder device was developed to prevent marine mammals from entering the fyke net. As of the 2011 field season, all 2-meter fyke nets are equipped with marine mammal excluder devices (14 centimeters spaced aluminum bars, see Appendix A). 1-meter fyke nets are constructed with entrances less than 14 centimeters wide. This size effectively prohibits marine mammals from entering the net.

2.2.10 Mitigation Measures for Protected Species during Research with Beach Seine Gear

2.2.10.1 Monitoring methods

- Beach seines are set inshore by small boat crews that visually survey the area for marine mammals prior to set and continually during the set.

2.2.10.2 Operational procedures

- Seines are deployed with one end held on shore by a crew member and the net slowly deployed by boat in an arc and then retrieved by pulling both ends onto shore. Typical seine hauls are less than 15 minutes with the resultant catch sampled and released. Marine mammals are unlikely to interact with the net as they would typically not remain on the shore or in the water in the presence of the field crew. If marine mammals are observed to be interacting with the gear, it will be lifted and removed from the water.

2.2.11 Mitigation Measures for Protected Species during Research with Rotary Screw Trap Gear

2.2.11.1 Monitoring methods

- The NEFSC deploys Rotary Screw Traps (RSTs) in coastal Maine rivers to monitor juvenile Atlantic salmon (smolts) during their migration from natal rivers into the Gulf of Maine. These are current-propelled sampling devices that operate under a variety of flow conditions. RSTs are deployed in April and removed according to sampling schedule (generally June). The traps are tended daily by sampling crews.

2.2.11.2 Operational Procedures

- RSTs are made of heavy gage aluminum and are anchored to trees, ledges, or boulders within the river/estuary using six-strand 3/8 inch steel cable (Appendix A). Traps operated by the NEFSC are in three sizes: four feet, five feet, and eight feet.
- RST tending schedules are adjusted according to conditions of the river/estuary and threats to protected species. Sampling can be modified (period fishing), delayed, or concluded according to the threat to Atlantic salmon or other protected species. Each RST is equipped with a 75 gallon 'live car' to hold captured fish. Under most conditions the live car is only 3/4 full of water which, in the remote chance a seal is caught in the trap, would allow an incidentally trapped animal to breath air. No marine mammals have been taken in this gear in the past.

2.2.12 Mitigation Measures for Protected Species during Research with Acoustic Telemetry Gear

2.2.12.1 Monitoring methods

- The NEFSC deploys passive acoustic telemetry receivers in many of Maine's rivers, estuaries, bays and into the Gulf of Maine. These receivers are used to monitor tagged Atlantic salmon, as well as other tagged animals of collaborators along the east coast. The receivers are set by small boat crews that visually survey the area for marine mammals prior to set, although interactions with the gear or boats are not expected.

2.2.12.2 Operational Procedures

- Receivers are anchored using a 24 pound mushroom anchor or a 79 pound cement mooring and attached to a surface float by 11/16 inch sinking pot warp with a weight rating of 1,200 pounds. Units in the estuary and bay are equipped with whale-safe weak links with a weight rating of 600 pounds.
- Other receivers are deployed on coastal commercial lobstermen's fishing gears which comply with fishing regulations for nearshore operations. The receivers are recovered twice annually, but the traps are tended according to required fishing schedules of the fishery.

2.2.13 Plankton Nets, Small-mesh Towed Nets, Oceanographic Sampling Devices, Video Cameras, and Remotely Operated Vessel (ROV) Deployments

The NEFSC deploys a wide variety of gear to sample the marine environment during many of their research cruises, such as plankton nets, oceanographic sampling devices, video cameras, and ROVs. These types of gear are not considered to pose any risk to protected species because of their small size, slow deployment speeds, and/or structural details of the gear and are therefore not subject to specific mitigation measures. However, the officer on watch and crew monitor for any unusual circumstances that may arise at a sampling site and use their professional judgment and discretion to avoid any potential risks to protected species during deployment of all research equipment.

2.2.14 Handling Procedures for Incidentally Captured Individuals

2.2.14.1 Marine Mammals

- Captured live or injured marine mammals are released from research gear and returned to the water as soon as possible with no gear or as little gear remaining on the animal as possible. Animals are released without removing them from the water if possible. Data collection is conducted in such a manner as not to delay release of the animal(s) and includes species identification, sex identification if genital region is visible, estimated length, disposition at release

(e.g., live, dead, hooked, entangled, amount of gear remaining on the animal, etc.) and photographs. The Chief Scientist or crew collect as much data as possible from hooked or entangled animals, considering the disposition of the animal; if it is in imminent danger of drowning, it is released as quickly as possible.

- If a large whale is alive and entangled in fishing gear, the vessel will immediately call the U.S. Coast Guard (USCG) at VHF Ch. 16 and/or the appropriate Marine Mammal Health and Stranding Response Network. Entangled whales will be reported to the NOAA Fisheries entanglement reporting hotline (1-866-755-6622).

2.2.14.2 Sea Turtles

- Many of the research cruises conducted or funded by the NEFSC include personnel that have been trained and certified in proper handling techniques for sea turtles and are authorized to measure and tag incidentally caught sea turtles. Crews that have not been trained or authorized to tag turtles typically have experience with proper handling procedures for turtles through training opportunities associated with commercial fishing. Any sea turtles caught on cruises with trained personnel on board are handled and resuscitated according to established procedures found at 50 CFR 223.206(d)(1) and described in the manual, "How To Resuscitate Sea Turtles" (Appendix D). Data collection includes species identification, length, weight, sex, visible injuries, disposition at release (e.g., live, dead, hooked, entangled, amount of gear remaining on the animal, etc.), photographs, and the presence of Passive Integrated Transponder (PIT) tags. If scientific personnel are onboard who have permits for sea turtle research, they may elect to install PIT tags in the flippers of animals that have not already been tagged. Captured turtles are quickly processed and released in accordance with established handling procedures (Appendix D).
- NEFSC policy currently is to not retain dead sea turtles unless permitted to do so and at the request of other researchers or agencies. Pending the outcome of consultation undertaken pursuant to section 7 of the ESA, sea turtle carcasses would be salvaged or biological data would be obtained from live turtles in accordance with established regulations (50 CFR 223.206 and 222.310).

2.2.14.3 Atlantic and Shortnose Sturgeon

- Captured live and injured Atlantic and shortnose sturgeon are handled in accordance with established handling procedures, which include immediate processing and release. Data collection includes species identification, length, weight, sex, visible injuries and the presence of PIT tags (Appendix D). Authorized scientific personnel will install PIT tags in animals that have not already been tagged.
- Current BiOps on the BTS and NEAMAP programs require that any dead Atlantic or shortnose sturgeon must be transferred to NMFS or an appropriately permitted research facility NMFS will identify so that a necropsy can be undertaken to attempt to determine the cause of death and/or other appropriate examinations can take place. Atlantic sturgeon carcasses should be held in cold storage until shipping.

2.2.14.4 Atlantic Salmon

- Captured live and injured Atlantic salmon are handled in accordance with established handling procedures, which include immediate processing and release. Data collection includes length, weight, description of visible injury, and search for presence of tags (elastomer, etc.) and/or fin clips. Photographs are taken if possible.

- Any Atlantic salmon incidentally killed during NEFSC research activities are frozen for future examination.

2.3 ALTERNATIVE 2 – PREFERRED ALTERNATIVE - CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH (NEW SUITE OF RESEARCH) WITH MITIGATION FOR MMPA AND ESA COMPLIANCE

The Preferred Alternative is comprised of a combination of research activities continued from the past and additional, new research surveys and projects. Several long-term surveys and projects described in Table 2.2-1 under the Status Quo Alternative will not be continued under the Preferred Alternative. Those surveys have been noted in Table 2.2-1 and include the following:

- Apex Pelagic Shark longline survey (Maryland to Canada),
- Ecosystem Monitoring survey, which has been expanded and renamed in the Preferred Alternative (see "Northeast Integrated Pelagic Survey" in Table 2.3-1), and
- Estuarine Habitat Dynamics and Telemetered Movements (a small tagging project in New Jersey).

Several new, long-term surveys and projects have been added to the Preferred Alternative that were not included in the Status Quo Alternative; these projects are summarized in Table 2.3-1. The short-term, cooperative research projects described in Table 2.2-2 in the Status Quo Alternative generally will not continue under the Preferred Alternative, although some of them may still be in progress or may continue under somewhat different configurations. These types of projects are designed to address emerging needs of the fishing industry for information about particular species or modifications to fishing gear to address conservation concerns. They are typically funded through competitive grant processes that entertain new research proposals every year. The exact scientific focus and research procedures for future proposals cannot be anticipated. However, the Preferred Alternative assumes that similar types of projects will be proposed and funded in the future. The NEFSC has estimated the types of fishing gear and level of effort required to accommodate future requests for short-term cooperative research projects, as summarized in Table 2.3-2. This level of fishing effort will be considered, along with the long-term projects described in Table 2.2-1 and Table 2.3-1, as the collective level of research activities under the Preferred Alternative. Future proposals for funding and other support for cooperative research will be compared to the scope of research described in these three tables to assess whether the projects are consistent with the NEPA analysis presented in this Final PEA.

Under this alternative, the NEFSC has applied for authorizations under the MMPA and ESA for incidental take of protected species during these research activities. This process requires regulations and authorizations for incidental take of marine mammals under the MMPA and incidental take of protected species under the ESA. Under this alternative, the NEFSC has applied to NMFS Headquarters Office of Protected Resources (OPR) requesting regulations governing the issuance of LOAs for incidental take of marine mammals under the MMPA. The OPR has made the necessary findings and promulgated regulations and issued an LOA to the NEFSC; the LOA prescribes mitigation measures intended to reduce the risk of potentially adverse interactions with marine mammals during the specified research activities.

In addition, both OPR and the NEFSC have engaged in ESA section 7 consultations with NMFS Greater Atlantic Regional Fisheries Office (and U.S. Fish and Wildlife Service [USFWS]) for species that are listed as threatened or endangered. These consultations have resulted in the development of a Biological Opinion (BiOp) that describes the determination of NMFS that the federal action is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of any critical habitat. The BiOp contains an incidental take statement (ITS) for ESA-listed species that includes reasonable and prudent measures along with implementing terms and conditions intended to minimize the impact of incidental take of ESA-listed species during NEFSC research activities.

2.3.1 Long-term Research Activities

Table 2.3-1 Summary Description of the Additional Long-Term NEFSC-Affiliated Surveys Considered under the Preferred Alternative.

These surveys and projects are in addition to those described under the Status Quo Alternative in Table 2.2-1. Units of measurement are presented in the format data was collected. Abbreviations used in the table: DAS = days at sea; m = meter; kts = knots; min = minutes; cm^2 = square centimeter; m^3 = cubic meter; kHz = kilohertz; ft = feet; in = inch; hr = hours; mi = miles.

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
NORTHEAST US CONTINENTAL SHELF LME								
Projects using pelagic trawl gear								
Northeast Fisheries Observer Program (NEFOP) Mid-Water Trawl Training Trip	This program provides certification training for NEFOP Observers.	Maine to North Carolina	Annually 5 DAS	Contracted commercial fishing vessels	Various commercial nets	Varies by gear supplied by chartered vessel	1-2 tows per trip 5-10 tows total	Standard Avoidance and Move-on Rule. All NEFOP Observer protocols followed as per current NEFOP Observer Manual.
Northeast Integrated Pelagic Survey (***Expanded and renamed version of Ecosystem Monitoring survey from Table 2.2-1***)	The objective of this project is to assess the pelagic components of the ecosystem including water currents, water properties, phytoplankton, microzooolankton, mesozooplankton, pelagic fish and invertebrates, sea turtles, marine mammals, and sea birds.	Cape Hatteras to Western Scotian Shelf	Quarterly 80 DAS	R/V *H.B. Bigelow*, R/V *Pisces*, R/V *G. Gunter*	Hydroacoustic Midwater Rope Trawl	Net size: 15 m x 30 m Tow speed: 4 kts Duration: 5-30 min at depth	80 tows	Standard Avoidance and Move-on Rule. Seabird/marine mammal observers provide additional monitoring capacity as they survey birds, mammals, and sea turtles from the flying bridge on transits between stations during daylight hours.
					Isaacs-Kidd midwater trawl	3 m and 4.5 m Tow type: oblique Tow speed: 2.5 kts Duration: 30 min (max)	160 tows	
					Midwater trawl for use in shallow water (>15 m depth)	8 m x 8 m opening Tow speed: 2.5 kts Duration: max 30 min	80 tows	
					Split beam and multi-beam acoustics	Output Freq: 18 kHz, 38 kHz,70 kHz, 120 kHz and 200 kHz	Continuous	
					Bongo net equipped with CTD	61 cm diameter Tow type: oblique Tow speed: 1.5 kts Duration: max 20 min	600 tows	
					Baby bongo: added to subset of Bongo tows	20 cm diameter attached above standard Bongo	480 casts	
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 1 hr (max)	250 casts	
					ADCP on vessel	300 kHz or 150 kHz	Continuous	
Projects using longline gear								
NEFOP Observer Bottom Longline Training Trips	This program provides certification training for NEFOP observers.	Maine to North Carolina	Annually 5 DAS	Contracted commercial fishing vessels	Commercial bottom longline gear	Mainline length: Approximately 3,000 ft Circle hooks: 600 per set	2-3 sets per trip 10-15 sets total	Standard Avoidance and Move-on Rule. All NEFOP Observer protocols followed as per current NEFOP Observer Manual. All applicable TRP gear requirements for commercial fisheries under the MSA.

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Projects using other gears								
DelMarVa Habitat Characterization	The objective of this project is to characterize and determine key hard bottom habitats in coastal ocean off the DelMarVa Peninsula as an adjunct to the DelMarVa Reef Survey.	Coastal waters off DE, MD and VA	August, annual 5 DAS, daytime only	R/V *Resolute*	ADCP	600 kHz ADCP	Continuous	Standard Avoidance and Move-on Rule
					Single beam, dual frequency sonar	38 and 120 kHz, transects at 2-4 kts for 4-6 hrs.	20 transects	
					Video Sled	Sea Cam 5,000 12 volt video camera: tow speed 1 kt, 15 min transects (~500 m)	20 transects	
					CTD	Sea Bird CTD	20 casts	
					YSI	YSI 6000	20 drops	
					Plankton net	1.4 m x 1.0 m Tucker trawl	20 vertical tows	
					Ponar grab	152 m x 152 m	20 drops	
					Kemmerer bottle	2.2 L	20 casts: 20 water samples	
DelMarVa Reefs Survey	The objective of this project is determination of extent and distribution of rock outcrops and coral habitats and their use by black sea bass and other reef fishes	Coastal waters off DE, MD and VA	August, annual 5 DAS	R/V *Sharp*	HabCam towed camera vehicle	Still cameras w/strobe lighting, CTD, sidescan sonar (200 kHz) Towing speed: 5 kts	continuous	Standard Avoidance and Move-on Rule
					CTD Profiler	Tow speed: 0 Duration: 5-15 min	30 casts	
Miscellaneous Fish Collections and Experimental Survey Gear Trials	The James J. Howard Sandy Hook Marine Laboratory occasionally supports short-term research projects requiring small samples of fish for various purposes or to test alterations of survey gear. These small and sometimes opportunistic sampling efforts have used a variety of gear types other than those listed under Status Quo projects. The gears and effort levels listed here are representative of potential requests for future research support.	NY Bight Estuary waters	TBD	R/V *Nauvoo*, R/V *Resolute*, R/V *Harvey*, R/V *Chemist*	Combination bottom trawl	Net size: 23 ft head rope, 32 ft sweep, 7 ft rise Tow speed: 2.5 kts Duration: 20 min	5 trawls	Standard Avoidance and Move-on Rule
					Lobster pots	18 in x 24 in x 136 in wire pot Connected by 3/8 in rope With 7 in x 14 in surface float	1-60 pots set for 24-96 hr between retrievals	
					Fish pots	9 in x 9 in x 18 in wire pot With 1/8 in mesh liner Connected by 3/8 in rope With 7 in x 14 in surface float	1-60 pots set for 24-96 hr between retrievals	
					2 m beam trawl	1/4 in mesh liner, towed at 2 kts for 15 min	5 tows	
					Seine net	25-200 ft net	5 sets	
					Trammel nets	Multi Trammel Net, 12 in walling, 3 in^2 mesh 6 ft deep x 25 ft long	5 sets	
SOUTHEAST US CONTINENTAL SHELF LME								
Projects using other gears								
Opportunistic Hydrographic Sampling	This program consists of opportunistic plankton and hydrographic sampling during ship transit.	Southeast LME at depths less than 300 m	Early summer—once per year	R/V *Okenos Explorer*	Plankton net	2 m x 1 m net deployed to 25 m, 330 micron mesh	50 samples	Standard Avoidance and Move-on Rule
					Expendable bathythermographs	Sippican	50 deployments	

2.3.2 Short-term Research Activities

Table 2.3-2 Collective Scope of Short-Term, Cooperative Research Activities Considered under the Preferred Alternative.

Gear Used	General Area of Operation	Season	Number of Samples
SURVEY PROJECTS			
Trawls • Flatfish Surveys • Monkfish, longfin squid and other catchability surveys	GOM, GB, SNE, MAB	Year round but primarily Summer-Fall	Flatfish surveys: 550 bottom tows per year, 20-30 min/tow at 3 kts Monkfish and catchability surveys: 630 pelagic tows per year, 20-30 min/tow at 3 kts
Hook and Line • Eastern Maine hook and line/ jig survey in hard bottom areas • Western-Central Gulf of Maine hard bottom longline survey	Downeast Maine coastal waters, western-central GOM, coastal waters and off-shore waters focused on sea mounts.	Spring and Fall	60 longline stations per year in eastern Maine, 90 longline stations per year in western-central GOM, up to 2,000 hooks per station depending on tide 48 stratified random jigging stations in eastern Maine, 5 lines per station, 3 hooks per line, 5 min soak time
Pots/traps • Scup & black sea bass pot survey	SNE, Rhode Island Bight, Nantucket Sound, MAB waters from shore to shelf edge.	Spring and fall for black sea bass. Year round for scup.	Scup/ black sea bass: 2,650 pot sets per year
CONSERVATION ENGINEERING PROJECTS			
Bottom Trawl • Gearnet conservation engineering work • Selectivity studies in Acadian redfish fishery and other Small mesh fisheries • Squid selectivity studies	GOM, GB, SNE, MAB	Year round sampling in various studies.	Estimated 500 tows per year under various protocols similar to commercial fishing conditions. Assume tow durations average 60 min per tow.
Dredge • Scallop dredge finfish and turtle excluder research • Hydrodynamic dredge development	GB, SNE, MAB	Annually Aug.-Jan.	Estimated over 1,700 dredge tows per year.
Hook and Line • Utilization of electric rod and reel jig fishing targeting groundfish in the Gulf of Maine	Western GOM	Oct.-Jan.	20 DAS total, two vessels with 4 jigging machines (electric reels) each.

Gear Used	General Area of Operation	Season	Number of Samples
Gillnets • Gillnet pinger exchange and research • Raised foot rope gillnet selectivity study	GOM and GB Gillnet raised foot rope-Statistical area 513	Pinger exchange summer 2013, fishing year around. Raised foot-rope gillnet fishing monthly.	Raised foot rope: 69 sets of 24 hr soak time duration. 100 ft long nets, 4-net sets. Pinger-details not available.
Pots/traps • Efficient cod harvesting using fish pots as an adjunct to otter trawl trips (TRAWLPOT)	Statistical areas: 525, 526, 537 (near CA1, western side of Great South Channel, and Block Island area)	5 sample periods, ideally in Spring	Newfoundland cod pots (2 m x 2 m x 1 m), 10 pots deployed at a time, 2-5 days soak, 100-250 pot soak days total
TAGGING PROJECTS			
Trawl • Winter flounder migration patterns	Coastal waters in Gulf of Maine from New Hampshire to Stonington/Mt. Desert Island, Maine	Spring and Summer	10 otter trawl tows daily, up to 650 bottom trawls per year, 15-20 min per tow at 2.5 kts
Hook & Line and Gillnet • Spiny dogfish tagging north and south of Cape Cod • Cusk & NE multi-species tagging	GOM and GB waters adjacent to Cape Cod, MA	Spring, Summer, Fall sampling periods	Long line: 5 sets per trip, 15 sets total. Gillnet: 5 sets per trip, 15 sets total. (10 min sets)
Gillnets • Monkfish tagging	GOM, SNE, MAB	Sept.–Jan.	18-20 DAS, 10 short-duration sets per day, 180-200 sets total
LIFE HISTORY PROJECTS			
Gillnets • Monkfish population dynamics and climate change	MAB (work conducted by University of MD Eastern Shore under Research Set Aside Program)	Spring through Summer	Collecting fishery dependent data from monkfish collaborators. Number of gillnet sets dependent on commercial fishing operations, unknown at present.
HABITAT PROJECTS			
Pots/traps (artificial substrate settlement studies) • Lobster settlement research • Wolffish and cusk habitat studies	SNE, Rhode Island Bight Western GOM, Jeffery's Ledge Closed Area	Spring, Summer Fall All months	Total of 120 traps, 20 trawls (strings) grouped in 4 locations, 5 trawls per location, total of 40 vertical buoy lines. 32 pot sets, 3-4 per month.

2.3.3 Mitigation Measures for Protected Species

Under the Preferred Alternative, the NEFSC would apply for authorizations under the MMPA and the ESA for incidental take of protected species while conducting the suite of research activities described above. The Preferred Alternative includes the same suite of mitigation measures described in the Status Quo Alternative to reduce the risk of adverse interactions with protected species but also includes several additional measures as described below. The mitigation measures to be implemented in this Preferred Alternative are non-discretionary requirements of the MMPA incidental take authorization and the ESA section 7 consultation process.

The NEFSC considers the current suite of monitoring and operational procedures to be necessary to avoid adverse interactions with protected species and still allow the NEFSC and its cooperating partners to fulfill their scientific missions. However, some mitigation measures such as the move-on rule require judgments about the risk of gear interactions with protected species and the best procedures for minimizing that risk on a case-by-case basis. Ship captains and Chief Scientists are charged with making those judgments at sea. They are all highly experienced professionals but there may be inconsistencies across the range of research surveys conducted and funded by the NEFSC in how those judgments are made. In addition, some of the mitigation measures described in the Status Quo Alternative could also be considered “best practices” for safe seamanship and avoidance of hazards during fishing (e.g., prior surveillance of a sample site before setting trawl gear). At least for some of the research activities considered in this Final PEA, especially those conducted by cooperative research partners, explicit links between the implementation of these best practices and their usefulness as mitigation measures for avoidance of protected species have not been formalized and clearly communicated with all scientific parties and vessel operators. In the case of at least some of the cooperative research projects funded through the NEFSC, scientific procedures and data reporting protocols have been specified in contracts with cooperating research partners but specific procedures to avoid or report interactions with protected species have not been incorporated into contracts. The NEFSC therefore intends to implement a series of improvements to its protected species training, awareness, and reporting procedures under the Preferred Alternative. The NEFSC expects these new procedures will facilitate and improve the implementation of the mitigation measures described under the Status Quo Alternative.

- Under the Preferred Alternative, the NEFSC would initiate a process for its Chief Scientists and vessel captains to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. As noted in the Status Quo Alternative description of mitigation measures, there are many situations where professional judgment is used to decide the best course of action for avoiding marine mammal and sea turtle interactions before and during the time research gear is in the water. The intent of this mitigation measure would be to draw on the collective experience of people who have been making those decisions, provide a forum for the exchange of information about what went right and what went wrong, and try to determine if there are any rules-of-thumb or key factors to consider that would help in future decisions regarding avoidance practices. The NEFSC would coordinate not only among its staff and vessel captains but also with those from other fisheries science centers with similar experience.
- NEFSC scientists conducting longline surveys for highly migratory species (e.g., Apex Predator Surveys and COASTSPAN) have received, and would continue to receive, formal training through NMFS Highly Migratory Species/Protected Species Safe Handling, Release, and Identification Workshops. Participants review mitigation methods required under various commercial fisheries whale and sea turtle take reduction plans as well as methods to release protected species safely (sea turtles, marine mammals, and smalltooth sawfish). However, such training has not been required under the Status Quo Alternative for researchers working with other gear types. Another new element of the Preferred Alternative would be the development of

a formalized protected species training program for all crew members that would be required for all NEFSC-affiliated research projects, including cooperative research partners. Training programs would be conducted on a regular basis and would include topics such as monitoring and sighting protocols, species identification, decision-making factors for avoiding take, procedures for handling and documenting protected species caught in research gear, and reporting requirements. This would be accomplished through participation in protected species training programs developed by the regional commercial fisheries Observer Program, which would typically be the Northeast Fisheries Observer Program but some NEFSC cooperative partners may receive training through the Southeast Region Fisheries Observer Program. The Fisheries Observer Program currently provides protected species training (and other types of training) for NMFS-certified observers placed onboard commercial fishing vessels. NEFSC Chief Scientists and appropriate members of NEFSC research crews would be trained using similar monitoring, data collection, and reporting protocols for protected species as is required by NEFOP. All NEFSC research crew members that may be assigned to monitor for the presence of marine mammals and sea turtles during future surveys would be required to attend an initial training course and refresher courses annually or as necessary. The implementation of this training program would formalize and standardize the information provided to all crew that might experience protected species interactions during research activities.

- For all NEFSC-affiliated research projects and vessels, written cruise instructions and protocols for avoiding adverse interactions with protected species would be reviewed and, if found insufficient, made fully consistent with the NEFOP training materials and any guidance on decision-making that arises out of the two training opportunities described above. In addition, informational placards and reporting procedures would be reviewed and updated as necessary for consistency and accuracy. Many research cruises already include pre-sail review of protected species protocols for affected crew but the NEFSC would emphasize the need for such pre-sail briefings and require them to be included before all research cruises, including those conducted by cooperating partners.
- The NEFSC would incorporate specific language into its contracts that specifies all training requirements, operating procedures, and reporting requirements for protected species that would be required for all charter vessels and cooperating partners.

2.3.4 Handling Procedures for Protected Species

Handling procedures for incidentally captured sea turtles would be the same under the Preferred Alternative as they are under the Status Quo Alternative. There is a difference, however, between the Status Quo Alternative and the Preferred Alternative in the handling and data collection procedures for incidentally captured marine mammals. Certain types of data are needed to evaluate the severity of marine mammal injuries, which has implications for marine mammal stock assessments and classification of takes for MMPA and ESA compliance purposes. The Chief Scientist or other designated scientists would receive training on the types of information needed to make injury determinations through the NEFOP Observer protocols and training described above. If the safety of the crew and captured animal would not be compromised, the scientific party or trained crew would attempt to collect biological information from captured, live marine mammals before they are released, including species identification, sex identification (if genital region is visible), estimated length, and photographs. This information would be recorded on standardized regional commercial fishery observer forms. If the safety of the crew or the captured animal would be compromised by this data collection effort, the animal would be immediately released. In addition to gathering data on incidentally caught animals, the Chief Scientist or trained crew would be required to remove as much gear as possible from an animal before release. Gear remaining on an animal has the potential to cause future entanglements and generally increases the chances that an

injury would be serious. Human safety is paramount when considering whether and how to disentangle or dehook a marine mammal.

The Chief Scientist would submit data on all captured animals to marine mammal experts at the appropriate NMFS Science Center who would use specific criteria to determine whether the injury is considered serious (i.e., more likely than not to result in mortality). If insufficient data has been collected for any reason, the marine mammal experts may not be able to determine the severity of the injury. However, the marine mammal experts may use other types of information to assign the injury to either the serious or non-serious categories.

2.3.5 Unknown Future NEFSC Research Activities

In addition to the activities identified above, the NEFSC may propose additional surveys or research activities within the timeframe covered by this programmatic analysis. Because of the annual cycle under which decisions to fund and/or conduct research are made, the NEFSC cannot identify in advance all the potential future activities that may take place in the near future. For purposes of this programmatic analysis, NMFS has examined the research activities that have occurred from 2008-2013 and used this information as a proxy for future proposed research activities. Taken together, these activities comprise the actions evaluated within this Final PEA under the Preferred Alternative.

In the future, as congressional appropriations and NMFS fisheries research budgets are established, the NEFSC would examine the proposed future research to determine if the activities are consistent with the scope of actions considered under the Preferred Alternative. To be considered 'within scope' under this Final PEA, future proposals for specific research projects must be consistent with the gear types, spatial/temporal distribution of research activities, and types of effects analyzed within this document. If future research projects are not consistent with the type or scope of fisheries research activities analyzed in this Final PEA, they may be subject to additional NEPA, ESA, and MMPA evaluations.

More specifically, the basic methodology used to evaluate any proposed future research activity would be as follows:

1. **Evaluate the activity to determine if it would be conducted within the geographic scope of the region evaluated in the Final PEA.** The evaluation described in Chapter 4 of this Final PEA is based on the historic spatial distribution of research surveys. Any future research activities proposed within the geographic areas described in Chapter 4 would pass this step of the evaluation. Any proposed research outside of those areas may require additional evaluation.
2. **Evaluate the seasonal distribution of the activity**. The activities evaluated in this Final PEA are conducted throughout the year but certain surveys are only conducted in specific time frames/seasons. If a program was proposed that was similar in methodology to past surveys but significantly shifted the timing of research activities from what was analyzed in this Final PEA, additional evaluation may be required.
3. **Evaluate the gear types proposed**. The gear types that were included in the analysis are described in Appendix A. If the proposed future research activity used the same or similar gear in the same manner analyzed in this Final PEA, then the research activity would fall within the analysis conducted. The research activity would not have to exactly match the descriptions in this Final PEA, because the same impacts would be expected from similar gear types and activities. For example, if a new side-scan sonar were to be deployed, but the signal strength and frequency were within the ranges evaluated for bottom sounding sonar evaluated in this Final PEA, then the impacts would be similar because only the area swept by the sonar would be changing. If a new type of gear was to be deployed, or if a gear type was to be used in substantially different ways than described, and if environmental impacts not considered in this Final PEA could result, then additional NEPA analysis would be required.

4. **Evaluate the status of the resources that may be affected by the research.** The Final PEA uses an average level of catch and bycatch as well as the frequency and nature of past interactions with various protected species to determine the impacts of research on marine resources. The Final PEA considers the effects of past research on living marine resources based on their current or recent status in regards to population level or conservation concern. However, the status of those resources, e.g., fish stocks, varies over time and by fishery management region. If a future project proposes to conduct research on a fish or invertebrate stock that is overfished or depleted at the time, or if it would occur in areas and with gear that would likely result in substantial bycatch of overfished stocks, the potential effects of the proposed research project could be much greater than estimated in the Final PEA and additional NEPA analysis may be required.

To reiterate, any proposed action 1) conducted in regional areas described in this Final PEA, 2) during times of the year considered, 3) using gear types and methods generally equivalent to the methods evaluated, and 4) being directed at fish or invertebrate stocks that would not be affected substantially by the research, would be considered covered by the scope of analysis and conclusions drawn in this Final PEA. If future proposed research activities, projects, or programs are not consistent with the type or scope of fisheries research activities analyzed in this Final PEA, they would require additional NEPA evaluations.

2.4 ALTERNATIVE 3 – MODIFIED RESEARCH ALTERNATIVE - CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH (NEW SUITE OF RESEARCH) WITH ADDITIONAL MITIGATION

Under Alternative 3, the NEFSC would continue fisheries research as described in Section 2.3 and Appendix A and would apply for authorizations of incidental take of protected species under the MMPA and the ESA. Alternative 3 would include all of the same mitigation measures required by the MMPA and ESA authorization procedures as described for the Preferred Alternative. The difference between Alternative 3 and the Preferred Alternative is that Alternative 3 includes a number of additional mitigation measures derived from a variety of sources including: 1) comments submitted from the public on potential mitigation of commercial fisheries impacts, 2) discussions within NMFS as a part of the proposed rulemaking process under the MMPA and consultation process under the ESA, and 3) a literature review of past and current research into potential mitigation measures. The new suite of research activities is a combination of past research and additional, new research, as described for the Preferred Alternative.

The NEFSC regularly reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluating new mitigation measures includes assessing their effectiveness in reducing risk to protected species, but measures must also pass safety and practicability considerations, meet survey objectives, allow survey results to remain consistent with previous data sets, and be consistent with the purpose and need for NEFSC research activities (Section 1.3). Some of the mitigation measures considered in this alternative (e.g., no night fishing or broad spatial/temporal restrictions) would essentially prevent the NEFSC from collecting data required to provide for fisheries management purposes under the MSA. Some research surveys necessarily sample in habitats important to protected species with an inherent risk of interactions with protected species and sea turtles during those surveys. The NEFSC acknowledges the inherent risk of these surveys and it has implemented a variety of measures to mitigate that risk. The NEFSC currently has no viable alternatives to collecting the data derived from these surveys and does not propose to implement potential mitigation measures that would preclude continuation of these surveys, such as the elimination of research activities conducted at night or periods of poor visibility. An analysis of the potential efficacy and practicability of the additional mitigation measures considered in this alternative is presented in Sections 4.4 and 4.6.

The secondary federal action covered under this Final PEA is the issuance of requested regulations and subsequent Letters of Authorization under Section 101(a)(5)(A) of the MMPA that would regulate the unintentional taking of small numbers of marine mammals incidental to the NEFSC's research activities. In order to authorize incidental take of marine mammals under the MMPA, NMFS must identify and evaluate mitigation measures to minimize impacts to marine mammals to the level of "least practicable adverse impact." As described above, some mitigation measures could prevent the NEFSC from maintaining the utility of ongoing scientific research efforts, and those mitigation measures would normally be excluded from consideration in the Final PEA under screening criteria 3 (Section 2.1). However, such mitigation measures were considered during the MMPA incidental take authorization process and/or ESA section 7 consultation and are therefore considered under Alternative 3 in this Final PEA.

2.4.1 Additional Mitigation Measures for Protected Species

2.4.1.1 Monitoring methods

Visual observations (using bridge binoculars as needed) by the officer on watch, Chief Scientist or other designated scientist, and crew standing watch are currently the primary means of detecting protected species in order to avoid potentially adverse interactions. However, there are other detection methods that have been used in commercial fisheries, naval exercises, and geotechnical exploration that could be

considered. These additional types of detection methods would be intended to be used in specific circumstances, such as operating at night or in low visibility conditions.

- Visual surveillance by dedicated protected species observers. This measure would require the NEFSC to use trained protected species observers whose dedicated job is to detect the presence of marine mammals and other protected species within the survey area and communicate their presence to ship operations personnel to implement mitigation measures and appropriate modifications of trawl operations. Considerations include the use of dedicated observers for all surveys or during trawl surveys of particular concern.
- Use of a camera or underwater video system to monitor any interactions of protected species with trawl gear. Underwater video technology may allow the NEFSC to determine the frequency of interactions with trawl gear and to evaluate the effectiveness of a measure’s ability to mitigate injurious or lethal interactions.
- Use of passive acoustic monitoring for marine mammal vocalizations to aid in the detection of marine mammals present in the survey area and to implement appropriate modifications of trawl operations.
- Use of aircraft, unmanned aerial vehicles, or autonomous underwater gliders to provide additional detection capabilities.
- Use of infrared (IR) technologies to detect protected species.
- Use of night-vision devices to detect protected species.

2.4.1.2 Operational restrictions

- This measure would alter the move-on rule by requiring the NEFSC to implement a minimum 30 minute monitoring period before any research trawl gear is put in the water. Assigned personnel would be dedicated to the role of protected species observer and would visually scan around the vessel as far as environmental conditions allow. If any marine mammals are seen over the 30 minute period, the gear would not be deployed. If the marine mammals leave the area or dive and are not seen again, a new 30 minute monitoring period would be conducted under the same protocols. Alternatively, the Chief Scientist may decide to abandon the station and move to the next sampling station to avoid potential marine mammal interactions.
- This measure would require the NEFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize interactions with protected species that would be difficult to detect by visual monitoring.
- Decoy vessels for longline projects. This measure would require use of a decoy research vessel playing prerecorded longline fishing sounds to distract marine mammals away from the fishing grounds.

2.4.1.3 Acoustic and visual deterrents

- This measure would require the NEFSC to use deterrents on gear that does not already include such deterrents, such as acoustic pingers or recordings of predator vocalizations (e.g., killer whale) to deter interactions with trawl gear, or use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope) to reduce marine mammal interactions with the gear.

2.4.1.4 Gear modifications

- This measure would require the NEFSC to use marine mammal and/or turtle excluder devices on all of its trawl nets or on a subset of those gears considered to have a high risk of protected

species interactions. There are a number of excluder devices currently used in commercial trawl fisheries that may be adaptable to trawl nets used for research. The NEFSC would need to examine the alternatives for excluder devices for each type of net that would be deployed in areas and seasons where sea turtles and marine mammals could be at risk of capture and conduct analyses as to their compatibility with research objectives. Under this alternative, the NEFSC would integrate any such devices into their research trawl nets that prove practicable.

- This measure would require the NEFSC to use large circle hooks (e.g., 18/0 or larger) and finfish bait for all of its longline surveys and projects in order to reduce incidental takes of sea turtles.
- Video sampling with an open cod end: The NEFSC would investigate the use of video cameras to identify fish and their encounter rates in lieu of a closed cod end on trawl surveys, which may take protected species as well as target fish. This approach could be appropriate for swept area surveys designed to determine the density of fish or verification of acoustic target identification. However, it would not be appropriate for surveys designed to determine the reproductive condition of adult fish or the growth rates of fish as these measurements require the dissection of specimens. Considerable insight and experience may be gained by experimenting with open cod end trawls and associated high-resolution, high-speed video cameras, particularly with real-time video feeds to the ship. In some cases this experience could lead to routine use of cameras instead of capture. In other situations the number of closed cod end trawls required for estimating vital rates could be reduced. While it would not be the primary objective, video camera data may also provide documentation of protected species interactions with trawl gear and may thus provide insight into the efficacy of other measures intended to reduce the interactions with protected species (e.g., excluder devices or chain mats).
- Streamer lines for longline projects. Under this measure, the NEFSC would deploy streamer lines before longline gear is set to mitigate the risk of catching seabirds. Deploying streamer lines on each side of the baited longline to discourage seabirds from diving on baited hooks has been proven effective in reducing seabird bycatch in some Pacific fisheries (Melvin et al. 2001).
- Comply with ALWTRP requirements (e.g., sinking groundline, fewer vertical lines, closed areas, weak links, etc.) for any pot/trap projects that are not already compliant.

2.4.1.5 Temporal or geographic restrictions

- Spatial/temporal restrictions are one of the most direct means of reducing adverse impacts to protected species. By reducing the overlap in time and space of the survey’s footprint with known concentrations of protected species, the NEFSC may reduce the amount of incidental take of such species. This measure would require the NEFSC to identify areas and times that are most likely to result in adverse interactions with protected species (e.g., areas of peak abundance) and to avoid, postpone, or limit their research activity to minimize the risk of such interactions with protected species as long as such spatial/temporal restrictions do not conflict with the ability of the NEFSC to conduct scientifically valid surveys and to provide the best scientific information available for purposes of managing commercial fisheries. This may include limits on specific locations, physical or oceanographic features, biologically important times, and/or gear types.
- Avoidance of federal and state marine protected areas. This measure would disallow or restrict NEFSC trawl surveys in federal and/or state marine protected areas (Section 3.1.2.4).

2.5 ALTERNATIVE 4 – NO RESEARCH ALTERNATIVE - NO FIELDWORK FOR FEDERAL FISHERIES AND ECOSYSTEM RESEARCH CONDUCTED OR FUNDED BY NEFSC

Under the No Research Alternative the NEFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this Final PEA in marine waters of the U.S. Atlantic coast. This moratorium on fieldwork would not extend to research that is not in scope of this Final PEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents. NMFS would need to rely on other data sources, such as fishery-dependent data (e.g., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its responsibility to manage, conserve and protect living marine resources in the U.S. Under this alternative, organizations that have participated in cooperative research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding. Any non-federal fisheries research would occur without NMFS funding, direct control of program design, or operational oversight. It is unlikely that these non-NMFS fisheries research surveys would directly continue the time-series data NMFS has collected over many years, which is the core information supporting NMFS science and management missions and vital to fishery management decisions made by the Fishery Management Councils, NMFS, and other marine resource management institutions, leading to greater uncertainty for fishery and other natural resource management decisions.

Currently, fisheries and marine ecological research is also being conducted or funded by the U.S. Navy, National Science Foundation, state agencies, other international agencies, and research institutes in the U.S. Atlantic coastal area, sometimes with funding support from the NEFSC. However, much of the fisheries related research conducted by non-NMFS entities is generally confined to state waters and near-shore ocean areas and does not cover many fisheries topics currently investigated by the NEFSC. Under the No Research Alternative, it is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by the NEFSC. No agencies or other entities would likely conduct fisheries and ecosystem research to replace the research abandoned by the NEFSC under the No Research Alternative.

2.6 ALTERNATIVES CONSIDERED BUT REJECTED FROM FURTHER ANALYSIS

As stated previously, the alternatives evaluated in a Final PEA must achieve the purpose and need of the proposed action without violating any of the applicable laws and regulations described in Chapter 6 and summarized in section 1.6. Other potential alternatives that do not satisfy the agency's purpose and need, or would not meet minimum environmental standards, are not considered reasonable and need not be carried forward for evaluation in a Final PEA. The following alternatives were considered but rejected because they do not meet the purpose and need as stated in Section 1.3 or the screening criteria described in Section 2.1.

2.6.1 Sole Reliance on Commercial Fishery Data

One alternative that NMFS considered was to rely solely on commercial fisheries data such as catch per unit effort, seasonal and geographic distribution of harvests, and other harvest data to assess the status of commercially important stocks. This alternative was rejected from further analysis because it would not provide sufficient information on the age/size class structure of exploited fish stocks and would be insufficient to track fish population dynamics or provide other types of predictive capabilities required to manage the fisheries. This approach would also not meet the need to maintain a standardized, objective, and unbiased sampling approach provided by independent surveys.

Conclusion: This alternative does not meet screening criteria 1 or 3. It would not meet statutory obligations because directed research activities would not be conducted. It would not maintain scientific integrity of research programs because the results would not maintain the consistency of data with prior research efforts. For these reasons this alternative is not carried forward for detailed evaluation.

2.6.2 New Methodologies

Another alternative considered was to adopt other types of survey methodologies or develop new methodologies based primarily on their potential to eliminate or greatly reduce interactions with protected species or effects on habitat, as opposed to adopting new methods and gear for fisheries research purposes. Although NMFS continues to place a high priority on avoiding adverse interactions with protected species and is continually reviewing potential mitigation measures for research activities, the purpose and need for conducting fisheries research requires future sampling methodologies be consistent with past data sets to maintain long-term trend analyses for commercially fished and ecologically important species. NMFS is currently evaluating alternative sampling methods for fisheries and marine ecosystem research, some of which may reduce the potential for incidental takes of protected species or effects on benthic habitats. However, these new methodologies would be evaluated primarily for consistency with the purpose and need for fisheries and marine ecosystem research and whether they provide information that can build on and supplement past data sets.

Conclusion: This alternative did not meet screening criterion 3. It would not maintain scientific integrity of research programs because the results would not maintain the consistency of data with prior research efforts. Therefore, this alternative is not carried forward for detailed evaluation.

2.6.3 Alternative Research Program Design

In this alternative the types of research conducted would be revised to determine if alternative levels of a particular research would result in different levels of impacts. This alternative would emphasize minimizing potential adverse environmental impacts when designing research activities. Other factors, such as maximizing efficient use of scientific research funding and maintaining the integrity of long-term data sets, would not be considered in this approach.

Conclusion: This alternative was rejected because it would not meet screening criterion 3 and would intrude on inherently technical and scientific decisions. Therefore, this alternative is not carried forward for detailed evaluation

Consistent with Section 1502.15 of the CEQ NEPA regulations (40 CFR Part 1500), this chapter describes key components of the human environment that could be directly and/or indirectly affected by the alternatives.

The Northeast Fisheries Science Center (NEFSC) is proposing to conduct scientific research activities designed to acquire information needed for the conservation and management of federal fishery resources. These activities potentially affect a broad range of resource issues that reflect the complex interactions between science and management, related environmental outcomes, and the connected social and economic interactions. These topics are discussed further below.

Three major components are examined in detail:

- Section 3.1 describes the current physical environment potentially affected by the proposed NEFSC research activities;
- Section 3.2 describes the current biological environment potentially affected by the proposed NEFSC research activities. This section includes a discussion of fish, marine mammals, birds, sea turtles, and invertebrates, including threatened and endangered species, and other protected species.
- Section 3.3 describes the social aspects of the fishing communities potentially affected by the proposed NEFSC research activities;

3.1 PHYSICAL ENVIRONMENT

NEFSC fisheries research activities are conducted off the Atlantic coast of the United States (U.S.), primarily within 200 miles of the shoreline from Cape Hatteras, North Carolina to the U.S.-Canada border. This primary research area is known as the Northeast U.S. Continental Shelf Large Marine Ecosystem (NE LME). In addition, a small number of NEFSC survey activities extend south into the Southeast U.S. Continental Shelf LME and north into the Scotian Shelf LME. However, the majority of NEFSC research activities occur within the NE LME.

3.1.1 Large Marine Ecosystems

Large Marine Ecosystems (LMEs) are large areas of coastal ocean space. LMEs generally include greater than 77,000 square miles of ocean surface area, and are located in coastal waters where primary productivity is generally higher than in open ocean areas. LME physical boundaries are based on four ecological criteria: bathymetry, hydrography, productivity, and trophic relationships. Based on these four criteria, 10 LMEs have been delineated for the coastal marine waters of the U.S., and a total of 64 distinct LMEs have been delineated around the coastal margins of the Atlantic, Pacific and Indian Oceans (Sherman et al. 2004). Figure 3.1-1 shows the world's LMEs as defined at www.lme.noaa.gov. Each color represents a distinct LME.

Globally, LMEs are the source of 80 to 95 percent of the world's marine fish harvest, and are centers of economic activity for oil and gas, shipping, and tourism industries. The LME concept provides a practical framework for the application of ecosystem-based approaches to fisheries assessment and management, habitat restoration, and research on pollution and ecosystem health. The National Oceanic and Atmospheric Administration (NOAA) and National Marine Fisheries Service (NMFS) have implemented a management approach designed to improve the long-term sustainability of LMEs and their resources by using practices that focus on ensuring the sustainability of the productive potential for ecosystem goods and services.

From a management perspective it is essential to establish a baseline condition of LMEs so that success or failure of management actions can be measured. This approach includes analyzing changes to LME productivity, fish and fisheries, ecosystem health, socioeconomics, and governance. For more detailed information on the LME management concept and trends in ecosystem health, see *The UNEP* [United Nations Environmental Program] *Large Marine Ecosystem Report: A perspective on changing conditions in LMEs of the world's Regional Seas* (Sherman and Hempel 2009), which is incorporated by reference.

The fisheries research activities conducted by the NEFSC take place primarily in the NE LME, with occasional projects extending into the Scotian Shelf LME to the north and the Southeast U.S. Continental Shelf LME to the south (Figure 3.1-1), or into deeper waters offshore. The NE LME has a total area of approximately 115,831 square miles, and is structurally very complex, with marked temperature changes, winds, river runoff, estuarine exchanges, tides and complex circulation regimes. The NE LME is subdivided into four major subareas: the Gulf of Maine (GOM), Georges Bank (GB), Southern New England (SNE), and the Mid-Atlantic Bight (MAB) (Figure 3.1-2). The following information on these LME subdivisions comes from Sherman *et al*. (1996), and Stevenson *et al*. (2004); refer to these references for more detailed information about the physical characteristics of the environment. The biological attributes of the LME subareas are described in other sections of this chapter, including fish (Section 3.2.1), marine mammals (3.2.2), birds (3.2.3), sea turtles (3.2.4), and invertebrates (3.2.5).

3.1.1.1 Gulf of Maine (GOM)

The GOM is an enclosed coastal sea characterized by relatively cold waters and deep basins. The GOM is bounded on the east by Browns Bank, on the north by Maine and Nova Scotia, on the west by Maine, New Hampshire, and Massachusetts, and on the south by Cape Cod and GB (Figure 3.1-2). Retreating glaciers (18,000-14,000 years ago) formed a complex system of deep basins, moraines, and rocky protrusions, leaving behind a variety of sediment types including silt, sand, clay, gravel, and boulders. These sediments are patchily distributed on the sea floor throughout the GOM, with occurrence largely related to the topography of the bottom.

Water patterns in the GOM exhibit a general counterclockwise current, influenced primarily by cold water masses moving in from the Scotian Shelf and offshore. Although large-scale water patterns are generally counterclockwise around the GOM, many small gyres and minor currents do occur. Freshwater runoff from the many rivers along the coast into the GOM influences coastal circulation as well. These water movements feed into and affect the circulation patterns on GB and in Southern New England (SNE), both of which are discussed below.

Water and sediment quality within the GOM may be influenced by current and historic disposal of dredged material. The Secretary of the Army, through the US Army Corp of Engineers (USACE) is currently authorized to issue permits for the disposal of dredged material. Within the GOM, there are four sites that were or are currently used for disposal of dredged material. Those sites are the St. Helena Island, Portland, Cape Arundel, and the Massachusetts Bay disposal sites. These sites were used to dispose of dredged material, and had limited regulation until Congress passed the Marine Protection, Research and Sanctuaries Act (MPRSA) to regulate ocean dumping of industrial waste, sewage sludge, biological agents, radioactive waste, and other wastes in U.S. territorial waters. A 1988 amendment to MPRSA, called the Ocean Dumping Ban Act, further limited ocean-dumping to strictly dredged material by 1992. Settled materials from offshore disposal have the potential to be impacted by research, due to the possibility of seafloor disturbance by bottom-contacting fishing gear. The USACE maintains a publicly-available database that tracks disposal activity occurring at each of these sites.

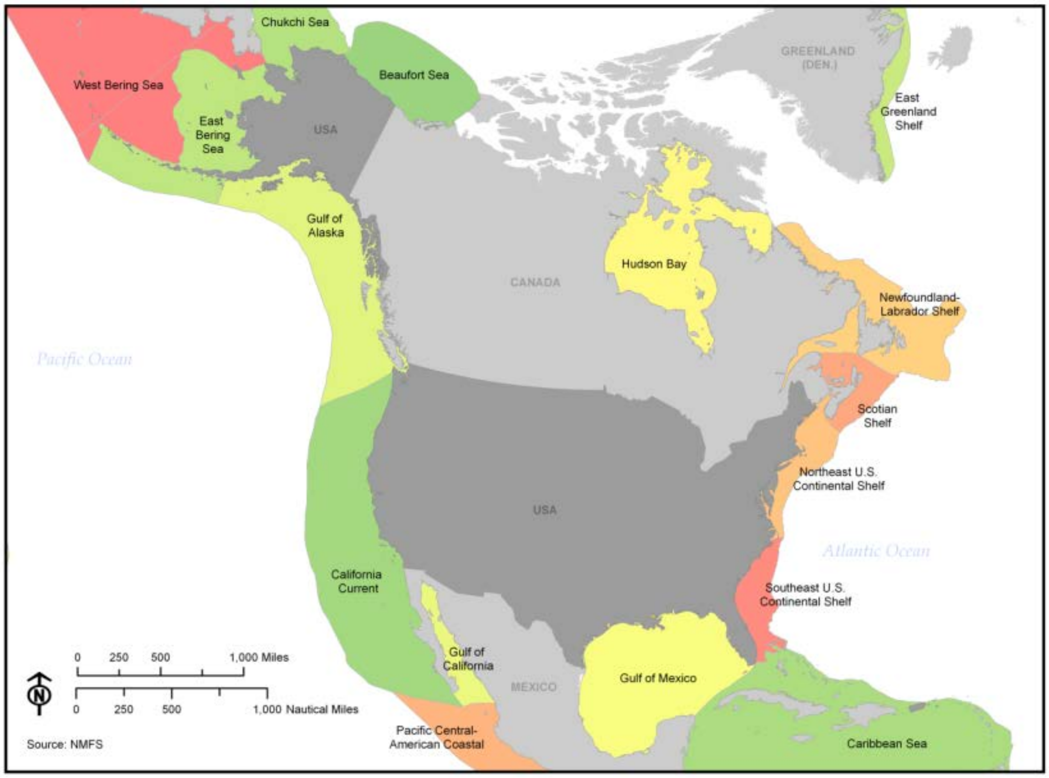


Figure 3.1-1 Large Marine Ecosystems off the Coasts of North America.

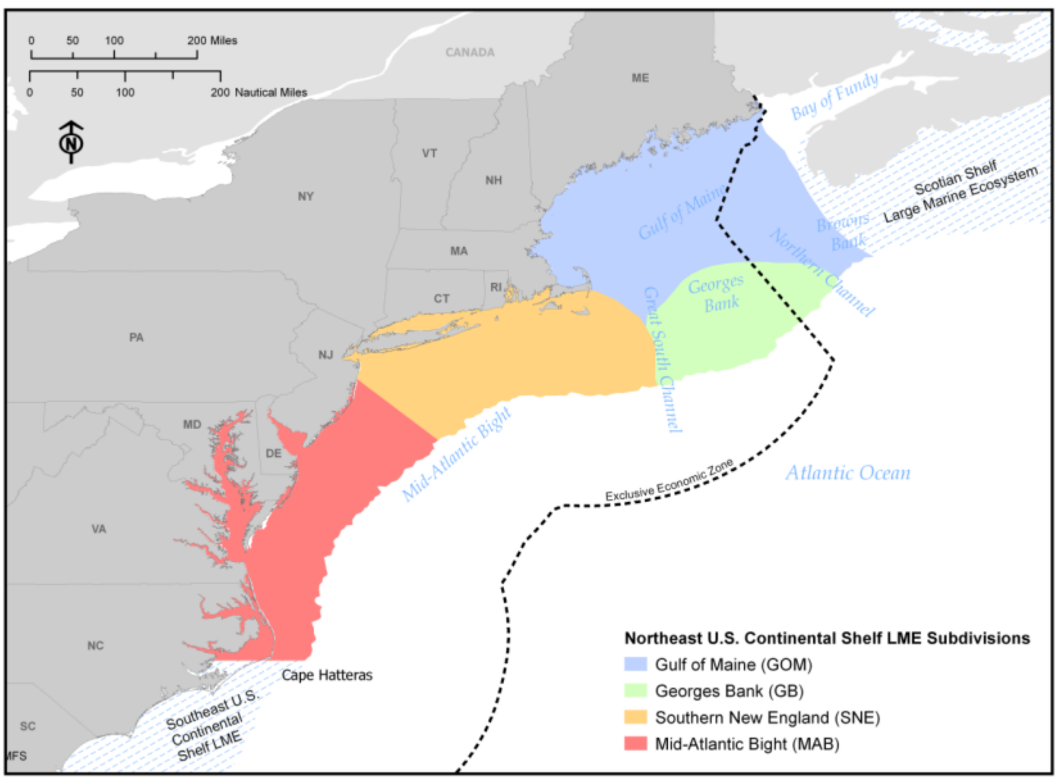


Figure 3.1-2 Subdivisions of the NE LME

GB is a shallow, elongate extension of the Northeast U.S. Continental Shelf, and it is characterized by a steep slope on its northern edge and a broad, flat, and gently sloping southern flank except where it is cut by submarine canyons. The GOM lies to the north of GB, the Northeast Channel is to the east (between GB and Browns Bank); the continental slope lies to the south, and the Great South Channel (GSC) separates GB and SNE to the west (Figure 3.1-2). Although the top of GB is predominantly characterized by sandy sediment, glacial retreat during the late Pleistocene era resulted in deposits of gravel along the northern edge of GB, and some patches of silt and clay can be found on the sea floor.

The most dominant oceanographic features of GB include a weak but persistent clockwise gyre that circulates over the whole bank, however strong tidal flows (predominantly northwest and southeast) and strong but intermittent storm-induced currents are also present. The strong tidal currents result in vertically well-mixed waters over the bank. The clockwise GB gyre is in part driven by the southwestern flow of shelf and slope water that forms a countervailing current to the Gulf Stream.

3.1.1.2 Southern New England (SNE)

The SNE subarea extends from the Great South Channel in the east to the MAB in the west (Figure 3.1-2). The southwestern flow of cold shelf water feeding out of the GOM and off GB dominates the circulatory patterns in this area. The SNE continental shelf is a gently sloping region with smooth topography. The shelf is approximately 62 miles wide, and the shelf break occurs at depths of between 328 to 656 feet. The continental slope extends from the shelf break to a depth of 6,562 feet. This zone has a relatively steep gradient, and the relief is moderately smooth. The continental rise (6,500 feet to 19,700 feet) is similar to the slope in having only gradual changes in bathymetry. However, the overall gradient of the continental rise is less than that of the continental slope (Theroux and Wigley 1998).

Sediments of the SNE subarea are dominated by fine-grained sand and silt. Patches of gravel can be found in places on the sea floor, such as on the western flank of the Great South Channel. Water and sediment quality within the SNE may be influenced by current and historic disposal of dredged material. Within the SNE, there are seven sites that were or are currently used for disposal of dredged material. Those sites are the Rhode Island Sound, East Rockaway Inlet, Mud Dump, the Historic Area Remediation Site, Shark River, Axel Carlson Reef, and Manasquan Inlet disposal sites. In addition, the 12-Mile Site, which is located in the New York Bight, was historically used for barge-based disposal of municipal sewage sludge. Settled materials from offshore disposal have the potential to be impacted by research, due to the possibility of seafloor disturbance by bottom-contacting fishing gear. The USACE maintains a publicly-available database that tracks disposal activity occurring at each of these sites.

3.1.1.3 Mid-Atlantic Bight (MAB)

The MAB includes the continental shelf and slope waters from SNE to Cape Hatteras (Figure 3.1-2). The basic morphology and sediments of the MAB were shaped during the retreat of the last ice sheet. The shelf slopes gently away from the shore out to 62 to-124 miles offshore, where it transforms into the continental slope at the shelf break (at water depths of 328 to 656 feet). Along the shelf break, numerous deep-water canyons incise the slope and shelf. The sediments and topography of the canyons are much more heterogeneous than the predominantly sandy top of the shelf, with steep walls and outcroppings of bedrock and deposits of clay.

Within the MAB, there are four sites that were or are currently used for disposal of dredged material. Those sites are the Barnegat Inlet, Absecon Inlet, Cold Springs Inlet, and Dam Neck disposal sites. In addition, the 106-Mile Deepwater Sludge Disposal Site, and 106-Mile Industrial Waste Site are located within the NEFSC research area offshore of the LME boundary. Use of the 106-Mile Deepwater Sludge Disposal Site began in 1986 as a result of the phasing out of disposal operations at its predecessor, the 12-Mile Site. Nine sewerage authorities from northern New Jersey and greater New York City were authorized to use the 106-Mile Site for sewage disposal, and between 1986 and 1992, roughly 42 million

wet tons of sewage sludge were dumped there. The 106-Mile Industrial Waste Site is located to the southwest of the 106-Mile Site and was used between 1961 and 1987 to dispose of industrial wastes, including paint and chemical production wastes, petroleum processing materials, sewage sludge, and fly ash. The total amount of industrial waste disposed of at this site was about 5.2 million wet tons. Settled materials from offshore disposal have the potential to be impacted by NEFSC research, due to the possibility of seafloor disturbance by bottom-contacting fishing gear. The USACE maintains a publicly-available database that tracks disposal activity occurring at each of these sites.

The Gulf Stream provides a source of warmer water along the coast as warm-core flows break off from the Gulf Stream and move shoreward, mixing with the colder shelf and slope water. As the shelf plain narrows to the south (the extent of the continental shelf is narrowest at Cape Hatteras), the warmer Gulf Stream waters run closer to shore.

3.1.1.4 Southeast U.S. Continental Shelf (SE LME)

The Southeast U.S. Continental Shelf LME (SE LME) includes an area of the Atlantic Ocean extending approximately 930 miles from Cape Hatteras, North Carolina south to the Straits of Florida (Yoder 1991). The continental shelf in the region reaches up to approximately 120 miles off shore and the region is strongly influenced by the Gulf Stream Current with minor upwelling occurring along the Gulf Stream front.

The total area of the SE LME is approximately 115,000 square miles, including several protected areas and coral reefs (Aquarone 2008). The LME also includes numerous estuaries and bays, such as the Albemarle-Pamlico Sound, nearshore and barrier islands, and extensive coastal marshes that provide valuable ecosystem services and habitats for numerous marine and estuarine species. A six to 12 mile-wide coastal zone is characterized by high levels of primary production throughout the year, while offshore, on the middle and outer shelf, upwelling along the Gulf Stream front and intrusions from the Gulf Stream cause seasonal phytoplankton blooms. Because of its high productivity, the SE LME supports active commercial and recreational fisheries (Shertzer *et al*. 2009).

Within the SE LME, there are four sites that were or are currently used for disposal of dredged material. Those sites are the Morehead City I, Morehead City II, Wilmington Harbor I, and Wilmington Harbor II Disposal Sites. Settled materials from offshore disposal have the potential to be impacted by NEFSC research, due to the possibility of seafloor disturbance by bottom-contacting fishing gear. The USACE maintains a publicly-available database that tracks disposal activity occurring at each of these sites.

3.1.2 Special Resource Areas and Essential Fish Habitat

3.1.2.1 Essential Fish Habitat (EFH)

Essential Fish Habitat (EFH) is defined by the MSA as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. EFH applies to federally managed species in both state and federal jurisdictional waters throughout the range of the species. The designation of EFH does not confer any protection of specific habitats from non-fishing or fishing impacts. Instead, it is a tool used by managers to reduce potential impacts via an interagency consultation process mandated by MSA. It is described and identified in Fishery Management Plans (FMPs) that are developed by regional fisheries management councils. FMPs contain conservation and management measures to facilitate long-term protection of EFH that are implemented by NMFS regional offices.

The EFH for a managed species is designated separately for each life stage: eggs, larvae, juveniles, and adults. In certain species EFH is also designated for spawning adults. Many species require different habitats for different life stages, which means that the EFH for a single species may cover a large geographic area. As a result, when taken over all species and all life stages, EFH occurs almost everywhere on the Northeast U.S. Continental Shelf. The areas in which NEFSC research surveys occur

has been identified as overlapping EFH for thirty-two different federally-managed species (Table 3.1-1). These species include those under the jurisdiction of the Mid-Atlantic Fishery Management Council (MAFMC), the New England Fishery Management Council (NEFMC), and the Gulf of Mexico Fishery Management Council (GMFMC) as well as highly migratory species (HMS) that are managed by the NMFS headquarters Office of Sustainable Fisheries HMS Division. Table 3.1-1 also lists the fisheries management council that has jurisdiction over each species, as well as the FMP under which each species is managed.

In general, the EFH for these federally-managed species includes oceanic waters, saltmarsh creeks, seagrass beds, mudflats, and open bay areas, as well as mud, sand, gravel, and shell sediments over the continental shelf, and structured habitat containing sponges and other biogenic organisms (NEFSC 2008). Detailed text descriptions and accompanying maps detailing EFH by species and life stage are included in various FMP documents, which are supplemented by information from the EFH source documents. Specifics on EFH for species listed in Table 3.1-1 have not been reproduced here but a summary of EFH descriptions for them can be found online (GARFO 2015).

3.1.2.2 Habitat Areas of Particular Concern (HAPC)

Habitat Areas of Particular Concern (HAPC) are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation. Fishery management councils may designate a specific habitat area as a HAPC based on one or more of the following reasons: the importance of the ecological function provided by the habitat; the extent to which the habitat is sensitive to human-induced environmental degradation; whether, and to what extent, development activities are, or will be, stressing the habitat type; and the rarity of habitat type. As with EFH, HAPC designation does not confer additional protection or restrictions upon an area but is used by managers to reduce impacts and improve fisheries management. HAPC within which NEFSC research surveys occur include:

- Atlantic cod HAPC - the northeast peak of Georges Bank for juveniles;
- Atlantic salmon HAPC - Eleven rivers in Maine for adults including: St. Croix, Denny's, East Machias, Machias, Pleasant, Tunk stream, Narraguagus, Penobscot, Ducktrap, Sheepscot, and Kennebec;
- Tilefish HAPC - the shelf/slope boundary in the Mid-Atlantic Bight and Southern New England for juveniles and adults;
- Sandbar shark HAPC - the mouth of Great Bay, middle and lower Delaware Bay, lower Chesapeake Bay and adjacent coastal waters off Cape Hatteras; and,
- Summer flounder HAPC - all portions of adult and juvenile summer flounder EFH where species of macroalgae, seagrasses, and freshwater and tidal macrophytes exist as either native or exotic species.

3.1.2.3 Closed Area Regulations

The NEFMC developed regulations for minimizing the adverse impacts of fishing on EFH as part of an amendment to the Northeast Multispecies FMP in 2003. The regulations created seven Habitat Closed Areas covering a total area of 3,710 square miles that prohibit the use of mobile, bottom-tending gear (bottom trawls and dredges) on a year-round basis. These areas partially overlap five larger areas that were closed year-round prior to 2003 to all gears capable of catching groundfish. Year-round closures currently exist in the western Gulf of Maine, on Cashes Ledge and Jeffreys Bank in the central Gulf of Maine, and in three large areas on Georges Bank and in southern New England (Figure 3.1-3). Detailed information on the restrictions within the Habitat and Groundfish Closed Areas can be found in the Multi-species Fishery Regulations (NOAA 2004). In addition, there are several seasonal closures on Georges Bank and in the Gulf of Maine and year-round closures in four submarine canyons on the outer

continental shelf, three of which are shown in Figure 3.1-3 (Veatch, Lydonia and Oceanographer canyons).

Table 3.1-1 Species with Designated EFH in the NEFSC Research Area

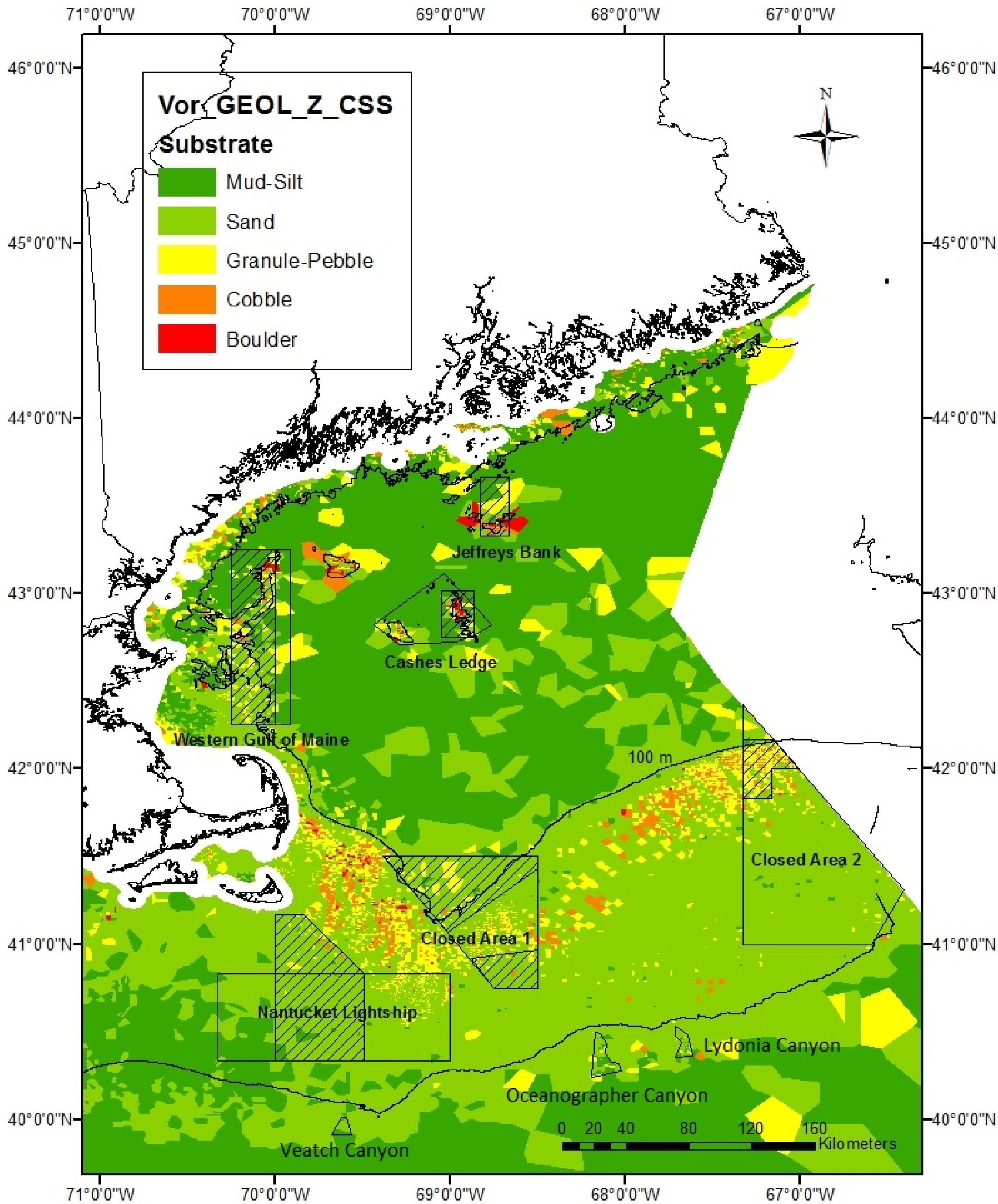
Species with EFH	Fisheries Management Council	Fisheries Management Plan	Life Stage Associated with Benthic Habitat
American Plaice	NEFMC	Northeast Multispecies (NM)	Juveniles, adults, and spawning adults
Atlantic Albacore Tuna	NEFMC and MAFMC	Consolidated Atlantic Highly Migratory Species (CAHMS)	NA
Atlantic Angel Shark	NEFMC and MAFMC	CAHMS	NA
Atlantic Sharpnose Shark	NEFMC and MAFMC	CAHMS	NA
Atlantic Bigeye Tuna	NEFMC and MAFMC	CAHMS	NA
Atlantic Bluefin Tuna	NEFMC and MAFMC	CAHMS	NA
Atlantic Bluefish	MAFMC	Atlantic Bluefish	NA
Atlantic Cod	NEFMC	NM	Juveniles, adults, and spawning adults
Atlantic Halibut	NEFMC	NM	Juveniles, adults, and spawning adults
Atlantic Herring	NEFMC	Atlantic Herring	Eggs, juveniles, adults, and spawning adults
Atlantic Mackerel	MAFMC	Squid, Atlantic Mackerel and Butterfish (SAMB)	NA
Atlantic Salmon	NEFMC	Atlantic Salmon	Eggs, larvae and juveniles
Atlantic Sea Scallop	NEFMC	Atlantic Sea Scallop	Eggs, larvae, juveniles, adults, and spawning adults
Atlantic Skipjack Tuna	NEFMC and MAFMC	CAHMS	NA
Atlantic Surfclam	MAFMC	Atlantic Surfclam and Ocean Quahog	Juveniles, adults
Atlantic Wolffish	NEFMC	NM	Eggs, juveniles, adults, and spawning adults
Atlantic Yellowfin Tuna	NEFMC and MAFMC	CAHMS	NA
Barndoor Skate	NEFMC	Northeast Skate Complex	Juveniles, adults
Basking Shark	NEFMC and MAFMC	CAHMS	NA
Bigeye Thresher	NEFMC and MAFMC	CAHMS	NA
Bignose Shark	NEFMC and MAFMC	CAHMS	NA

Species with EFH	Fisheries Management Council	Fisheries Management Plan	Life Stage Associated with Benthic Habitat
Black Sea Bass	MAFMC	Summer Flounder, Scup, Black Sea Bass (SFSB)	Larvae, juveniles, adults
Blacktip Shark	NEFMC and MAFMC	CAHMS	NA
Blue Marlin	NEFMC and MAFMC	CAHMS	NA
Blue Shark	NEFMC and MAFMC	CAHMS	NA
Butterfish	MAFMC	SAMB	NA
Clearnose Skate	NEFMC	Northeast Skate Complex	Juveniles, adults
Cobia	GMFMC and MAFMC	Coastal Migratory Pelagics (CMP)	All
Deep Sea Red Crab	NEFMC	Deep Sea Red Crab	Eggs, juveniles, adults, and spawning adults
Dusky Shark	NEFMC and MAFMC	CAHMS	NA
Golden Tilefish	MAFMC	Golden Tilefish	Juveniles, adults
Great Hammerhead	NEFMC and MAFMC	CAHMS	NA
Haddock	NEFMC	NM	Juveniles, adults, and spawning adults
King Mackerel	GMFMC and MAFMC	CMP	All
Little Skate	NEFMC	Northeast Skate Complex	Juveniles, adults
Longbill	NEFMC and MAFMC	CAHMS	NA
Longfin Mako	NEFMC and MAFMC	CAHMS	NA
Long-fin Squid	MAFMC	SAMB	Eggs
Monkfish	NEFMC	Monkfish	Juveniles, adults, and spawning adults
Night Shark	NEFMC and MAFMC	CAHMS	NA
Oceanic Whitetip	NEFMC and MAFMC	CAHMS	NA
Ocean Pout	NEFMC	NM	Eggs, larvae, juveniles, adults, and spawning adults
Ocean Quahog	MAFMC	Atlantic Surfclam and Ocean Quahog	Eggs, adults
Offshore Hake	NEFMC	NM	Juveniles, adults, and spawning adults
Pollock	NEFMC	NM	Juveniles, adults, and spawning adults

Species with EFH	Fisheries Management Council	Fisheries Management Plan	Life Stage Associated with Benthic Habitat
Porbeagle	NEFMC and MAFMC	CAHMS	NA
Red Hake	NEFMC	NM	Juveniles, adults, and spawning adults
Redfish	NEFMC	NM	Juveniles, adults, and spawning adults
Rosette Skate	NEFMC	Northeast Skate Complex	Juveniles, adults
Sailfish	NEFMC and MAFMC	CAHMS	NA
Sand Tiger	NEFMC and MAFMC	CAHMS	NA
Sandbar Shark	NEFMC and MAFMC	CAHMS	NA
Scalloped Hammerhead	NEFMC and MAFMC	CAHMS	NA
Scup	MAFMC	SFSB	Juveniles, adults
Shortfin Mako	NEFMC and MAFMC	CAHMS	NA
Short-fin Squid	MAFMC	SAMB	NA
Silky Shark	NEFMC and MAFMC	CAHMS	NA
Silver Hake (whiting)	NEFMC	NM	Juveniles, adults, and spawning adults
Smooth Skate	NEFMC	Northeast Skate Complex	Juveniles, adults
Smoothhound (Smooth Dogfish)	NEFMC and MAFMC	CAHMS	NA
Spanish Mackerel	GMFMC and MAFMC	CMP	All
Spearfish	NEFMC and MAFMC	CAHMS	NA
Spinner Shark	NEFMC and MAFMC	CAHMS	NA
Spiny Dogfish	MAFMC	Spiny Dogfish	NA
Summer Flounder	MAFMC	SFSB	Juveniles, adults
Swordfish	NEFMC and MAFMC	CAHMS	NA
Tiger Shark	NEFMC and MAFMC	CAHMS	NA
Thorny Skate	NEFMC	Northeast Skate Complex	Juveniles, adults
Thresher Shark	NEFMC and MAFMC	CAHMS	NA

Species with EFH	Fisheries Management Council	Fisheries Management Plan	Life Stage Associated with Benthic Habitat
White Hake	NEFMC	NM	Juveniles, adults, and spawning adults
White Marlin	NEFMC and MAFMC	CAHMS	NA
White Shark	NEFMC and MAFMC	CAHMS	NA
Windowpane Flounder	NEFMC	NM	Juveniles, adults, and spawning adults
Winter Flounder	NEFMC	NM	Eggs, larvae, juveniles, adults, and spawning adults
Winter Skate	NEFMC	Northeast Skate Complex	Juveniles, adults
Witch Flounder	NEFMC	NM	Juveniles, adults, and spawning adults
Yellowtail Flounder	NEFMC	NM	Juveniles, adults, and spawning adults

GMFMC: Gulf of Mexico Fishery Management Council, MAFMC: Mid-Atlantic Fishery Management Council, NEFMC: New England Fishery Management Council



Source: GIS data on dominant substrate types from NEFMC (2011a), available online at: http://s3.amazonaws.com/nefmc.org/Appendix_D_Swept_Area_Seabed_Impact_approach_1.pdf

Figure 3.1-3 Closed Areas and Dominant Substrate Types in the Northeast Atlantic Region

Figure 3.1-3 shows the different benthic substrate types in the Northeast region, including those within each of the closed areas (Cashes Ledge, Closed Area I, Closed Area II, Jeffrey's Bank, Nantucket Lightship, Western Gulf of Maine, and three canyons on the outer continental shelf). Areas closed specifically to protect bottom habitats are cross-hatched. A complete description of the data sources and methods used to create the substrate data layer can be found in NEFMC (2011b).

Substrate composition estimates for each of the twelve major closed areas in the region are shown in Table 3.1-2. With the exception of the habitat closure in the northern portion of Closed Area 2, the closed areas on Georges Bank and in southern New England are predominantly sand. The Closed Area 2 Habitat Closure – which is also a HAPC for juvenile cod – is composed mostly of gravel, with moderate amounts of sand and cobble. The Gulf of Maine closed areas all have higher proportions of mud than the other areas, less sand, and some gravel. The closed areas on Jeffreys Bank and Cashes Ledge include some cobble and boulder-dominated habitats. Data quality in the Gulf of Maine is poor compared to Georges Bank and southern New England due to reduced survey coverage, especially in deeper water in the center of the gulf (see NEFMC 2011b for details).

Table 3.1-2 Area and Percentage of Predominant Seafloor Substrate Type in Each Closed Area

Closed Area	Area (km^2)	Mud	Sand	Gravel	Cobble	Boulder
Grain size (diameter, in inches)		<1/16	1/16-.08	>.08-2.52	>2.52-10.1	>10.1
Jeffreys Bank Habitat	499	41	20	21	14	5
Cashes Ledge Groundfish	1373	65	20	10	0	4
Cashes Ledge Habitat	443	36	29	22	0	4
Western Gulf of Maine Groundfish	3030	40	40	17	2	2
Western Gulf of Maine Habitat	2272	34	48	14	2	2
Nantucket Lightship Groundfish	6248	14	82	3	0	0
Nantucket Lightship Habitat	3387	4	94	2	1	0
Closed Area 1 Groundfish	3939	1	83	14	2	1
Closed Area 1 North Habitat	1937	2	86	12	<1	0
Closed Area 1 South Habitat	584	<1	92	7	1	0
Closed Area 2 Groundfish	6862	2	89	9	2	<1
Closed Area 2 Habitat	641	2	33	54	12	<1

Source: NEFMC 2014

3.1.2.4 Marine Protected Areas (MPA)

A Marine Protected Area (MPA) is defined by Executive Order (EO) 13158 as "any area of the marine environment that has been reserved by federal, state, tribal, territorial, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." They are a group of sites, networks, and systems established and managed by federal, state, tribal, and local governments. Most MPAs have legally established goals, conservation objectives, and intended purposes. MPAs generally address one or more of three areas of conservation focus:

1. **Natural Heritage**: established and managed wholly or in part to sustain, conserve, restore, and understand the protected area's natural biodiversity, populations, communities, habitats, and

ecosystems; the ecological and physical processes upon which they depend; and the ecological services, human uses and values they provide to this and future generations.

2. **Cultural Heritage**: established and managed wholly or in part to protect and understand submerged cultural resources that reflect the nation's maritime history and traditional cultural connections to the sea.
3. **Sustainable Production**: established and managed wholly or in part with the explicit purpose of supporting the continued extraction of renewable living resources (such as fish, shellfish, and plants) that live within the MPA, or that are exploited elsewhere but depend upon the protected area's habitat for essential aspects of their ecology or life history.

Areas with some form of management protection are found in almost the entire area where research surveys are conducted. They include state MPAs, National Wildlife Refuges, National Park Service MPAs and National Marine Sanctuaries. MPAs vary widely in the level and type of legal protection afforded to the site's natural and cultural resources and ecological processes. Many of the MPAs within the action area have various levels of fishing restrictions. Details of MPAs occurring in the action area along with the level of protection afforded and fishing restrictions can be found on the List of National System Marine Protected Areas (NOAA 2010a). This list also includes Habitat Closure Areas and Closed Areas (see Section 3.1.2.3). Although these areas are not formally classified as marine reserves, they may provide similar levels of protection for many species.

The National Marine Sanctuaries Act (NMSA) authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries. Day-to-day management of national marine sanctuaries has been delegated by the Secretary of Commerce to NOAA's Office of National Marine Sanctuaries. The primary objective of the NMSA is to protect marine resources, such as coral reefs, sunken historical vessels or unique habitats.

The Stellwagen Bank National Marine Sanctuary sits at the mouth of Massachusetts Bay, entirely within federal waters within the NEFSC research area (Figure 3.1-4). The Stellwagen Bank National Marine Sanctuary was designated for a multitude of reasons, including the long history of human use and high natural productivity of the area. Habitats within the Stellwagen Bank National Marine Sanctuary provide cover and anchoring locations for invertebrates, as well as feeding and nursery grounds for cetacean species including humpback, northern right, sei, and fin whales. The area supports foraging activity by seabirds, including loons, fulmars, shearwaters, storm petrels, cormorants, phalaropes, gulls, jaegers, and terns. Fish and invertebrate communities within the sanctuary include both demersal and pelagic species, such as bluefin tuna, herring, cod, flounder, lobster, and scallops. Leatherback and Kemp's ridley sea turtles use the area for feeding. In addition, several important shipwreck sites are located within the sanctuary, including the wreck of the steamship *Portland*, which sank in 1898.

Monitor National Marine Sanctuary (Figure3.1-5) was established on January 30, 1975, as the United States' first national marine sanctuary. The sanctuary was established to preserve the unique and archaeologically significant wreck site of the Civil War ironclad USS Monitor. The Monitor was a major technological advancement in warship design and is often called the most significant ship in American history. It sank in 230 feet of water during a storm on December 31, 1862, off Cape Hatteras, North Carolina, in an area popularly known as the Graveyard of the Atlantic. The wreck of the Monitor is listed on the National Register of Historic Places and is a national landmark.

Gray's Reef National Marine Sanctuary (Figure3.1-6) is one of the largest near-shore live-bottom reefs of the southeastern United States. Gray's Reef was designated as a sanctuary on January 16, 1981, and is the only protected natural reef area on the continental shelf off the Georgia coast. The 22 square miles of Gray's Reef protects an area that is recognized nationally and internationally.

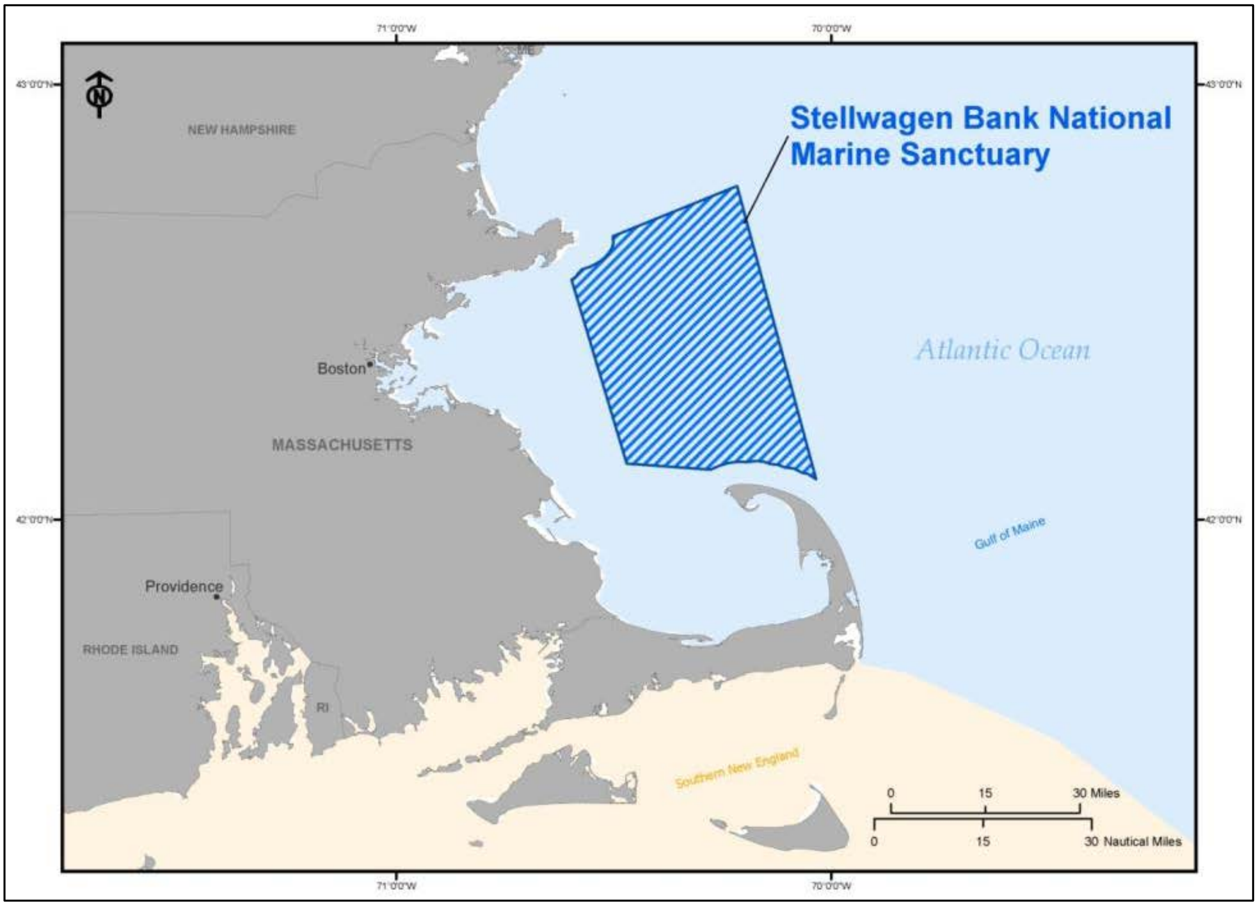


Figure 3.1-4 Stellwagen Bank National Marine Sanctuary is at the Mouth of Massachusetts Bay between Cape Cod and Cape Ann.

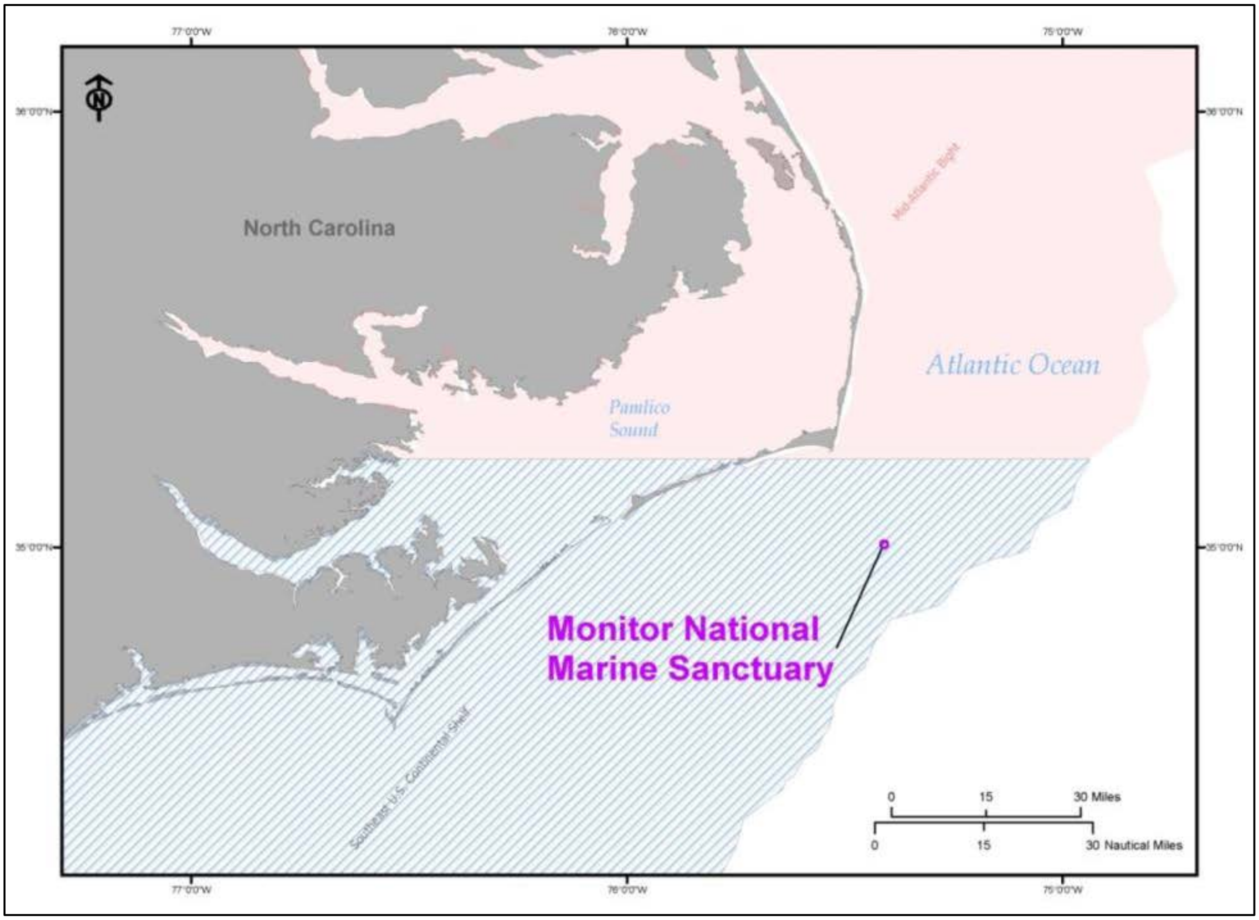


Figure 3.1-5 Monitor National Marine Sanctuary

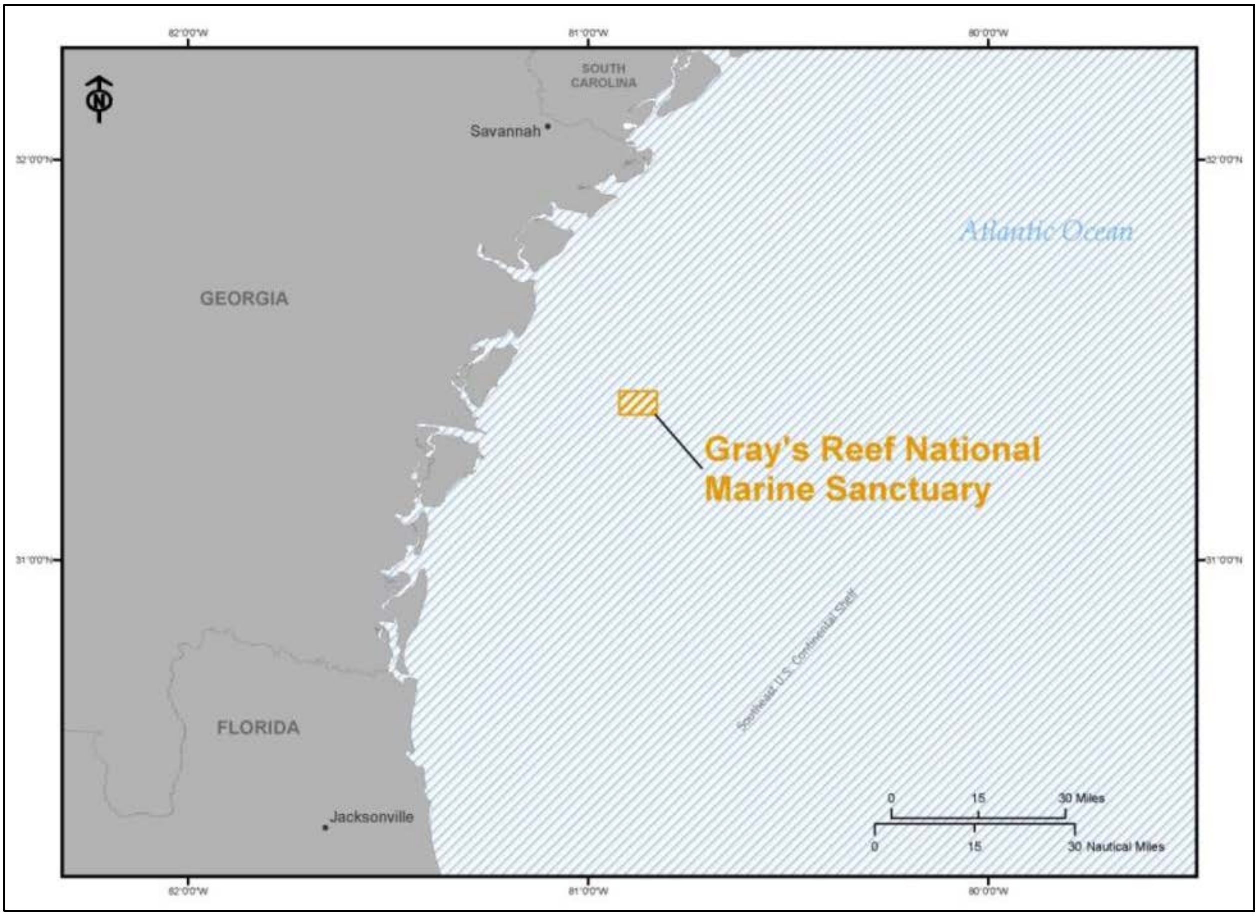


Figure 3.1-6 Gray's Reef National Marine Sanctuary

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 Fish

There are a few thousand species of finfish that occur within the area surveyed by the various NEFSC surveys. During the 45-year history of the NEFSC Standard Bottom Trawl Survey (BTS), 641 species have been collected and identified. For the purpose of this Programmatic Environmental Assessment (PEA), only those species with a combined research catch from all NEFSC surveys and NEFSC-funded cooperative research projects of at least one ton (2000 pounds, 2008-2012 average annual catch) are shown in Table 3.2-1. Where applicable, the research survey seasons and gear types used to determine biomass indices are described. Four fish species that are listed under the Endangered Species Act (ESA) are discussed in Section 3.2.1.1. Target species, highly migratory species, and other species are discussed in Sections 3.2.1.2, 3.2.1.3, and 3.2.1.4, respectively.

3.2.1.1 Threatened and Endangered Fish Species

The information presented in the following species accounts is primarily from the NOAA Fisheries Office of Protected Resources (OPR) website (NOAA 2012a), available online at: http://www.nmfs.noaa.gov/pr/species/fish/.

Atlantic salmon

The Gulf of Maine (GOM) Distinct Population Segment (DPS) of anadromous Atlantic salmon, *Salmo salar*, was initially listed as an endangered species by the USFWS and NMFS on November 17, 2000 (65 FR 69459). Subsequent rulings in 2009 included an expanded range for the GOM DPS of Atlantic salmon (74 FR 29344) and designated critical habitat (74 FR 29300). Essential Fish Habitat was designated for Atlantic salmon in 1998 (NEFMC 1998). Presently, the GOM DPS includes all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River. Included are all associated conservation hatchery populations used to supplement these natural populations Critical habitat includes 45 specific areas occupied by Atlantic salmon at the time of listing that include approximately 12,160 miles of perennial river, stream, and estuary habitat and 308 square miles of lake habitat within the range of the GOM DPS and in which are found those physical and biological features essential to the conservation of the species. The entire occupied range of the GOM DPS in which critical habitat is designated is within the State of Maine.

Atlantic sturgeon

The Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus*, is an anadromous species distributed along the U.S. Atlantic coast. NMFS listed five distinct population segments of Atlantic sturgeon under the ESA in 2012; The Gulf of Maine DPS was listed as threatened while the New York Bright, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered (77 FR 5880 and 77 FR 5914). Stocks declined in the 20th century as a result of overfishing and habitat destruction. Atlantic sturgeon are a large, slow growing, late-maturing, long-lived, estuary dependent fish that spawn in fresh water though they spend the majority of their lives in salt water (NMFS 2010a). Their historical range included most major estuaries and river systems from Labrador to Florida. At present populations are found in 35 rivers and spawning occurs in 20 of these rivers. Spawning adults migrate upriver in late winter/early spring beginning in about February or March in the south and April through May in the mid-Atlantic and May to June in Canadian waters. Spawning occurs in the flowing water between the salt front and the fall line of large rivers (NMFS 2010a). This species is managed by the Atlantic States Marine Fisheries Commission (ASMFC). Catch of this species is currently prohibited since a 1997 moratorium was declared throughout its range and it is illegal to fish, catch, or keep Atlantic sturgeon from U.S. waters.

Shortnose Sturgeon

The shortnose sturgeon**,** *Acipenser brevirostrum*, is an endangered benthic fish that mainly occupies deep channel sections of large rivers along the Atlantic coast of North America in the Southeast and NE LMEs. They can be found in rivers along the western Atlantic coast from St. Johns River, Florida (possibly extirpated from this system), to the St. Johns River in New Brunswick, Canada. Shortnose sturgeon migrate from the marine environment to freshwater to spawn during late winter-early summer, with these migrations occurring later in the year at higher latitudes. Spawning generally occurs in the lower sections of rivers. Juvenile sturgeons remain in fresh water for their first summer before migrating to estuaries in winter. Juveniles remain in the freshwater-estuary system for three to five years before migrating to the near-shore marine environment as adults. Migration into the marine environment has only recently been documented for the shortnose sturgeon. Sturgeon are long lived, potentially reaching ages in excess of 60 years for females and about 30 for males. There have been no documented cases of shortnose sturgeon takes in any of the NEFSC fisheries research surveys or similar commercial fisheries that operate in the action area.

Smalltooth Sawfish

The smalltooth sawfish, *Prisits pectinata*, was listed as endangered in 2003. NMFS designated critical habitat along the south and west coast of Florida and published a Recovery Plan in 2009 (NMFS 2009d). There is no critical habitat in the area surveyed by the NEFSC. The range of the smalltooth sawfish in the Atlantic has contracted markedly over the past century. Historic capture records within the U.S. range from Texas to New York .Today, they mainly occur off peninsula Florida with only one recorded north of Florida since 1963 (NMFS 2000). They are relatively common only in the Everglades region at the southern tip of Florida (NMFS 2012a). Both encounter reports and satellite tagging indicate that mature animals are regularly found in waters in excess of 164 feet (50 m) (Poulakis and Seitz 2004, Simpfendorfer and Wiley 2004). Their long, toothed saw makes them particularly vulnerable to entanglement in virtually all kinds of large mesh gear and bycatch in fisheries has played a principal role in the decline of smalltooth sawfish (NMFS 2000). There have been no documented cases of smalltooth sawfish takes in any of the NEFSC fisheries research surveys.

3.2.1.2 Target Species

Target species are those fish which are managed under an FMP, commercially or recreationally fished, and for which stock assessments are conducted using NEFSC-affiliated fisheries research. Table 3.2-1 identifies 36 target species encountered in NEFSC-affiliated research activities for which the average annual research catch exceeded 2,200 pounds during 2008-2012 or that are currently listed as overfished or subject to overfishing. Current stock status, council jurisdiction, and applicable fishery management plan are included.

For additional information on each of the species, see the NEFSC website: http://www.nefsc.noaa.gov/rcb/fish/.

Table 3.2-1 Target Fish Species

Species	Scientific Name	Stock Status[1] Overfished/ overfishing occurring	Council Jurisdiction	Fisheries Management Plan
Acadian redfish	*Sebastes fasciatus Storer*	Not overfished- Rebuilt	NEFMC	Northeast Multispecies
Alewife	*Alosa pseudoharengus*	Unknown	ASMFC	Interstate Shad and River Herring
American plaice	*Hippoglossoides platessoides*	Not overfished-Rebuilding	NEFMC	Northeast Multispecies
Atlantic cod	*Gadus morhua*	GB and GOM: Overfished/overfishing	NEFMC	Northeast Multispecies
Atlantic croaker	*Micropogonias undulatus*	Unknown	ASMFC	Interstate
Atlantic halibut	*Hippoglossus hippoglossus*	Overfished/ no overfishing	NEFMC	Northeast Multispecies
Atlantic herring	*Clupea harengus*	Not overfished	NEFMC and ASMFC	Atlantic Herring
Atlantic mackerel	*Scomber scombrus*	Unknown	MAFMC	Atlantic Mackerel, Squid and Butterfish
Atlantic wolffish	*Anarhichas lupus*	Overfished/ no overfishing	NEFMC	Northeast Multispecies
Barndoor skate	*Dipturus laevis*	Not overfished	NEFMC	Northeast Skate Complex
Black sea bass	*Centropristis striata*	Not overfished	ASMFC and MAFMC	Summer Flounder, Scup, Black Sea Bass
Blueback herring	*Alosa aestivalis*	Unknown	ASMFC	Interstate Shad and River Herring
Bluefish	*Pomatomus saltatrix*	Not overfished	MAFMC	Bluefish
Butterfish	*Peprilus triacanthus*	Not overfished	MAFMC	Atlantic Mackerel, Squid and Butterfish
Clearnose skate	*Raja eglanteria*	Not overfished	NEFMC	Northeast Skate Complex
Goosefish (Monkfish)	*Lophius americanus*	Not overfished-Rebuilt	NEFMC and MAFMC	Monkfish
Haddock	*Melanogrammus aeglefinus*	GB stock: not overfished; GOM stock: approaching overfished situation	NEFMC	Northeast Multispecies
Little skate	*Raja erinacea*	Not overfished	NEFMC	Northeast Skate Complex
Ocean pout	*Zoarces americanus*	Overfished/ no overfishing	NEFMC	Northeast Multispecies
Pollock	*Pollachius pollachius*	Not overfished	NEFMC	Northeast Multispecies
Red hake	*Urophycis chuss*	Not overfished	NEFMC	Northeast Multispecies – Small Mesh

Species	Scientific Name	Stock Status[1] Overfished/ overfishing occurring	Council Jurisdiction	Fisheries Management Plan
Scup	*Stenotomus chrysops*	Not overfished	ASMFC and MAFMC	Summer Flounder, Scup, Black Sea Bass
Silver hake (whiting)	*Merluccius bilinearis*	Not overfished-Rebuilt	NEFMC	Northeast Multispecies – Small Mesh
Spiny dogfish	*Squalus acanthias*	Not overfished	NEFMC and MAFMC	Spiny Dogfish
Spot	*Leiostomus xanthurus*	Unknown	ASMFC	Interstate
Striped bass	*Morone saxatilis*	Not overfished-Rebuilt	ASMFC	Interstate
Summer flounder (fluke)	*Paralichthys dentatus*	Not overfished	ASMFC and MAFMC	Summer Flounder, Scup, Black Sea Bass
Thorny skate	*Amblyraja radiata*	Overfished/ no overfishing	NEFMC	Northeast Skate Complex
Weakfish	*Cynoscion regalis*	Unknown	ASMFC	Interstate
White hake	*Urophycis tenuis*	Not overfished/ rebuilding	NEFMC	Northeast Multispecies
Windowpane flounder (sand dab)	*Scophthalmus aquosus*	GB & GOM: Overfished/overfishing; SNE & MAB: not overfished	NEFMC	Northeast Multispecies
Winter flounder (blackback)	*Pseudopleuronectes americanus*	GB stock: Not overfished; GOM stock: Unknown; SNE/MAB stock: Overfished	NEFMC	Northeast Multispecies
Winter skate	*Leucoraja ocellata*	Not overfished	NEFMC	Northeast Skate Complex
Witch flounder (grey sole)	*Glyptocephalus cynoglossus*	Northwest Atlantic Coast stock: Overfished/ overfishing SNE/MAB stock: Overfished/ no overfishing	NEFMC	Northeast Multispecies
Yellowtail flounder	*Limanda ferruginea*	Cape Cod/GOM and GB stocks: Overfished; SNE/MAB stock: Not overfished	NEFMC	Northeast Multispecies

1. As of June 30, 2013. Source: NMFS. 2013. National Marine Fisheries Service—2nd Quarter 2013 Update. http://www.nmfs.noaa.gov/sfa/statusoffisheries/2013/second/Q2%202013%20Stock%20Status%20Tables.pdf

3.2.1.3 Highly Migratory Species

Highly migratory species (Table 3.2-2) are those fish species which migrate variable distances across oceans for feeding or reproduction, and have wide geographic distributions. These species are pelagic and are typically found both within the 200-mile EEZ and in open oceans, although some life history stages may occur in nearshore waters. NEFSC and NEFSC-affiliated HMS research focuses on sharks. For additional details on highly migratory species, see http://www.nmfs.noaa.gov/sfa/hms/.

Table 3.2-2 Atlantic Highly Migratory Species

Species	Scientific Name	Species	Scientific Name
SHARKS		**Sandbar shark**	*Carcharhinus plumbeus*
Atlantic angel shark	*Squatina dumeril*	**Sand tiger**	*Carcharias taurus*
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	**Scalloped hammerhead**	*Sphyrna lewini*
Basking shark	*Cetorhinus maximus*	**Sharpnose sevengill shark**	*Heptranchias perlo*
Blacktip shark	*Carcharhinus limbatus*	**Shortfin mako**	*Isurus oxyrinchus*
Blue shark	*Prionace glauca*	**Silky shark**	*Carcharhinus falciformis*
Bigeye sand tiger	*Odontaspis noronhai*	**Smalltail shark**	*Carcharhinus porosus*
Bigeye sixgill shark	*Hexanchus nakamurai*	**Smoothhound**	*Mustelus canis*
Bigeye thresher	*Alopias superciliosus*	**Spinner shark**	*Carcharhinus brevipinna*
Bignose shark	*Carcharhinus altimus*	**Smooth hammerhead**	*Sphyrna zygaena*
Blacknose shark	*Carcharhinus acronotus*	**Thresher shark**	*Alopias vulpinus*
Bluntnose sixgill shark	*Hexanchus griseus*	**Tiger shark**	*Galeocerdo cuvier*
Bonnethead	*Sphyrna tiburo*	**Whale shark**	*Rhincodon typus*
Bull shark	*Carcharhinus leucas*	**White shark**	*Carcharodon carcharias*
Caribbean reef shark	*Carcharhinus perezi*	**TUNAS**	
Caribbean sharpnose shark	*Rhizoprionodon porosus*	**Albacore tuna**	*Thunnus alalunga*
Dusky shark[1]	*Carcharhinus obscurus*	**Bigeye tuna**	*Thunnus obesus*
Finetooth shark	*Carcharhinus isodon*	**Bluefin tuna**	*Thunnus thynnus*
Galapagos shark	*Carcharhinus galapagensis*	**Skipjack tuna**	*Katsuwonus pelamis*
Great hammerhead[1]	*Sphyrna mokarran*	**Yellowfin tuna**	*Thunnus albacares*
Lemon shark	*Negaprion brevirostris*	**SWORDFISH**	
Longfin mako	*Isurus paucus*	**Swordfish**	*Xiphias gladius*
Narrowtooth shark	*Carcharhinus brachyurus*	**BILLFISH**	
Night shark	*Carcharhinus signatus*	**Blue marlin**	*Makaira nigricans*
Nurse shark	*Ginglymostoma cirratum*	**Longbill spearfish**	*Tetrapturus pfluegeri*
Oceanic whitetip shark	*Carcharhinus longimanus*	**Sailfish**	*Istiophorus platypterus*
Porbeagle	*Lamna nasus*	**White marlin**	*Tetrapturus albidus*

Source: Consolidated Atlantic HMS FMP.

1. ESA candidate species, see http://www.nmfs.noaa.gov/pr/species/esa/candidate.htm

3.2.1.4 Other Species

Fish species in this section include target species that are infrequently encountered in the NEFSC research surveys, and other species that are not managed under an FMP but may be caught on a regular basis during NEFSC fisheries research surveys. Table 3.2-3 displays a list of regularly caught species, along with their respective council jurisdictions and FMPs, if applicable. This is not a complete list of all species that have ever been caught in NEFSC surveys in the past. For additional information on each of the species, see the NEFSC website: http://www.nefsc.noaa.gov/rcb/fish/.

Table 3.2-3 Other Species Encountered by NEFSC Research Surveys

Species	Scientific Name	Council	Fishery Management Plan
American eel	*Anguilla rostrata*	ASMFC	Interstate FMP for American eel [depleted]
American shad	*Alosa sapidissima*	ASMFC	Interstate FMP for Shad and River Herring [depleted]
Atlantic hagfish (slime eel)	*Myxine glutinosa*		Candidate for Future FMP
Atlantic menhaden	*Brevoortia tyrannus*	ASMFC	Interstate FMP for Atlantic menhaden [overfishing occurring]
Bay anchovy	*Anchoa mitchilli*		
Bluntnose stingray	*Dasyatis say*		
Bullnose ray	*Myliobatis freminvillii*		
Cownose ray	*Rhinoptera bonasus*		
Cusk[1]	*Brosme brosme*		
Four spotted Flounder	*Paralichthys oblongus*		
Golden tilefish	*Lopholatilus chamaeleonticeps*	MAFMC	Tilefish
Kingfish	*Menticirrhus spp.*		
Longhorn Sculpin	*Myoxocephalus octodecemspinosus*		
Northern sand lance	*Ammodytes dubius*		
Northern sea robin	*Prionotus carolinus*		
Offshore hake	*Merluccius albidus*	NEFMC	Northeast Multispecies - Small Mesh
Red drum	*Sciaenops ocellatus*	ASMFC	Red drum
Roughtail stingray	*Dasyatis centroura*		
Round herring	*Etrumeus teres*		
Sea raven	*Hemitripterus americanus*		
Spanish mackerel	*Scomberomorus maculatus*	ASMFC	Spanish mackerel
Spiny butterfly ray	*Gymnura altavel*		
Spotted hake	*Urophycis regius*		
Spotted seatrout	*Cynoscion nebulosus*	ASMFC	Spotted seatrout
Striped anchovy	*Anchoa hepsetus*		
Tautog	*Tautoga onitis*	ASMFC	Tautog [overfished and overfishing occurring]

1. ESA candidate species, see http://www.nmfs.noaa.gov/pr/species/esa/candidate.htm

3.2.2 Marine Mammals

The marine mammal species listed in Table 3.2-4 typically occur in the areas frequented by the NEFSC research surveys. All marine mammals are federally protected under the Marine Mammal Protection Act (MMPA) of 1972. Six large whale species found in the region are listed as endangered under the ESA of

1973. The coastal stocks of bottlenose dolphins are listed as depleted under the MMPA, although they are not listed as either threatened or endangered under the ESA (Table 3.4-4). Threatened and endangered species encountered in the NEFSC survey areas are described in Section 3.2.2.2. Non-ESA listed marine mammals for which takes are requested by NEFSC in the LOA Application (Appendix C) are described in section 3.2.2.3. Information provided here summarizes data on stock status, abundance, density, distribution and habitat, and auditory capabilities, as available in published literature and reports, including marine mammal stock assessments.

Table 3.2-4 Marine Mammal Species Encountered in the NEFSC Research Areas.

SPECIES		
Common Name	**Scientific Name**	**Federal ESA/MMPA Status**[1]
CETACEANS		
North Atlantic right whale	*Eubalaena glacialis*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Minke whale	*Balaenoptera acutorostrata*	-
Blue whale	*Balaenoptera musculus*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Pygmy sperm whales	*Kogia breviceps*	-
Dwarf sperm whale	*Kogia sima*	-
Killer whale	*Orcinus orca*	-
Pygmy killer whale	*Feresa attenuata*	-
Northern bottlenose whale	*Hyperoodon ampullatus*	-
Cuvier’s beaked whale	*Ziphius cavirostris*	-
Blainville's beaked whale	*Mesoplodon densirostris*	-
Gervais’ beaked whale	*Mesoplodon europaeus*	-
Sowerby's beaked whale	*Mesoplodon biden*	-
True's beaked whale	*Mesoplodon mirus*	-
Melon-headed whale	*Peponocephala electra*	-
Risso’s dolphin	*Grampus griseus*	-
Long-finned pilot whale	*Globicephala melas*	-
Short-finned pilot whale	*Globicephala macrorhynchus*	-
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	-
White-beaked dolphin	*Lagenorhynchus albirostris*	-
Short-beaked common dolphin	*Delphinus delphis delphis*	-
Atlantic spotted dolphin	*Stenella frontalis*	-
Pantropical spotted dolphin	*Stenella attenuata*	-
Striped dolphin	*Stenella coeruleoalba*	-

SPECIES		
Common Name	**Scientific Name**	**Federal ESA/MMPA Status[1]**
Fraser's dolphin	*Lagenodelphis hosei*	-
Rough-toothed dolphin	*Steno bredanensis*	-
Clymene dolphin	*Stenella clymene*	-
Spinner dolphin	*Stenella longirostris*	-
Bottlenose dolphin	*Tursiops truncatus*	
-Coastal stocks		Strategic
-Offshore stock		-
-Estuarine stocks		Strategic
Harbor porpoise	*Phocoena phocoena*	Strategic
PINNIPEDS		
Harbor seal	*Phoca vitulina concolor*	-
Gray seal	*Halichoerus grypus grypus*	-
Harp seal	*Pagophilus groenlandica*	-
Hooded seal	*Cystophora cristata*	-

1. Denotes ESA listing as either endangered or threatened, or MMPA listing as depleted. By default, all species listed under the ESA as threatened or endangered are also considered depleted under the MMPA. All marine mammal stocks are legally protected under the MMPA.

3.2.2.1 Marine Mammal Acoustics and Hearing

Marine mammals rely on sound production and reception for social interactions (e.g., reproduction, communication), to find food, to navigate, and to respond to predators. General reviews of cetacean and pinniped sound production and hearing may be found in Richardson et al. (1995), Edds-Walton (1997), Wartzok and Ketten (1999), and Au and Hastings (2008). Several recent studies on hearing in individual species or species groups of odontocetes and pinnipeds also exist (e.g., Kastelein et al. 2009, Kastelein et al. 2013, Ruser et al. 2014). Interfering with these functions through anthropogenic noise could result in potential adverse impacts.

Southall et al. (2007) provided a comprehensive review of marine mammal acoustics including designating functional hearing groups. Assignment was based on behavioral psychophysics (the relationship between stimuli and responses to stimuli), evoked potential audiometry, auditory morphology, and, for pinnipeds, whether they were hearing through air or water. Because no direct measurements of hearing exist for baleen whales, hearing sensitivity was estimated from behavioral responses (or lack thereof) to sounds, commonly used vocalization frequencies, body size, ambient noise levels at common vocalization frequencies, and cochlear measurements. NOAA modified the functional hearing groups of Southall et al. (2007) to extend the upper range of low-frequency cetaceans and to divide the pinniped hearing group into Phocid and Otariid hearing groups (NOAA 2013). Detailed descriptions of marine mammal auditory weighting functions and functional hearing groups are available in NOAA (2013). Table 3.2-5 presents the functional hearing groups and representative species or taxonomic groups for each; most species found in the NEFSC project areas are in the first two groups, low frequency cetaceans (baleen whales) and mid frequency cetaceans (odontocetes).

Table 3.2-5 Summary of the Five Functional Hearing Groups of Marine Mammals

Functional Hearing Group	Estimated Auditory Bandwidth	Species or Taxonomic Groups
Low Frequency Cetaceans (Mysticetes–Baleen whales)	7 Hertz (Hz) to 25 kilohertz (kHz) (best hearing is generally below 1000 Hz, higher frequencies for humpback whales)	All baleen whales
Mid- Frequency Cetaceans (Odontocetes—Toothed whales)	150 Hz to 160 kHz (best hearing is from approximately 10-120 kHz)	Includes species in the following genera: *Steno*, *Tursiops*, *Stenella*, *Delphinus*, *Lagenodelphis*, *Lagenorhynchus*, *Grampus*, *Peponocephala*, *Feresa*, *Orcinus*, *Globicephala*, *Physeter*, *Hyperoodon*, *Ziphius*, *Mesoplodon*
High-frequency Cetaceans (Odontocetes)	200 Hz to 180 kHz (best hearing is from approximately 10-150 kHz)	Includes species in the following genera: *Kogia* and *Phocoena*
Phocid pinnipeds (true seals)	75 Hz to 100 kHz (best hearing is from approximately 1-30 kHz)	Includes species in the genera *Phoca* and *Halichoerus*
Otariid pinnipeds (sea lions and fur seals)	100 Hz to 40 kHz (best hearing is from approximately 1-16 kHz)	None occur in NEFSC research area

3.2.2.2 Threatened and Endangered Species

This section only discusses species listed as threatened or endangered under the ESA; Table 3.2-4 lists all marine mammal species encountered in the NEFSC Research Areas.

North Atlantic Right Whale

Status and trends: The North Atlantic right whale is one of the most critically endangered large whales in the world (Clapham et al. 1999, Perry et al. 1999). The western North Atlantic right whale population was estimated to include at least 444 individuals in 2009 (Waring et al. 2013a. The estimated population growth rate was 2.5 percent for the period 1986-1992 (Knowlton et al. 1994). Subsequent analyses suggested declining survival probability in the 1990s (Best et al. 2001, Caswell et al. 1999, Clapham 2002). Recent review of the minimum number alive population index derived from the individual sightings database indicates a positive population trend, with a mean growth rate of 2.6 percent for the years 1990-2009 (Waring et al. 2013). A Recovery Plan, originally published in 1991 and most recently revised in 2005, is currently in effect for this species (NMFS 2005).

Based on the minimum population size of 444, a recovery factor of 0.1 and a maximum productivity rate of 0.04, the PBR for the Western Atlantic stock of North Atlantic right whales is 0.9. The minimum rate of anthropogenic mortality and serious injury to right whales averaged 3.0 per year (U.S. waters, 2.4; Canadian waters, 0.6), 2006-2010. This includes reported incidental fishery entanglements of 1.8 per year (U.S. waters, 1.6; Canadian waters, 0.2) and reported ship strikes of 1.2 per year (U.S. waters, 0.8; Canadian waters, 0.4). Over half of the fishery entanglements resulting in serious injury or mortality reported in U. S. waters during this period occurred before the Atlantic Large Whale Take Reduction Plan's sinking-groundline rule went into effect in 2009. Three of the 4 reported ship strike serious injury and mortalities in U.S. waters were in 2006; one was in 2010, after the speed limit rule went into effect in December 2009 (Waring et al. 2013). Given that the species is critically endangered and that the average annual anthropogenic mortality and serious injury exceeds PBR, no mortality or serious injury is considered insignificant (Waring et al. 2013).

Distribution and habitat preferences: The range of the western North Atlantic right whale population extends from wintering and calving grounds in the southeastern U.S. to summer feeding and nursery grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (CETAP 1982, Kraus and Rolland 2007, Waring et al. 2007). The six major congregation areas are: coastal waters of the southeastern U.S.; the GSC; GOM/GB; CCB and Massachusetts Bay; the Bay of Fundy; and the Scotian Shelf (Waring et al. 2009a). Right whales have been sighted from the MAB to the GOM during all months of the year (NMFS 2006b). Peak abundance of right whales in CCB begins in late winter. In May, abundance shifts to the GSC (Kenney et al. 1995). During late June and July, distribution gradually shifts to the northern edge of GB. In late summer and fall, the population concentrates in the Bay of Fundy and Roseway Basin (Kenney et al. 2001, Kenney et al. 1995, Winn et al. 1986).

New England waters constitute important feeding habitat for right whales, which feed primarily on copepods of the genera *Calanus* and *Pseudocalanus* in this area. Feeding has been well documented in the coastal waters off Massachusetts. Right whales also feed along the margins of GB, in the GSC, in the GOM, in the Bay of Fundy, and over the Scotian Shelf (Kenney 2001). Recent evidence suggests that the central GOM may also be a mating ground for North Atlantic right whales from November through January (Cole et al. 2013). In 1994, NMFS designated critical habitat areas for the North Atlantic right whale in U.S. waters (Federal Register 1994). The Cape Cod Bay Critical Habitat and the Great South Channel Critical Habitat lie within the fisheries research action area (Figure 3.2-1). Their importance as feeding and nursery areas warranted the designations. The Southeastern U.S. Critical Habitat Area (Figure 3.2-2) is located off the coasts of Florida and Georgia and is a primary calving area for this population.

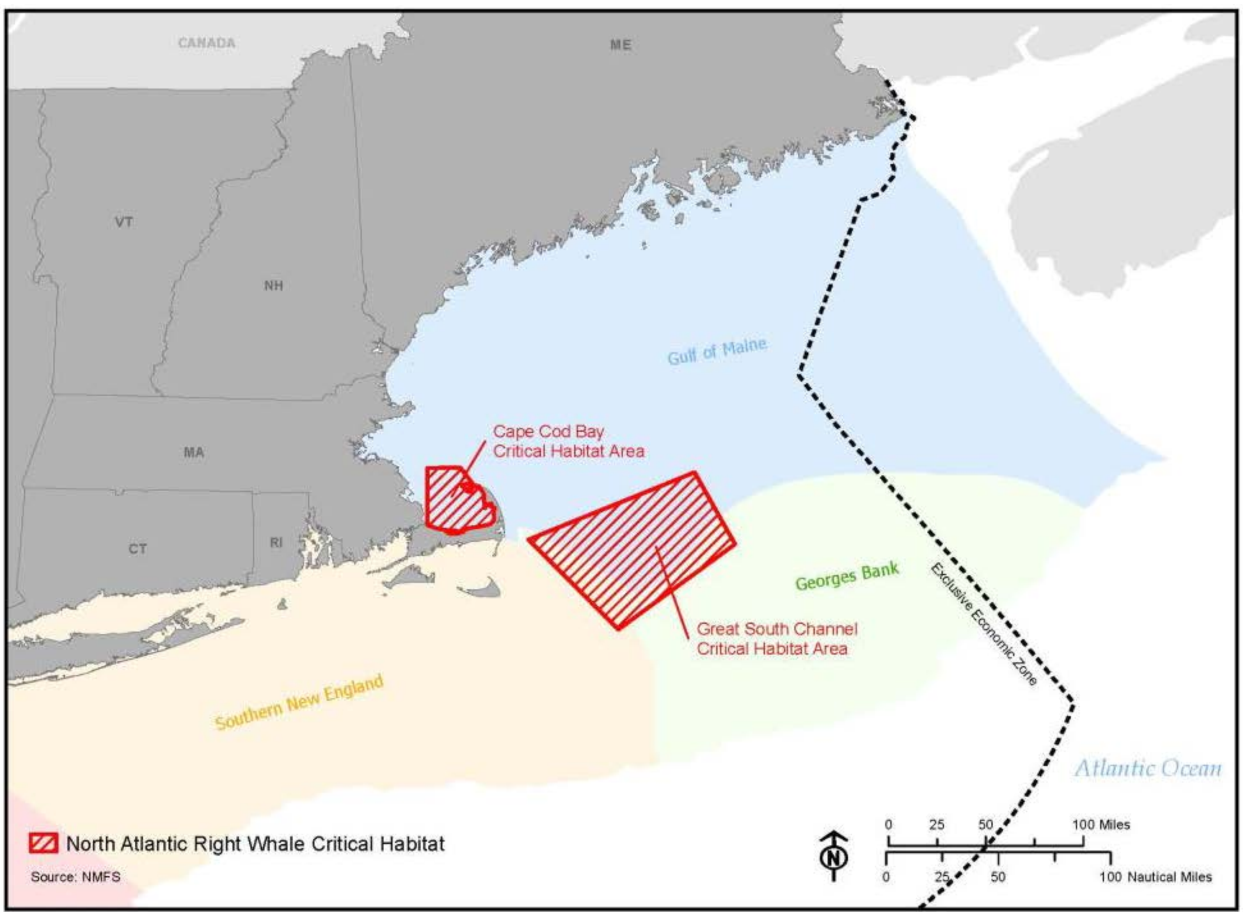


Figure 3.2-1 Designated Critical Habitat for the North Atlantic Right Whale in the Northeast Region

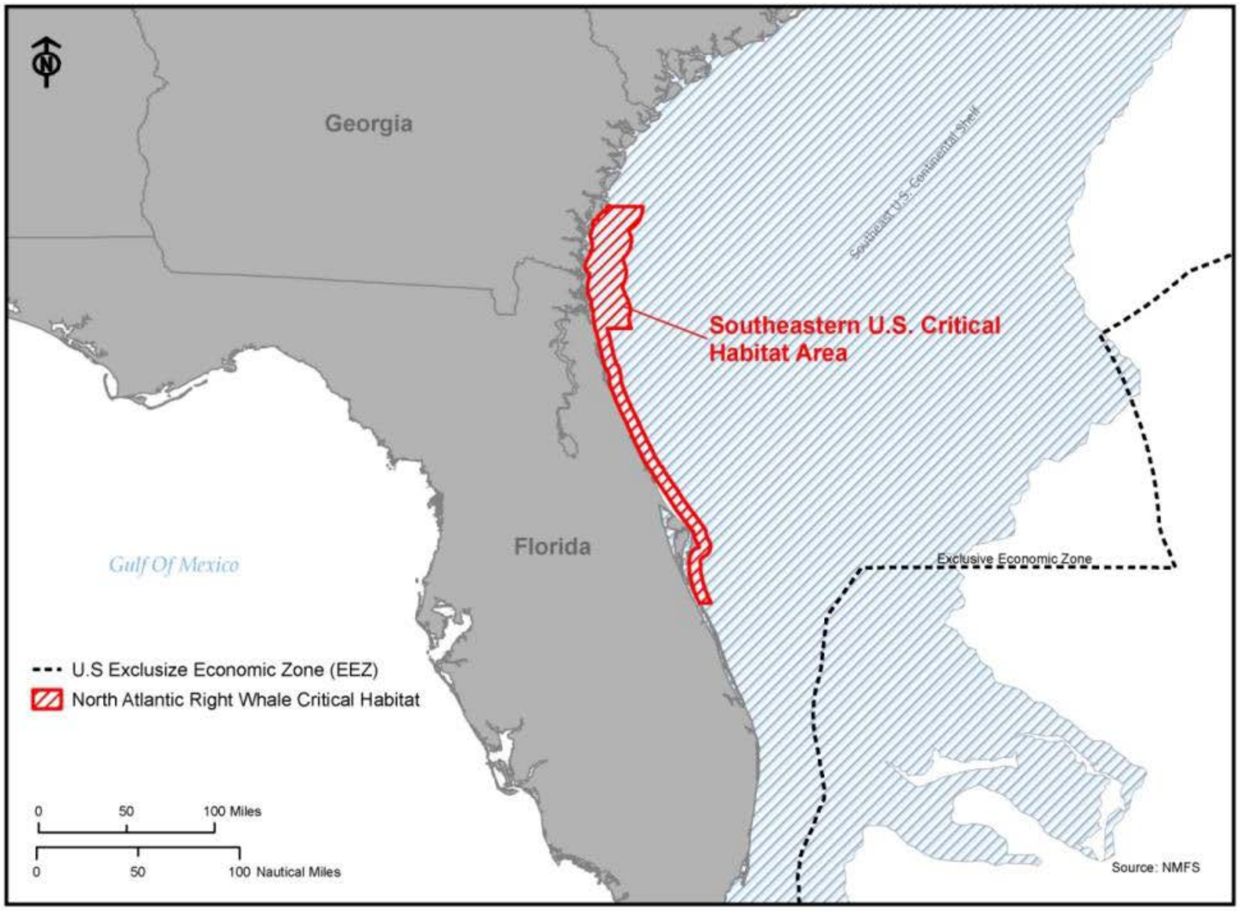


Figure 3.2-2 Designated Critical Habitat for the North Atlantic Right Whale in the Southeast Region

Behavior and life history: Breeding, mating, and calving of right whales occurs during winter, typically in shallow coastal regions or bays; calving may take place at geographically distant sites from mating (Kenney 2009). Calving takes place between December and March in the western North Atlantic after 12-13 months of gestation (Best et al. 2001) The mean calving interval from 1980-1992 was calculated as 3.67 years (Knowlton et al. 1994), increased to five years using data from 1998-2003 (Best et al. 2001), and, most recently (2004-2005), appears closer to three years (Kraus et al. 2005). North Atlantic right whales feed primarily on copepods of the genera *Calanus* and *Pseudocalanus* in New England and eastern Canadian waters (Kenney 2001).

Humpback Whale

Status and trends: The western North Atlantic humpback whale population includes six relatively discrete feeding-area subpopulations: the east coast of the U.S. (including the GOM and GB), the Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and northern Norway (Clapham et al. 2003, Katona and Beard 1990, Palsbøll et al. 1997, Waring et al. 2013). Based on genetic analyses, the GOM feeding stock is treated as a separate management stock (IWC 2002, Palsbøll et al. 1995).

The best available estimate for the entire North Atlantic humpback whale population is 11,570, based on data collected in 1992 and 1993, and the average annual rate of increase from 1979-1993 was estimated at 3.1 percent (Stevick et al. 2003). Although recent abundance estimates indicate continued population growth, the size of the humpback whale stock off the U.S. east coast may still be below its optimum sustainable population (OSP). Based on photographically identified individual humpback whales in the

Gulf of Maine, the estimated minimum number alive in 2008 was 823 whales (Waring et al. 2013). PBR for this stock is 2.7 whales (Waring et al. 2013). From 2006 through 2010, the minimum annual rate of human-caused mortality and serious injury averaged 7.8 Gulf of Maine humpback whales per year (U.S. waters, 7.2; Canadian waters, 0.6). This includes 5.8 incidental fishery interactions (U.S. waters, 5.2; Canadian waters, 0.6) and 2.0 vessel collisions, all in U.S. waters (Henry et al. 2012). Although total U.S. fishery-caused mortality and serious injury is unknown, reported levels exceed 10 percent of PBR, so cannot be considered insignificant or approaching zero mortality and serious injury rate. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and because the North Atlantic humpback whale is an endangered species (Waring et al. 2013). A Recovery Plan was published and is currently in effect (NMFS 1991).

Distribution and habitat preferences: Humpback whales are found in all oceans of the world and migrate from high latitude feeding grounds to low latitude breeding and calving areas. They are typically found in coastal or shelf waters in summer and close to islands and reef systems in winter. Humpback whales feed in New England waters during spring, summer, and fall. Their distribution shifts in response to prey availability (Payne et al. 1986, Payne et al. 1990). Important feeding areas include: sandy shoals in the southwestern GOM, offshore waters of Cultivator Shoal, the Northeast Peak of GB, Jeffreys Ledge, and the northern GOM (Paquet et al. 1997, Payne et al. 1986). Most North Atlantic humpback whales, including the GOM stock, migrate to the West Indies during the winter to mate and calve (Katona and Beard 1990, Palsbøll et al. 1995). Not all migrate south, however. Significant numbers occur in mid- and high-latitude regions in winter, including off Chesapeake and Delaware Bays and along the Virginia and North Carolina coasts (Clapham et al. 1993, Swingle et al. 1993, Wiley et al. 1995). Most of the individually identified whales in this region were from the GOM, but some were from Newfoundland and the Gulf of St. Lawrence. The Mid-Atlantic region appears to be a supplemental winter feeding area for humpbacks whales (Barco et al. 2002).

Behavior and life history: Humpback whales are known for their spectacular aerial behaviors and for the complex songs of males, the latter of which is presumably to attract females. They breed and calve in warm tropical waters after an 11 month gestation period; calves feed independently after about six months. Humpback whales feed in high-latitude waters on euphausiids and various schooling fish, including herring, capelin, sand lance, and mackerel (Paquet et al. 1997).

Fin Whale

Status and trends: Fin whales of the western North Atlantic stock commonly occur in U.S. waters from Cape Hatteras northward. The best abundance estimate for this stock is 3,522 whales and the minimum population estimate is 2,817 whales. The calculated PBR is 5.6 fin whales (Waring et al. 2013). From 2006 through 2010, the minimum annual rate of human-caused mortality and serious injury for western North Atlantic fin whales averaged 2.0 (U.S. waters, 1.8; Canadian waters, 0.2). This includes 0.8 incidental fishery interactions (U.S. waters, 0.6; Canadian waters, 0.2) and 1.2 vessel collisions, in U.S. waters only (Henry et al. 2012). Total human-caused mortality and serious injury is unknown, although minimum levels currently exceed 10 percent of PBR (Waring et al. 2013).

The fin whale is listed as endangered under the ESA, yet the status of the stock off the U.S. Atlantic coast, relative to optimum sustainable population, is unknown and data are inadequate to determine the population trend for fin whales. A Final Recovery Plan for fin whales was published in 2010 (NMFS 2010e).

Distribution and habitat preferences: Fin whales are distributed widely in the world's oceans and occur in both the Northern and Southern Hemispheres between 20–75^{o} latitude (DON 2008b). Fin whales are common in waters off the U.S. east coast, principally from Cape Hatteras northward. New England waters represent a major feeding area for fin whales (Hain et al. 1992; Kenney et al. 1997), with key feeding grounds in the western Gulf of Maine from Stellwagen Bank to Jeffreys Ledge, and the Great South Channel. These are areas associated with sand lance (Kenney and Winn 1986, Hain et al. 1992, DON

2005). Secondary seasonal areas of importance are off eastern Long Island, along the northern edge of GB and in the northern GOM (CETAP 1982, Waring and Finn 1995, DON 2005). Fin whales historically accounted for 46 percent of the large whales and 24 percent of all cetaceans sighted over the NE LME during marine mammal aerial surveys between Cape Hatteras and Nova Scotia during 1978-82 (CETAP 1982). Fin whales are likely the dominant large cetacean species in this region during all seasons, with the largest standing stock, the largest food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Hain et al. 1992, Kenney et al. 1997).

Behavior and life history: Fin whales off the U.S. Atlantic coast may migrate into Canadian waters, open-ocean areas, or even subtropical or tropical regions. It is, however, unlikely that fin whales undergo distinct annual migrations (Waring et al. 2012). Calving, mating, or wintering areas are unknown for most of the population, although Hain et al. (1992) suggested calving takes place during October to January off the U.S. Mid-Atlantic region. Fin whales become sexually mature between six to 10 years of age, and reproduce primarily in the winter. Gestation lasts about 11 months and nursing occurs for six to 11 months (Aguilar 2009). Fin whales feed on planktonic crustaceans, including *Thysanoessa* sp. and *Calanus* sp., as well as schooling fish including sand lance, herring, capelin and mackerel (Aguilar 2009).

Sei Whale

Status and trends: Sei whales in the NEFSC survey area are part of the Nova Scotia stock. The best population estimate for this stock of sei whales, based on surveys in 2011, was 357 individuals. The minimum estimate was 236 whales. This is considered a conservative estimate since the survey did not include the entire known range and there remain uncertainties about population structure and movements. The calculated PBR for the Nova Scotia stock of sei whales is 0.5 (Waring et al. 2013). From 2006 through 2010, the minimum annual rate of human-caused mortality and serious injury to the Nova Scotia stock of sei whales averaged 1.2 (U.S. waters, 1.0; Canadian waters, 0.2). This includes 0.6 incidental fishery interactions (U.S. waters, 0.4; Canadian waters, 0.2) and 0.6 vessel collisions, in U.S. waters only (Henry et al. 2012). Total human-caused mortality and serious injury is unknown, although minimum levels currently exceed PBR (Waring et al. 2013). Sei whales are listed as endangered under the ESA, but stock status is unknown and data are insufficient for assessing population trends. A Final Recovery Plan for sei whales was published in 2011 (NMFS 2011a).

Distribution and habitat preferences: Sei whales have a worldwide distribution, but are found primarily in cold temperate to subpolar latitudes (Horwood 2009). The Nova Scotia sei whale stock frequents northerly waters, including the Scotian Shelf, for feeding (Mitchell and Chapman 1977). During spring and summer, the southern extent of the range includes the GOM and GB. Abundance in U.S. waters is highest in spring, with sightings concentrated along the eastern edge of GB and into the Northeast Channel area, and along the southwestern edge of GB (CETAP 1982). Sei whales often occur in the deeper waters of the continental shelf edge region (Hain et al. 1985). Sei whales occasionally move into shallow inshore waters. Sei whales (like right whales) primarily feed on euphausiids and copepods in the North Atlantic. In years of greater abundance of this prey resource inshore, sei whales were reported in the GSC and Stellwagen Bank (Payne et al. 1990).

Behavior and life history: Sei whales spend the summer months feeding in subpolar higher latitudes and return to lower latitudes to calve in the winter. There is some evidence from whaling catch data of differential migration patterns by reproductive class, with females arriving at and departing from feeding areas earlier than males. For the most part, the location of winter breeding areas is unknown (Horwood 2009). Sei whales mature at about 10 years for both sexes. Breeding and calving take place in lower-latitude waters after a nearly one year gestation period. Most calves wean on high-latitude feeding grounds after about seven months (Horwood 2009). Sei whales primarily feed on euphausiids and copepods in the North Atlantic (Payne et al. 1990).

Blue Whale

Status and trends: Little is known about the population size of blue whales except for in the Gulf of St. Lawrence area. The count of 440 blue whales individually identified in the Gulf of St. Lawrence between 1979 and 2009 is considered a minimum population estimate for the western North Atlantic stock (Waring et al. 2010). Data are insufficient to determine population trends. The calculated PBR is 0.9 whales per year. There are no recent confirmed records of human-caused mortality or serious injury in the U.S. Atlantic EEZ (Henry et al. 2012, Waring et al. 2010). Blue whales are listed as endangered under the ESA, although the status of this stock is unknown and data are insufficient to determine population trends (Waring et al. 2010). A Recovery Plan has been published (Reeves et al. 1998) and is in effect.

Distribution and habitat preferences: Blue whale distribution in the western North Atlantic generally extends from the Arctic to at least mid-latitude waters. Most sightings are in the waters off eastern Canada, particularly the Gulf of St. Lawrence (Sears et al. 1987). The blue whale is best considered as an occasional visitor in U.S. Atlantic waters, which may represent the current southern limit of its feeding range (CETAP 1982, Wenzel et al. 1988).

Behavior and life history: Blue whales reach sexual maturity at 5-15 years of age; length at sexual maturity in the Northern Hemisphere for females is 69 to 75 feet and for males it is 66 to 69 feet (Sears and Perrin 2009). Females give birth about every 2-3 years in winter after a 10-12 month gestation; longevity is thought to be at least 80-90 years (Sears and Perrin 2009). Blue whales occur primarily in offshore deep waters (but sometimes near shore) and feed almost exclusively on euphausiids.

Sperm Whale

Status and trends: The International Whaling Commission recognizes one sperm whale stock in the North Atlantic. Although several population estimates exist for particular times or locations, there is no reliable estimate of total abundance in the western North Atlantic. The best recent population estimate for sperm whales off the U.S. east coast from North Carolina to the lower Bay of Fundy was 1,593 in 2011. This estimate was not corrected for dive times, so likely underestimates true abundance. The minimum population estimate is 1,187 and the PBR for western North Atlantic sperm whales is 2.4 (Waring et al. 2013). Between 2006 and 2010, the annual average human caused mortality was 0.6 sperm whales. This includes one ship strike mortality off Portland, Maine in 2006 and two reported mortalities in the Canadian Labrador halibut longline fishery in 2009 and 2010. There have been no documented incidental takes in observed U.S. Atlantic commercial fisheries (Waring et al. 2013). Sperm whales are listed as endangered under the ESA. A Recovery Plan was published and is currently in effect (NMFS 2010f).

Distribution and habitat preferences: Sperm whales occur primarily along the continental shelf edge, over the continental slope, and into mid-ocean regions (CETAP 1982, Waring et al. 1993, 2001, 2007). Distribution varies seasonally off the Northeast U.S. coast (CETAP 1982, Scott and Sadove 1997). In winter, sperm whales concentrate east and northeast of Cape Hatteras. In spring, distribution shifts northward to east of Delaware and Virginia, and is widespread throughout the central MAB and the southern part of GB. Summer distribution includes the area east and north of GB and into the Northeast Channel region, as well as the continental shelf south of New England (Scott and Sadove 1997, Waring et al. 2001). In fall, sperm whales are abundant on the continental shelf south of New England and occur along the continental shelf edge in the MAB (Waring et al. 2007). CETAP and NMFS/NEFSC sightings in shelf-edge and off-shelf waters included many social groups with calves/juveniles (CETAP 1982, Waring et al. 1993).

Behavior and life history: Females reach sexual maturity when approximately nine years old and roughly 30 feet long and give birth about every five years; gestation is 14-16 months (Whitehead 2009). Sperm whales consume a wide variety of deep water fish and cephalopods. They forage during deep dives that routinely exceed a depth of 1,300 feet and duration of 30 minutes. They are capable of diving to depths of over 6,500 feet with durations of over 60 minutes. Sperm whales spend up to 83 percent of

daylight hours underwater. Males do not spend extensive periods of time at the surface, whereas females may spend one to five hours daily at the surface without foraging (Whitehead 2009).

3.2.2.3 Non-ESA Listed Marine Mammals that could be taken during the course of NEFSC fisheries research activities.

Species included in this section are non-ESA listed species that could be taken by mortality/serious injury or 'Level A' harassment during the course of NEFSC fisheries research over the next five years. This includes species that have historically (2008-2012) been taken and those with vulnerabilities similar to those previously taken and could, therefore, be taken in the future. Species historically taken include minke whale, harbor porpoise, bottlenose dolphin, harbor seal, and gray seal. Detailed species descriptions and take determinations are available in Appendix C (the LOA Application) and, for the latter, in Table 4.2-11 of this Final PEA.

Minke whale

Minke whales off the east coast of the U.S. are part of the Canadian East Coast stock, which ranges from eastern Davis Strait (45º W) to the Gulf of Mexico (Waring et al. 2013). The best current abundance estimate for the entire stock (20,741) was derived from a 2007 survey that encompassed more of the minke whale range than any previous surveys, but did not include U.S. waters. Combined shipboard and aerial surveys during summer 2011 resulted in an abundance estimate of 2,591 minke whales from North Carolina to the lower Bay of Fundy. The PBR for the Canadian East Coast minke whale stock is 162 (Waring et al. 2013). The average annual minimum human-caused mortality and serious injury was 7.85 minke whales from 2007 to 2011. This includes 1.8 from observed U.S. fisheries, 1.0 from U.S. fisheries based on strandings and entanglements, 5.05 from U.S. and Canadian fisheries using strandings and entanglement data, and 1.0 from U.S. ship strikes (Waring et al. 2014).

Minke whales are common and widely distributed off the northeast U.S. coast, particularly in the GOM/GB regions, during spring and summer. Numbers diminish during fall and minke whales are largely absent from the area in winter (CETAP 1982, Mitchell 1991, Waring et al. 2012).

Risso's dolphin

Stock structure of Risso's dolphins in the western North Atlantic is unknown, although the Gulf of Mexico and Atlantic stocks are currently considered separate stocks (Waring et al. 2013). The best abundance estimate is 18,250, derived from 2011 surveys from North Carolina to the lower Bay of Fundy. The PBR for western North Atlantic Risso's dolphins is 126. The total annual estimated average fishery-related mortality or serious injury was 62 dolphins from 2007 to 2011 (Waring et al. 2014).

Risso's dolphins typically occur along the continental shelf edge from Cape Hatteras northward to GB during the spring, summer, and autumn (CETAP 1982; Payne et al. 1984). In winter, the range extends from the MAB to offshore, oceanic waters (Payne et al. 1984). The population occupies the Mid-Atlantic continental shelf edge year round, and is rarely seen in the GOM (Payne et al. 1984).

Long-finned pilot whale

The two species of pilot whales in the western North Atlantic—the long-finned pilot whale and the short-finned pilot whale (see below)—are difficult to differentiate at sea. Much information, therefore, refers to *Globicephala* sp. (CETAP 1982; Waring et al. 2012). The best available abundance estimate is from 2006 aerial surveys from the southern GOM to the uppoer Bay of Fundy and Scotian Shelf. The resulting estimate for long-finned pilot whales is 26,535 and the PBR is 199 (Waring et al. 2014).

Total U.S. fishery-related mortality and serious injury of long-finned pilot whales cannot be determined due to an inability to partition mortality estimates between long-finned and short-finned pilot whales in the bottom trawl and mid-water trawl fisheries. Estimates from these two fisheries include both species

combined (Waring et al. 2014). Biopsy data and genetic analyses indicate that only short-finned pilot whales are taken as bycatch in the pelagic longline fishery, so those data are excluded from the estimates presented here. From 2007 to 2010, the total annual estimated average fishery-related mortality or serious injury of pilot whales was 43. One undetermined pilot whale mortality was observed in the Northeast sink gillnet fishery; the rest were undetermined pilot whales in either mid-water or bottom trawl fisheries, including 26 in the mid-Atlantic bottom trawl fishery (Waring et al. 2014).

Pilot whales occur throughout the NEFSC survey area from Canada to Cape Hatteras. Long-finned pilot whales concentrate along the Northeast U.S. shelf edge during mid-winter and early spring (CETAP 1982; Payne and Heinemann 1993; Abend and Smith 1999). In late spring, pilot whales move from the Mid-Atlantic region onto GB and the Scotian Shelf, and into the GOM, where they remain through late autumn (Sergeant and Fisher 1957; Mitchell 1975; CETAP 1982; Payne and Heinemann 1993; Waring et al. 2012).

Short-finned pilot whale

As noted above for long-finned pilot whales, long–finned and short-finned pilot whales are difficult to differentiate at sea. Survey data, therefore, often references *Globicephala* sp. (CETAP 1982; Waring et al. 2012). The best abundance estimate for short-finned pilot whales is from summer 2011 surveys between central Florida and the lower Bay of Fundy. Combining survey data with genetic analysis of the spatial distribution of the two species allowed for the derivation of abundance estimates for each species. The resulting estimate for short-finned pilot whales is 21,515. PBR is 159 whales (Waring et al. 2014). Total annual human-caused mortality and serious injury of short-finned pilot whales is indeterminable for the reasons described above for long-finned pilot whales. Total annual estimated average fishery-related serious injury or mortality during 2007-2011 was 162 pilot whales, 119 of which were short-finned pilot whales taken in the pelagic longline fishery. The remainder includes serious injury or mortality takes in the fisheries for which estimates are combined for both species (Waring et al. 2014).

Short-finned pilot whales occur worldwide in tropical to warm temperate waters and may seasonally extend into shelf-edge waters north of Cape Hatteras (Leatherwood and Reeves 1983). Short-finned and long-finned pilot whales overlap spatially along the mid-Atlantic shelf break from Cape Hatteras, North Carolina to New Jersey, between 38°N and 40°N latitude (Waring et al. 2012).

Atlantic white-sided dolphin

Distribution of white-sided dolphins of the western North Atlantic stock shows evidence of the possible existence of separate stock units in the Gulf of Maine, Gulf of St. Lawrence, and Labrador Sea. The best available current abundance estimate for the entire stock (48,819) was derived from surveys from North Carolina to the lower Bay of Fundy conducted in summer 2011 (Waring et al. 2013). The PBR for the western North Atlantic stock of white-sided dolphins is 304 and the total annual estimated average fishery-related mortality and serious injury was 117 during 2007 to 2011. Most (73) of the estimated mortalities are attributed to the Northeast Bottom Trawl fishery (Waring et al. 2014).

Atlantic white-sided dolphins occur primarily in continental shelf waters in temperate and sub-polar regions of the North Atlantic from central West Greenland to North Carolina. During January to May, low numbers occur from GB to Jeffreys Ledge, with some occurrence south of GB, as evidenced by strandings in Virginia and North Carolina. White-sided dolphins are prevalent from GB to the lower Bay of Fundy, including the western GOM and southeast of Cape Cod, from June through September (CETAP 1982; Selzer and Payne 1988; Hamazaki 2002). They occur at lower densities from October to December from southern GB to southern GOM (Payne and Heinemann 1990).

White-beaked dolphin

The total number of white-beaked dolphins in U.S. and Canadian waters is unknown (Waring et al. 2007). The best and only recent abundance estimate for the western North Atlantic stock (2,003) is from aerial

survey data from 2006. This is presumably negatively biased since the survey covered only part of the species' range. PBR for this stock is 10. The total number of white-beaked dolphins incidentally caught in Canadian fisheries is unknown and there are no documented reports of fishery-related mortality and serious injury in the U.S. EEZ (Waring et al. 2007).

White-beaked dolphins are the more northerly of the two species of *Lagenorhynchus* in the northwest Atlantic (Leatherwood et al. 1976). They range from SNE north to western and southern Greenland and Davis Straits (Leatherwood et al. 1976; CETAP 1982), and from the Barents Sea south to at least Portugal (Reeves et al. 1999). White-beaked dolphin sightings off the northeastern U.S. are primarily in the western GOM and around Cape Cod (CETAP 1982).

Short-beaked common dolphin

Currently, the best available abundance estimate for short-beaked common dolphins off the U.S. or Canadian Atlantic coast is 173,486, based on a 2007 Canadian Trans-North Atlantic Sighting Survey (Waring et al. 2014). PBR for the western North Atlantic stock is 1,125 and the total annual estimated average fishery-related mortality or serious injury was 168 from 2007 to 2011. The majority (96) were in the Mid-Atlantic Bottom Trawl fishery (Waring et al. 2014).

Common dolphins are distributed world-wide in temperate, tropical, and subtropical seas. They occur along the continental shelf break and slope and are associated with Gulf Stream features in waters off the northeastern U.S. coast (CETAP 1982; Selzer and Payne 1988; Waring et al. 2007). They are widespread from Cape Hatteras northeast to GB (35˚ to 42˚ N) in outer continental shelf waters from mid-January to May (Hain et al. 1981; CETAP 1982; Payne et al. 1984) and move northward onto GB and the Scotian Shelf from mid-summer to autumn. Large aggregations (greater than 3000 animals) may occur on GB in autumn and they are occasionally found in the GOM (Selzer and Payne 1988).

Atlantic spotted dolphin

The two forms of Atlantic spotted dolphin may be distinct sub-species, although they are currently considered as one western North Atlantic stock for assessment and management purposes. A large, heavily spotted form inhabits the continental shelf, usually inside or near the 650-foot isobath and a smaller, less spotted island and offshore form occurs in the Atlantic Ocean, but not in the Gulf of Mexico. The two forms can be difficult to differentiate where they co-occur (Waring et al. 2013 and citations therein). The best current available abundance estimate for Atlantic spotted dolphins is 44,715, based on a 2011 survey from central Florida to the lower Bay of Fundy (Waring et al. 2014). PBR for the combined offshore and coastal forms is 316. Total annual estimated average fishery-related mortality or serious injury to this stock was zero (2007-2011) (Waring et al. 2014).

Atlantic spotted dolphins are distributed in tropical and warm temperate waters of the western North Atlantic (Leatherwood et al. 1976). They range from SNE, south through the Gulf of Mexico and the Caribbean to Venezuela (Leatherwood et al. 1976; Perrin et al. 1994). They regularly occur in the inshore waters south of Chesapeake Bay and near the continental shelf edge and continental slope waters north of this region (Payne et al. 1984; Mullin and Fulling 2003). Atlantic spotted dolphins north of Cape Hatteras also associate with the north wall of the Gulf Stream and warm-core rings (Waring et al. 1992).

Bottlenose dolphin

The coastal and offshore forms of bottlenose dolphins are morphologically and genetically distinct morphotypes (Duffield et al. 1983; Duffield 1986). Both inhabit waters along the U.S. Atlantic coast (Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997).

From 1995 to 2001, NMFS recognized only one migratory stock of coastal bottlenose dolphins in the western North Atlantic, with the entire stock listed as depleted under the MMPA. Stock structure was revised in 2002 to recognize both multiple stocks and seasonal management units and again in 2008 and

2009 to recognize resident estuarine stocks and migratory and resident coastal stocks (Waring et al. 2010). The Western North Atlantic coastal stock was, subsequently, divided into the Central Florida, Northern Florida, South Carolina-Georgia, and the Southern Migratory and Northern Migratory Coastal stocks (Rosel et al. 2009, Waring et al. 2010). All coastal stocks retain the depleted status (Waring et al. 2010). The resident estuarine stocks within range of the NEFSC research area include: Northern North Carolina Estuarine System (NNCES), Southern North Carolina Estuarine System (SNCES), Northern South Carolina Estuarine System (NSCES), Charleston Estuarine System (CES), Northern Georgia/Southern South Carolina Estuarine System (NGSSCES), Southern Georgia Estuarine System (SGES), Jacksonville Estuarine System (JES), and Indian River Lagoon Estuarine System (IRLES). The Western North Atlantic offshore, Southern Migratory Coastal, and Northern Migratory Coastal stocks are those most likely to interact with NEFSC fisheries research activities; the estuarine system stocks do not overlap in time or space with most NEFSC-affiliated research activities; only the COASTSPAN and Apex predators surveys occur in areas where these stocks may occur.

The best abundance estimates for the Northern and Southern Migratory Coastal stocks are from summer 2010 and 2011 surveys. The resulting abundance estimate for the Northern Migratory Coastal stock was 11,548 and the Southern Migratory Coastal Stock was 9,173. The respective PBRs are 86 and 63 (Waring et al. 2014). Total U.S. fishery-related mortality and serious injury for these stocks cannot be directly estimated because of spatial overlap of several stocks in North Carolina. Best estimates of annual average mortality and serious injury for 2007-2011 was 3.8-5.8 for the Northern Migratory Coastal stock and 2.6-16.5 for the Southern Migratory Coastal stock. Most are taken in the Mid-Atlantic coastal gillnet fishery (Waring et al. 2014).

The best available abundance estimates for the estuarine system stocks are based on 2006 survey data. Please refer to Table 3.2-6 for abundance estimates and PBRs for the numerous estuarine stocks. Many of these stocks are small or of unknown size so PBR values are small or cannot be determined for lack of a minimum population estimate. These stocks are considered strategic under the MMPA either because estimated human-caused mortality and serious injury exceeds 10 percent of PBR (i.e., NNCES and SNCES) or because relatively few human-caused mortality and serious injuries would likely exceed PBR if it could be calculated (i.e., stocks with unknown PBR).

The western North Atlantic offshore bottlenose dolphin stock is not listed as depleted under the MMPA. Stock status within U.S. Atlantic waters is unknown and data are insufficient to determine population trends. The best available abundance estimate for offshore bottlenose dolphins is from 2011 surveys between central Florida and the lower Bay of Fundy. The resulting abundance estimate is 77,532. PBR for this stock is 561 and total annual human-caused mortality and serious injury was 41.7 due to interactions with the Northeast bottom trawl, mid-Atlantic bottom trawl, and pelagic longline fisheries (Waring et al. 2014).

The coastal morphotype of bottlenose dolphins is continuously distributed along the Atlantic coast south of Long Island, New York around the Florida peninsula and into the Gulf of Mexico. The estuarine stocks are believed to stay in nearshore waters within 1.8 miles of shore and may overlap with coastal stocks in these waters (Waring et al. 2014 and citations therein). The SNCES occupies estuarine and nearshore coastal waters (< 2 miles from shore) from near to the North Carolina/South Carolina border to New River during cold water months, with minimal range extension during warm months northward to Core Sounds and southern Pamlico Sound (Waring et al. 2014 and citations therein). The offshore form is distributed primarily along the outer continental shelf and continental slope from GB to Cape Hatteras during spring and summer (CETAP 1982; Kenney 1990). North of Cape Hatteras, there is separation of the two morphotypes across bathymetry during summer months.

Table 3.2-6 Stocks of Bottlenose Dolphins (*Tursiops truncatus*) that Could Interact with NEFSC Fisheries Research Activities

Stock	MMPA Status	Best Abundance Estimate	PBR
Western North Atlantic Offshore		77,532	561
Coastal, Northern Migratory	Depleted	11,548	86
Coastal, Southern Migratory	Depleted	9,173	63
Coastal, South Carolina & Georgia	Depleted	4,377	31
Coastal, Northern Florida	Depleted	1,219	7
Coastal, Central Florida	Depleted	4,895	29
Northern North Carolina Estuarine System	Strategic	950	7.9
Southern North Carolina Estuarine System	Strategic	188	1.6
Northern South Carolina Estuarine System	Strategic	unknown	unknown
Charleston Estuarine System	Strategic	289	2.8
Northern Georgia/Southern South Carolina Estuarine System	Strategic	unknown	unknown
Southern Georgia Estuarine System	Strategic	194	1.9
Jacksonville Estuarine System	Strategic	unknown	unknown
Indian River Lagoon Estuarine System	Strategic	unknown	unknown

1 Source: Waring et al. 2014.

Harbor porpoise

The Gulf of Maine/Bay of Fundy stock of harbor porpoise occurs in U.S. and Canadian Atlantic waters (Waring et al. 2013). Population trends are unknown. The best current population estimate for harbor porpoise in the GOM/Bay of Fundy region is 79,883 based on 2011 survey results. PBR is 706 porpoises per year (Waring et al. 2013). The total annual estimated average human-caused mortality of 719 porpoises (675 from U.S. fisheries and 44 from Canadian fisheries) exceeds PBR, making this a strategic stock under the MMPA. Recent Gulf of Maine/Bay of Fundy harbor porpoise takes have been in the U.S. Northeast sink gillnet, mid-Atlantic gillnet, and Northeast bottom trawl fisheries and in the Canadian herring weir fisheries (Waring et al. 2014).

Gulf of Maine/Bay of Fundy harbor porpoise primarily occupy cooler, relatively shallow coastal waters off the Northeast U.S., Bay of Fundy and southwest Nova Scotia, Canada (Gaskin 1984; Palka et al. 1996; Read 1999). During summer (July to September), they concentrate in the northern GOM and southern Bay of Fundy, with a few sightings in the upper Bay of Fundy and northern edge of GB (Gaskin 1977, Gaskin and Watson 1985, Kraus et al. 1983, Palka 1995a, b, Palka et al. 1996, Palka 2000). Harbor porpoise widely disperse from New Jersey to Maine during fall (October-December) and spring (April-June). Part of the population occupies shelf waters from Massachusetts to North Carolina during fall (Palka et al. 1996). During winter (January to March), harbor porpoise range from New Jersey to North Carolina, with lower densities off New York to New Brunswick, Canada. Habitat use appears associated with prey (Recchia and Read 1989; Palka 1995b; Gannon et al. 1998).

Harbor seal

The western North Atlantic harbor seal stock structure is unknown, although harbor seals along the eastern U.S. and Canadian coasts are thought to represent one population (Temte et al. 1991). Harbor seal numbers along the New England coast steadily increased since passage of the MMPA in 1972. The most recent coast-wide aerial survey along the Maine coast was conducted in May/June 2012 during pupping; the 2012 estimate, corrected for seals not hauled out, was 70,141 (Waring et al. 2014). PBR for the western North Atlantic stock of harbor seals is 1,469. Total human caused mortality and serious injury to harbor seals is estimated to be 407 per year (2007-2011). This includes 389 from the 2007–2011 observed fishery, and 12 from 2007–2012 non-fishery-related, human interaction stranding mortalities (Waring et al. 2014).

Harbor seals in the western north Atlantic range from the eastern Canadian Arctic and Greenland to SNE and New York, and occasionally to the Carolinas (Mansfield 1967; Boulva and McLaren 1979; Katona et al. 1993; Gilbert and Guldager 1998; Baird 2001). Breeding and pupping in the U.S. normally occur in waters north of the New Hampshire/Maine border (Temte et al. 1991; Katona et al. 1993). Harbor seals occur year-round in the coastal waters of eastern Canada and Maine (Katona et al. 1993), and seasonally along the SNE and New York coasts from September through late May (Schneider and Payne 1983). Seals move southward from the Bay of Fundy to SNE waters in fall and early winter (Rosenfeld et al. 1988; Whitman and Payne 1990; Barlas 1999; Jacobs and Terhune 2000). A northward movement from SNE to Maine and eastern Canada occurs prior to the pupping season in mid-May through June (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Kenney 1994; deHart 2002). Recent data indicate that some pupping is occurring at high-use haul out sites off Manomet, Massachusetts (Waring et al. 2013).

Gray seal

The three major populations of gray seals in the North Atlantic are in eastern Canada, northwestern Europe, and the Baltic Sea (Katona et al. 1993). The western North Atlantic stock is equivalent to the eastern Canada population, and ranges from New England to Labrador (Mansfield 1966; Katona et al. 1993; Davies 1957; Lesage and Hammill 2001). Current estimates of the total western North Atlantic population are not available, although estimates for stock components exist. The combined estimated total abundance for Sable Island, Gulf of St. Lawrence, and Coastal Nova Scotia was 331,000 in 2012 (Waring et al. 2014). The minimum population size and PBR for western North Atlantic gray seals in U.S. waters are unknown. The total estimated annual human caused mortality and serious injury to gray seals was 4,980 from 2007-2011. This includes 1,120 from the U.S. observed fishery; nine from non-fishery related, human interaction stranding mortalities; 750 from the Canadian seal hunt; 82 from Department of Fisheries and Oceans (DFO) Canada scientific collections; and 3,019 removals of nuisance animals in Canada (Waring et al. 2014).

The population in U.S. waters is increasing due to a combination of recolonization by Canadian gray seals and increased pupping. Gray seal breeding colonies in New England include Muskget Island, Massachusetts and Green and Seal Islands in Maine, where a combined minimum of 2,620 pups were born in 2008 (Wood Lafond 2009). Pups have also recently been seen on Matinicus Rock, Maine (Waring et al. 2013). Gray seals are also observed in New England outside of the pupping season. A maximum count of 15,756 gray seals was made in southeastern Massachusetts coastal waters in March 2011 (Waring et al. 2013). Gray seals have also recently been recorded in surveys off eastern Long Island (Waring et al. 2013).

3.2.3 Seabirds

3.2.3.1 Threatened and Endangered Species

Two bird species in the NEFSC research area are listed under the ESA, the roseate tern (*Sterna dougallii)*, which was listed as endangered in the U.S. in 1987, and the Bermuda petrel (*Pterodroma cahow*), listed as endangered in 1970. The least tern (*Sterna antillarum)* is listed as endangered in the interior part of its U.S. range but is not listed on the Atlantic coast (U.S Fish and Wildlife Service [USFWS] 2010).

Roseate tern

Roseate terns have nesting populations in tropical and subtropical areas of the Indian and North Atlantic Oceans as well as temperate zone breeding populations in North America, Europe, South Africa, and Western Australia (Spendelow 1995). Along the North Atlantic coast, roseate terns almost always nest in colonies with common terns. These birds winter in coastal areas of northern South America. The population was subject to extensive mortality from historical feather hunters but has also suffered from nesting habitat loss due to coastal development and heavy predation and competition from large gulls (Spendelow 1995). There have been no documented cases of roseate terns or any other birds being taken in any of the NEFSC fisheries research surveys.

Bermuda petrel (cahow)

The cahow is a pelagic seabird that nests only on the islands of Bermuda. Once thought to have numbered more than half a million birds, cahows were catastrophically affected by the arrival of humans and introduced mammal predators on the island in the early 1600s. During the summer, solitary cahows are occasionally seen in the warm waters of the Gulf Stream off the coasts of North and South Carolina (Alsop III 2001). This pelagic species ranges widely on the open ocean; however, is considered rare and only occurring in low numbers off the Atlantic coast (SAFMC 2012).Predominant threats are habitat loss, predation, and contaminants (SAFMC 2012). Other threats include human encroachment at breeding sites, offshore oil and gas exploration at Gulf Stream foraging sites, lighted ships and platforms that attract birds at night leading to collisions with wires or other structures, and conflicts with off-shore fishing gear as they may be attracted to baited hooks (Hunter et al. 2006).

3.2.3.2 Other Bird Species

The bird species in Table 3.2-7 are frequently found in the NEFSC research area (Department of Interior [DOI] U. S. Minerals Management Service [MMS] 2009, NEFSC 2009). All species likely to occur in the project area are protected by the Migratory Bird Treaty Act (16 U.S. Code [USC] 703 *et.seq.*). Many of the following species are at least seasonally common in the project area and may be taken incidental to commercial fisheries (NEFSC 2009). A number of species have had high levels of adverse interactions with various fisheries in the Northeast to the point that they may have had or are at risk of population level effects (Zollett 2009, Table 3.2-7). However, there have been no birds reported as being caught incidentally in NEFSC fisheries surveys. Natural history information on these marine species is provided in the Cape Wind Energy Project Final Environmental Impact Statement (DOI MMS 2009), which is incorporated by reference.

Table 3.2-7 Common Bird Species in the NEFSC Reseach Area

Species	Scientific Name	Species	Scientific Name
Common loon [1]	*Gavia immer*	**Barrow's goldeneye**	*Bucephala islandica*
Red-throated loon [1]	*Gavia stellata*	**Red Phalarope**	*Phalaropus lobatus*
Horned grebe	*Podiceps auritus*	**Red-necked Phalarope**	*Phalaropus fulicaria*
Red-necked grebe [1]	*Podiceps grisegena*	**Great black-backed gull**	*Larus marinus*
Northern fulmar [1]	*Fulmarus glacialis*	**Herring gull** [1]	*Larus argentatus*
Greater shearwater [1]	*Puffinus gravis*	**Bonaparte's gull**	*Larus philadelphia*
Sooty shearwater [1]	*Puffinus griseus*	**Sabine's gull** [1]	*Xema sabini*
Manx shearwater [1]	*Xema sabini*	**Black-legged kittiwake** [1]	*Rissa tridactyla*
Leach's storm-petrel	*Oceanites leucorhoa*	**Laughing gull**	*Larus atricilla*
Wilson's storm-petrel	*Oceanites oceanicus*	**Ring-billed gull**	*Larus delawarensis*
Northern gannet [1]	*Morus bassanus*	**Parasitic jaeger**	*Stercorarius parasiticus*
Double-crested cormorant	*Phalacrocorax auritus*	**Pomerine jaeger** [1]	*Stercorarius pomarinus*
Great cormorant	*Phalacrocorax carbo*	**Common tern**	*Sterna hirundo*
Canada goose	*Branta canadensis*	**Roseate tern**	*Sterna dougallii (Endangered)*
Snow goose	*Chen caerulescens*	**Arctic tern**	*Sterna paradisaea*
Brant	*Branta bernicla*	**Least tern**	*Sterna antillarum*
American black duck	*Anas rubripes*	**Black tern**	*Chlidonias niger*
Greater scaup	*Aythya marila*	**Forster's tern**	*Sterna forsteri*
Common eider	*Somateria mollissima*	**Razorbill** [1]	*Alca torda*
Long-tailed duck	*Clangula hyemalis*	**Thick-billed murre** [1]	*Uria lomvia*
Black scoter	*Melanitta nigra*	**Common murre** [1]	*Uria aalga*
White-winged scoter	*Melanitta fusca*	**Dovekie**	*Alle alle*
Surf scoter	*Melanitta perspicillata*	**Atlantic puffin** [1]	*Fratercula arctica*
Red-breasted merganser	*Mergus serrator*	**Black guillemot** [1]	*Cepphus grille*
Common goldeneye	*Bucephala clangula*		

1. Species identified with adverse fisheries interactions in the Mid-Atlantic and New England areas which pose a serious threat to their populations (Zollett 2009).

3.2.4 Sea Turtles

Five species of sea turtles can be found within the area of the proposed NEFSC research activities. Additional background information on the range-wide status of these species can be found in a number of published documents, including sea turtle status reviews and biological reports (NMFS and USFWS 1995, 2007a, 2007b, 2007c, 2007d, 2013a, 2013b, Hirth 1997, USFWS 1997, marine Turtle Expert Working Group [TEWG] 1998, 2000, 2007, Conant *et al*. 2009, NMFS and SEFSC 2009), and recovery plans for the leatherback sea turtle (NMFS and USFWS 1992a), Kemp's ridley sea turtle (NMFS and USFWS 1992b, NMFS et al. 2011), green sea turtle (NMFS and USFWS 1991a), hawksbill sea turtle (NMFS and USFWS 1993), and loggerhead sea turtle (NMFS and USFWS 1991b, 2008).

3.2.4.1 Threatened and Endangered Species

All of the sea turtles found in the NEFSC research area are listed as threatened or endangered under the ESA. They are listed in Table 3.2-8 and described below.

Table 3.2-8 Sea Turtles in the NEFSC Research Area

Common Name	Scientific Name	Status
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Green sea turtle	*Chelonia mydas*	Endangered
Loggerhead sea turtle (Northwest Atlantic Ocean DPS)	*Caretta caretta*	Threatened
Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered

1. Green turtles in U.S. waters are listed as threatened except for the Florida breeding population which is listed as endangered. Due to the inability to distinguish between these populations away from the nesting beach, green turtles are considered endangered wherever they occur in U.S. waters.

Leatherback Sea Turtle

Leatherback sea turtles are widely distributed throughout the Atlantic Ocean, Pacific Ocean, Indian Ocean, Caribbean Sea, Gulf of Mexico, and the Mediterranean Sea (Ernst and Barbour 1972, NMFS and USFWS 2013a). The leatherback sea turtle is the largest living turtle and ranges farther than any other sea turtle species, exhibiting broad thermal tolerances that allow it to forage into the colder northeast region waters (NMFS and USFWS 1995). Evidence from tag returns and strandings in the western north Atlantic suggests that adults engage in routine migrations among boreal, temperate, and tropical waters (NMFS and USFWS 1992a). In the U.S., leatherback turtles are found throughout the western north Atlantic during the warmer months along the continental shelf and near the Gulf Stream edge. A 1979 aerial survey of the outer Continental Shelf from Cape Hatteras, to Cape Sable, Nova Scotia showed leatherbacks to be present throughout the area, with the most numerous sightings made from the GOM south to Long Island (CETAP 1982). Shoop and Kenney (1992) also observed concentrations of leatherbacks during the summer off the south shore of Long Island and New Jersey. Leatherbacks in these waters are thought to be following jellyfish, which is their preferred prey. Tagging and satellite telemetry data indicate that leatherbacks from the nesting beaches of the western North Atlantic use the entire North Atlantic Ocean (TEWG 2007).

Declines in the leatherback population have resulted from fishery interactions as well as exploitation of the eggs (Ross 1996). Eckert and Lien (1999) and Spotila et al. (1996) reported that adult mortality has increased significantly, particularly as a result of driftnet and longline fisheries. Zug and Parham (1996) attributed the sharp decline in leatherback populations to the combination of the loss of long-lived adults in fishery related mortality, and the lack of recruitment, stemming from elimination of annual influxes of hatchlings because of egg harvesting. The five-year status review (NMFS and USFWS 2007a) and the Turtle Expert Working Group (TEWG) report (TEWG 2007) indicate that leatherbacks seem to be the most vulnerable to entanglement in fishing gear, particularly in trap and pot gear. Leatherback nesting populations are declining dramatically in the Pacific Ocean, yet appear stable in many nesting areas of the Atlantic Ocean and Indian Ocean (NMFS and USFWS 2013a). An increasing or stable trend of leatherback nests for five of seven populations or groups of populations (Florida, North Caribbean, Southern Caribbean, South Africa, and Brazil) has been reported from the Turtle Expert Working Group (TEWG 2007), with the exception of the Western Caribbean and West Africa groups.

Based on its five-year status review of the leatherback species, NMFS and USFWS (2013a) determined that endangered leatherback sea turtles should not be delisted or reclassified. An analysis and review of the species was recommended to be conducted in the future to determine whether Distinct Population Segments should be identified for this species.

Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle is the most endangered of the world's sea turtle species. Of the seven extant species of sea turtles, the Kemp's ridley has declined to the lowest population level. This species typically occurs only in the Gulf of Mexico and the northwestern Atlantic Ocean (NMFS and USFWS 1992b). Juvenile Kemp's ridleys use northeastern and Mid-Atlantic coastal waters of the U.S. Atlantic coastline as primary developmental habitat during summer months, with shallow coastal embayments serving as important foraging grounds. Next to loggerheads, they are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June (Keinath et al. 1987, Musick and Limpus 1997). With the onset of winter and the decline of water temperatures, ridleys migrate to more southerly waters from September to November (Keinath et al. 1987, Musick and Limpus 1997). Turtles that do not head south soon enough face the risks of cold stunning in northern waters. Cold stunning can be a significant natural cause of mortality for sea turtles in Cape Cod Bay and Long Island Sound.

Like other turtle species, the severe decline in the Kemp's ridley population seems to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. Currently, impacts to the Kemp's ridley population are similar to those discussed above for other sea turtle species. Takes of Kemp's ridley turtles have been recorded in the northeast otter trawl fisheries, pelagic longline fisheries, and southeast shrimp and summer flounder bottom trawl fisheries. Kemp's ridleys may also be affected by large-mesh gillnet fisheries.

Based on the five-year status review of the Kemp's ridley sea turtle, NMFS and USFWS (2007b) determined that this species should remain classified as endangered under the ESA.

Green Sea Turtle

Green sea turtles are distributed circumglobally. In the western Atlantic they range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean, but are considered rare north of Cape Hatteras (Wynne and Schwartz 1999). Most green turtle nesting in the continental U.S. occurs on the Atlantic Coast of Florida (Ehrhart 1979).

As with loggerhead and Kemp's ridley sea turtles, green sea turtles use Mid-Atlantic and northern areas of the western Atlantic coast as important summer developmental habitat. Green turtles are found in estuarine and coastal waters as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds (Musick and Limpus 1997). Like loggerheads and Kemp's ridleys, green sea turtles that use northern waters during the summer must return to warmer waters when water temperatures drop or face the risk of cold stunning. Cold stunning of green turtles may occur in southern areas as well (e.g., Indian River, Florida), as these natural mortality events are dependent on water temperatures and not solely geographical location.

Impacts to the green sea turtle population are similar to those discussed for other sea turtles species. Fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality. Sea sampling coverage in the pelagic driftnet, pelagic longline, sea scallop dredge, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles.

Based on its five-year status review, NMFS and USFWS (2007c) determined that the green sea turtle should not be delisted or reclassified and an analysis should be conducted in the future to determine whether DPSs should be identified.

Loggerhead Sea Turtle

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans in a wide range of habitats. These include open ocean, continental shelves, bays, lagoons, and estuaries (NMFS and USFWS 1995, Witherington et al. 2006). Loggerhead sea turtles are primarily

benthic feeders, opportunistically foraging on crustaceans and mollusks (Wynne and Schwartz 1999, Witherington et al. 2006). Under certain conditions, they may also scavenge fish or forage on jellyfish in the water column (NMFS and USFWS 1991b). Horseshoe crabs are known to be a favorite prey item in the Chesapeake Bay area (Lutcavage and Musick 1985). Genetic information indicates the Grand Banks off Newfoundland are foraging grounds for a mixture of loggerheads from all the North Atlantic rookeries. Shallow water habitats with large expanses of open ocean access provide year-round foraging areas for adult male and female loggerheads (Conant *et al*. 2009).

The threatened loggerhead sea turtle is the most abundant of the sea turtles listed as threatened or endangered in the U.S. waters. In the western North Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the gulf coast of Florida. The activity of the loggerhead is limited by temperature. Loggerheads commonly occur throughout the inner continental shelf from Florida through Cape Cod, Massachusetts. Loggerheads may also occur as far north as Nova Scotia when oceanographic and prey conditions are favorable. Surveys conducted offshore, as well as sea turtle stranding data collected during November and December off North Carolina, suggest that sea turtles emigrating from northern waters in fall and winter months may concentrate in nearshore and southerly areas influenced by warmer Gulf Stream waters (Epperly et al. 1995). This is supported by the collected work of Morreale and Standora (1998), who satellite-tracked 12 loggerheads and three Kemp's ridleys. All of the turtles followed similar spatial and temporal corridors, migrating south from Long Island Sound, New York, during October through December. The turtles traveled within a narrow band along the continental shelf and became sedentary for one or two months south of Cape Hatteras.

In the Northeast Atlantic, satellite telemetry studies of post-nesting females from Cape Verde found two distinct dispersal patterns for the female loggerheads from this nesting area. Larger females migrated to benthic foraging areas off the Africa coast and smaller females foraged pelagically off the Africa coast. Recaptures of tagged juveniles and nesting females showed movement up and down the coasts of South America (Conant *et al*. 2009).

Loggerhead sea turtles do not usually appear on the most northern summer foraging grounds in the GOM until June, but are found in Virginia as early as April. They remain in the Mid-Atlantic and northeast areas until as late as November and December in some cases, but the majority leaves the GOM by mid-September. Aerial surveys of loggerhead turtles north of Cape Hatteras indicate that they are most common in waters from 72 to 161 feet deep, although they range from the beach to waters beyond the continental shelf (Shoop and Kenney 1992).

Loggerhead sea turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the north Atlantic gyre for as long as seven to 12 years before settling into benthic environments. Once loggerheads enter the benthic environment in waters off the coastal U.S., they are exposed to a suite of fisheries in federal and state waters including trawl, purse seine, hook and line, gillnet, pound net, longline, and trap fisheries. Loggerhead sea turtles are captured in fixed pound net gear in Long Island Sound, in pound net gear and trawls in summer flounder and other finfish fisheries in the Mid-Atlantic and Chesapeake Bay, in gillnet fisheries in the Mid-Atlantic and elsewhere, and in multi-species, monkfish, spiny dogfish, and northeast sink gillnet fisheries.

Currently, there are no population estimates for loggerhead sea turtles in any of the oceans in which they occur. A recent assessment by NMFS states that the adult female population in the western North Atlantic ranges from 20,000 to 40,000 or more, with a large range of uncertainty in population size (NMFS and SEFSC 2009).

In September of 2011 NMFS and the USFWS determined that the loggerhead sea turtle is composed of nine distinct population segments around the world. The population that occurs in the NEFSC research area is the Northwest Atlantic Ocean DPS, which is listed as endangered. NMFS has proposed to designate critical habitat for the Northwest Atlantic Ocean DPS off the U.S. Atlantic coast and in the Gulf of Mexico (78 FR 43006, 18 July 2013). The proposal includes offshore migratory and wintering habitat

around Cape Hatteras, North Carolina, and nearshore breeding and reproductive areas south of Cape Hatteras.

Hawksbill Sea Turtle

The hawksbill sea turtle is uncommon in the waters of the continental U.S. Hawksbills may occupy a range of habitats that include coral reefs or other hard bottom habitats, seagrass, algal beds, and mangrove bays and creeks (NMFS and USFWS 2013b). Hawksbills feed primarily on a wide variety of sponges but also consume bryozoans, coelenterates, and mollusks. The Culebra Archipelago of Puerto Rico contains especially important foraging habitat for hawksbills. Nesting areas in the western north Atlantic include Puerto Rico and the Virgin Islands. There are accounts of hawksbills in south Florida and a number are encountered in Texas. In the north Atlantic, small hawksbills have stranded as far north as Cape Cod (Sea Turtle Stranding and Salvage Network database). However, many of these strandings were observed after hurricanes or offshore storms. No takes of the endangered hawksbill sea turtle have been recorded in northeast or Mid-Atlantic fisheries covered by the NEFSC observer program which include: sink gill net, bottom coastal gill net, drift coastal gill net, sea scallop dredge, lobster pot, purse seine, and pelagic longline fisheries.

3.2.5 Invertebrates

The abundance and distribution of invertebrate populations varies greatly between and within the LME subareas, with concentrations of different species reflecting differences in sediment composition, depth, water temperature, food availability and other factors (NEFSC 2011a). Mollusks (particularly clams and scallops) and echinoderms (including starfish, brittle stars, sand dollars, sea urchins and sea cucumbers) make up a major portion of the benthic invertebrate biomass throughout the NE LME. The highest benthic invertebrate biomass was found in the SNE, which was dominated by mollusks. Relatively high biomass of both echinoderms and mollusks was also observed in areas of GB. Other invertebrate groups had similar clumped distribution patterns according to their habitat needs.

Theroux and Wigley (1998) described the composition of benthic invertebrate communities in the NE LME based on extensive benthic grab samples during 1956-1965. They reported that, in terms of numbers, the most common groups of benthic invertebrates in the GOM were annelids (35 percent), mollusks (33 percent), and amphipod crustaceans (14 percent). Biomass was dominated by bivalve mollusks (24 percent), sea cucumbers (22 percent), sand dollars (18 percent), annelids (12 percent), and sea anemones (nine percent). On GB, crustaceans (49 percent) and annelids (28 percent) numerically dominated the samples. Biomass in GB was dominated by echinoderms (50 percent) and mollusks (33 percent). Crustaceans and annelids were numerically dominant in assemblages of benthic fauna in SNE samples, while biomass was dominated by echinoderms and mollusks. Wigley and Theroux (1981) reported on similar studies in the MAB, where amphipod crustaceans (44 percnet) and bivalve mollusks (22 percnet) accounted for most of the individuals but mollusks dominated the biomass (70 percent).

3.2.5.1 Threatened and Endangered Species

No invertebrate species in the NEFSC research area are ESA-listed.

3.2.5.2 Target Species

Invertebrate species that are federally or state-managed within the NEFSC region include:

- American lobster
- Horseshoe crab
- Northern shrimp
- Longfin squid
- Northern shortfin squid
- Atlantic surfclam
- Ocean quahog
- Deep sea red crab
- Atlantic sea scallop

For the purpose of this Final PEA, only those species with a combined research catch from all NEFSC surveys and NEFSC-funded cooperative research projects of at least one ton (2008-2012 average annual catch) are shown in Table 3.2-9. Life history and fisheries related information for all invertebrate species may be found at www.nefsc.noaa.gov and www.asmfc.org. Stock assessment information is available at www.nefsc.noaa.gov/sos/. Species name, council jurisdiction, applicable FMPs, and status of the stocks are listed in Table 3.2-9.

Table 3.2-9 Primary Invertebrates Caught in NEFSC Research Surveys and Cooperative Research Projects 2008-2012

Species	Scientific Name	Council Jurisdiction	Fishery Management Plan	Status of the Stock
American lobster	*Homarus americanus*	ASMFC	Interstate	GOM and GB not overfished; SNE overfished and depleted
Northern shrimp	*Pandalus borealis*	ASMFC	Interstate	Not overfished
Longfin squid	*Loligo pealeii*	MAFMC	Atlantic Mackerel/ Squid/Butterfish	Unknown
Northern shortfin squid	*Illex illecebrosus*	MAFMC	Atlantic Mackerel/ Squid/Butterfish	Unknown
Atlantic surfclam	*Spisula solidissima*	MAFMC	Atlantic Surfclam & Ocean Quahog	Not overfished
Ocean quahog	*Arctica islandica*	MAFMC	Atlantic Surfclam & Ocean Quahog	Not overfished
Atlantic sea scallop	*Placopecten magellanicus*	NEFMC	Sea Scallop	Not overfished
Horseshoe crab	*Limulus polyphemus*	ASMFC	Interstate FMP for Horseshoe Crab	Regional population trends varied

3.2.5.3 Corals

Although there are no known coral reefs in northeastern U.S. waters, various growth forms of coral do occur in both shallow and deep water in the region (Lumsden 2007). The deep-sea corals listed here may not be the only ones that occur in this region but are considered the most likely to be encountered by bottom tending fishing gear on the continental shelf and at the shelf edge and slope (Packer and Drohan 2013). No deep-sea corals or sponges in the NEFSC research area are listed as threatened or endangered under the ESA; however, *Oculina varicose* (which occurs from the east Florida coast to North Carolina) has been identified as a "species of concern" (NOAA CRCP 2010).

There are three majors groups of deep water corals in the northeastern U.S.:

1. Hexacorals (or Zoantharia) which include the hard or stony corals (16 species),
2. Ceriantipatharians which include the black and thorny corals, (four or more species), and
3. Octocorals (or Alcyonaria) that include the true soft corals (nine species), gorgonians (21 species), and sea pens (21 species).

Deep corals provide habitat for other marine life, increase habitat complexity, and contribute to marine biodiversity, and their destruction could have a significant impact on other marine species. Anecdotal data suggests that deep corals have become less common due to the impacts of bottom fishing. Deep corals are

especially susceptible to damage by fishing gear because of their often fragile, complex, branching form of growth and slow growth rates (Heifetz 2009). In 2010, NOAA completed a Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation (NOAA CRCP 2010) that identifies goals, objectives, and approaches to guide NOAA's research, management, and international cooperation activities on deep-sea coral and sponge ecosystems through 2019. Recently, the MAFMC acted to establish a 38,000 square mile closed area in the Mid-Atlantic region that, when approved by NOAA, would protect deep-sea corals and their habitats from interactions with fishing gear. This area includes a series of submarine canyons on the outer continental shelf and slope and extends out to the outer boundary of the U.S. EEZ. A working group of the NEFMC is developing a series of proposals to designate one or more deep-sea coral protection zones in New England, a range of possible management options for those zones, and suggestions for future research.

3.2.5.4 Other Species

The invertebrate species in Table 3.2-10 are not managed by any federal or state agencies within the NE LME; however, these species have been encountered during NEFSC research surveys.

Commercial fisheries have listed the following invertebrates as significant bycatch; however, less than 2,200 pounds have been encountered in the NEFSC research surveys:

- Cancer crab (including Atlantic rock crab (*Cancer irroratus)* and Jonah crab (*Cancer borealis*)
- Icelandic scallop (*Chlamys islandica*)

Table 3.2-10 Other Invertebrate Species Encountered in Research Surveys

Species	Scientific Name	Species	Scientific Name
Friendly blade shrimp	*Spirontocaris lilljeborgii*	**Gladiator box crab**	*Acanthocarpus alexandri*
Royal red shrimp	*Pleoticus robustus*	**Spoonarm octopus**	*Bathypolypus arcticus*
Sevenspine bay shrimp	*Crangon septemspinosa*	**Common octopus**	*Octopodus vulgaris*
Norwegian shrimp	*Pontophilus norvegicus*	**Cuttlefish**	*Sepia novaehollandiae*
Aesop shrimp	*Pandalus montagui*	**Atlantic brief squid**	*Lolliguncula brevis*
Pink glass shrimp	*Pasiphaea multidentata*	**Arrow squid**	*Loligo plei*
Brown shrimp	*Crangon crangon*	**Lady crab**	*Ovalipes ocellatus*
Parrot shrimp	*Spirontocaris spinus*	**Atlantic calico scallop**	*Argopecten gibbus*
White shrimp	*Penaeus setiferus*	**Knobbed whelk**	*Busycon carica*
Punctate blade shrimp	*Spirontocaris phippsii*	**Channeled whelk**	*Busycotypus canaliculatus*
Shrimp (no common name)	*Pandalus propinquus*	**Waved whelk**	*Buccinum undatum*
Ridged slipper lobster	*Scyllarides nodifer*	**Stimpson's whelk**	*Colus stimpsoni*
Caribbean spiny lobster	*Panulirus argus*	**Ten-ridged whelk**	*Neptunea decemcostata*
Northern stone crab	*Lithodes maja*	**Razor clam**	*Siliqua costata*
Coarsehand lady crab	*Ovalipes stephensoni*	**Jacknife clam**	*Ensis directus*
Blue crab	*Callinectes sapidus*	**Northern horsemussel**	*Modiolus modiolus*
Bathyal swimming crab	*Bathynectes longispina*	**Blue mussel**	*Mytilus edulis edulis*
Blotched swimming crab	*Portunus spinimanus*	**Sea star**	*Asteroidea sp.*
Snow crab	*Chionoecetes opilio*	**Brittle star**	*Ophiurida sp.*
Hermit crab	*Paguritta gracilipes*	**Sea urchin**	*Echinoidea sp.*
Spider crab	*Majidae sp.*		

3.3 SOCIAL AND ECONOMIC ENVIRONMENT

Activities associated with fisheries research have several implications for the social and economic environment. These include providing guidance for federally managed commercial, recreational, and subsistence fisheries and direct and indirect expenditures on goods and services associated with fisheries research. The NEFSC's fisheries research activity is concentrated in the Northeast LME, which includes primarily coastal communities from the northern border of the United States to Cape Hatteras, North Carolina. The NEFSC also conducts three longline shark surveys that cover areas within both the SE LME and NE LME. However, the influence of the NEFSC on the social and economic environment of communities is largely in the northeastern U.S.

The NEFSC conducts field and laboratory research to help conserve and manage the region's living marine resources in compliance with the Magnuson-Stevens Fishery Conservation and Management Act of 1996, the Marine Mammal Protection Act of 1972, and the Endangered Species Act of 1973. The 1996 amendments to the Magnuson-Stevens Fishery Conservation Management Act (MSA) require assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities (NMFS 2007a). The MSA states:

> *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 in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.*

The NMFS Economics Program monitors status and trends in performance of the commercial and recreational fishing sectors, including assessing regional economic impacts (sales, value-added and job impacts). The Human Dimensions Program conducts community studies and develops statistical methodologies and economic models for identifying and describing communities substantially engaged in fishing. This information is ultimately utilized by fishery managers, whose decisions balance the needs of a variety of fisheries communities and users. This information is also used to help NMFS comply with Executive Order 12989 on Environmental Justice, which directs federal agencies to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations.

The NEFSC compiled baseline socioeconomic information about Northeast U.S. fishing communities in *Community Profiles for the Northeast Fisheries* (Colburn et al 2010). NMFS also published *Fishing Communities of the United States* (NMFS 2009e) which estimates community engagement and dependence on managed fisheries. Factors included in the estimations include commercial market conditions, recreational fishing expenditures and levels of participation, key species, and community profiles. The profiles are developed with data about the home ports of vessels' participation in a particular fishery, the residence of commercial or recreational fishing participants, port landings, and the location of processing and service facilities.

3.3.1 Commercial Fisheries

Fisheries Economics of the United States 2012 analyzed data for the New England (Connecticut, Maine, Massachusetts, New Hampshire, and Rhode Island), Mid-Atlantic (Delaware, Maryland, New Jersey, New York, and Virginia), and South Atlantic (includes North Carolina) regions for 2012 (NMFS 2014a). Key commercial species, accounting for 85 percent of revenue for the New England region between 2003 and 2012, include lobster, Atlantic herring, Atlantic mackerel, bluefin tuna, cod and haddock, flounder, goosefish, quahog clam, sea scallop, and squid. Key species for the Mid-Atlantic region include lobster, Atlantic surfclam, ocean quahogs, blue crab, eastern oyster, menhaden, sea scallop, squid, striped bass, and summer flounder (NMFS 2014a). Table 3.3-1 shows top species landings by pounds, and associated revenue data for 2008 to 2012 for the New England and Mid-Atlantic states, and North Carolina. For

2012, Massachusetts had the highest landings revenue ($618 million), and Virginia had the largest number of pounds landed (462 million) (NMFS 2014b).

Table 3.3-1 Commercial Landings, Revenue, and Top Species (by Weight) for New England and Mid-Atlantic States 2008-2012

	All Species		Top Species				Top Species Percent of All Species (Pounds)	Top Species Percent of All Species (Revenue)
	Pounds	Revenue	Pounds	Revenue	Price per Pound	Top Species		
Maine								
2008	185,241,829	$308,210,501	69,863,132	$245,145,913	$3.51	**Lobster**	37.71%	79.54%
2009	186,857,537	$292,465,228	81,175,847	$237,673,217	$2.93	**Lobster**	43.44%	81.27%
2010	199,063,136	$377,820,918	95,506,383	$315,874,779	$3.31	**Lobster**	47.98%	83.60%
2011	269,922,865	$424,711,769	104,693,316	$334,183,027	$3.19	**Lobster**	38.79%	78.68%
2012	262,588,523	$448,567,982	126,647,792	$340,487,307	$2.69	**Lobster**	48.23%	75.91%
New Hampshire								
2008	10,462,713	$17,470,983	2,567,031	$12,267,329	$4.78	**Lobster**	24.54%	70.22%
2009	13,887,136	$17,756,935	3,119,919	$270,770	$0.09	**Atlantic Herring**	22.47%	1.52%
2010	11,819,834	$20,653,033	3,658,894	$14,889,834	$4.07	**Lobster**	30.96%	72.10%
2011	12,320,500	$23,482,611	3,917,461	$16,337,205	$4.17	**Lobster**	31.80%	69.57%
2012	12,138,439	$23,175,680	4,216,008	$17,129,928	$4.06	**Lobster**	34.73%	73.91%
Massachusetts								
2008	326,234,448	$399,921,384	94,233,399	$11,335,849	$0.12	**Atlantic Herring**	28.89%	2.83%
2009	355,862,918	$400,827,539	133,530,726	$15,322,196	$0.11	**Atlantic Herring**	37.52%	3.82%
2010	282,834,896	$478,626,525	71,921,943	$10,253,258	$0.14	**Atlantic Herring**	25.43%	2.14%
2011	255,797,706	$565,238,197	66,514,743	$8,719,272	$0.13	**Atlantic Herring**	26.00%	1.54%
2012	297,561,270	$618,247,074	81,781,049	$11,696,737	$0.14	**Atlantic Herring**	27.48%	1.89%
Rhode Island								
2008	71,922,563	$66,300,392	14,660,015	$13,539,533	$0.92	**Longfin Squid**	20.38%	20.42%
2009	83,937,329	$61,750,764	15,310,064	$5,203,644	$0.34	**Northern Shortfin Squid**	18.24%	8.43%
2010	77,476,759	$62,676,828	12,431,611	$5,159,934	$0.42	**Northern Shortfin Squid**	16.05%	8.23%

All Species			Top Species				Top Species Percent of All Species (Pounds)	Top Species Percent of All Species (Revenue)
	Pounds	Revenue	Pounds	Revenue	Price per Pound	Top Species		
2011	77,236,308	$75,956,346	16,078,884	$9,037,349	$0.56	**Northern Shortfin Squid**	20.82%	11.90%
2012	83,289,715	$80,786,959	11,967,930	$1,986,894	$0.17	**Atlantic Herring**	14.37%	2.46%
Connecticut								
2008	7,113,764	$17,206,069	2,178,185	$1,436,381	$0.66	**Silver Hake**	30.62%	8.35%
2009	7,951,266	$16,476,410	2,113,380	$1,189,545	$0.56	**Silver Hake**	26.58%	7.22%
2010	6,623,416	$18,099,048	1,972,970	$1,340,516	$0.68	**Silver Hake**	29.79%	7.41%
2011	7,077,862	$19,667,605	2,040,124	$1,615,219	$0.79	**Silver Hake**	28.82%	8.21%
2012	8,673,000	$20,608,386	1,816,434	$1,361,035	$0.75	**Silver Hake**	20.94%	6.60%
New York								
2008	34,565,284	$59,207,140	8,752,926	$5,669,578	$0.65	**Atlantic Surfclam**	25.32%	9.58%
2009	34,424,510	$49,379,116	8,798,554	$5,857,616	$0.67	**Atlantic Surfclam**	25.56%	11.86%
2010	27,720,791	$33,994,822	4,540,135	$3,070,406	$0.68	**Silver Hake**	16.38%	9.03%
2011	27,162,140	$37,722,959	5,628,873	$7,248,539	$1.29	**Longfin Squid**	20.72%	19.22%
2012	30,030,000	$39,308,397	4,306,621	$3,536,145	$0.82	**Scup**	14.34%	9.00%
New Jersey								
2008	162,303,700	$168,517,907	39,346,425	$24,349,551	$0.62	**Atlantic Surfclam**	24.24%	14.45%
2009	161,611,282	$150,030,062	34,266,347	$4,064,587	$0.12	**Menhaden**	21.20%	2.71%
2010	161,844,281	$178,080,158	50,497,253	$5,049,726	$0.10	**Menhaden**	31.20%	2.84%
2011	175,516,208	$214,190,520	74,324,485	$5,945,959	$0.08	**Menhaden**	42.35%	2.78%
2012	180,501,729	$187,732,415	85,457,890	$7,226,120	$0.08	**Menhaden**	47.34%	3.85%
Delaware								
2008	4,706,100	$6,900,334	3,507,868	$4,604,738	$1.31	**Blue Crab**	74.54%	66.73%
2009	5,010,744	$7,541,983	3,413,801	$5,434,963	$1.59	**Blue Crab**	68.13%	72.06%

	All Species		Top Species				Top Species Percent of All Species (Pounds)	Top Species Percent of All Species (Revenue)
	Pounds	Revenue	Pounds	Revenue	Price per Pound	Top Species		
2010	5,214,109	$7,840,387	4,109,647	$5,957,263	$1.45	**Blue Crab**	78.82%	75.98%
2011	4,920,702	$7,091,476	3,501,968	$4,819,108	$1.38	**Blue Crab**	71.17%	67.96%
2012	5,239,357	$7,897,255	4,200,827	$6,119,753	$1.46	**Blue Crab**	80.18%	77.49%
Maryland								
2008	63,533,116	$73,196,259	34,871,757	$50,115,238	$1.44	**Blue Crab**	54.89%	68.47%
2009	66,818,584	$75,892,194	38,800,803	$52,049,315	$1.34	**Blue Crab**	58.07%	68.58%
2010	102,911,316	$104,876,713	66,611,031	$79,511,968	$1.19	**Blue Crab**	64.73%	75.81%
2011	78,196,532	$76,721,607	50,019,015	$59,137,787	$1.18	**Blue Crab**	63.97%	77.08%
2012	73,414,972	$77,858,646	42,690,146	$59,369,462	$1.39	**Blue Crab**	58.15%	76.25%
Virginia								
2008	422,594,753	$146,611,091	353,895,252	$21,270,652	$0.06	**Menhaden**	83.74%	14.51%
2009	426,282,450	$152,021,704	351,387,718	$23,577,557	$0.07	**Menhaden**	82.43%	15.51%
2010	509,841,262	$183,893,909	433,240,773	$34,476,161	$0.08	**Menhaden**	84.98%	18.75%
2011	494,028,366	$191,664,734	413,835,360	$32,977,529	$0.08	**Menhaden**	83.77%	17.21%
2012	461,943,838	$175,640,081	390,283,964	$31,104,139	$0.08	**Menhaden**	84.49%	17.71%
North Carolina								
2008	71,209,454	$86,821,982	32,338,899	$25,429,241	$0.79	**Blue Crab**	45.41%	29.29%
2009	68,962,222	$77,248,224	29,140,483	$25,039,362	$0.86	**Blue Crab**	42.26%	32.41%
2010	71,993,699	$79,865,134	29,794,332	$23,801,608	$0.80	**Blue Crab**	41.38%	29.80%
2011	67,483,195	$71,177,197	28,964,480	$18,016,541	$0.62	**Blue Crab**	42.92%	25.31%
2012	56,670,559	$72,905,625	25,991,391	$20,198,895	$0.78	**Blue Crab**	45.86%	27.71%

Source: NOAA, 2012 b, c. http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html, NMFS 2014b, NMFS 2013b

This page intentionally left blank.

Commercial fishers in the Mid-Atlantic and New England regions landed 751 million pounds and 664 million pounds, respectively, of fish and shellfish in 2012. Landings revenue in the Mid-Atlantic Region totaled $488 million in 2012. This was a 37% increase (a 2% decrease in real terms) from 2003 levels ($357 million) and an 8.6% decrease (an 8.2% decrease in real terms) relative to 2011 ($534 million). In the New England Region, landings revenue totaled $1.2 billion in 2012. This was a 72% increase (a 24% increase in real terms) from 2003 levels ($691 million) and an 8.1% increase (an 8.5% increase in real terms) relative to 2011 ($1.1 billion) (NMFS 2014a).

In 2012, Massachusetts had the second highest landings revenue in the nation at $618 million, followed by Maine at $449 million. Virginia had the third largest commercial landings in the U.S. at 462 million pounds. Massachusetts had the fifth largest landings at 298 million pounds (NMFS 2014a). In 2012, Massachusetts had the second largest number of jobs supported by the seafood industry (107,064) and the third highest sales impacts generated by the seafood industry ($8.4 billion) in the United States. Nationwide, New Jersey had the fourth highest sales impacts ($7.9 billion) and New York had the sixth highest sales impacts ($6.4 billion) generated by the seafood industry. New York had the nation's sixth largest number of jobs (51,681) supported by the seafood industry, followed by New Jersey (50,754) (NMFS 2014a). Table 3.3-2 shows commercial landings data by port (NMFS 2014c).

Table 3.3-2 Top Commercial Landings Locations (by Revenue) in New England and the Mid-Atlantic

Year	U.S. Rank (by Dollar Value)	Port	Millions of Pounds	Millions of Dollars
2003	1	New Bedford, MA	155.5	$176.2
	4	Hampton Roads Area, VA	30.1	$78.0
2004	1	New Bedford, MA	175.4	$207.7
	3	Hampton Roads Area, VA	34.7	$100.8
2005	1	New Bedford, MA	153.4	$282.5
	4	Hampton Roads Area, VA	23.5	$85.1
2006	1	New Bedford, MA	168.3	$281.4
	9	Hampton Roads Area, VA	13.0	$51.0
2007	1	New Bedford, MA	150.0	$268.9
	5	Hampton Roads Area, VA	21.1	$71.2
2008	1	New Bedford, MA	146.4	$241.3
	4	Cape May-Wildwood, NJ	82.9	$73.7
2009	1	New Bedford, MA	170.0	$249.2
	5	Cape May-Wildwood, NJ	63.9	$73.4
2010	1	New Bedford, MA	133.4	$306.0
	7	Cape May-Wildwood, NJ	43.1	$81.0
2011	1	New Bedford, MA	116.7	$368.8
	6	Cape May-Wildwood, NJ	39.5	$102.7
2012	1	New Bedford, MA	143.0	$411.1
	11	Cape May-Wildwood, NJ	27.8	$71.7

Source: NMFS 2014c

3.3.2 Recreational Fisheries

NMFS estimates recreational fishing data based on a variety of sources. Data are partially derived from intercept surveys and mail and phone surveys, with contacts sampled from applicable fishing licenses. NMFS uses a regional input-output economic model to generate different metrics for assessing the contributions to a region's economy from expenditures on marine recreational fishing (Lovell et al. 2013).

In the New England Region in 2012, 1.3 million recreational anglers fished in 6.2 million trips. Key recreational species included Atlantic cod, Atlantic mackerel, bluefin tuna, bluefish, little tunny, scup, striped bass, summer flounder, winter flounder, and tautog. Striped bass was the most commonly caught key species, averaging 7.1 million fish annually between 2003 and 2012. Of these, 92 percent were released rather than harvested (NMFS 2014a).

In the Mid-Atlantic Region in 2012, over 2.3 million recreational anglers took 14 million fishing trips. Key recreational species included black seabass, bluefish, Atlantic croaker, spot, scup, striped bass, summer flounder, weakfish drum, winter flounder, and tautog. Summer flounder was the most commonly caught key species, averaging 20 million fish annually between 2003 and 2012. Of these, 88 percent were released rather than harvested (NMFS 2014a).

The estimated economic effects of marine recreational fishing in 2011 in New England, the Mid-Atlantic, and North Carolina are shown in Table 3.3-3. For the purposes of this table, marine recreational fishing is defined as fishing for finfish in the open ocean or any body of water that is marine or brackish for sport or pleasure. Overall, the largest outputs (sales impacts) in 2011 were generated by angler expenditures in Ney Jersey ($1.8 billion), followed by North Carolina ($1.6 billion) and Virginia ($1.0 billion) (Lovell et al. 2013).

Table 3.3-3 Total Economic Impacts Generated from Marine Recreational Fishing, by State, in 2011

		Economic Contribution				
	Expense ($1,000)	Employment (Jobs)	Income ($1,000)	Value Added ($1,000)	Output ($1,000)	Taxes ($1,000)
Maine	$94,589	1,197	$46,977	$71,758	$118,336	$18,773
New Hampshire	$43,053	441	$20,536	$32,137	$47,999	$8,841
Massachusetts	$722,024	6,550	$348,511	$540,866	$799,558	$162,271
Rhode Island	$178,805	1,940	$81,298	$131,016	$208,021	$37,142
Connecticut	$126,356	1,190	$75,496	$114,823	$156,415	$34,828
New York	$330,315	3,094	$160,031	$254,728	$398,881	$78,132
New Jersey	$1,491,629	12,818	$693,886	$1,087,155	$1,841,343	$318,133
Delaware	$132,188	1,403	$60,509	$93,806	$132,223	$26,745
Maryland	$809,106	6,466	$313,977	$482,551	$724,394	$146,803
Virginia	$923,405	9,454	$386,143	$626,991	$969,571	$180,687
North Carolina	$1,606,436	15,831	$604,275	$970,422	$1,622,060	$264,010

Source: Lovell et al. 2013

3.3.3 Fishing Communities

Fisheries management is of importance to traditional, recreational, and/or commercial value to the communities of the region (NMFS 2009e). Fishing communities have been identified by NMFS because of their links to commercial and/or recreational fishing. Marine fisheries off the northeast coast of the United States are managed by two different regional fishery management councils, the New England Fishery Management Council (NEFMC) and the Mid-Atlantic Fishery Management Council (MAFMC), and the Atlantic States Marine Fisheries Commission (ASMFC). The NEFMC encompasses the coastal states from Maine through Connecticut, while the MAFMC includes coastal states from New York to Virginia. The ASMFC was formed by the 15 Atlantic coast states and coordinates the conservation and management of near shore fishery resources shared by member states through the creation of FMPs. North Carolina, South Carolina, Georgia and Eastern Florida communities have also been included because some fisheries overlap between the MAFMC and the South Atlantic Fishery Management Council (SAFMC) (Colburn et al 2010). Fishing communities from Maine to eastern Florida are listed below (NMFS 2009e).

3.3.3.1 Maine

Addsion, Bailey Island, Bar Harbor, Bath, Beals, Belfast, Boothbay Harbor, Bremen, Bucks Harbor, Cape Porpoise, Corea, Cundy's Harbor, Cushing, Cutler, Deer Isle, Eastport, Fallmouth, Frenchboro, Friendship, Gouldsboro Town, Harpswell, Islesford, Jonesport, Kennebunkport, Kittery, Milbridge, New Harbor, North Haven, Ogunquit, Owls Head, Pemaquid, Port Clyde, Portland, Prospect Harbor, Rockland, Saint George Town, Sebasco Estates/Phippsburg, Sorrento, South Bristol, South Thomaston, Southwest Harbor, Spruce Head, Stonington, Swans Island, Tenants Harbor, Tremont, Vinalhaven, Westport, Whiting, and Winter Harbor.

3.3.3.2 New Hampshire

Durham, Hampton, New Castle, Newington, Portsmouth, Rye, and Seabrook.

3.3.3.3 Massachusetts

Barnstable, Beverly, Boston, Chatham, Chilmark, Cohasset, Danvers, Fairhaven, Fall River, Gloucester, Harwich Port, Hull, Manchester, Marblehead, Marshfield, Nantucket, New Bedford, Newburyport, Orleans, Plymouth, Provincetown, Rockport, Salisbury, Sandwich, Saugus, Scituate, Wellfleet, Westport, and Woods Hole.

3.3.3.4 Connecticut

Branford, Bridgeport, Darien, East Haven, Groton, New Haven, New London, Norwalk, Portland, Stonington, and Waterford.

3.3.3.5 New Jersey

Atlantic City, Avalon, Barnegat/Long Beach, Belmar, Brielle, Cape May, Cape May Courthouse, Highlands, Newark, Point Pleasant/Beach, Port Norris, Sea Isle City, Toms River, Vineland, Waretown, and Wildwood.

3.3.3.6 Delaware

Indian River, Lewes, and Milford.

3.3.3.7 New York

Amagansett, Brooklyn, Captree Island, City Island, Freeport, Greenport, Hampton Bay/Shinnecock, Islip, Montauk, Mattituck, New York, Oceanside, and Point Lookout.

3.3.3.8 Rhode Island

Block Island, Bristol, Little Compton, Newport, North Kingstown, Point Judith/Narraganset, Portsmouth, Providence, South Kingston, Tiverton Wakefield, Warren, and Warwick.

3.3.3.9 Maryland

Cambridge and Ocean City

3.3.3.10 Virginia

Carrolton, Cheriton, Chincoteague, Hampton, Newport News, Norfolk, Poquoson, Seaford, Virginia Beach, and Wachapreague.

3.3.3.11 North Carolina

Atlantic, Atlantic Beach, Aurora, Avon, Ayden, Bayboro, Beaufort, Belhaven, Columbia, Engelhard, Hatteras, Kill Devil Hills, Lowland, Manteo, Morehead City, Nags Head, New Bern, Ocracoke, Oriental, Sneads Ferry, Swan Quarter, Swansboro, Vandemere, Wanchese, Varnamtown, Bath, Harker's Island, Elizabeth City, Carolina Beach, Surf City/Topsail Beach, Southport/Bald Head Island, Shilo, Wilmington, and Wrightsville Beach.

3.3.3.12 South Carolina

Beaufort/Port Royal, Bluffton, Burton, Charleston, Edisto Beach, Georgetown, Green Pond, Hilton Head Island, Isle of Palms, Little River, McClellanville, Mt. Pleasant, Murrells Inlet, North Charleston, Port Royal, Seabrook Island, Saint Helena Island, Wadmalaw Island, and Walterboro.

3.3.3.13 Georgia

Brunswick, Crescent, Darien, Midway, Richmond Hill, Savannah, Saint Mary's, Saint Simons Island, Thunderbolt, Townsend, Tybee Island, Waynesville, and Valona.

3.3.3.14 Florida –East

Atlantic Beach, Big Pine Key, Boca Raton, Cape Canaveral, Cocoa Beach, Fernandina Beach, Key West, Fort Lauderdale, Fort Pierce, Islamorada, Jacksonville, Jupiter, Key Largo, Marathon, Margate, Mayport, Merritt Island, Miami, Palm Beach, Ponce Inlet, Port Orange, Saint Augustine, Sebastian, and Titusville.

Table 3.3-4 shows population, poverty rates, per capita income, and unemployment rates for states along the Atlantic seaboard. It also shows information about select fishing communities in each state. The communities tend to be smaller in population, though some large cities such as Boston dominate because of centralized vessel services and fish processing facilities located there (NMFS 2009e). Nationwide, 2010 unemployment in the Agriculture, Forestry, Fishing and Hunting sector was 13.9 percent (USDOL 2012). The figures demonstrate that there is wide variation in economic status among fishing communities.

Table 3.3-4 Economic Status of Atlantic States and Select Fishing Communities, 2010, and 2008-2012 Annual Averages

	Population[1]	Poverty Rate[2]	Per Capita Income[2]	Unemployment Rate[3]
USA	308,747,508	14.9	$28,051	9.6
Maine	1,328,361	13.3	$26,464	7.1
Portland	66,194	19.4	$28,874	*
Rockland	7,297	16.9	$21,761	*
New Hampshire	1,316,469	8.4	$32,758	6.3
Hampton	9,656	6.1	$38,602	*
Portsmouth	20779	7.8	$40,111	*
Massachusetts	6,547,629	11.0	$35,485	8.1
New Bedford	95,072	21.6	$21,343	*
Boston	617,594	21.2	$33,589	*
Gloucester	28,789	8.3	$36,919	*
Connecticut	3,574,000	10.0	$37,807	8.5
New London	27,569	20.0	$22,157	*
Bridgeport	145,638	23.6	$19,743	*
New Jersey	8,864,590	9.9	$35,928	8.7
Wildwood	5,325	24.1	$23,422	*
Atlantic City	39,558	29.9	$18,850	*
Delaware	897,934	11.5	$29,733	7.7
Milford	9,709	16.0	$23,823	*
New York	19,378,104	14.9	$32,104	8.2
Freeport	43,016	12.7	$28,979	*
Hampton Bay	13,603	6.5	$33,637	*
Rhode Island	1,052,292	13.2	$30,005	8.9
Providence	178,042	27.9	$21,512	*
Newport	11,769	10.8	$37,276	*
Maryland	5,773,552	9.4	$36,056	7.3
Ocean City	7,102	10.4	$46,297	*
Cambridge	12,326	25.7	$21,160	*
Virginia	8,185,867	11.1	$33,326	6.5
Newport News	180,719	14.5	$25,549	*
Poquoson	12,150	4.1	$38,243	*

	Population[1]	Poverty Rate[2]	Per Capita Income[2]	Unemployment Rate[3]
North Carolina	9,535,483	16.8	$25,285	9.7
Kill Devil Hills	6,683	6.8	$29,747	*
New Bern	29,524	23.8	$22,762	*
Wilmington	106,476	22.9	$28,482	*
South Carolina	4,625,364	17.6	$23,904	10.2
Georgetown	9,163	26.7	$17,485	*
Charleston	120,083	19.8	$31,554	*
Georgia	9,687,663	17.4	$25,309	9.9
Brunswick	15,383	36.9	$16,598	*
Savannah	136,280	26.6	$19,835	*
Florida	18,802,690	15.6	$26,451	10.3
Fort Pierce	41,590	32.5	$16,521	*
Jacksonville	821,784	16.1	$25,433	*

[1] US Census 2010

[2] American Community Survey Average 2007-2011

[3] American Community Survey 2010

*not available

Source: US Census, http://www.census.gov/

3.3.4 NEFSC Operations

Research-related spending directly generates jobs and income, and benefits businesses in the private economy by expenditures on research-related equipment. The NEFSC carries out research in facilities located in Massachusetts, Rhode Island, Connecticut, New Jersey, Washington DC, and Maine. At sea assessments extend south across the Atlantic Seaboard. The NEFSC's annual spending fluctuates, but has averaged about $60 million in the 2008-2012 period (NEFSC Operations Management and Information Staff pers. comm. 2013).

The NEFSC routinely charters University-National Oceanographic Laboratory System (UNOLS) research vessels and commercial fishing vessels to conduct various types of fisheries research and cooperative research. From 2008 through 2010, the number of leased vessel days has ranged from 69 (2008) – 150 (2010) operating days with a total budget ranging from $595,000 (2008) to $1,400,000 (2010). Cooperative Research grants and Research Set Aside programs also generate a significant amount of vessel leasing activities by external grant recipients. Fees generated from leasing contribute to the local economies and may be an important component of total income for some vessel owners.

In addition to leasing vessels, fisheries research contributes to local economies through operational support of NOAA vessels and chartered vessels (fuel, supplies, crew wages, shoreside services), operational costs of research support facilities (utilities, supplies, services), and employment of researchers who live in nearby communities. The NEFSC spends approximately $15.7 million annually in support of the fisheries research activities covered in this Final PEA, including charter fees and operating costs for all vessels, salaries for federal and contractual staff participating in fisheries research, travel, and other incidental expenses, but not including capital costs of vessels and facilities (NEFSC Operations Management and Information Staff pers. comm. 2013).

4.1 INTRODUCTION AND ANALYSIS METHODOLOGY

This chapter presents an analysis of the potential direct and indirect effects of the alternatives on the physical, biological, and social environments consistent with Section 1502.16 of the Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations (40 Code of Federal Regulations [CFR] Part 1500) and NOAA Administrative Order 216-6 (Environmental Review Procedures for Implementing the National Environmental Policy Act). Four alternatives have been brought forward for detailed analysis (see Chapter 2):

- The No Action/Status Quo Alternative, where fisheries and ecosystem research programs conducted and funded by the Northeast Fisheries Science Center (NEFSC) would be performed as they were at the end of 2013. This is considered the No Action Alternative for ongoing programs under NEPA.
- The Preferred Alternative, where the NEFSC would receive MMPA incidental take authorization and conduct research programs similar to the recent past with some new research activities, and would implement required new protocols intended to mitigate impacts to protected species in addition to those described under the Status Quo Alternative.
- The Modified Research Alternative, where the NEFSC would conduct fisheries and ecosystem research with scope and protocols modified to minimize risks to protected species.
- The No Research Alternative, where the NEFSC would no longer conduct or fund fieldwork in marine waters for the fisheries and ecosystem research considered in the scope of this Programmatic Environmental Assessment (PEA).

In addition to a suite of fisheries and ecological research conducted or funded by the NEFSC as the primary federal action under the Status Quo Alternative, the Preferred Alternative and the Modified Research Alternative would also include promulgation of regulations and subsequent issuance of Letters of Authorization (LOAs) under Section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA) for the incidental, but not intentional, taking of marine mammals as the secondary federal action.

As was discussed in Chapter 1 of this Final Programmatic Environmental Assessment (PEA), the National Marine Fisheries Service (NMFS) is fundamentally a science-based agency, its primary mission being the stewardship of living marine resources through science-based management. The first three alternatives evaluated in this Final PEA enable the NEFSC to collect additional scientific information that otherwise would not be fully replaced by other sources while the fourth alternative considered does not. In NMFS view, the inability to acquire scientific information essential to managing fisheries on a sustainable basis and rebuilding overfished stocks would ultimately imperil the agency’s ability to meet its mandate to promote healthy fish stocks and restore the nation’s fishery resources. Similar concerns apply to the conservation and management of protected species, their habitats, and other marine ecosystem components. However, there are several plausible scenarios (such as federal budget cuts, legal actions against NMFS, or natural disasters affecting NEFSC facilities) where the research activities of the NEFSC could be severely curtailed or eliminated for a period of time. The No Research Alternative therefore allows NMFS to examine the effects on the human environment of discontinuing federally funded fisheries and ecosystem research in the NEFSC research areas.

4.1.1 Impact Assessment Methodology

The authors of the sections in this chapter are subject matter experts. They developed a discussion of the effects on each resource component based on their best professional judgment; relying on the collective knowledge of other specialists in their respective fields and the body of accepted literature.

The impact assessment methodology consists of the following steps:

1. Review and understand the proposed action and alternatives (Chapter 2).
2. Identify and describe:
   a. Direct effects that would be "caused by the action and occur at the same time and place" (40 CFR § 1508.8(a)), and
   b. Indirect effects that would be "caused by the action and (would occur) later in time or farther removed in distance, but are still reasonably foreseeable" (40 CFR § 1508.8(b)).
3. Compare the impacts to the baseline conditions described in Chapter 3 and rate them as major, moderate, or minor. In order to help consistently assess impacts and support the conclusions reached, the authors developed a criteria table that defines impact ratings for the resource components (Table 4.1-1). The criteria provide guidance for the authors to place the impacts of the alternatives in an appropriate context, determine their level of intensity, and assess the likelihood that they would occur. Although some evaluation criteria have been designated based on legal or regulatory limits or requirements (see description of criteria for marine mammals below), others are based on best professional judgment and best management practices. The evaluation criteria include both quantitative and qualitative analyses, as appropriate to each resource. The authors then determine an overall rating of impacts to a given resource by combining the assessment of the impact components.

As described in Section 1.4, the reason an EA is developed is to determine whether significant environmental impacts could result from a proposed action and to inform the decision about whether an Environmental Impact Statement needs to be developed. If no significant impacts are discovered, NMFS can document its decision on the proposed action with a Finding of No Significant Impact. The assessment methodology described in this section is consistent with NOAA Administrative Order 216-6, as preserved by NAO 216-6A, which provides guidance on how the agency should make determinations of significance in NEPA documents.

Table 4.1-1 Criteria for Determining Effect Levels

Resource Components	Assessment Factor	Effect Level		
		Major	**Moderate**	**Minor**
Physical Environment	**Magnitude or intensity**	Large, acute, or obvious changes that are easily quantified	Small but measurable changes	No measurable changes
	Geographic extent	> 10% of project area (widespread)	5-10% of project area (limited)	0-5% of project area (localized)
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible
Biological Environment	**Magnitude or intensity**	Measurably affects population trend For marine mammals, mortality and serious injury greater than or equal to 50% of PBR[1]	Population level effects may be measurable For marine mammals, mortality and serious injury between 10% and 50% of PBR	No measurable population change For marine mammals, mortality and serious injury less than or equal to 10% of PBR
	Geographic extent	Distributed across range of a population	Distributed across several areas identified to support vital life phase(s) of a population	Localized to one area identified to support vital life phase(s) of a population or non-vital areas
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible
Social and Economic Environment	**Magnitude or intensity**	Substantial contribution to changes in economic status of region or fishing communities	Small but measurable contribution to changes in economic status of region or fishing communities	No measurable contribution to changes in economic status of region or fishing communities
	Geographic extent	Affects region (multiple states)	Affects state	Affects local area
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible

1. Potential Biological Removal (PBR).

4.1.2 Impact Criteria for Marine Mammals

The impact criteria for the magnitude of effects on marine mammals have been developed in the context of two important factors derived from the MMPA. The first factor is the calculation of Potential Biological Removal (PBR) for each marine mammal stock. The MMPA defined PBR at 16 U.S.C. § 1362(20) as, "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable

population." PBR was intended to serve as an upper limit guideline for anthropogenic mortality for each species. Calculations of PBR are stock-specific and include estimates of the minimum population size, reproductive potential of the species, and a recovery factor related to the conservation status of the stock (e.g., whether the stock is listed under the Endangered Species Act (ESA) or depleted under the MMPA). NMFS and USFWS are required to calculate PBR (if possible) for each stock of marine mammals they have jurisdiction over and to report PBR in the annual marine mammal stock assessment reports (SARs) mandated by the MMPA. The PBR metric has been used extensively to assess human impacts on marine mammals in many commercial fisheries involving mortality and serious injury (M&SI) and is a recognized and acceptable metric used by NMFS Office of Protected Resources in the evaluation of commercial fisheries incidental takes of marine mammals in US waters as well as for other sources of mortality such as ship strikes.

The second factor is the categorization of commercial fisheries with respect to their adverse interactions with marine mammals. Under Section 118 of the MMPA, NMFS must classify all US commercial fisheries into one of three categories based on the level of marine mammal M&SI that occurs incidental to each fishery, which it does in the List of Fisheries (LOF) published annually. Category III fisheries are considered to have a remote likelihood of or no known incidental M&SI of marine mammals. Category II fisheries are those that have occasional incidental M&SI of marine mammals. Category I fisheries are those that have frequent incidental M&SI of marine mammals. A two-tiered classification system is used to develop the LOF, with different thresholds of incidental M&SI compared to the PBR of a given marine mammal stock.

However, the LOF criteria is primarily used for managing commercial fisheries based on their actual levels of marine mammal M&SI and is not necessarily designed to assess impacts of projected scientific research takes on a given marine mammal stock. Because the analysis of direct impacts of NEFSC research on marine mammals in this Final PEA is based on projected takes rather than actual takes, we use a similar but not identical model to the LOF criteria.

In spite of some fundamental differences between most NEFSC research activities and commercial fishing practices, it is appropriate under NEPA to assess the impacts of incidental takes due to research in a manner similar to what is done for commercial fisheries for two reasons:

- NEFSC research activities are similar to many commercial fisheries in the fishing gear and types of vessels used, and
- NEFSC research plays a key role in supporting commercial fisheries.

As part of the NEPA impact assessment criteria (Table 4.1-1), if the projected annual M&SI of a marine mammal stock from all NEFSC research activities is less than or equal to 10 percent of PBR for that stock, the effect would be considered minor in magnitude for the marine mammal stock, similar to the LOF's Category III fisheries that have a remote likelihood of M&SI with marine mammals with no measurable population change. Projected annual M&SI from NEFSC research activities between 10 and 50 percent of PBR for that stock would be moderate in magnitude for the marine mammal stock, similar to the LOF's Category II fisheries that have occasional M&SI with marine mammals where population effects may be measurable. Projected annual M&SI from NEFSC research activities greater than or equal to 50 percent of PBR would be major in magnitude for the marine mammal stock, similar to the LOF's Category I fisheries that have frequent M&SI with marine mammals which measurably affect a marine mammal stock's population trend. Note that NEPA requires several other components to be considered for impact assessments (see Table 4.1-1); the magnitude of impact is not necessarily the same as the overall impact assessment in a NEPA context.

In the MMPA LOA application, NEFSC estimated takes for each marine mammal stock are grouped by gear type (i.e., trawl gear and longline gear) with the resulting take request not apportioned by individual

research activities (e.g., by survey). This precludes impact analysis at the individual activity or project level within the Final PEA.

NMFS recognizes that, in addition to the NEFSC, one of its other regional Fisheries Science Centers (FSCs) may interact with the same stock of marine mammals in the Atlantic, namely the Southeast Fisheries Science Center (SEFSC), and that the collective impact from both of these FSCs on marine mammal stocks should be considered. The SEFSC is currently working on their own NEPA and MMPA compliance processes but has not yet developed estimates of future marine mammal incidental takes. Because the NEFSC projected takes include estimates for species that it has not taken historically, and the SEFSC may do the same, the analysis of combined impacts based on projected takes from both FSCs cannot be completed at this time. However, historical data on incidental takes from the SEFSCs will be considered along with the contribution of the NEFSC in the Cumulative Effects section of this Final PEA (Chapter 5). NMFS does not anticipate incidental takes from SEFSC research activities to substantially increase the aggregate impacts on marine mammal stocks shared with the NEFSC. When the SEFSC submits their LOA application and supporting NEPA analysis, the total requested takes for shared stocks from both FSCs will be analyzed within those documents.

The contribution of NEFSC research activities to overall impacts on marine mammals will be aggregated with past, present, and reasonably foreseeable future impacts on marine mammals from commercial fisheries and other factors external to NEFSC research activities in the Cumulative Effects analysis in Chapter 5. NMFS will report all sources of M&SI in the annual marine mammal stock assessment reports (SARs), including any incidental M&SI takes that may occur from any of the FSCs. The cumulative effects analysis will use the same impact assessment criteria and thresholds as described in Table 4.1-1, only they will be applied to collective sources of M&SI and other types of impacts on marine mammals.

4.2 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 1 – NO ACTION/STATUS QUO ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 1 – the No Action/Status Quo Alternative on the physical, biological, and social environment. Under this Alternative, fisheries research programs conducted and funded by the NEFSC would be performed as they have been over the previous five years. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under Alternative 1 is presented below in Table 4.2-1.

Table 4.2-1 Alternative 1 Summary of Effects

Resource	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
SECTION #	**4.2.1**	**4.2.2**	**4.2.3**	**4.2.4**	**4.2.5**	**4.2.6**	**4.2.7**	**4.2.8**
Effects Conclusion	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to Moderate *beneficial*

4.2.1 Effects on the Physical Environment

Section 3.1.1 describes the physical environment within the NEFSC research area. This section describes the effects that NEFSC fisheries and ecosystem research activities may have on the physical environment. The potential effects of fisheries research activities on the physical environment would vary depending on the types of survey gear and other equipment used, but could generally include:

- Physical damage to benthic (seafloor) habitat
- Changes in water quality

<u>Physical Damage to Benthic (Seafloor) Habitat</u>

Fishing gear that contacts the seafloor can alter and/or physically damage seafloor habitat. Physical damage includes furrowing and smoothing of the seafloor as well as the displacement of rocks and boulders as fishing gear is towed across the bottom (Morgan and Chuenpagdee 2003). Physical damage to the seafloor can increase with multiple tows in the same area (NRC 2002).

These types of effects on the physical environment are primarily caused by bottom trawling and dredging equipment as it comes in contact with the seafloor (NRC 2002, Morgan and Chuenpagdee 2003) although stationary gear such as fish and lobster pots can also have impacts (Barnette 2001). Further, the effects of bottom contact gear differ in each type of benthic environment. In sandy habitats with "high energy" water movement for example, the furrows created by mobile bottom contact gear quickly begin to erode because lighter weight sand at the edges of furrows can be easily moved by water back towards the center of the furrow (NEFSC 2002). Duration of effects in these environments therefore tend to be very short because the terrain and associated organisms are accustomed to natural disturbance. By contrast, the physical features of more stable hard bottom habitats are less susceptible to disturbance, but once damaged or removed by fishing gear, the organisms that grow on gravel, cobbles, and boulders can take years to recover, especially in deeper water where there is less natural disturbance (NRC 2002). This is discussed further in Section 4.2.7, the Effects on Invertebrates.

Bottom contact fishing gear historically used in NEFSC fishery research activities includes bottom trawls, otter trawls, sea scallop dredges, and hydraulic surfclam dredges (Table 2.2-1, Appendix A). Short-term cooperative research projects have also used pot gear for research on scup and sea bass as well as lobsters (Table 2.2-2). Bottom trawls have historically been used in each of the Northeast U.S. Continental Shelf LME subareas during each season, however, bottom trawl effort is generally lower in the winter relative to other seasons. Dredges have also been used in each of the LME subareas, however, dredging is restricted to spring, summer, and fall (Appendix B).

Physical damage to the seafloor caused by fishing gear can last for months or even years. Furrows created by trawl doors are up to 10 cm deep in mud, with berms 10-20 cm along the edges, and 2 cm deep with a 5.5 cm berm in sand (Stevenson et al. 2004). Door tracks can last for months or for more than a year in muddy habitats or in deeper sandy habitats, but only for days in shallow sandy areas. Trawls and dredges also smooth out rough bottom, removing high habitat features and filling in depressions. Studies have shown that recovery of seafloor topography can take six months to a year depending on sediment type and the degree of natural disturbance (Stevenson et al. 2004). Physical features in sandy and muddy habitats generally recover more quickly in shallower, more dynamic environments than in deeper, less disturbed areas (NRC 2002). Recovery times in gravel and more complex rocky habitats do not vary as much with depth because the substrate is more stable and less affected by natural disturbance. In areas that are rarely trawled or dredged - such as areas that have been closed to commercial fishing with bottom contact gear for years – the impacts of even a single tow can be pronounced, but limited to the immediate area swept by the gear. By contrast, commercial trawling grounds, where much larger areas may be towed repeatedly are susceptible to more acute and prolonged impacts because there is limited opportunity for habitat features to recover (NRC 2002).

Based on this information, it is expected that surveys using trawls and dredges are more likely to adversely impact physical features of the seafloor in muddy habitats and deeper sandy habitats. Physical damage to the seafloor (excluding biological impacts, see Section 4.2.7) is likely to be less in rocky habitats except in cases where fishing gear is towed over cobble piles or boulder reefs (NEFMC 2011), which the NEFSC and research partners avoid. Hydraulic clam dredges, which inject pressurized water into the sand, have a greater impact on the seafloor than trawls or scallop dredges and the effects can last for years in deeper water, but recovery is much faster in shallow water environments that are exposed to strong bottom currents and wave action (NEFSC 2001, Stevenson et al. 2004, Gilkinson et al. 2015).

Table 4.2-2 shows estimates of the proportion of each NE LME subregion that would be affected by NEFSC research bottom trawls and dredges. Data was derived from Table 2.2-1 and, although there is variability year to year depending on the particular mix of short-term research projects that are funded, is typical of annual effort under the Status Quo.

As shown, bottom trawl surveys are deployed much more often and have a much larger annual combined area than dredges, indicating they likely have a larger overall impact on the benthic environment. However, the Standard Bottom Trawl Surveys (BTS) as well as other NEFSC bottom trawl research utilize a stratified random design that results in the number of stations in a given area fluctuating annually, reducing the likelihood that a location towed in one survey season is replicated in subsequent seasons or years. An analysis of effects from such "single tow" deployments is outlined in Stevenson et al. (2004) which indicates that in many cases, "single tows" result in a recovery period of weeks to months (dependent on bottom composition). This effect is more pronounced in closed areas where commercial fishing has been prohibited long enough for biological communities to have recovered partially or completely to conditions that existed before closure.

Based on the data in Table 4.2-2, the geographic area directly affected by NEFSC bottom trawl and dredge surveys is estimated to be about 122 square miles, a very small fraction of the total area of the NE LME subregions. The GOM covers an area of approximately 35,000 square miles, the GB covers more than 16,000 square miles, the SNE subregion covers approximately 30,500 square miles, and the MAB

covers approximately 32,000 square miles. Bottom disturbance resulting from annual NEFSC fisheries research activity with trawl and dredge gear would affect less than 0.05 percent of the total area of each NE LME subregion (Table 4.2-2).

Soft bottom habitats are typically less affected by pot gear than vegetated or hard bottom habitats (Barnette 2001, NEFMC 2011a). Weights and anchors associated with fishing pots may physically damage fragile species such as corals, which are more common in rocky substrates (Macdonald et al. 1996, Eno et al. 2001). Although pot gear may be deployed in some hard bottom habitats that are not suitable for trawling or dredging, its use is not limited to rocky substrates and data on the substrate for each pot used in past research is not available for quantitative estimates by habitat type. Overall, the magnitude of benthic habitats affected by pot gear used for fisheries research is expected to be very small, especially compared to the number of pots used for commercial fisheries in the Northeast.

Table 4.2-2 Area of Seafloor Affected by NEFSC and Cooperative Research Bottom-Tending Gear by LME Subarea and Season

GULF OF MAINE (35,300 MI^2)						
Season	**Number Bottom Trawls**	**Area Affected by Trawls (mi^2)**	**Number Dredges**	**Area Affected by Dredges (mi^2)**	**Total Area Affected (mi^2)**	**Percent of GOM Affected**
Spring	300	11.0	50	0.09	11.09	0.03%
Summer	200	7.3	100	0.17	7.51	0.02%
Fall	300	11.0	100	0.17	11.18	0.03%
Winter	100	3.67	0	0	3.67	0.01%
Totals	900	33.01	250	0.44	33.45	0.09%
GEORGES BANK (16,400 MI^2)						
Season	**Number Bottom Trawls**	**Area Affected by Trawls (mi^2)**	**Number Dredges**	**Area Affected by Dredges (mi^2)**	**Total Area Affected (mi^2)**	**Percent of GB Affected**
Spring	300	11.0	300	0.52	11.53	0.07%
Summer	225	7.72	100	0.52	8.24	0.05%
Fall	100	3.67	200	0.35	4.02	0.02%
Winter	75	2.75	0	0	2.75	0.02%
Totals	700	25.15	600	1.39	26.54	0.16%
SOUTHERN NEW ENGLAND (30,500 MI^2)						
Season	**Number Bottom Trawls**	**Area Affected by Trawls (mi^2)**	**Number Dredges**	**Area Affected by Dredges (mi^2)**	**Total Area Affected (mi^2)**	**Percent of SNE Affected**
Spring	200	7.34	300	0.52	7.86	0.03%
Summer	200	7.34	300	0.52	7.86	0.03%
Fall	200	7.34	200	0.35	7.68	0.03%
Winter	100	3.67	0	0	3.67	0.01%
Totals	700	25.68	800	1.39	27.07	0.09%
MID-ATLANTIC BIGHT (32,000 MI^2)						
Season	**Number Bottom Trawls**	**Area Affected by Trawls (mi^2)**	**Number Dredges**	**Area Affected by Dredges (mi^2)**	**Total Area Affected (mi^2)**	**Percent of MAB Affected**

Spring	350	12.84	400	0.69	13.53	0.04%
Summer	100	3.67	400	0.69	4.36	0.01%
Fall	350	12.84	200	0.35	13.19	0.04%
Winter	100	4.00	0	0	4.00	0.01%
Totals	900	33.34	1000	1.74	35.08	0.11%

Changes in Water Quality

Fishing gear that contacts the seafloor could increase the turbidity of the water by re-suspending fine sediments and benthic algae from the seafloor. Resuspension of fine sediments and turnover of sediment could also result in localized increases in the concentrations of dissolved organic material, nutrients, and trace metals in seawater near the seafloor (Stevenson et al. 2004).

Several areas of known contamination from historic ocean dumping exist within the areas where NEFSC fisheries research activities are conducted (Section 3.1). The areas of the historic ocean dumping sites are small relative to the overall area where NEFSC fisheries research activities are conducted, and most of the historic dumping sites are located close to shore where survey effort is sparse. For these reasons, effects resulting from the interaction of historic dumping sites with NEFSC fisheries research activities conducted under the Status Quo Alternative are unlikely. If such effects were to occur, they would be infrequent, temporary, and localized, and would therefore be considered negligible.

Likewise, potentially adverse effects to benthic habitats resulting from discharge of contaminants from vessels used during research surveys are possible, but unlikely. If such effects were to occur, they would be infrequent, temporary, and localized. All NOAA and ocean going vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (NOAA 2010b). MARPOL includes six Annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (International Maritime Organization IMO 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). NOAA vessels are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills occurring and increase the chance that they will be responded to and contained quickly. Oil spill prevention training and equipment may be more variable on commercial fishing vessels used in cooperative research although all vessels are required to comply with U.S. Coast Guard regulations on spills. Potential effects on the physical environment resulting from discharged or spilled materials are not gear type dependent and would be minor to negligible throughout the NEFSC research areas.

4.2.1.1 Conclusion

The effects of the Status Quo Alternative on the physical environment include potential changes to the benthic environment and changes in water quality. The geographic extent of any physical contact with benthic habitats caused by NEFSC fisheries research activities would be about 0.1 percent of the NEFSC research area and therefore considered minor in magnitude. These effects could persist over multiple survey seasons (based on a conservative 18-month timeline for recovery), which would be considered a long-term effect. However, the stratified random design of the BTS and other surveys reduces the likelihood of reworking the same ground each year, allowing additional time for recovery and a frequency of minor. Adverse effects on water quality through accidental contamination from research activities are possible, but unlikely. If such effects were to occur, their intensity, extent, duration, and frequency would be minor.

The overall effects of the Status Quo Alternative on the physical environment would be minor in magnitude, dispersed over a large geographic area, and long-term in duration but would not be repetitive in the same location. The effects would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.2.2 Effects on Special Resource Areas and Essential Fish Habitat

Section 3.1.2 describes the special fisheries related areas that are likely to occur in the same geographic areas and seasons as the NEFSC fishery research activities. This section describes the effects that NEFSC fisheries and ecosystem research activities would have on the following special resource areas:

- Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC)
- Closed Areas (to commercial fishing)
- Marine Protected Areas (MPAs) and National Marine Sanctuaries.

4.2.2.1 EFH and HAPC

Stevenson et al. (2004) acknowledges that the information base required to quantify the physical effect of fishing on each life stage of EFH for different species is insufficient. However, the authors made an attempt to do so, utilizing available data and EFH descriptions in effect at the time. They created a qualitative analysis of the effects of the three mobile bottom gears (New Bedford-style scallop dredges, bottom otter trawls, and hydraulic clam dredges) of most concern to EFH impacts in the Northeast region. All of these gear types are utilized to some extent in NEFSC research. An EFH vulnerability matrix was produced containing weighted parameters based on the perceived importance among various input fields. Not included in the matrix were life stages which were not indicated to have a benthic component (for example, bluefish were considered to be pelagic in all life stages). The authors found that 20 percent of the 70 evaluated life stages had a high vulnerability to bottom otter trawls, and 80 percent had moderate or low vulnerability to otter trawls. Similarly, for New Bedford-style scallop dredges, vulnerability was high for 17 percent of life stages; for hydraulic clam dredges, vulnerability was high for 8 percent of the benthis life stages. Species that ranked high included American plaice, Atlantic cod, black sea bass, haddock, ocean pout, red hake, redfish, and tilefish.

As discussed previously, the number of research tows with different mobile bottom-contact gears in each closed area varies from year to year but is typically small numbers with short duration tows. As noted in Table 3.1-2, the majority of each of the EFH closed areas has been characterized as sand or sand mixed with other small-grain material such as silt or clay. In the discussion above on effects to physical habitat, the ability of some sandy habitats to rebound from the effect of mobile bottom contact gear is variable but can be considerably faster than with other types of environments. However, the actual effect on habitats within a closed area would depend on the specific location and bottom habitat at the site of gear deployment, the degree of natural disturbance, and the duration and intensity of commercial trawling and dredging activity at the site and in the area in general prior to closure. In most cases, hard bottom habitats in year-round special resource areas are expected to be more vulnerable to adverse impacts than soft bottom habitats, especially if there is a significant amount of current and/or wave action (e.g., from storms). Bottom habitats are also also likely to be more vulnerable in an area that has been closed to the use of commercial trawls and dredges for 10-20 years as opposed to an area that has been closed for just a few years.

The geographical areas directly affected by the Status Quo Alternative bottom trawl and dredge surveys every year are estimated to be about 33 square miles in the GOM, 27 square miles in the GB, 27 square miles in the SNE, and 35 square miles in the MAB. Together, these areas represent a very small fraction (about 0.1 percent) of the NE LME (Table 4.2-2). The geographic extent of research impacts on EFH habitat is therefore considered minor in magnitude. Although any particular research tow may traverse

sites with different qualities of benthic habitat and the resultant impacts to EFH values could vary from tow to tow, the analysis presented here is necessarily made from a programmatic perspective considering a broad distribution of different habitat qualities. Impacts to benthic substrates could last several months to several years, which would be considered of moderate duration or long-term, but the frequency of impacts to specific sites would be only a single occurrence as research samples occur in different areas every year. EFH impacts of survey and research activities conducted in special resource areas are likely to be relatively more important for the 6-14 benthic life stages listed in Stevenson et al. (2004) as being highly vulnerable to trawls and dredges than for the other 56-64 life stages listed with moderate or low rankings. Considering the small area affected by research gears each year and the lack of repeated disturbances in the same location, the overall effects of the Status Quo Alternative on EFH are considered minor according to the impact criteria in Table 4.1-1.

With the exception of the juvenile cod HAPC on eastern Georges Bank, the impacts of NEFSC survey activities on HAPCs for sandbar sharks, summer flounder, tilefish, and Atlantic salmon are negligible because these HAPCs occur primarily outside of bottom trawl and dredge survey areas. Salmon HAPC is mostly in freshwater rivers and coastal estuaries, submerged aquatic vegetation (HAPC for summer flounder) is only found in shallow coastal waters and on offshore shoals where there is enough sunlight to support plant growth. Sandbar shark HAPC is limited to coastal waters and tilefish HAPC exists in offshore canyons that are beyond the range of NEFSC surveys.

4.2.2.2 Closed Areas

A number of NEFSC fisheries research surveys and cooperative research projects occur in areas that are closed on a seasonal or year-round basis to the use certain commercial and recreational fishing gears. In addition to the year-round EFH closure areas established in 2003, areas were closed in 1994, 1998, and 2001 to limit fishing mortality. These include overlapping portions of the Western Gulf of Maine, Cashes Ledge, Closed Area I, Closed Area II, and Nantucket Lightship areas (Figure 3.1-3). Commercial fishing using mobile bottom gear has been prohibited in each of these closed areas for a considerable amount of time, since 1994 in some cases. Closures have allowed these areas (as well as open areas that are lightly fished) to revert to a more natural state than heavily fished grounds because the physical environment and associated benthic communities have been undisturbed by fishing for 12-20 years. Research has shown that gravel and cobble habitats on eastern Georges Bank require about 5-10 years to recover form the effects of fishing (Collie et al. 2005, 2009, Asch and Collie 2008). The use of mobile bottom contact research gear by the NEFSC and cooperating partners is expected to have a greater impact in closed areas with more structured, hard bottom habitats (e.g., the Closed Area 2 Habitat Closure and the habitat and groundfish closures in the Gulf of Maine) than in areas composed predominantly of mud or sand that are exposed to considerable natural disturbance (e.g., Nantucket Lightship, Closed Area 1, and the majority of Closed Area 2 south of the habitat management area) (see NEFMC 2014).

The number of NEFSC surveys stations where bottom contact gear (trawls and dredges) was used within closed areas from 2003-2007 was less than 200 per year (NEFSC 2008) and it is assumed that a similar amount of survey effort would continue in the future. The total number of cooperative research survey stations that would be in closed areas in the near future cannot be determined because of the variable nature of such projects. However the level of effort has been and is likely to continue to be smaller than that of NEFSC-conducted surveys. Given the size of the sampling gear and the tow length of standard surveys, the area of seafloor affected by each NEFSC Standard Bottom Trawl Survey (BTS) station is estimated to be 0.037 square miles, the area affected by each shrimp trawl station is estimated to be 0.134 square miles, and the area affected by each scallop dredge station is estimated at 0.0017 square miles (NEFSC 2008). Assuming a higher than normal level of cooperative research surveys in closed areas, equal to the NEFSC-conducted surveys, the total of 400 annual survey stations using bottom trawl and dredge gear would affect approximately 15 square miles (using the larger BTS profile for trawls) and 0.77 square miles (for dredges) of benthic habitat per year. As the combined area of these closed areas is over

3,780 square miles, the total area affected by bottom contact gear would likely be less than 0.4 percent of the total for closed areas. Despite the greater impact to seafloor habitats in some of the closed areas versus open areas, the magnitude of effects on benthic habitat from fisheries research surveys is very small. As described in Section 4.2.1, physical effects to the benthic environment are expected to be of moderate duration or long-term (one to 18 months) (Stevenson et al. 2004). However, the impacts to specific sites would be limited to only a single occurrence as research samples are collected in different locations every year. Furthermore, bottom trawl and dredge surveys are only conducted on towable benthic substrates, e.g. sand, silt or gravel bottoms with few large rocks or sharp surfaces that may damage the gear. Given the selection for less structured bottom substrates and avoidance of coral areas, disturbance of physical habitat features and the removal of organisms that produce benthic structure for other species within fishery closed areas is likely to be minimal.

As discussed in Section 4.2.1, bottom contact fishing gear can increase turbidity and alter the geochemistry in the water column around the trawl or dredge. However, these effects are temporary and localized. Given the small number of survey stations in closed areas and the short-term and localized nature of the effects, the overall effect of the Status Quo Alternative on closed areas is considered minor according to the impact criteria in Table 4.1-1.

4.2.2.3 Marine Protected Areas

MPAs that are designated for cultural and natural heritage values tend to be nearshore sites that are not subject to survey efforts. In the case of known ship wrecks, which are sometimes protected by MPAs, bottom contact survey gear would not be used because it may be damaged or hung up on the wreckage. Pelagic trawls and oceanographic measurements may be taken in such areas, but they would have no effect on the values of the MPA.

MPAs that are managed for sustainable production and/or have restrictions for commercial or recreational fishing encompass almost the entire area where research surveys are conducted (NOAA 2010c). The amount of research conducted in each MPA is not readily available but based on the general effects of research on the environment as discussed in Section 4.2.1, the effects on MPAs is likely to be minor in geographic extent, and minor in duration or frequency. The effect of the Status Quo Alternative on marine protected areas is therefore considered minor according to the impact criteria in Table 4.1-1.

National Marine Sanctuaries

National Marine Sanctuaries (NMS) are MPAs with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities. There are three National Marine Sanctuaries in the NEFSC research area; Stellwagen Bank, Gray’s Reef, and Monitor (Figures 3.1-4, 3.1-5, and 3.1-6).

Section 304(d) of the National Marine Sanctuaries Act (NMSA) requires interagency consultation between the NOAA Office of National Marine Sanctuaries and federal agencies taking actions that are “likely to destroy, cause the loss of, or injure a sanctuary resource.” Sanctuary consultation requires the federal action agency to submit a “sanctuary resource statement,” which describes the agency action and its potential effects on sanctuary resources. Sanctuary resource statements are not necessarily separate documents prepared by the federal agency, and may consist of documents prepared in compliance with other statutes such as the NEPA. The following analysis describes the potential effects of NEFSC research activities on each of the three Atlantic Coast National Marine Sanctuaries, and provides the requisite information for a sanctuary resource statement pursuant to section 304(d) of the NMSA.

Table 4.2-3 Number and Percentage of NEFSC Survey Stations Conducted within Atlantic Coast National Marine Sanctuaries

Table indicates the number and percentage of survey stations that occur within each of the Sanctuaries. See Table 2.2-1 for information on the gear types and seasonality of each survey. Only surveys with stations located within an NMS are shown. Both surveys use stratified random designs so the number of stations in a given area fluctuates annually. Data are an average of the number of stations conducted within NMS boundaries from 2008-2012.

Survey Name	Total # Stations in survey	Stellwagen Bank NMS		Monitor NMS		Gray's Reef NMS		Combined percentage of survey effort occurring in NMS
		# within NMS	% of total	# within NMS	% of total	# within NMS	% of total	
NEFSC Standard Bottom Trawl Surveys	800	19	2.4	0	0	0	0	2.4 %
Northern Shrimp Surveys	82	6	7.3	0	0	0	0	7.3 %

Only two NEFSC survey programs (BTS and Northern Shrimp Surveys) are conducted partially within the Stellwagen Bank NMS (Table 4.2-3). Although Monitor NMS and Gray's Reef NMS are located within the general area where NEFSC fisheries research activities are conducted, there are no survey stations located within Monitor NMS or Gray's Reef NMS, and therefore NEFSC fisheries research surveys are not expected to have substantial effects on sanctuary resources within Monitor NMS or Grays Reef NMS. Potential impacts resulting from NEFSC fisheries research activities conducted within Stellwagen Bank NMS are discussed below.

The types of effects on NMS resulting from NEFSC research are substantially the same as those discussed for physical and biological resources elsewhere in this Final PEA. These potential effects primarily involve disturbance of benthic habitat and historic artifacts with bottom-contact gear, removal of fish and invertebrates through sampling with research gear, interactions with protected species, and the risk of accidental spills or contamination from vessel operation. BTS surveys use 19 meter wide bottom trawls that are towed at 3 knots for 20 minutes. The shrimp survey trawls are 17 meters wide and are towed at 2 knots for 15 minutes. On average, the number of tows from these two surveys conducted within the Stellwagen Bank NMS would have a total footprint of about two square kilometers per year, which is very small relative to the size of the Sanctuary and would be considered minor in magnitude. These tows would be dispersed throughout the Sanctuary and the effects on bottom habitat would be temporary or short-term. Overall gear effects on benthic habitat within the Sanctuary would therefore be considered minor according to the impact criteria in Table 4.1-1.

Bottom trawl, dredges, and any other research gear that contacts the ocean floor has the potential to have unintentional interactions with shipwrecks that may be considered historic properties or archaeological resources within Stellwagen Bank NMS. The precise position of known historical properties and archeological resources are not made public in order to minimize the risk of unauthorized salvage efforts. However, prior to NEFSC cruises using bottom contact gear, the NEFSC sends coordinates for proposed sampling sites to the Office of National Marine Sanctuaries to compare with their list of historical sites. If there is a potential conflict the NEFSC is notified and chooses a new sampling site for that cruise. Stations located within Stellwagen Bank NMS are identified prior to the cruise and reported to the chief scientist. In addition, current NEFSC cruise protocols for bottom trawl surveys include checking for hazards along a station transect before the trawl gear is deployed, typically by using sonar gear to look for unsuitable bottom topography, but also by checking maritime charts for known shipwreck sites. Any known shipwreck sites would be avoided as they could snag and ruin the research gear so new survey stations are selected if hazards are identified. These protocols apply to all bottom trawl survey stations regardless of whether or not they occur in an NMS. If these precautions do not identify potential shipwrecks and the research gear incidentally interacts with a wreck, current NEFSC policy stipulates that

any artifacts brought aboard the vessel due to fishing in Stellwagen Bank NMS must be photographed and Sanctuary staff immediately contacted for directions on the disposition of the artifact. This may include returning the artifact, as near as possible, to the location of interception. An artifact is defined as anything of manmade origin with the exception of modern fishing gear. Due to these established protocols, the NEFSC finds that the proposed activity would have "No Adverse Effect" on submerged historic or archaeological properties.

The use of other scientific research gear, including various plankton nets, water sampling devices, and acoustic survey equipment would result in temporary changes to pelagic habitat within Stellwagen Bank NMS. The presence of pelagic sampling equipment and active acoustic equipment may result in temporary disturbance or displacement of pelagic species that happen to be close to the gear. These potential effects would be low in magnitude, temporary, and dispersed across large areas and would be considered minor for all species.

Amounts of biomass removed from sanctuaries are small, and the effects of biomass removal on biological populations and habitats would be minor. Table 4.2-4 shows mean annual biomass removal from Stellwagen Bank NMS resulting from previous NEFSC surveys from 2008-2012. Under the Status Quo Alternative, the NEFSC would conduct a relatively small amount of research within Stellwagen Bank NMS and that research effort would result in the removal of very small amounts of biomass.

Table 4.2-4 Mean Annual Biomass Removal from Stellwagen Bank National Marine Sanctuary Resulting from NEFSC Standard Bottom Trawl Surveys

Mean annual biomass removal from Stellwagen Bank National Marine Sanctuary was calculated for the ten most abundant species by weight caught during 2008-2012 NEFSC BTS. Biomass removal was calculated by multiplying the total catch of each species during NEFSC BTS by the fraction of survey effort occurring within Stellwagen Bank National Marine Sanctuary. Although the Monitor National Marine Sanctuary and the Gray's Reef National Marine Sanctuary are both located within the general area where NEFSC research may occur, surveys are not usually conducted within the boundaries of those sanctuaries.

Species	Average catch/year	Species	Average catch/year	Species	Average catch/year
Spiny dogfish	3,666 lb	Silver hake	381 lb	Atlantic croaker	218 lb
Skate spp.	1,228 lb	Atlantic herring	306 lb	Atlantic cod	198 lb
Haddock	487 lb	Butterfish	247 lb	Long-finned squid	172 lb
Acadian redfish	419 lb				

NEFSC survey activities within National Marine Sanctuaries may result in interactions with protected species, including marine mammals and sea turtles. Interactions with marine mammals may include disturbance from vessels and active acoustic equipment and incidental take. Historically NEFSC fisheries research survey activities have not resulted in any serious injury or mortality takes of marine mammals within NMS boundaries (Figure 4.2-2) or any captures of sea turtles within NMS boundaries (Figure 4.2-4). Similarly small and rare levels of interaction with protected species would be expected to result from the NEFSC research activities included under the Status Quo Alternative. Mitigation measures intended to mitigate the effects of interactions with protected species are described in Section 2.2 of this document.

MPAs, including National Marine Sanctuaries, which are managed for sustainable production and/or have restrictions for commercial or recreational fishing, encompass a large fraction of the area where NEFSC research surveys are conducted (NOAA 2010c). NEFSC survey activities provide essential information related to the science-based management, conservation, and protection of living marine resources and ecosystem services within these areas. The information developed from NEFSC research activities is essential to the development of a broad array of fisheries, habitat, and ecosystem management actions taken not only by NMFS, but also by other federal, state, and international authorities. Science-based management of marine resources supported by NEFSC research activities included under the Status Quo Alternative would therefore result in beneficial effects to MPAs, including National Marine Sanctuaries,

in addition to the minor adverse effects to sanctuary resources that may result from NEFSC research activities.

4.2.2.4 Conclusion

Special resource areas within the NEFSC research area include EFH and HAPC areas, closed areas, and MPAs, including National Marine Sanctuaries. Impacts from NEFSC-affiliated fisheries research under the Status Quo Alternative include effects on the physical environment as well as biological components. The analysis of effects on these general components (Section 4.2.1 for the physical environment and Sections 4.2.3-4.2.7 for the biological components) are reflected in the analysis for the special resource areas. The magnitude of effects on benthic habitats is relatively small (less than 0.1 percent of the research area is affected by bottom-contact research gear per year) and such effects would be temporary or short-term in duration. The removal of fish and invertebrates during research is also relatively small in magnitude and dispersed over time and space and unlikely to affect the populations of any species. The analysis of research impacts within Stellwagen Bank National Marine Sanctuary is consistent with the relatively small and temporary or short-term effects described in general. The overall effects on special resource areas under the Status Quo Alternative would be certain to occur but minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1. In contrast to these adverse effects, the scientific data generated from NEFSC research activities would contribute to beneficial effects on special resource areas, including National Marine Sanctuaries, through their contribution to science-based conservation management practices.

4.2.3 Effects on Fish

This section describes the types of effects of the Status Quo Alternative on fish species in the NEFSC research areas (Section 3.2.1). The potential effects of research vessels, survey gear, and other associated equipment on fish include:

- Mortality from fisheries research activities
- Contamination from discharges
- Disturbance and changes in behavior due to sound sources

Mortality from Fisheries Research Activities

Direct mortality of fish occurs as a result of various fisheries research activities. Fish are caught in a variety of gear types, some of which involve experimental tests of gears designed to reduce incidental catch of non-target species or protected species. These surveys provide important data to determine biomass estimates, reproductive potential, and distribution of fish stocks, which are necessary for fisheries managers to maintain healthy populations and rebuild overfished/depressed stocks. These surveys also sample closed areas to monitor the status of depressed and overfished stocks for which the areas have received protection in the form of fishery restrictions. The NEFSC also conducts surveys to provide indices of juvenile abundance that are used to identify and characterize the strength of year classes before fish are large enough to be harvested by commercial or recreational fisheries. Stock assessments based on accurate abundance and distribution data are essential to developing effective management strategies.

The majority of fish affected by the long-term NEFSC research projects are caught and killed during these seven annual trawl surveys:

- NEFSC BTS conducted in the spring and fall throughout the NE LME
- Northern Shrimp Survey,
- NEAMAP surveys,
- MADMF Bottom Trawl Surveys,
- Benthic Habitat Surveys,
- Atlantic Herring Survey, and
- Atlantic Salmon Trawl Survey.

Most of the longline and hook-and-line projects conducted by the NEFSC and its cooperating partners are intended to catch fish for morphological measurements and tagging. Since most of these fish are released alive, mortality rates are low. The capture rate of fish species in research surveys varies substantially within each LME subarea, with higher numbers in samples from some areas and very low or no individuals collected in other samples. This variability in catch is used to determine species abundance and distribution. Concentrations of biomass and species richness depend on topographic features, water temperature and salinity, prey availability, and other habitat characteristics. For example, fall BTS data indicates that total biomass is higher in the nearshore regions of the MAB and SNE, the western GOM, and the northern edge of GB (NEFSC 2011a). The pattern of species richness for fish shows a similar structure with greater diversity of vertebrate species along the coastlines of the MAB and SNE during fall surveys (NEFSC 2011a).

Short-term cooperative research projects funded by or otherwise affiliated with the NEFSC (Table 2.2-2) have a wide variety of research objectives. Some have no catch of fish (e.g., video camera projects and morphometric measurements of fish caught on commercial fishing trips) while others catch substantial amounts of fish in an effort to compare the efficiency of different gear types or new bycatch reduction methods. It is difficult to project what projects will be funded in the future, and therefore how much fish may be caught, because proposals are developed every year to address current issues and each proposal must be screened for scientific validity and compete with other proposals for funding. The following analysis considers the catch data from the cooperative research projects in the past five years (status quo) to estimate future catch due to these types of projects. For this analysis, the combined catch from NEFSC conducted surveys and short-term cooperative research projects provided the estimated catch from all NEFSC affiliated fisheries research activities.

The impact of mortality from fisheries research depends on the magnitude of the research catch relative to the overall biomass or population level of the species. Measuring these relative effects is difficult because there are many species for which total biomass estimates have fairly large confidence intervals so comparisons would also have a large range of relative magnitude. For the purpose of assessing the magnitude of mortality effects in this Final PEA, the amount of fish caught in NEFSC research is compared to the amount caught in commercial fisheries, which is well known, and the estimated catch from recreational fisheries (estimates are only available for the most popularly harvested species). Commercial harvest limits are set at a fraction of overall stock biomass so the magnitude of research catches relative to overall population levels would be much less than what is indicated in the comparisons with commercial landings. The Final PEA does not attempt to analyze the effects of research mortality on each of the hundreds of species caught in the various surveys. Rather, to demonstrate the effects of research mortality on fish stocks, it analyzes only the effects on species that are caught most frequently in the surveys (total catch over one ton), and species that are overfished or where overfishing is occurring. Based on the amount of additional annual mortality attributed to fisheries research, the NEFSC estimated that past, present and proposed survey activity conducted on NOAA vessels and NOAA chartered vessels was equivalent to adding 1.2 vessels to the commercial groundfish fleet (NEFSC 2008).

More research surveys (Appendix B) are conducted during the spring, summer, and fall when target fish species are more likely to be encountered in higher numbers. Spatially, trawl and longline surveys that target fish are disbursed fairly evenly among the four Northeast Continental Shelf LME subareas, although some cooperative research may be conducted in specific locations important to commercial fisheries or habitat conservation. In comparison to commercial fisheries-related mortality, mortality due to research activities occurs in small areas, research tow times are much shorter than commercial tows, and sampling is usually not repeated in the same area, in contrast to commercial fisheries that focus primarily on areas of fish concentrations.

Disturbance and Changes in Behavior Due to Sound Sources

There are several mechanisms by which noise sources from research activities could potentially disturb fish and alter behavior, including the physical movement of marine vessels and fishing gear through the water, gear contact with the substrate, and operational sounds from engines, hydraulic gear, and acoustical devices used for navigation and research.

Noise from active acoustic devices used on vessels conducting fisheries research could potentially affect fish. The LOA application (Appendix C, Section 6.2) describes the types of acoustic devices used on NEFSC research vessels. Fish with a swim bladder (or other air bubble) that is near, or connected to, the auditory structures likely have the best hearing sensitivity among fish, with a presumed functional hearing range of approximately 50 hertz to 4 kilohertz (Popper and Fay 2011). Herring are in this category of fish, which are specialized to hear high frequency sounds that are within the range of acoustic devices used in research. These types of fish are likely to detect acoustic devices, but only if they are relatively near the source. Because vessels are usually moving while using acoustic gear, the source of potentially disturbing sounds would be localized and the behavioral response of fish would likely be limited to temporary avoidance behavior.

Globally, approximately 25,000 fish species have a swim bladder (or other air cavity) that is not near the ear (for example, salmonids). These species probably detect some pressure from large physical disturbances of the water or vessel traffic, but functional hearing is most likely in the 30 hertz to 500 hertz range (Popper and Fay 2011) and higher frequency acoustic devices used in research are unlikely to be audible. Any acoustical effect that is audible and that would cause avoidance disturbance, would be minor in intensity, occur over a local geographic extent, and the duration would be temporary.

Commercial vessel and fishing gear noise, and recreational vessel noise are common components of background (ambient) noise in the marine environment. At present, there are thousands of commercial fishing, transport vessels, and recreational vessels in the project area that contribute to background vessel noise.

Potential disturbance and acoustic masking effects from research vessel noise under the Status Quo Alternative would likely be geographically localized, minimal in magnitude, and temporary in duration; this type of effect would be considered minor adverse for all fish species according to the impact criteria in Table 4.1-1.

Contamination from Discharges

Discharge from vessels, whether accidental or intentional, include sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and plastics. Impacts to fish exposed to the discharge range from superficial exposure to ingestion and related effects. Even at low concentrations that are not directly lethal, some contaminants can cause sub-lethal effects on sensory systems, growth, and behavior of animals, or may be bioaccumulated (DOE 2008, NOAA 2010d).

All NOAA vessels and NEFSC chartered vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (NOAA 2010b). MARPOL includes six annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (IMO 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). In addition, all NOAA vessels are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills occurring and increase the chance that they will be responded to and contained quickly.

Discharge of contaminants from NEFSC vessels and NEFSC chartered vessels is possible, but unlikely to occur in the near future. If an accidental discharge does occur, it is likely to be a rare event and the potential volume of material is likely to be small and localized. The potential impacts to fish would be similarly short-term, localized, and likely affect a small number of animals. The overall impact of accidental contamination of fish would therefore be considered minor adverse.

As the potential effects of discharges, regulations governing discharges, and the likelihood of discharges are universal throughout the NEFSC research area, this type of potential effect on fish will not be discussed further in this analysis.

4.2.3.1 ESA-listed Species

There are four marine fish species in the project area currently listed under the ESA, the Atlantic salmon, shortnose sturgeon, and smalltooth sawfish are listed as endangered and the Atlantic sturgeon is listed as threatened or endangered depending on its location. The Atlantic sturgeon has five distinct population segments (DPS) within the NEFSC research area; the Gulf of Maine DPS is listed as threatened while the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered. The NEPA context for impacts to these species is considered important due to their status as ESA species.

Directed research on ESA-listed species requires permitting under section 10 of the ESA, which is subject to its own NEPA analysis, and is not covered under this Final PEA. The following discussion involves effects on ESA-listed species incidental to the purpose of NEFSC-affiliated fisheries research.

<u>Mortality from Fisheries Research Activities</u>

Atlantic salmon are a highly prized game and food fish native to New England rivers. Significant declines in abundance of Atlantic salmon populations in the U.S. prompted an endangered listing of the species under the ESA (65 Federal Register [FR] 69459, November 17, 2000). Results from a 2001 post-smolt trawl survey in Penobscot Bay and the nearshore waters of the GOM indicate that Atlantic salmon post-smolts are prevalent in the upper water column throughout this area in mid to late May. Only two Atlantic salmon have been captured during the NEFSC annual fishery surveys; one in the BTS in 1977 and the second during the spring 2012 BTS. Both fish were captured along the coastline of Maine. There have been no records of Atlantic salmon takes in short-term cooperative research projects under the Status Quo. Future NEFSC research activities on NOAA vessels and cooperative research surveys could encounter Atlantic salmon but it would likely be a rare occurrence with minimal magnitude of effect and, therefore, would be considered a minor adverse effect according to the criteria in Table 4.1-1.

To date, there have been no documented cases of shortnose sturgeon takes in the NEFSC bottom/midwater trawl or sea scallop dredge surveys or similar commercial fisheries. Future catch of this species in NEFSC research is possible but would likely be a rare event and the effect of fishery research activities on this species through direct mortality is therefore considered minor adverse.

Atlantic sturgeon have been caught on an infrequent but regular basis during the NEFSC BTS. From 1963 through 2011 the BTS caught 140 Atlantic sturgeon in a total of 36,960 trawls (NMFS 2012b) for an average of 0.00379 Atlantic sturgeon captured per trawl. Since Atlantic sturgeon were listed under the ESA in February 2012, the BTS surveys have caught six sturgeon in 1,600 trawls (Table 4.2-5) for an average of 0.00375 sturgeon per trawl. All of the fish captured in BTS surveys were measured, tagged, and released alive and in apparent good condition. Table 4.2-6 and Figure 4.2-1 provide details of Atlantic sturgeon takes since they were listed under the ESA.

Both the northern and southern portions of the NEAMAP surveys have also caught Atlantic sturgeon on a regular basis in the past. These NEAMAP surveys use the same gear and protocols as the BTS but are conducted in shallower, inshore waters. All sturgeon caught in NEAMAP trawls were measured, tagged, and released alive and in good condition. The northern portion of the NEAMAP survey is conducted by the Maine Department of Marine Resources and occurs in waters off Maine and New Hampshire (ME-

NH). The ME-NH inshore trawl surveys caught nine Atlantic sturgeon in 800 trawls from 2008 through 2011, for an average of 0.01125 sturgeon per trawl (Table 4.2-5). Since their ESA listing, the ME-NH surveys have caught four Atlantic sturgeon in 400 trawls (Table 4.2-5 and Table 4.2-6), for an average of 0.01 sturgeon per trawl. The southern portion of the NEAMAP survey is conducted by the Virginia Institute of Marine Science (VIMS) and occurs in waters from New York to Cape Hatteras, NC. The VIMS surveys caught 100 Atlantic sturgeon in 1,200 trawls from 2008 through 2011 for an average of 0.0833 sturgeon per trawl. Since their ESA listing, the VIMS surveys have caught 36 Atlantic sturgeon in 600 trawls (Table 4.2-5 and Table 4.2-6), for an average of 0.06 sturgeon per trawl.

The differences in catch rates among these similar surveys can likely be attributed to differences in Atlantic sturgeon abundance within their respective survey areas. The BTS is generally conducted further offshore and in relatively deeper water than NEAMAP which, given the preference of Atlantic sturgeon for shallower nearshore waters (NMFS 2012b), would explain the reduced frequency of interactions. Many more interactions have occurred in the southern parts of the NEFSC research area (Figure 4.2-1) where Atlantic sturgeon are more common in the spring and fall survey seasons due to their migration to and from their southern winter waters (NMFS 2013c).

Table 4.2-5 Summary of Atlantic Sturgeon Capture Rates during NEFSC-affiliated research

All Atlantic sturgeon caught were released alive and in good condition.

Survey Name	Field seasons	Total caught and released	Total trawls	Capture rate (sturgeon/trawl)
NEFSC BTS	1963-2011	140	36,960	0.00379
	2012-2013	6	1,600	0.00375
	Total (1963-2013)	**146**	**38,560**	**0.00379**
NEAMAP (ME-NH)	2008-2011	9	800	0.01125
	2012-2013	4	400	0.01
	Total (2008-2013)	**13**	**1200**	**0.01083**
NEAMAP (VIMS)	2008-2011	100	1200	0.0833
	2012-2013	36	600	0.06
	Total (2008-2013)	**136**	**1800**	**0.07556**
Combined NEAMAP Total	**2008-2013**	**149**	**3000**	**0.04967**

Table 4.2-6 Takes of ESA-listed Atlantic Sturgeon during NEFSC-affiliated Research (2012 through 2013)

All Atlantic sturgeon caught were released alive and in good condition.

Survey Name	Date (Time) Taken	# Caught and Released	Total Taken
2013			
NEFSC BTS	22 Mar. (3:06 pm)	1	1
NEAMAP (ME-NH)	17 May (time not available)	1	1
NEAMAP (VIMS)	26 Apr. (7:22 am)	1	14
	26 Apr. (11:38 am)	1	
	27 Apr. (8:26 am)	1	
	29 Apr. (8:53 am)	1	
	29 Apr. (5:26 pm)	2	
	29 Apr. (6:53 pm)	1	
	1 May (3:35 pm)	1	
	13 May (5:18 pm)	1	
	17 Oct. (3:57 pm)	1	
	17 Oct. (5:16 pm)	1	
	25 Oct. (3:38 pm)	1	
	26 Oct. (12:39pm)	1	
	10 Nov. (4:49pm)	1	
2012			
NEFSC BTS	4 Mar. (8:57 am)	1	5
	12 Mar. (10:18 am)	1	
	13 Mar. (11:06 am)	2	
	24 Mar. (2:32 pm)	1	
NEAMAP (ME-NH)	7 May (n/a)	2	3
	3 Oct. (n/a)	1	
NEAMAP (VIMS)	3 May (10:55 am)	1	22
	4 May (8:10 am)	5	
	11 May (7:28 pm)	2	
	13 May (2:34 pm)	1	
	3 Oct. (11:12 am)	2	
	3 Oct. (2:49 pm)	1	
	3 Oct. (5:58 pm)	1	
	4 Oct. (7:22 am)	1	
	4 Oct. (5:11 pm)	3	
	10 Oct. (4:17 pm)	1	
	12 Oct. (10:46 am)	1	
	16 Oct. (7:49 am)	1	
	18 Oct. (7:37 am)	1	
	18 Oct. (9:02 am)	1	

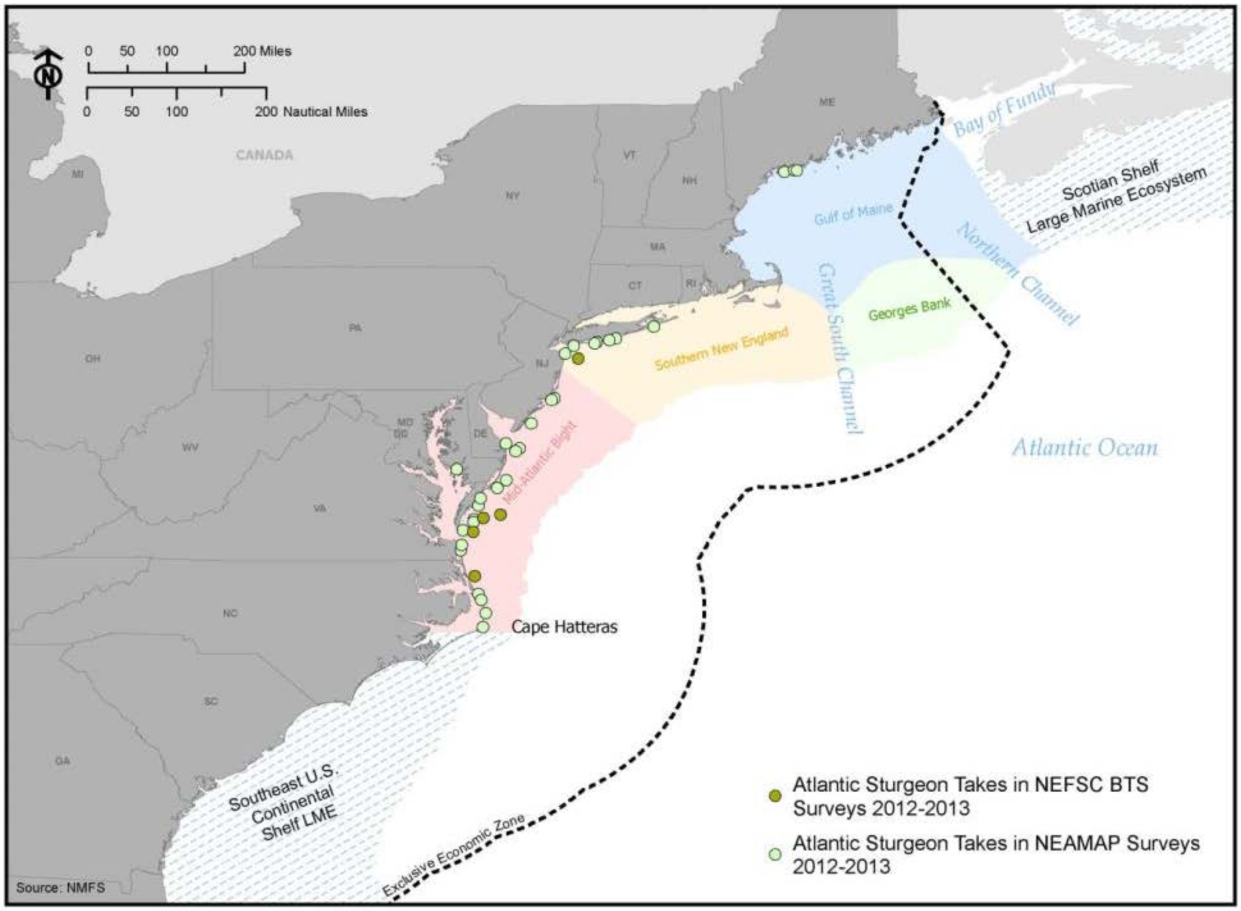


Figure 4.2-1 Location of Atlantic Sturgeon Takes during NEFSC-affiliated Research from 2012 through 2013

Nine other long-term research programs (Table 2.2-1) and many short-term cooperative research projects (Table 2.2-2) use bottom trawl gear. Only two of these other research efforts have reported any captures of Atlantic sturgeon using bottom trawl gear. The short-term cooperative research projects titled, "A method to reduce butterfish retention in the offshore Loligo squid fishery through the use of a bycatch reduction device (BRD) adapted to pre-existing gear" and "Exploring bycatch reduction of summer, winter, yellowtail, and windowpane flounders using 12-inch drop chain trawl net design in the small mesh fishery" (Table 2.2-2), each caught one Atlantic sturgeon using otter trawl gear but the disposition of the fish (mortality, injury, or released alive) were not recorded. Both of these fish were caught before Atlantic sturgeon were listed under the ESA in 2012. The first project was designed to test the BRD under conditions similar to commercial fishing operations and used one hour tow durations, which are longer than many fisheries research protocols and likely increased the risk of mortality relative to the BTS and NEAMAP protocols. The second project used 40 minute tows, which is also longer than the BTS and NEAMAP protocols.

There are many factors which influence the risk of capturing Atlantic sturgeon in research gear, including location, time of year, depth of water, water temperature, size of fishing gear, duration of the tow, etc. For the purposes of this Final PEA analysis, estimates of future Atlantic sturgeon takes under the Status Quo Alternative will be made in several parts. The long-term surveys with a history of sturgeon catch (BTS and NEAMAP) will be assessed separately based on their respective capture rates, as described above and summarized in Table 4.2-5. All of these surveys had similar capture rates before and after Atlantic sturgeon were listed under the ESA. Given this similarity, the total capture rate for each survey will be

used to estimate future takes. For the purpose of estimating the future impacts of other long-term, NEFSC-conducted research using bottom trawl gear (905 trawls total, Table 2.2-1), this Final PEA will assume that these surveys would collectively have the same potential to capture Atlantic sturgeon as the BTS. Short-term cooperative research projects are more varied in terms of the gear and protocols they use and are often conducted on smaller fishing vessels that can operate in shallower waters than the BTS. For the purposes of this Final PEA analysis, the capture rate for these types of research projects will be assumed to be closer to the NEAMAP surveys, which are greater than the BTS and therefore provide a more conservative estimate of potential future takes. To account for the fact that such short-term cooperative research projects occur throughout the Northeast region, the capture data for the ME-NH and VIMS portions of the NEAMAP survey will be combined to provide an average capture rate for such projects in the future. The average number of bottom trawl tows by short-term cooperative research projects from 2008-2012 equaled 614 tows per year, including several conservation engineering projects that used paired trawls (Table 2.2-2).

Table 4.2-7 provides estimates of Atlantic sturgeon take for each set of research activities and the overall total for NEFSC-affiliated fisheries research. Based on this analysis, up to 65 Atlantic sturgeon per year could be captured in NEFSC-affiliated research using bottom trawl gear under the Status Quo Alternative. This estimate is considered conservative in that it exceeds past recorded takes and actual take levels are likely to be less than the estimate. Most Atlantic sturgeon caught would be expected to be released alive and in good condition based on past experience. Given the continued use of fishing gears that have caused mortality of sturgeon in commercial fisheries, and since some cooperative research projects may include research protocols similar to commercial fishing conditions, there is a potential for NEFSC-affiliated fisheries research to cause mortality of sturgeon in the future. However, given the substantially shorter tow times and other differences between research and commercial fishing, such incidents would likely be rare based on the past record of Status Quo research.

Table 4.2-7 Estimated Future Takes of Atlantic sturgeon under the Status Quo Alternative

Research Activity	Trawls per year	Capture rate (sturgeon per trawl)	Estimated annual captures	Estimated Atlantic sturgeon takes per year (rounded up)
BTS	800	0.00379	3.03	4
NEAMAP (ME-NH)	200	0.01083	2.17	3
NEAMAP (VIMS)	300	0.07556	22.67	23
Other long-term research using bottom trawl gear	905	0.00379	3.43	4
Short-term cooperative research using bottom trawl gear	614	0.04967	30.50	31
Total estimated Atlantic sturgeon takes per year in NEFSC-affiliated bottom trawl gear				**65**

No other long-term or short-term research projects have reported any interactions with Atlantic sturgeon using gillnets or any other gear. However, gillnets are used for several long-term and short-term research projects, including the Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) Gillnet Surveys and NEFOP Observer Gillnet Training Trips. The COASTSPAN surveys use short set times (3 hours) and continuously run the net to collect target species (sharks) and release all other species quickly. Based on past experience, the potential for capturing sturgeon in COASTSPAN surveys is low and the potential for mortality is negligible. The observer training trips are very limited and captures of Atlantic sturgeon in the future would likely be rare events.

Several short-term cooperative research projects have used gillnet gear for research in association with commercial fisheries that have caught Atlantic sturgeon in the past. One past project, "Bycatch Reduction Engineering Program (BREP) monkfish gillnet – sturgeon", was a pilot project to begin examining factors that could affect bycatch of Atlantic sturgeon in a commercial fishery. That project continued after Atlantic sturgeon were listed under the ESA in 2012 but it required a section 10 permit under the ESA; coordination moved to the NEFSC Protected Species Branch and the project was covered under directed research permits issued under the ESA (NMFS 2013c). Such directed research on ESA-listed species is not covered in this Final PEA under the Status Quo Alternative. Any future proposed projects that had a reasonable chance of adverse interactions with ESA-listed fish species would either be covered under directed research permits or, if the effects were incidental to the intent of the research, would receive additional scrutiny (section 7 consultation) to ensure that the research does not harm the stock before it is issued a research permit.

Overall, the potential effects of bycatch of Atlantic sturgeon during NEFSC-affiliated fisheries research conducted under the Status Quo Alternative would be low in magnitude, distributed over a wide geographic area, and temporary or short-term (for fish captured and released); the effects are considered minor adverse according to the criteria in Table 4.1-1.

4.2.3.2 Target and Other Fish Species

Mortality from Fisheries Research Activities

Table 4.2-8 shows the average annual catch (by weight) of the most frequently caught fish species in the past five years (2008-2012) from NEFSC-affiliated research surveys and cooperative research projects. These average annual research catches are compared to the average annual commercial landings of target species to give an indication of their relative size. In addition, for species that are frequently caught by recreational anglers, estimates of average annual recreational catches are also provided for comparison. These data indicate that for most target species the average amount of fish killed in NEFSC-affiliated research is much less than one percent of commercial and recreational landings. For these species, the magnitude of research mortality is very small relative to the fisheries and even smaller relative to the estimated populations of these fish.

The most frequently caught species in NEFSC research, spiny dogfish, is very abundant and a substantial number are landed commercially. However, they are also often caught as bycatch in commercial fisheries and discarded rather than brought to market (Sosebee and Rago 2006). The data on commercial landings is therefore small compared to total numbers of dogfish caught. Given the large bycatch for this species, scientific data provided by NEFSC surveys are important to monitor the status of the species, which is currently not considered overfished.

For a few species which do not have a large commercial market, such as butterfish, weakfish, fourspot flounder, northern searobin, and blueback herring, the research catch exceeds one percent of commercial catch. For most of these species, commercial landings are greatly diminished from historical fisheries for various reasons. They currently do not have directed fisheries, so landings data do not reflect population status. NEFSC surveys, which are important for monitoring the stocks, catch a broader size/age class of the stock rather than just marketable size fish.

NEFSC surveys and cooperative research projects catch stocks of species that are considered overfished or in regions where overfishing is occurring, including regional stocks of haddock, winter flounder, Atlantic cod, yellowtail flounder, windowpane flounder, ocean pout, witch flounder, thorny skate, Atlantic halibut, and Atlantic wolfish (Table 4.2-8). In general, the type of programmatic analysis presented in this section indicates that research activities have minimal impact on these populations and therefore pose little conservation concern. However, this programmatic analysis is based on average catch levels over a five-year period, with all fishery management regions combined, and comparisons with an

area-wide harvest metric from a particular year. This approach precludes the assessment of potential effects of research on overfished stocks or where overfishing is occurring in one or more fishery management regions. The status and trends of such stocks can change rapidly, either increasing or decreasing, and average catch per unit effort can vary dramatically from year to year with change in abundance. In addition, research catch in one fishery management region where a species is not overfished (e.g., yellowtail flounder in the SNE), could be problematic if it was conducted in a region where the stock is overfished (e.g., yellowtail flounder in the GOM) and the commercial fisheries have been curtailed to help the overfished stock rebuild.

Most research activities conducted by the NEFSC are multi-species surveys that cover large areas, involve minimal sampling, and do not target overfished species. Research catches in these surveys are generally very small for uncommon species. However, many of the short-term cooperative research projects are focused on a particular species or group of fish (e.g., flounders) and could catch substantial amounts of targeted fish in a relatively small area, e.g, studies comparing different configurations of commercial fishing gear. Such research directed at an overfished stock could theoretically account for a substantial portion of the Annual Catch Limit for that stock or other fishery management metric (e.g., overfishing level) and could interfere with the rebuilding plan for that stock.

Research data is necessary for monitoring the status of overfished stocks and other stocks of conservation concern and to determine if management objectives for rebuilding those stocks are being met. Under the Status Quo Alternative, scientific research proposals for both long-term and short-term projects require scientific research permits or experimental fishing permits. The potential impacts of those proposed projects are assessed for each stock, including overfished stocks, before those permits are issued. Fisheries managers typically consider the estimated amount of research catch from all projects along with other sources of mortality (e.g., bycatch in other fisheries and predation) before setting commercial fishing limits to prevent overfishing of stocks or to help overfished stocks rebuild. This type of annual review of research proposals would continue to occur in the future under the Status Quo Alternative. Any future proposed projects targeting overfished stocks, or projects likely to have substantial bycatch of an overfished stock, would receive additional scrutiny on a stock by stock basis to ensure minimal impact on the stock before a research permit is issued. These permitting reviews would also determine whether the proposed projects were consistent with the NEPA analysis presented in the Final PEA or whether additional NEPA analysis was required (see Section 2.3.5).

Table 4.2-8 indicates that, while mortality to fish species is a direct effect of the NEFSC surveys and cooperative research projects, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of fish taken in commercial and recreational fisheries, which are just fractions of the total populations for these species. For all target species in the Northeast region, mortality from NEFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Status Quo Alternative.

This page intentionally left blank.

Table 4.2-8 Comparison of Estimated Fish Caught under the Status Quo Alternative Compared to Commercial Catch (Landings) and Recreational Catch

Species are listed in descending order of total research catch by weight. Only species with total catch greater than one ton (2000 pounds) and those that are overfished or where overfishing is occurring are listed

Species	Stock status[1]	Average NEFSC research catch per year (tons) (2008-2012)	Average cooperative research catch per year (tons) (2008-2012)	Total average NEFSC affiliated research catch per year (tons) (2008-2012)	Average commercial catch per year in Northeast Region (tons)[2] (2008-2011)	Average recreational catch estimate per year for Atlantic Coast[3] (tons) (2008-2012)	Total average annual commercial and recreational catch (tons)	Average NEFSC research catch compared to commercial and recreational catch (percentage)
Spiny dogfish	Not overfished	97.3	31.5	128.9	6,918.2	NA	6,918.2	1.85%
Undetermined skate	NA	0	55.0	55.0	NA	NA	NA	NA
Little skate	Not overfished	24.1	0.8	24.9	4,481.8	NA	4,481.8	0.56%
Butterfish	Not overfished	13.6	8.9	22.6	663.0	NA	663.0	3.41%
Winter skate	Not overfished	19.0	2.1	21.1	NA	NA	NA	NA
Silver hake (whiting)	Not overfished	13.9	1.2	18.0	8,193.7	NA	8,193.7	0.22%
Atlantic croaker	Unknown	13.9	0	13.9	7,843.9	2,318.3	10,162.2	0.14%
Atlantic herring	Not overfished	13.2	0.1	13.4	89,754.8	NA	89,754.8	0.01%
Scup	Not overfished	7.1	3.7	10.8	4,867.6	2,079.5	6,947.1	0.16%
Summer flounder (fluke)	Not overfished	2.3	7.5	9.8	6,111.2	3,1773	9,288.5	0.11%
Haddock	GOM: approaching overfished/ overfishing; GB: Not overfished	9.0	0.6	9.6	7,631.1	NA	7,631.1	0.13%

Species	Stock status[1]	Average NEFSC research catch per year (tons) (2008-2012)	Average cooperative research catch per year (tons) (2008-2012)	Total average NEFSC affiliated research catch per year (tons) (2008-2012)	Average commercial catch per year in Northeast Region (tons)[2] (2008-2011)	Average recreational catch estimate per year for Atlantic Coast[3] (tons) (2008-2012)	Total average annual commercial and recreational catch (tons)	Average NEFSC research catch compared to commercial and recreational catch (percentage)
Smoothhound (smooth dogfish)	**Unknown**	8.3	1.3	9.5	1,412.4	NA	1,412.4	0.67%
Acadian redfish	**Not overfished**	9.3	<0.1	9.3	1,731.4	NA	1,731.4	0.53%
Weakfish	**Unknown**	7.7	<0.1	7.7	150.7	125.6	276.6	2.79%
Spot	**Unknown**	7.2	0.1	7.3	2,000.6	1,144.3	3,144.9	0.23%
Winter flounder (blackback)	**GOM: Unknown; GB: Not overfished; SNE/MAB: Overfished**	3.6	2.9	6.4	2,268.4	120.4	2,388.8	0.27%
Clearnose skate	**Not overfished**	6.3	<0.1	6.3	NA	NA	NA	NA
Red hake	**Not overfished**	4.7	1.5	6.3	663.7	NA	663.7	0.95%
Atlantic cod	**GOM and GB: Overfished/ overfishing**	4.2	1.2	5.4	9,275.2	15,79.1	10,854.2	0.05%
Yellowtail flounder	**Cape Cod/GOM & GB: Overfished/ overfishing; SNE/MAB: Not overfished**	2.5	1.9	4.4	1,767.0	NA	1,767.0	0.25%
Goosefish (monkfish)	**Not overfished**	3.9	0.4	4.3	9,928.6	NA	9,928.6	0.04%
Striped bass	**Not overfished**	3.6	0.6	4.1	3,732.9	12,351.0	16,083.8	0.03%

Species	Stock status[1]	Average NEFSC research catch per year (tons) (2008-2012)	Average cooperative research catch per year (tons) (2008-2012)	Total average NEFSC affiliated research catch per year (tons) (2008-2012)	Average commercial catch per year in Northeast Region (tons)[2] (2008-2011)	Average recreational catch estimate per year for Atlantic Coast[3] (tons) (2008-2012)	Total average annual commercial and recreational catch (tons)	Average NEFSC research catch compared to commercial and recreational catch (percentage)
White hake	**Not overfished**	3.1	0.4	3.5	2,132.9	NA	2,132.9	0.17%
Fourspot Flounder	**Unknown**	2.0	1.2	3.2	7.9	NA	7.9	40.28
Spotted Hake	**Unknown**	2.6	0.1	2.6	NA	NA	NA	NA
Barndoor skate	**Not overfished**	2.2	0.3	2.5	NA	NA	NA	NA
Atlantic mackerel	**Unknown**	2.3	0.2	2.4	15,087.3	828.9	15,087.3	0.02%
Alewife	**Unknown**	2.3	<0.1	2.3	830.1	NA	830.1	0.28
Kingfish (*Menticirrhus spp.*)	**Unknown**	2.3	<0.1	2.3	NA	798.2	798.2	0.29%
American plaice	**Not overfished**	2.2	0.1	2.3	1,460.2	NA	1,460.2	0.16%
Cownose ray	**Unknown**	2.0	0.2	2.1	45.5	NA	NA	NA
Longhorn Sculpin	**Unknown**	1.9	0.2	2.1	NA	NA	NA	NA
Bluefish	**Not overfished**	1.2	0.6	1.9	3,183.9	7,372.2	10,556.2	0.02%
Windowpane flounder (sand dab)	**GOM & GB: Overfished/ overfishing;** **SNE & MAB: not overfished**	1.0	0.7	1.7	74.2	NA	74.2	2.38%
Northern searobin	**Unknown**	1.2	0.6	1.7	49.6	NA	49.6	3.33%
Spiny butterfly ray	**Unknown**	1.5	0	1.5	NA	NA	NA	NA

Species	Stock status[1]	Average NEFSC research catch per year (tons) (2008-2012)	Average cooperative research catch per year (tons) (2008-2012)	Total average NEFSC affiliated research catch per year (tons) (2008-2012)	Average commercial catch per year in Northeast Region (tons)[2] (2008-2011)	Average recreational catch estimate per year for Atlantic Coast[3] (tons) (2008-2012)	Total average annual commercial and recreational catch (tons)	Average NEFSC research catch compared to commercial and recreational catch (percentage)
Striped anchovy	**Unknown**	1.4	<0.1	1.4	NA	NA	NA	NA
Bullnose ray	**Unknown**	1.3	0	1.3	NA	NA	NA	NA
Pollock	**Not overfished**	1.0	0.2	1.2	8,214.1	1,016.8	9,231.2	0.01%
Roughtail stingray	**Unknown**	1.0	0.2	1.2	NA	NA	NA	NA
Black sea bass	**Not overfished**	0.7	0.4	1.1	1,006.3	1,402.0	2,408.3	0.05%
Bluntnose stingray	**Unknown**	1.1	0.1	1.1	NA	NA	NA	NA
Ocean pout	**Overfished**	0.8	<0.1	0.9	2.8	NA	2.8	32.0%
Witch flounder (grey sole)	**Overfished/ overfishing**	0.7	<0.1	0.7	986.1	NA	986.1	0.07%
Blueback herring	**Unknown**	0.7	0	0.7	11.1	NA	11.1	5.94%
Thorny skate	**Overfished**	0.6	<0.1	0.6	NA	NA	NA	NA
Atlantic halibut	**Overfished**	0.2	0.2	0.4	34.0	NA	34.0	1.30%
Atlantic wolffish	**Overfished**	<0.01	0.3	0.3	31.4 [4]	NA	31.4	1.05%
Cusk	**Unknown**	<0.1	<0.1	0.1	46.8	NA	46.8	0.24%

1. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Second quarter 2013 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm
2. Source: Commercial catch data from NMFS Office of Sustainable Fisheries website: http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index
3. Source: Recreational catch data from NOAA Fisheries Marine Recreational Information Program website: http://www.st.nmfs.noaa.gov/recreational-fisheries/index
4. Commercial catch data for Atlantic wolfish only available for 2008-2010; information in table is an average catch over those three years.

4.2.3.3 Highly Migratory Species

Mortality from Fisheries Research Activities

NEFSC-affiliated research surveys for highly migratory species (HMS) are focused on sharks. They do not typically involve the capture of other HMS, such as tunas and swordfish, although opportunistic sampling is conducted on board a commercial swordfish vessel and commercially harvested species may be sampled periodically. These surveys provide scientific advice, data, and analyses directly to NMFS HMS Management Division and to the Southeast Data Assessment and Review (SEDAR) process run by the South Atlantic Fishery Management Council. Information from the SEDAR process is used to develop and amend the Consolidated Atlantic Highly Migratory Species Fisheries Management Plan.

The Apex Predators Surveys use commercial style bottom and pelagic longline gears and methods to standardize results from survey to survey. The Cooperative Atlantic States Shark Pupping Nursery (COASTSPAN) surveys are an ongoing cooperative study of known and presumed shark nursery grounds along the U.S. Atlantic coast from Rhode Island to Florida. These surveys are designed to capture sharks alive, take a series of morphometric measurements, tag, and release the sharks. Only animals that are considered in good condition are generally tagged for release. Fish that are not tagged are released alive if possible. Data on the tagging and recapture locations for some tagged sharks later caught in recreational and commercial fisheries, by other federal and state agencies, and by academic institutions are used to determine abundance, distribution, and migratory patterns.

Catch information from 2008-2012 is presented in Table 4.2-9. Data are presented as numbers of fish rather than weight. Mortality observed during these tagging surveys is relatively low and is caused by a combination of depredation by other sharks as hooked fish are being hauled in, fish sacrificed for scientific sampling, and fish that are dead upon retrieval.

Table 4.2-9 Summary of the Number of Sharks Caught and Tagged during NEFSC Shark Surveys from 2008 to 2012

Fish that are not tagged or mortalities are released.

Species	Apex Predators Bottom Longline Coastal Shark Survey[1] Total caught (tagged) [mortality]			Apex Predators Pelagic Nursery Grounds Shark Survey[2] Total tagged	COASTSPAN Longline and Gillnet Surveys [3] Total caught (tagged) [mortality]		
Sandbar shark	2146	(2066)	[16]		3538	(3250)	[71]
Tiger shark	344	(320)	[2]		51	(44)	[0]
Dusky shark	610	(381)	[57]		22	(18)	[2]
Atlantic sharpnose shark	216	(50)	[97]		9609	(333)	[337]
Scalloped hammerhead	32	(23)	[7]		509	(132)	[75]
Blue shark				2824			
Blacktip shark	135	(67)	[56]		1049	(879)	[73]
Silky shark	1	(1)					
Bignose shark					2	(2)	[0]
Thresher shark				1			
Bonnethead					2062	(1049)	[215]

Species	Apex Predators Bottom Longline Coastal Shark Survey[1] Total caught (tagged) [mortality]	Apex Predators Pelagic Nursery Grounds Shark Survey[2] Total tagged	COASTSPAN Longline and Gillnet Surveys [3] Total caught (tagged) [mortality]
Shortfin mako		163	
Spinner shark	5 (0) [5]		136 (102) [12]
Blacknose shark	2 (2)		1089 (838) [121]
Finetooth shark			1500 (816) [75]
Great hammerhead			5 (3) [1]
White shark	1 (1)		1 (1) [0]
Sand tiger	5 (5)		209 (195) [0]
Nurse shark			44 (20) [0]
Bull shark			37 (34) [0]
Lemon shark			32 (21) [0]
Smoothhound			966 (185) [19]
Smooth hammerhead			97 (0) [2]
Spiny dogfish			49 (3) [0]
Porbeagle		30	

1. Apex Predators Bottom Longline Coastal Shark Survey conducted 2009 and 2012
2. Apex Predators Pelagic Nursery Grounds Shark Survey conducted annually 2008-2012
3. COASTSPAN Surveys conducted annually 2008-2012

Source: NEFSC

Sharks are also periodically caught in NEFSC surveys using trawl and other gear. Data from these surveys are tabulated and presented in Table 4.2-10 by weight rather than the number of individual fish caught. Given the large size of many sharks, these data indicate relatively few individuals are caught each year. Many of the sharks caught during NEFSC research surveys were captured alive, measured, tagged, and released alive.

Table 4.2-10 Catch Summary of Sharks Caught in NEFSC Research Surveys from 2008 to 2012

Species	Average weight of sharks caught in long-term surveys (pounds/year)	Species	Average weight of sharks caught in long-term surveys (pounds/year)
Atlantic angel shark	743	**Sandbar shark**	452
Atlantic sharpnose shark	296	**Sand tiger**	747
Basking shark	1,764	**Shark (unclassified)**	15
Blacknose shark	7	**Silky shark**	2
Dusky shark	26	**Spinner shark**	7
White shark	44	**Thresher shark**	831

Source: NEFSC unpublished data, 2013.

NEFSC and cooperative research surveys will continue to catch HMS sharks intentionally and incidental to surveys targeting other species, but mortality will likely be low in magnitude, infrequent, and distributed over a wide geographic area; the effects of mortality on HMS shark species from NEFSC fisheries research under the Status Quo Alternative would be considered minor adverse according to the criteria in Table 4.1-1.

4.2.3.4 Conclusion

NEFSC fisheries research conducted under the Status Quo Alternative could have effects on ESA-listed species, commercially and recreationally targeted species, non-managed fish species, and highly migratory species through mortality, disturbance, and changes in habitat.

For ESA-listed species, incidental capture of Atlantic sturgeon has occurred on a regular basis in bottom-trawl surveys, especially in nearshore surveys in shallower water, but all of these fish have been released alive and in apparently good condition. Such incidental captures would likely continue to occur on a regular basis under the Status Quo Alternative but the risk of mortality would be low due to short tow times in research protocols. Incidental capture of Atlantic salmon has occurred and would likely continue to occur only rarely and would have minimal effects on the population. Impacts on Atlantic sturgeon and Atlantic salmon habitat would be limited to temporary and localized increases in turbidity from research bottom-contact gear and accidental contamination from fuel spills and other compounds from research vessels. Given the spill response equipment and emergency training required of all research vessels by Coast Guard regulations regarding safety and pollution prevention, and the experience of NOAA Corps and charter captains and crew, the potential for accidental fuel spills or other contamination from research vessels is considered small and any incidents would likely be rare, small in magnitude, and quickly contained (Section 4.2.1). The overall effects of the Status Quo Alternative on ESA-listed fish would be minor in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1.

For most species targeted by commercial fisheries and managed under Fishery Management Plans, mortality due to research surveys and projects is much less than one percent of commercial and recreational harvest and is considered to be minor in magnitude for all species. For a few species which do not have a large commercial market due to various market conditions or past overfishing, the research catch exceeds one percent of commercial catch but is still small relative to the population of each species and is considered minor in magnitude. Proposed research projects that target stocks that are overfished or where overfishing is occurring are reviewed annually before research permits are issued to determine if they would conflict with rebuilding plans or present other conservation concerns. For highly migratory species (almost exclusively sharks) and species that are not managed under FMPs, research catch is also relatively small and considered to be minor in magnitude for all species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities. Disturbance of fish and benthic habitats from research activities would be temporary and minor in magnitude for all species. As described above, the potential for accidental contamination of fish habitat is considered minor in magnitude and temporary or short-term in duration. The overall effects of the Status Quo Alternative on non-ESA-listed fish would be minor in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1.

In contrast to these adverse effects, NEFSC research also provides long-term beneficial effects on managed fish species throughout the Northeast region through its contribution to sustainable fisheries management. Data from NEFSC-affiliated research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks. The beneficial effects of the time-series data provided by NEFSC research programs effects are especially valuable for long-term trend analysis for commercially harvested fish and, combined with other oceanographic data

collected during fisheries research, provide the basis for monitoring changes to the marine environment important to fish populations.

4.2.4 Effects on Marine Mammals

Section 3.2.2 describes the marine mammals that are likely to overlap with NEFSC fisheries research activities in the Atlantic. This section describes the potential effects of the NEFSC research activities on marine mammals under the Status Quo Alternative, including the mitigation measures that have been implemented in the past to mitigate those effects. Because the secondary federal action considered in this Final PEA is the promulgation of regulations and subsequent issuance of LOAs under Section 101(a)(5)(A) of the MMPA, this section provides more information and analysis for effects on marine mammals than is presented for the analysis of effects on other resources.

Potential effects of fishery research vessels, survey gear, sonar and other active acoustic devices, and other associated equipment on marine mammals include:

- Disturbance and behavioral changes due to acoustic equipment
- Injury or mortality due to ship strikes
- Injury or mortality due to entanglement in gear
- Changes in food availability due to research removal of prey and discards
- Contamination from discharges

The first part of the analysis in this section provides information on the mechanisms for these different types of effects. For some types of effects, the level of impact is similar for all species of marine mammals and the analysis is not repeated in the following subsections.

The second part of the analysis provides information on the effects of the NEFSC research activities on marine mammals and their habitat. An application for Incidental Take Authorization under the MMPA (referred to in this document as the LOA application) must include estimates of the numbers of animals that may be taken by serious injury or mortality, harassment that has the potential to injure (Level A harassment takes), and harassment that has the potential to disturb (Level B harassment takes). The NEFSC LOA application (Appendix C) only concerns the Preferred Alternative because that is the NEFSC's proposed action. However, the analysis of takes in the LOA application is based on essentially the same scope of research activities as the Status Quo Alternative and is therefore helpful in describing the potential effects of the Status Quo Alternative. For those research areas and marine mammal species or stocks where the effects of the Status Quo are considered the same or very similar to the Preferred Alternative, analysis provided in the LOA application is summarized and referenced in this section. Where the scope of activities differs between the Status Quo and Preferred Alternatives, the analysis of effects from the LOA application are summarized and referenced in the Preferred Alternative (Section 4.3.5). The following analysis focuses on the types of research gear most likely to have adverse interactions with marine mammals.

<u>Disturbance and Behavioral Responses due to Acoustic Equipment</u>

Several mechanisms exist by which research activities could potentially disturb marine mammals and alter behavior, including the physical presence of marine vessels and fishing gear combined with operational sounds from engines, hydraulic gear, and acoustical devices used for navigation and research. The impacts of anthropogenic noise on marine mammals have been summarized in numerous articles and reports including Richardson et al. (1995), NRC (2005), and Southall et al. (2007). Marine mammals use hearing and sound transmission to perform vital life functions. Sound (hearing and vocalization/ echolocation) serves four primary functions for marine mammals, including: 1) providing information about their environment, 2) communication, 3) prey detection, and 4) predator detection. Introducing

sound into their environment could disrupt those behaviors. The distances to which anthropogenic sounds are audible depend upon source levels, frequency, ambient noise levels, the propagation characteristics of the environment, and hearing sensitivity of the marine mammal (Richardson et al. 1995).

In assessing potential effects of noise, Richardson et al. (1995) suggested four criteria for defining zones of influence:

- Zone of audibility **–** the area within which the marine mammal might hear the sound. Marine mammals as a group have functional hearing ranges of 10 hertz to 180 kilohertz, with highest sensitivities to sounds near 40 kilohertz (Ketten 1998, Kastak et al. 2005, Southall et al. 2007). These data show reasonably consistent patterns of hearing sensitivity within each of four groups: baleen whales, small odontocetes (such as the harbor porpoise), medium-sized odontocetes (such as the beluga and killer whales), and pinnipeds.
- Zone of responsiveness **–** the area within which the animal reacts behaviorally or physiologically. The behavioral responses of marine mammals to sound depend on: 1) acoustic characteristics of the noise source; 2) physical and behavioral state of animals at time of exposure; 3) ambient acoustic and ecological characteristics of the environment; and 4) context of the sound (e.g., whether it sounds similar to a predator) (Richardson et al. 1995, Southall et al. 2007). Temporary behavioral effects, however, often merely show that an animal heard a sound and may not indicate lasting biological consequences for exposed individuals (Southall et al. 2007).

  Factors that may affect the response of a marine mammal to a given noise cannot generally be determined ahead of time. In lieu of having this information, NMFS uses a standardized noise level to help determine how many animals may be disturbed (harassed) by a given activity during the MMPA authorization process. NMFS currently uses a sound threshold of 160 decibels referenced to 1 micro Pascal for impulse noises to determine the onset of behavioral harassment for marine mammals (Level B harassment takes) (NMFS 2005). Any animal exposed to impulse noises above this level is assumed to respond in a way consistent with the definition of a behavioral “take” under the MMPA, although NMFS acknowledges that some marine mammals may react to sounds below this threshold and that some animals exposed to sounds at or above this threshold may not react in ways consistent with behavioral harassment.
- Zone of masking **–** the area within which the noise may interfere with detection of other sounds, including communication calls, prey sounds, or other environmental sounds.
- Zone of hearing loss, discomfort, or injury **–** the area within which the received sound level is potentially high enough to cause discomfort or tissue damage to auditory or other systems. Underwater sounds produced by acoustic active equipment used during NEFSC research have several characteristcs (e.g., frequency, pulse duration, directionality, and power level) that make them highly unlikely to produce hearing loss or injury (Level A harassment) in marine mammals, which is an issue of concern for industrial and military actions.

The NEFSC has been using a variety of sonar systems during its research cruises to characterize marine habitats and fish aggregations. The sounds produced by equipment used by the NEFSC range from 18-333 kilohertz and from 206 decibels to 225 decibels referenced to one micro Pascal (Appendix C, Section 6.2). This acoustic equipment sends pulses of sound into the marine environment which provide information as they reflect back to the ship and are recorded (see Appendix A for a more detailed description of active acoustic instruments used in NEFSC research, including frequency ranges, beam width, source power levels, and other sound characteristics). The LOA application (Appendix C, Section 6.2) categorized active acoustic sources used by the NEFSC during research based on operating frequency and output characteristics. Category 1 active acoustic sources include short range echosounders and acoustic Doppler current profilers (ADCPs). These have output frequencies >300 kilohertz, are generally of short duration, and have high signal directivity. Category 2 active acoustic sources include various

single, dual, and multi-beam echosounders, devices used to determine trawl net orientation, and current profilers of lower output frequencies than category 1 sources. Output frequencies of category 2 sources range from 12 to 200 kilohertz, have short ping durations, and are usually highly directional for mapping purposes.

Although these acoustic systems have been used for years and may have been a source of disturbance for nearby marine mammals, no direct observations of disturbance have been documented, primarily because any such disturbance, if it occurred, would have taken place under water. For animals at the surface, it is very difficult to determine whether a given sound source has caused any observed changes in behavior or whether the physical presence of the vessel has caused the disturbance. In many cases it is likely to be a combination of visual and audio components that causes a disturbance. It may also be difficult to determine if an animal has actually changed its behavior to avoid a disturbance or if it is moving for other reasons (e.g., to pursue nearby prey). For these reasons there have been no records or documentation of how many animals may have been disturbed (Level B harassment) by sounds generated from acoustic equipment during NEFSC research cruises in the past. However, the MMPA requires applicants who are requesting authorization for incidental take of marine mammals to estimate how many animals may be affected by their actions.

NMFS regulations for implementing the MMPA distinguish between Level B harassment that causes behavioral changes in the affected marine mammals and Level A harassment that has the potential to cause injury. Animals exposed to intense sounds may experience reduced hearing sensitivity for some period of time following exposure. This change in hearing threshold is known as noise induced threshold shift (TS). The amount of TS incurred is influenced by amplitude, duration, frequency content, temporal pattern, and energy distribution of the noise (Richardson et al. 1995, Southall et al. 2007). It is also influenced by characteristics of the animal, such as hearing range of the species, behavior, age, history of noise exposure, and health. The magnitude of TS generally decreases over time after noise exposure and if it eventually returns to zero, it is known as 'temporary threshold shift' (TTS). If TS does not return to zero after some time (generally on the order of weeks), it is known as 'permanent threshold shift' (PTS). Sound levels associated with TTS onset are generally considered to be below the levels that would cause PTS, which is considered to be auditory injury.

The current NMFS policy regarding Level A harassment is that cetaceans should not be exposed to impulsive sounds greater than 180 decibels re 1 micro Pascal and that pinnipeds should not be exposed to impulsive sounds greater than 190 decibels re 1 micro Pascal (NMFS 2000). However, these criteria were established before information was available about minimum received levels of sound that would cause auditory injury in marine mammals. They are likely lower than necessary and are intended to be precautionary estimates above which physical injury may occur (Southall et al. 2007).

Southall et al. (2007) assessed the potential for discrete sound exposures to produce TTS and PTS in marine mammals and concluded that, for the kinds of relatively brief exposures associated with transient sounds such as the active acoustic sources used by the NEFSC for research, received sound pressure levels in the range of approximately 180-220 decibels re 1 micro Pascal are required to induce the onset of TTS levels for most pinnipeds and odontocete cetaceans. Southall et al. (2007) also provided some frequency weighting functions for different marine mammal groups to account for the fact that impacts of noise on hearing depend in large part on the overlap between the range of frequencies in the sound source and the hearing range of the species. Based on the Southall et al. (2007) results, Lurton and DeRuiter (2011) modeled the potential impacts (PTS and behavioral reaction) of conventional echosounders on marine mammals. They estimated PTS onset at typical distances of 32 to 328 feet for the kinds of acoustic sources used in fisheries surveys considered here. They also emphasized that these effects would very likely only occur in the cone ensonified below the ship and that behavioral responses to the vessel at these extremely close ranges would very likely influence the probability of animals being exposed to these levels.

Animals are likely to avoid a moving vessel, either because of its physical presence or because of behavioral harassment resulting from exposure to sound from active acoustic sources. It is unlikely that animals would remain in the presence of a harassing stimulus absent some overriding contextual factor. Because of this likely avoidance behavior, as well as the source characteristics (i.e., intermittent pulsing and narrow cones of ensonification), the NEFSC has determined that the risk of animals experiencing repetitive exposures at the close range or of the duration necessary to cause PTS is negligible. The NEFSC therefore does not anticipate causing any Level A harassment by acoustic sources of marine mammals and the LOA application includes no such take estimates. The potential for this type of impact on marine mammals will not be discussed further in this Final PEA.

However, the NEFSC recognizes that the use of active acoustic equipment in its research activities has the potential to cause Level B harassment of marine mammals. In its LOA application for the Preferred Alternative, the NEFSC estimated the numbers of marine mammals that may be exposed to sound levels of 160 decibels or above due to the use of acoustic sonars during research cruises (Level B harassment takes). The LOA application used the operational conditions and scope of work conducted in the past five years to estimate what may occur in the future under the Preferred Alternative. The Preferred Alternative would include a few changes in the long-term surveys and short-term research projects relative to the Status Quo Alternative (Tables 2.3-1 and 2.3-2), but none of them would deploy new types of acoustic devices or use protocols that would otherwise change the potential for acoustic disturbance of marine mammals. The acoustic take estimates presented in the LOA application therefore also represent potential numbers of animals affected under the status quo conditions.

As explained in the LOA application, these estimates attempt to quantify a dynamic situation with substantial unavoidable uncertainty regarding the propagation of sound in the water and distribution of marine mammals over very large areas. The scientific description of sound generated by sonar gear and its propagation through water is complicated, especially considering a sound source that is moving (on a vessel) through waters of different depths and properties (e.g. salinity and temperature) that affect sound transmission. The LOA application provides details on the assumptions that were made about the source levels and acoustic properties of sonar pulses, the directionality of the sound, and propagation/attenuation properties that were used to calculate an “ensonified area” considered loud enough to harass marine mammals. One part of the NEFSC acoustic take calculation used a model of sound propagation from typical sonar equipment used during research to estimate the shape and dimensions of a typical ensonified zone ≥ 160 decibels re 1 micro Pascal, which was multiplied by the distance research ships travel with active sonar gear to derive an estimated total area ensonified to the Level B harassment take guidelines.

Another aspect of this Level B harassment take estimation process subject to large uncertainty concerns the distribution and abundance of marine mammals in the area. Marine mammal abundance and distribution is not uniform in different parts of the study area. Although most marine mammal surveys are conducted during the summer and density information is only available for this season, distribution and abundance of most species also varies seasonally. No species is distributed evenly throughout its range; they are typically patchy in distribution with strong seasonal variations and preferences for certain zones within the water column. Although some preferred habitats and general distributions are known, there is no way to know exactly how many animals will be in any area at any point in the future. The estimation process therefore uses average density of each species within the different research areas to estimate how many may be affected within the ensonified area. One refinement that has been built into the Level B harassment take model is to categorize each marine mammal species according to its typical dive depth range, which affects the size of the ensonified zone they may be exposed to (Appendix C). The estimation process is admittedly subject to great uncertainty and there is no way to assess how realistic these estimates are in terms of the number of animals that would be disturbed by the activity. However, the development of the Level B harassment take model was conservative in the sense that assumptions were made that would tend to overestimate the size of the ensonified area and the number of animals affected.

This Final PEA (and the LOA application) must also assess what the likely biological effects may be for these estimated Level B harassment takes by acoustic sources. The LOA application (Appendix C, Section 6.2) provides an analysis of the potential effects of acoustic equipment used in NEFSC research on marine mammals. The analysis in this Final PEA is a summary of the LOA application analysis and will be provided in the subsections on cetaceans and pinnipeds because of their different hearing ranges and frequencies used for communication, which determines what the effects of different acoustic equipment might be. This effort to examine the biological importance of acoustic disturbance requires knowledge about whether animals can perceive the sonar signals, their potential reactions to various types of sounds, and the conditions under which particular sound sources may lead to biologically meaningful effects (i.e. interference with feeding opportunities or critical social communication). However, many key aspects of marine mammal behavior relevant to this discussion are poorly known. Most of the data on marine mammal hearing and behavioral reactions to sound comes from relatively few captive, trained animals and likely does not reflect the diversity of behaviors in wild animals. Some behavioral reactions, if they occur in one or more species, could substantially reduce the numbers of animals exposed to high sound levels (e.g. swimming away from an approaching ship before sound levels reach the 160 decibel level). Industrial projects such as seismic exploration for oil and gas and pile driving in relation to coastal developments are typically required to monitor marine mammal behavioral responses in relation to percussive industrial sounds but there have been few efforts to document behavioral changes in response to acoustic equipment commonly used in fisheries research.

Injury or Mortality due to Ship Strikes

The eastern seaboard of the U.S. includes numerous shipping lanes, active ports, and vessel traffic. Vessel collisions with marine mammals, or ship strikes, can lead to death by massive trauma, hemorrhaging, broken bones, or propeller wounds (Knowlton and Kraus 2001). Large whales, such as fin whales, are occasionally found draped across the bulbous bow of large ships upon arriving in port. Massive propeller wounds can be immediately fatal. If more superficial, the whales may survive the collisions (Silber et al. 2009). Jensen and Silber (2003) summarized large whale ship strikes world-wide and found that most collisions occurred in the open ocean involving large vessels. Commercial fishing vessels were responsible for four of 134 records (three percent), and one collision (0.75 percent) was reported for a research boat, pilot boat, whale catcher boat, and dredge boat. Between 2006 and 2010, there were 57 confirmed ship strikes involving baleen whales, 27 of which were fatal, along the U.S. east coast and Canadian Maritime provinces (Henry et al. 2012). Ship strikes are a major cause of mortality and serious injury in right whales, accounting for 35 percent of deaths from 1970-1999 (Knowlton and Kraus 2001). Average annual reported mortality and serious injury of right whales from ship strikes, 2006-2010, was 1.2 (Waring et al. 2013). Ship strikes may occur with any large whales, including humpbacks (2.0/year, 2006-2010) and fin whales (1.2/year, 2005-2009) (Henry et al. 2012).

Vessel speed appears to be key in determining the frequency and severity of ship strikes, with the potential for collision increasing at ship speeds of 15 knots and greater (Laist et al. 2001, Vanderlaan and Taggart 2007). In the relatively few recorded cases of ship strikes at speeds below 15 knots, the chance of mortality declines from approximately 80 percent at 15 knots to approximately 20 percent at 8.6 knots (Vanderlaan and Taggart 2007). Reducing the co-occurrence of whales and vessels may be the only sure way to reduce ship strikes, but this is not always feasible (Silber et al. 2009).

Vessel speed restrictions or advisories are widely used to reduce the likelihood and severity of ship strikes, particularly for endangered large whales. All vessels 65 feet in length or greater are currently subject to ship strike management measures in defined areas during certain times of the year (78 FR 73726; December 9, 2013). This includes NOAA ships, commercial vessels (fishing vessels, tugs and tows, passenger vessels, passenger vessels for hire, large commercial vessels) and recreational vessels (NERO 2004). NMFS based the 65 feet threshold on analysis of ship strike mortalities and serious injuries. Most vessels involved were greater than 262 feet long. However, one right whale calf was struck

and killed by an 82 feet vessel. Vessels smaller than 65 feet may also pose a threat, but the 65 feet threshold was deemed appropriate since it included most vessels involved in collisions and corresponded with established size criteria used in several other existing regulatory requirements (NERO 2004, NMFS 2008a). These measures are aimed specifically at reducing collisions with endangered right whales.

No collisions with large whales have been reported from any fisheries research activities conducted or funded by the NEFSC. As described in Section 2.2.1, vessel speeds are restricted on research cruises in part to reduce the risk of ship strikes with marine mammals. Transit speeds vary from 6-14 knots, but average 10 knots. The vessel's speed during active sampling is typically 2-4 knots due to sampling design and these much slower speeds essentially eliminate the risk of ship strikes.

Given the relatively slow speeds of research vessels, the presence of bridge crew watching for marine mammals during many survey activities, and the small number of research cruises, ship strikes with marine mammals during the research activities described in this Final PEA would be considered rare in frequency, localized in geographic scope, and unlikely to occur in the future. The potential for fisheries research vessels to cause serious injury or mortality to any cetaceans or pinnipeds due to ship strikes is considered minor adverse throughout the NEFSC research area using vessel types and protocols currently in use. This potential effect of research will not be discussed further in the following analysis.

Injury or Mortality due to Entanglement in Gear

Entanglement, capture, or hooking in fishing gear is a significant source of human-caused injury or mortality for some marine mammals. There were 206 confirmed entanglements of baleen whales along the U.S. east coast between 2006 and 2010. Twenty-four were fatal and 33 caused serious injury (Henry et al. 2012). Although not always as immediately fatal as ship strikes, entanglements can lead to prolonged weakening or deterioration of an animal (Knowlton and Kraus 2001). This is particularly true for large whales; small whales, dolphins, porpoises, and seals are more likely to die when entangled.

Commercial fisheries along the U.S. east coast with known bycatch of marine mammals include those using pelagic longlines, sink gillnets, drift gillnets, lobster traps/pots, mixed species traps/pots, bottom trawls, mid-water trawls, purse seines, stop seine/weirs, and haul/beach seines (Garrison and Stokes 2012, Waring et al. 2010, Zollet 2009). Further details regarding specific fisheries and marine mammal bycatch will be discussed when considering cumulative effects (Section 5.3.2). Several of these gear types are employed during NEFSC fisheries research surveys, including bottom and mid-water trawls, pelagic longlines, gillnets, pots/traps (cod and lobster), Fyke nets, and purse seines (Appendix A and B).

The 1994 amendments to the MMPA tasked NMFS with establishing monitoring programs to estimate mortality and serious injury of marine mammals incidental to commercial fishing operations. In addition, NMFS was tasked with developing Take Reduction Plans (TRPs) in order to reduce the level of commercial fishing mortality and serious injury of strategic marine mammals stocks below Potential Biological Removal (PBR). The Atlantic Large Whale Take Reduction Plan (ALWTRP) was developed to reduce mortality and serious injury of North Atlantic right, humpback, and fin whales in gillnets and pot/trap gear but also benefits minke whales (NMFS 2010b). The Harbor Porpoise Take Reduction Plan focuses on reducing incidental mortality and serious injury of harbor porpoise in gillnets in the GOM, SNE, and MAB (NMFS 2010c, 2010d). The Bottlenose Dolphin Take Reduction Plan was created to reduce bycatch and mortality of coastal bottlenose dolphins in gillnet and purse seine fisheries (50 CFR 229.35). The Atlantic Pelagic Longline Take Reduction Plan was developed to reduce serious injury and morality of pilot whales and Risso's dolphins in the Mid-Atlantic portion of the pelagic longline fishery (50 CFR 229.36). The Atlantic Trawl Gear Take Reduction Strategy (ATGTRS) addresses protected species interactions (primarily pilot whales, short-beaked common dolphins, and Atlantic white-sided dolphins) in bottom and midwater trawl fisheries through research, education and outreach (ATGTRT 2008).

Incidental take of marine mammals in fishing gear during NEFSC fisheries research is uncommon. Eight marine mammals were entangled in fishing gear during NEFSC research activities during the last ten years (2004 through 2013), with the last entanglement occurring in 2010 (Table 4.2-11 and Figure 4.2-2). There are substantial differences in how NEFSC fisheries research is conducted relative to commercial fishing, including shorter tow and set times as well as smaller nets and other gear differences. The NEFSC has made efforts to develop and implement mitigation measures that are compatible with research objectives in order to reduce the risk of entangling or hooking marine mammals in research gear. These mitigation measures are part of the Status Quo Alternative and are described in Section 2.2.1. In addition, many short-term cooperative research projects include fishing industry partners and take place on commercial vessels using commercial gear. These projects all comply with the TRP mitigation measures specified for their respective fisheries and areas (e.g., pingers, sinking groundlines, and weak links on gillnet gear) unless a particular element of the TRP is a focus of the research, in which case they may be exempted from those regulations through the conditions of a Scientific Research Permit.

Most of the non-gear-related NEFSC mitigation measures rely on visual detection of marine mammals near the vessel or fishing gear. There are many variables that influence the effectiveness of visual monitoring at any one time, including the lighting and sea state and the capabilities of the person assigned to watch, so it is impossible to determine an overall measure of effectiveness, such as how many animals may have been avoided with visual monitoring compared to having no monitors. It is also difficult to scientifically determine the effectiveness of gear modifications, such as the excluder devices used on Fyke nets, without intentionally targeting a known concentration of marine mammals with before/after trials. The value of implementing some mitigation measures is therefore based on general principles and best available information even if their effectiveness at reducing takes has not been scientifically demonstrated.

Figure 4.2-2 shows the spatial distribution of marine mammals that have been taken in NEFSC surveys from 2004 through 2013, and Table 4.2-11 indicates the date and time of interaction. With so few takes it is difficult to ascertain whether there is any spatial pattern of high risk areas (i.e., “hot spots” for marine mammal takes) or any temporal pattern with regard to seasons or times of day.

The MMPA authorization process requires the applicant (NEFSC) to estimate how many marine mammals may be captured or entangled in the future under the proposed set of conditions. As is the case for Level B harassment takes by acoustic sources, the LOA application (Appendix C) describes the methodology used to estimate the species and numbers of animals that may be taken by Level A harassment and serious injury or mortality during future research conducted under the Preferred Alternative. The LOA application combines estimated Level A harassment takes with serious injury or mortality takes because the degree of injury resulting from gear interaction cannot be predicted. The lethal take estimates are based on the past history of takes (both lethal takes and animals captured and released alive) by the NEFSC under the status quo conditions. For the species that have been taken historically during NEFSC research, the LOA application uses the calculated average annual numbers of takes that occurred in the past ten years (2004-2013) and “rounds up” this annual average to the next highest whole number of animals. Since the LOA application requests takes for a five-year period, this intentionally inflated annual average is multiplied by five to produce an estimate higher than the historic average take for each species that has been taken incidentally during NEFSC research. This methodology has been used in order to ensure accounting for a precautionary amount of potential take in the future.

The LOA application also includes estimates for future incidental takes of a number of species that have not been taken historically but exist in the same areas and show similar types of behaviors and vulnerabilities as species that have been taken in the past. For species that are considered analogous (i.e., having similar behavior, distribution, and abundance as well as having historical takes in commercial fisheries operating in similar areas and using similar gear types) to one of the species that have been taken historically, the LOA application estimates take based on the maximum number of similar animals that have been taken by the NEFSC in any one incident historically. This method is based on the assumption

that such takes would likely occur rarely, if at all, but may involve more than one animal in a given trawl or set given the social nature of many marine mammals. See Appendix C, Section 6.1, for a more detailed explanation of the LOA application estimation methodology.

Take estimates also include consideration of the new conservation engineering and mitigation measures being proposed for development under the Preferred Alternative, which should reduce the risk of taking marine mammals in the future. The estimates of injury, serious injury, and mortality takes in the LOA application are relevant to the discussion of effects from the Status Quo Alternative. The analysis of entanglement effects is limited to the gear types that have a history of marine mammal takes in either NEFSC research or similar commercial fisheries in the research areas. Gear types and other scientific equipment that have no history of takes and are very unlikely to result in takes in the future (e.g. small-mouthed nets designed to sample plankton and larval fish, CTD rosettes, and ROVs), are not discussed further.

Table 4.2-11 Historical Takes of Marine Mammals during NEFSC Surveys from 2004 through 2013

Survey Name	Protected Species Taken	Gear Type	Date (Time) Taken	# Killed	# Released Alive	Total Taken
2010						
Maine Estuaries Diadromous Survey	Harbor seal	Fyke net	25 October (3:10 pm)	1	0	1
2009						
Atlantic Herring Survey	Minke whale	Midwater trawl	11 October (11:17 pm)	0	1[1]	1
NEFOP Observer Gillnet Training Trips	Harbor porpoise	Gillnet	4 May (10:24 am)	1	0	1
NEFOP Observer Gillnet Training Trips	Gray seal	Gillnet	4 May (7:39 am)	1	0	1
2008						
COASTSPAN	Bottlenose dolphin (Northern South Carolina Estuarine System stock)	Gillnet	29 September (12:40 pm)	1	0	1
2007						
NEFSC Standard Bottom Trawl Survey	Short-beaked common dolphin (Western NA stock)	Bottom trawl	11 November (12:18 am)	1	0	1
2004						
Atlantic Herring Survey	Short-beaked common dolphin (Western NA stock)	Midwater trawl	8 October (midnight)	2	0	2
Total				**7**	**1**	**8**

1. According to the incident report, "The net's cod end and whale were brought aboard just enough to undo the cod end and free the whale. It was on deck for about five minutes. While on deck, it was vocalizing and moving its tail up and down. The whale swam away upon release and appeared to be fine. Estimated length was 19 feet." This incidental take was later classified as a serious injury using NMFS criteria for such determinations published in January 2012 (Cole and Henry 2013).

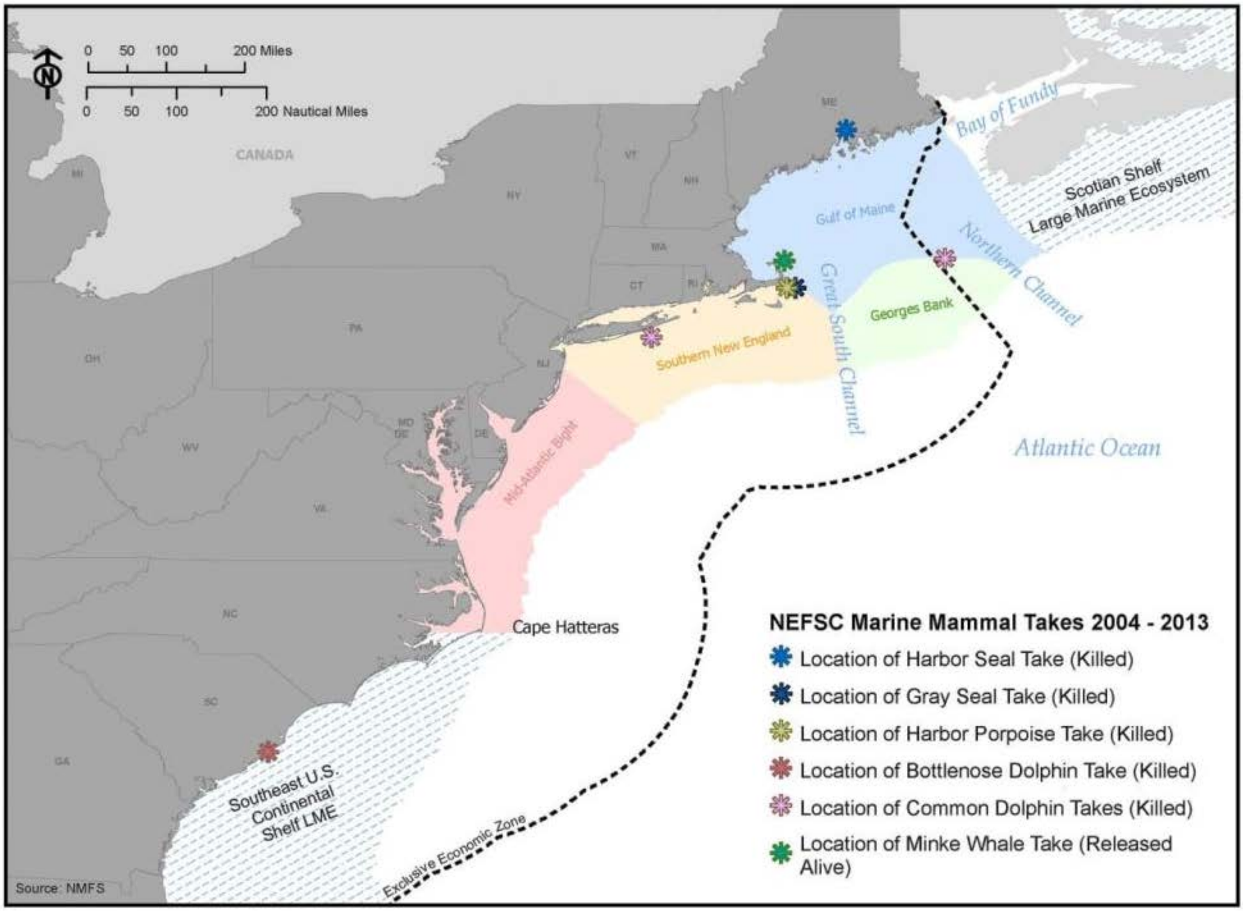


Figure 4.2-2 Location of Marine Mammal Takes during NEFSC Research from 2004 through 2013

<u>Changes in Food Availability due to Research Survey Removal of Prey and Discards</u>

Marine mammals are significant consumers of prey (zooplankton, forage fish, squid) in the NE LME (Kenney et al. 1997). Whales, dolphins, and porpoises were estimated to consume approximately 1.3 million tons of fish, 337,000 tons of squid, and 244,000 tons of zooplankton annually in the NE LME (Kenney et al 1997). These data and estimates are several years old and may not account for possible recent changes in abundance or prey availability, yet they provide a useful metric for comparing marine mammal food requirements to commercial fishery harvests and fisheries research catches.

Prey of right whales, sei whales, and blue whales (primarily zooplankton) are sampled during many NEFSC research cruises but the biomass of plankton collected is negligible and would have no effect on prey availability for these whales. There is some overlap in prey of humpback and fin whales (e.g., Atlantic herring) and, possibly, sperm whales (squid) with species taken during fisheries research. The total prey removal by all NEFSC fisheries research surveys and projects, regardless of season and location across the NE LME, totals a few hundreds of tons of fish per year (Table 4.2-8), which is a negligible percentage of the estimated fish consumed by cetaceans. The NEFSC research catch of invertebrate prey is also small; the average annual NEFSC research catch of long-finned squid was less than 12 tons (Table 4.2-19).

In addition to the small total biomass taken, some of the size classes of fish targeted in research surveys are smaller than that generally targeted by marine mammals. Research catches are also distributed over a wide area because of the random sampling design covering large sample areas. Fish removals by research

are therefore highly localized and unlikely to affect the spatial concentrations and availability of prey for any marine mammal species. This is especially true for pinnipeds in the Atlantic, which are opportunistic predators that consume a wide assortment of fish and squid. With pinniped populations increasing and ranges expanding in New England, food availability does not appear to be a limiting factor (Baraff and Loughlin 2000).

In the SE LME, NEFSC-affiliated fisheries research is primarily catch, tag, and release studies of sharks, with minimal numbers of finfish collected for lab analysis. This level of effort would have no impact on prey sources for marine mammals in the SE LME region.

NEFSC fisheries research catch levels are very small relative to the estimated consumption of prey by marine mammals, dispersed over large areas and time periods, and are unlikely to affect changes in prey type or quantity available to any marine mammals. The overall effect of research catches on marine mammals through competition for prey is therefore considered minor adverse for all species in the NEFSC research area.

<u>Contamination from Discharges</u>

Discharge from vessels, whether accidental or intentional, include sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and plastics. Impacts to marine mammals exposed to the discharge range from superficial exposure to ingestion and related effects. Even at low concentrations that are not directly lethal, some contaminants can cause sub-lethal effects on sensory systems, growth, and behavior of animals, or may be bioaccumulated (DOE 2008, NOAA 2010d).

All NOAA vessels and NEFSC chartered vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (NOAA 2010b). MARPOL includes six annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (IMO 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). In addition, all NOAA vessels are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills occurring and increase the chance that they will be responded to and contained quickly.

Discharge of contaminants from NEFSC vessels and NEFSC chartered vessels is possible, but unlikely to occur in the near future. If an accidental discharge does occur, it is likely to be a rare event and the potential volume of material is likely to be small and localized. The potential impacts to marine mammals would be similarly short-term, localized, and likely affect a small number of animals. The overall impact of accidental contamination of marine mammals would therefore be considered minor adverse.

As the potential effects of discharges, regulations governing discharges, and the likelihood of discharges are universal throughout the NEFSC research area, this type of potential effect on marine mammals will not be discussed further in this analysis.

4.2.4.1 ESA-listed Species

The endangered marine mammal species in the NEFSC research area include North Atlantic right, humpback, fin, sei, blue, and sperm whales. Human-caused mortality and serious injury may have more profound effects on right whales than on any other whales due to their small population size and low reproductive rate. Ship strikes and entanglement in fishing gear are considered major factors limiting population growth and recovery of right whales (Waring et al. 2014).

Disturbance and Behavioral Responses due to Acoustic Equipment

The LOA application (Appendix C) includes calculations of the number of marine mammals that may be exposed to sound levels at or above 160 decibels from all active acoustic devices used during NEFSC research activities. Those calculations include a number of assumptions and elements with large variables over time and space (e.g., the densities of marine mammals and the propagation of sound under different conditions). The NEFSC believes this quantitative approach benefits from its simplicity and consistency with current NMFS guidelines on estimating Level B harassment by acoustic sources, but cautions that the resulting take estimates should be considered as overestimates of behavioral harassment from acoustic devices. The Final PEA reports the results of those estimates in Table 4.2-12 below, but see Appendix C for a discussion about the derivation and concerns about the accuracy of these estimates. The likely impact on ESA-listed species from the different types of acoustic devices is discussed below.

Table 4.2-12 Estimated Annual Level B Harassment Takes of Marine Mammals by Acoustic Sources During NEFSC Research

Species (Common name)	Estimated take per year by all acoustic sources[1] (numbers of animals)	Species (Common name)	Estimated take per year by all acoustic sources[1] (numbers of animals)
LME REGION			
North Atlantic right whale[2]	11	**Atlantic white-sided dolphin**	144
Humpback whale[2]	5	**White-beaked dolphin**	48
Fin whale[2]	21	**Short-beaked common dolphin**	1247
Sei whale[2]	16	**Atlantic spotted dolphin**	10[1]
Minke whale	39	**Pantropical spotted dolphin**	10[1]
Blue whale[2]	10[1]	**Striped dolphin**	10[1]
Sperm whale[2]	10[1]	**Fraser's dolphin**	10[1]
Dwarf sperm whale	10[1]	**Rough toothed dolphin**	10[1]
Pygmy sperm whale	10[1]	**Clymene dolphin**	10[1]
Killer whale	10[1]	**Spinner dolphin**	10[1]
Pygmy killer whale	10[1]	**Bottlenose dolphin (offshore)**	35
Northern bottlenose whale	10[1]	**Bottlenose dolphin (coastal)**	609
Cuvier's beaked whale	13	**Harbor porpoise**	113
Mesoplodon beaked whales	13	**Harbor Seal**	1678
Melon-headed whale	10[1]	**Gray Seal**	10[1]
Risso's dolphin	13	**Harp Seal**	10[1]
Long-finned pilot whale	203	**Hooded Seal**	10[1]
Short-finned pilot whale	203		
OFFSHORE REGION			
North Atlantic right whale[2]	10[1]	**Risso's dolphin**	66
Humpback whale[2]	10[1]	**Long-finned pilot whale**	32
Fin whale[2]	10[1]	**Short-finned pilot whale**	32
Sei whale[2]	10[1]	**Atlantic white-sided dolphin**	10[1]

Species (Common name)	Estimated take per year by all acoustic sources[1] (numbers of animals)	Species (Common name)	Estimated take per year by all acoustic sources[1] (numbers of animals)
Minke whale	10[1]	**White-beaked dolphin**	10[1]
Blue whale[2]	2	**Short-beaked common dolphin**	146
Sperm whale[2]	19	**Atlantic spotted dolphin**	16
Dwarf sperm whale	2	**Pantropical spotted dolphin**	10[1]
Pygmy sperm whale	2	**Striped dolphin**	236
Killer whale	10[1]	**Fraser's dolphin**	10[1]
Pygmy killer whale	10[1]	**Rough toothed dolphin**	1
Northern bottlenose whale	2	**Clymene dolphin**	10[1]
Cuvier's beaked whale	20	**Spinner dolphin**	10[1]
Mesoplodon beaked whales	20	**Bottlenose dolphin (offshore)**	41
Melon-headed whale	10[1]		

1. For all species with unknown or very low volumetric density (i.e., ≤0.004 animals per km^3), and for species unlikely to be impacted by the predominant acoustic sources outlined above, the NEFSC has requested a precautionary Level B Harassment take of 10 individuals. The number chosen is indicative of the very low probability of sighting or interaction with these species during most research cruises with the active acoustic instruments used in NEFSC research.

2. ESA-listed species

The output frequencies of Category 1 active acoustic sources (short range echosounders, Acoustic Doppler Current Profilers) are >300 kilohertz and are generally short duration signals with high signal directivity (Appendix C, Section 6.2). The functional hearing range of baleen whales is 7 hertz-30 kilohertz, with highest sensitivity generally below 1 kilohertz, and that of sperm whales is 150 hertz-160 kilohertz, with highest sensitivity from 10-120 kilohertz. These functional hearing ranges fall below the output frequency of Category 1 sources, which are unlikely to be detected by right, humpback, fin, sei, blue, or sperm whales (Figure 4.2-3).

Category 2 active acoustic sources (various single, dual, and multi-beam echosounders, devices used to determine trawl net orientation, and several current profilers) have frequencies of 12-200 kilohertz, short ping durations, and are usually highly directional. These are unlikely to be heard by most baleen whales, but are within the hearing range of sperm whales. If detected, short term avoidance is the most likely response, which would tend to reduce the exposure of animals to high sound levels, so that the potential for direct physical injury is virtually zero (Appendix C, Section 6.2).

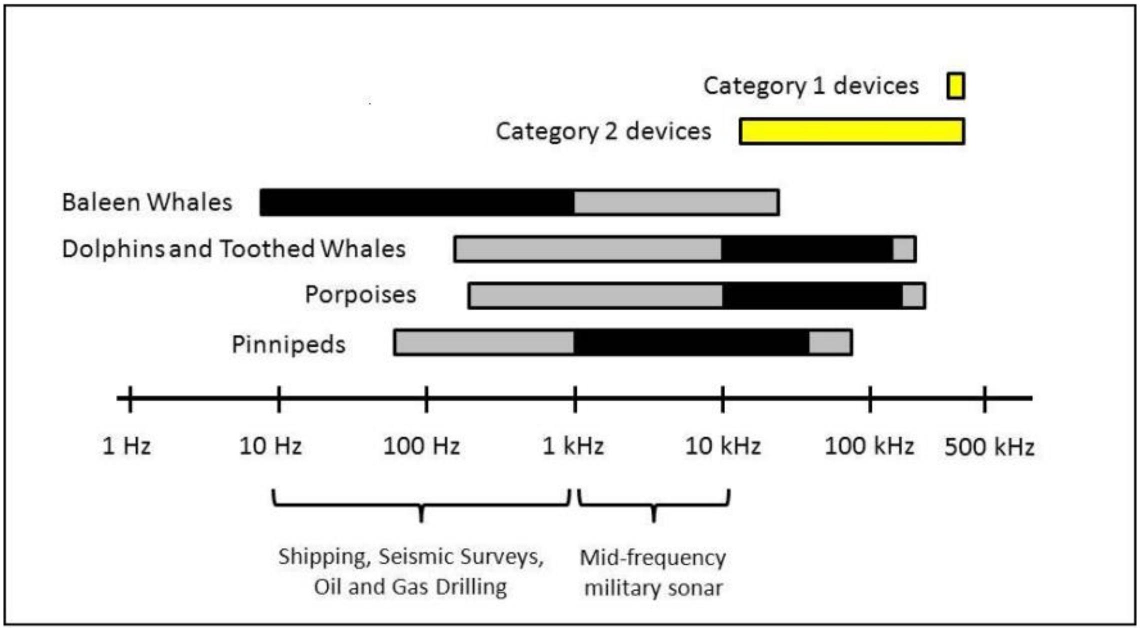


Figure 4.2-3 Typical Frequency Ranges of Hearing in Marine Mammals.

Figure 4.2-3 shows hearing ranges for different marine mammal groups (gray and black bars) relative to the frequency outputs of the two categories of acoustic devices used in NEFSC research (yellow bars). Black bars indicate the most sensitive hearing ranges of different marine mammals. Brackets indicate frequency ranges of several industrial sound sources as well as U.S. Navy mid-frequency active sonar for comparison. Data on hearing ranges is from Southall et al. (2007) and modified from DON (2008b).

The anticipated effects of active acoustic sources used during NEFSC fisheries research on threatened and endangered marine mammals is likely to occur infrequently, although they may occur over a large geographic area. Most of the frequencies are well above detection ranges for ESA-listed baleen whales, while Category 2 output overlaps with the hearing range of sperm whales. To date, there have been no reports or observations of sounds from NEFSC research activities disturbing or affecting behavioral changes in ESA-listed species.

Vessel noise may affect large whales through masking of biologically important sounds, particularly for low frequency baleen whales (Clark et al. 2009). The biological significance of masking from vessel noise has not been demonstrated with empiricle evidence for any species but presumably the effects could include a decreased ability to detect sounds used in communication, predator avoidance, and orientation. However, the relatively small number of NEFSC research vessels is likely to only result in temporary and minimal effects from acoustic masking as vessels pass through an area (Appendix C, Section 6.2).

The potential effects from the use of active acoustic devices during research activities would be small in magnitude and short-term in duration, although they would be dispersed over a wide geographic area and certain to occur under the Status Quo Alternative. The overall impacts of acoustic disturbance to ESA-listed marine mammals throughout the NEFSC research area therefore considered to be minor adverse.

Injury and Mortality due to Entanglement in Gear

Table 4.2-11 indicates marine mammal takes by all NEFSC research activities from 2004 to the start of 2014. There have been no entanglements or takes of ESA-listed marine mammals in NEFSC fisheries research from NOAA vessels, NOAA chartered vessels, or cooperative research projects. The NEFSC LOA application (Appendix C) does not include any projected takes of ESA-listed marine mammals by entanglement in research gear.

Measures to mitigate the risk of entanglements are described in Section 2.2.1. Vessel captains, bridge officers, and crew watch for marine mammals while underway and while setting fishing gear and take action to avoid them. The lack of entanglements of threatened and endangered marine mammals thus far indicates that the frequency of these types of interactions in fisheries research gear is low, and continued adherence to requirements of ALWTRP (which does not cover all gear types), reduces the likelihood of future occurrence. Any entanglement of a right whale in NEFSC fisheries research gear, especially if it caused serious injury or mortality, would be considered a major effect and would be considered during future ESA section 7 consultations. Based on the past history of takes and estimated future takes considered here, the potential effects on ESA-listed marine mammals from entanglement in research gear is considered minor adverse throughout the NEFSC research area during all seasons using gear types similar to those currently in use.

4.2.4.2 Other Cetaceans

This section describes impacts to cetaceans that are not ESA-listed. The minke whale is the only baleen whale species included in this section. The remaining cetaceans are toothed whale species (i.e., odontocetes), including whales, porpoises, and dolphins (Table 3.2-4).

Disturbance and Behavioral Responses due to Acoustic Equipment

The analysis of acoustic effects on these species is similar to that discussed for ESA-listed species above. Table 4.2-12 provides summaries of the numbers of each species that could be taken by Level B acoustic harassment during NEFSC research activities. The likely impact on cetaceans from the different types of acoustic devices is discussed below.

The mid-frequency odontocetes (e.g., pilot whales and dolphins) have a functional hearing range of 150 hertz to 160 kilohertz, with highest sensitivity from 10-120 kilohertz. The high-frequency odontocetes (e.g., harbor porpoise) have a functional hearing range of 200 hertz to 180 kilohertz, with highest sensitivity from 10-150 kilohertz. The output frequencies of Category 1 active acoustic sources (>300 kilohertz) are above the functional hearing range of baleen whales and cetaceans in the mid- and high-frequency hearing groups (Figure 4.2-3). Because they would not be able to hear them, cetaceans are not expected to be affected by Category 1 sound sources (Appendix C, Section 6.2).

Category 2 active acoustic sources are unlikely to be heard by most baleen whales, but are within the range of hearing for various odontocetes, especially high frequency hearing harbor porpoise. Some of these devices are used on trawl nets during fishing so their use is intermittent, localized and directional, and they are deployed on moving sources. Other Category 2 devices, such as echosounders and current profilers, may be deployed continuously or over long periods during a research cruise. These sound sources are highly directional. The sounds could be loud to cetaceans in close proximity to the sound source but physical damage is unlikely, although TTS could occur if animals remained close to the source (tens to a few hundred meters) for prolonged periods (Appendix C, Section 6.2). Given the deployment of such devices on moving vessels/gear and their narrow beam widths, it is unlikely that any marine mammals would be exposed to the zone of ensonification for more than a few seconds. If detected, short term avoidance is the most likely response (Appendix C, Section 6.2).

There have been no documented cases of marine mammals being disturbed or changing their behavior in response to NEFSC research vessels other than bow-riding by dolphins, which is common with marine vessels and does not appear to have a detrimental effect on the animals. The active sound sources used during fisheries research would not likely be detected by minke whales, although they may be detected by odontocetes, particularly harbor porpoise. The seasonal distribution of harbor porpoise in the NEFSC research area, from the MAB in fall and winter to the northern GOM in summer, means they could overlap with NEFSC fishery research vessels throughout their range. Sound emission from these active sources is short-term in any localized area. The most likely effect on cetaceans would be localized and

temporary avoidance (Appendix C, Section 6.2). Potential disturbance from active acoustic equipment used during research would, therefore, not have any measurable effect on the population of any cetacean and would be considered minor in magnitude. Such disturbance is likely to occur wherever survey vessels use the equipment, but cetaceans would only be close enough to a vessel to be affected on a rare or intermittent basis and any behavioral changes would be temporary. The overall impact of active acoustic sound sources on non ESA-listed cetaceans throughout the NEFSC research area is considered to be minor adverse according to the criteria in Table 4.1-1.

<u>Injury, Serious Injury, or Mortality due to Entanglement in Gear</u>

Table 4.2-11 shows the recent history of marine mammal takes by all NEFSC research activities, including one take each of minke whale, harbor porpoise, and bottlenose dolphin and three takes of short-beaked common dolphins. Measures to mitigate the risk of entanglements are described in Section 2.2.1. Cetaceans may be caught or entangled in trawl nets, gillnets, longlines, and other types of gear attached with lines to buoys. The minke whale was caught in a midwater trawl, brought on deck for about five minutes whie the trawl net was removed, and released alive. This minke whale swam off on its own but was later determined to have experienced a serious injury according to NMFS criteria for determining injury levels (Cole and Henry 2013). The harbor porpoise and bottlenose dolphin each died in gillnets. One short-beaked common dolphin was caught in a bottom trawl while the other two were caught in a mid-water trawl. The NEFSC used this information to help develop its request for future takes (Table 4.2-13). The LOA application combines estimated Level A harassment takes with serious injury or mortality takes because the degree of injury resulting from gear interaction cannot be predicted.

The NEFSC LOA application (Appendix C) includes estimates of the potential number of other cetaceans that may interact with research gear based on their similarity to the above species and historical takes in commercial fisheries operating in similar areas and using similar gear types (Table 4.2-13). Note that the LOA application does not request authorization to take all species of marine mammals that occur in the NEFSC research area, only those species and stocks considered to have a reasonable risk of adverse interactions with gear used for NEFSC research. As described earlier, the LOA application used conservative procedures to estimate potential future takes of marine mammals, so these estimates are greater than what is likely to occur in the future, especially for species that have never been taken in the past and that are infrequently encountered during research surveys.

The LOA application includes a request for takes of one “undetermined delphinid species” in each of trawl gear, gillnet gear, and longline gear for the five-year LOA authorization period. This request is made to account for similar looking dolphin species that may be caught or entangled in gear, but free themselves or are released before they can be identified or photographed by research personnel. This type of situation would be more likely to occur during the night or other periods of poor visibility.

The estimated average annual take for each species in all gears is well below 10 percent of PBR for all species, and less than one percent for most species for which takes are requested (Table 4.2-13). This level of mortality, if it occurred, would be considered minor in magnitude. However, the average annual takes are less than one for most species and only whole animals can be taken. One way to analyze potential impacts of an actual take, if it occurred, would be to round up the fractional averages to whole numbers of animals. In a “worst case” analysis, one could assume all requested takes for a given species in different gears occurred in a given year (rather than spread out over a five-year period) and were all mortalities. Taking this very conservative approach, the estimated level of mortality, if it occurred, would still be equal to or less than 10 percent of PBR for most species and would be considered minor in magnitude.

The exception is for one coastal stock of bottlenose dolphin with a very small PBR value (Table 4.2-13). The NEFSC take request for bottlenose dolphin includes two in trawl gear, five in gillnet gear, and one in longline gear over the five-year authorization period. The total for all gear types is eight, which rounds up

to an average of two bottlenose dolphins per year in all gear types. These takes could be distributed among all 16 currently defined stocks within the overall region of NEFSC research (Table 3.2-6). However, such taking but would be more likely to occur in the offshore stock and the two coastal migratory stocks due to their greater numbers and occurrence in waters where the great majority of NEFSC research activity takes place. Furthermore, there is a small possibility for these two takes in any one year to be concentrated in one stock in any one year. Thus a "worst case" analysis would be to assume that this was the case and to assess the relative impact to each stock on the assumption that all takes occurred within each of the six stocks most likely to coincide with NEFSC research activities (Table 4.2-13). Following this approach, for the offshore stock, two coastal migratory stocks, and the coastal stocks for South Carolina & Georgia and Central Florida, two takes per year would be less than 10 percent of their respective PBRs and would be considered minor in magnitude according to the criteria described in Table 4.1-1. The PBR for the Northern Florida coastal stock is seven and if the entire requested take of two per year occurred in this stock it would be between 10 percent and 50 percent of PBR and would be considered moderate in magnitude according to the criteria described in Table 4.1-1. However, it is very unlikely that NEFSC-affiliated research would actually capture two animals from this stock in a given year based on the lack of historical takes, the active mitigation measures employed, and the limited amount of NEFSC-affiliated research which occurs in nearshore areas within the range of this stock.

The one NEFSC historical take of a bottlnose dolphin was assigned to the Northern South Carolina Estuarine System stock in the most recent stock assessment report (Waring et al. 2014). The take occurred in 2008 before this stock was delineated and the assignment was based only on the location of the take, not a genetic sample. Given the potential for dolphins from other stocks to occur in this same area, including more numerous coastal stocks, there is some uncertainty regarding the actual identity of the stock from which the historical take occurred. The COASTSPAN longline and gillnet survey is the only NEFSC-affiliated research effort which occurs in nearshore areas within the range of this stock. Given this limited research effort, the mitigation measures in place for this survey, and the uncertainty about the historical take assigned to this stock, the NEFSC considers it very unlikely that it would actually take any animals from this stock or any of the other estuarine stocks and has not requested any takes from the estuarine stocks of bottlenose dolphins in its LOA application.

Overall, the NEFSC considers the estimated takes to represent a conservative estimate of potential gear interactions and that actual future interactions would be rare events. The overall impact of the potential takes of these species, if they occurred, would be considered minor adverse for all species according to the criteria described in Table 4.1-1.

Table 4.2-13 Potential Number of Non-ESA-Listed Marine Mammal Takes by Entanglement/Hooking in Research Gear in the NEFSC Research Area

This table summarizes information presented in the LOA application (Appendix C) on the combined potential takes of marine mammals by mortality and serious injury (M&SI) and Level A harassment over a five-year period using trawl, fyke, gillnet, and longline gear types. All population estimates, Potential Biological Removal (PBR) values, and total annual mortality and serious injury data are from the most recent stock assessment report (Waring et al. 2014). The average annual mortality and serious injury data include known interactions with commercial fisheries and ship strikes. Note that PBR is an annual measure of mortality. The LOA application estimates potential takes for the five-year period and these have been averaged for an annual take estimate that can be compared with PBR.

Species	Minimum Population Estimate	PBR (animals per year)	Average Annual M&SI from all sources	Total NEFSC Takes 2004-2013	Potential M&SI and Level A Take Average per Year (total for five-year period)			
					Trawl	Fyke	Gillnet	Longline
Minke whale	16,199	162	7.85	1 (trawl)	1 (5)	0	0	0
Risso's dolphin	12,619	126	62		0.4 (2)	0	0	0.2 (1)
Long-finned pilot whale	19,930	199	44		0.4 (2)	0	0	0.2 (1)
Short-finned pilot whale	15,913	159	162		0.4 (2)	0	0	0.2 (1)
Atlantic white-sided dolphin	30,401	304	116		0.4 (2)	0	0.2 (1)	0
White-beaked dolphin	1,023	10	0		0.4 (2)	0	0	0
Short-beaked common dolphin	112,531	1,125	168	3 (trawls)	1 (5)	0	0.2 (1)	0.2 (1)
Atlantic spotted dolphin	31,610	316	0		0.4 (2)	0	0	0
Bottlenose dolphin [1]	WNAO - 56,053 NMC – 8,620 SMC – 6,326 SCGC – 3,097 NFC – 730 CFC – 2,851	WNAO – 561 NMC – 86 SMC – 63 SCGC – 31 NFC – 7 CFC - 29	WNAO – 41.7 NMC – 6.0 SMC – 16.5 SCGC – 1.2 NFC – 0.4 CFC – 1.0	1 (gillnet)	0.4 (2)	0	1 (5)	0.2 (1)
Harbor porpoise	61,415	706	709	1 (gillnet)	0.4 (2)	0	1 (5)	0
Undetermined delphinid species					0.2 (1)	0	0.2 (1)	0.2 (1)
Harbor seal	48,980	1,469	409	1 (Fyke net)	0.2 (1)	1 (5)	1 (5)	0
Gray seal	unk	unk	4,980	1 (gillnet)	0.2 (1)	0.2 (1)	1 (5)	0
Undetermined pinniped species					0	0.2 (1)	0.2 (1)	0.2 (1)

1 Bottlenose stock abbreviations: Western North Atlantic Offshore (WNAO), Northern Migratory Coastal (NMC), Southern Migratory Coastal (SMC), South Carolina & Georgia (SCGC), Northern Florida Coastal (NFC), and Central Florida Coastal (CFC).

4.2.4.3 Pinnipeds

Gray seals and harbor seals are the most numerous of the pinnipeds in the NEFSC survey area, with seasonal shifts in abundance and distribution and the potential to overlap with NEFSC fisheries research. Harp and hooded seals are infrequently seen in the survey areas, so the likelihood of coinciding with NEFSC fisheries research surveys is low.

Disturbance and Behavioral Responses due to Acoustic Equipment and Physical Presence of Researchers

The functional hearing range of seals in the NEFSC operations areas is 75 hertz to 75 kilohertz. This is well below the output frequency of Category 1 active acoustic sources used by NEFSC, so pinnipeds are unlikely to detect these sounds. Some Category 2 acoustic sources, such as net transponders, are within the hearing range of pinnipeds. The sounds most likely to be audible are of short duration and restricted to areas very close to the research vessel, such as on an active net, so potential interactions are likely to be intermittent and infrequent. Table 4.2-12 provides summaries of the numbers of each species that could be taken by acoustic disturbance during NEFSC research activities. There are no reports or anecdotal observations of pinnipeds being disturbed or altering behavior due to acoustic devices usedi in NEFSC fisheries research activities to date. The potential impacts of acoustic disturbance to pinnipeds throughout the NEFSC research area are, therefore, considered to be minor adverse according to the criteria described in Table 4.1-1.

There is only one set of research activities where the physical presence of researchers may result in Level B incidental harassment of pinnipeds on haulouts. Several research efforts to monitor fish communities in the Penobscot River Estuary require researchers in small skiffs to pass seals on one tidal ledge (Odum Ledge) where approximately 50 harbor seals and perhaps a few gray seals are periodically hauled out. These surveys do not entail intentional approaches to seals on haulouts (i.e., the boats avoid close approach to tidal ledges) and no research gear is deployed near the tidal ledge; only behavioral disturbance incidental to small boat activities is anticipated. Behavioral disturbance may include head lifts, shifts in body position towards the water, or seals entering the water. The LOA application conservatively estimates that all hauled out seals may be disturbed by passing research skiffs, although researchers have estimated that only about 10 percent (5 animals in a group of 50) have been visibly disturbed in the past. The LOA application calculates 50 harbor seals and 20 gray seals may be disturbed by the passage of researchers for each survey effort (100 fyke net sets, 100 beach seine sets, and 200 Mamou shrimp trawls per year). The resulting estimate is that 20,000 harbor seals and 8,000 gray seals may be disturbed by the physical presence of researchers in skiffs each year (Level B harassment). The NEFSC recognizes this is very likely a large over-estimate and that actual taking by harassment will be considerably smaller. This level of periodic incidental harassment would have temporary effects, would not be expected to alter the continued use of the tidal ledge by seals, and would be considered minor adverse.

Injury and Mortality due to Entanglement in Gear

Table 4.2-11 shows the recent history of pinniped takes by all NEFSC research activities. Takes are rare and, to date, include one gray seal that died in a sink gillnet in 2009 and one harbor seal mortality in a fyke net in 2010. Measures to mitigate the risk of entanglements are described in Section 2.2.1. The NEFSC LOA application (Appendix C) includes calculations of the number of these and other pinnipeds that may interact with research gear based on their similarity to these two species and historical takes in commercial fisheries operating in similar areas and using similar gear types (Table 4.2-13). The NEFSC does not expect this many pinnipeds will actually be taken in the next five years, but is using a conservative estimation procedure to ensure accounting for a precautionary amount of potential take. The NEFSC has also included estimated takes of undetermined pinnipeds to account for the potential that a pinniped could be caught but get free of the gear before it could be identified, as was described above for undetermined delphinids.

For harbor seals, the estimated annual take, if it occurred, would be less than 0.1 percent of PBR and would therefore be considered minor in magnitude. Although PBR is presently undetermined for gray seals, the requested takes should also be well below 10 percent of any potential PBR level. Given the extremely low historic number of seal interactions with research gear and the implementation of mitigation measures, such as excluder devices on Fyke nets, future mortalities of pinnipeds would be considered rare events and would be unlikely to actually occur at this estimated rate in the next five years. Any actual take would occur in a localized area, but these animals travel over large geographic areas so the potential loss of an animal would affect more than a localized population. The overall impact of potential takes of harbor seals and gray seals in NEFSC research gear, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

4.2.4.4 Conclusion

Potential direct and indirect effects of NEFSC research activities on marine mammals have been considered for all gear types used for fisheries research under the Status Quo Alternative. Given the very small amounts of fish and invertebrates removed from the ecosystem during scientific sampling, the dispersal of those sampling efforts over large geographic areas, and the short duration of sampling efforts, the overall risk of causing changes in food availability for marine mammals is considered minor adverse. Also, given the crew training, required emergency equipment, and adherence to environmental safety protocols on NOAA research vessels and NOAA chartered vessels, the risk of altering marine mammal habitat through contamination from accidental discharges into the marine environment is considered minor adverse. All species may be exposed to sounds from active acoustic equipment used in NEFSC research, although several acoustic sources are not likely audible to many species. Those that are audible would likely cause temporary and minor changes in behavior for nearby animals as the ships pass through a given area. The potential for temporary threshold shifts in hearing is remote for high frequency cetaceans (harbor porpoise) and essentially zero for other species. The potential for hearing loss or injury to any marine mammal is essentially zero. Because of the minor magnitude of effects and the temporary duration of acoustic disturbance, the overall effects of acoustic disturbance would be considered minor adverse for all species throughout the NEFSC research area.

The numbers of marine mammals estimated to be taken in future NEFSC-affiliated research under the Status Quo Alternative are based on the historical capture of six cetaceans (three short-beaked common dolphins and one each of bottlenose dolphin, harbor porpoise, and minke whale) and two pinnipeds (gray seal and harbor seal) during NEFSC research surveys and NEFOP Observer training trips from 2004 through 2013. The available historic data and other data on mortalities in commercial fisheries using similar gear were used to estimate the potential for combined Level A harassment takes and serious injuries and mortalities under status quo conditions, which include a suite of mitigation measures currently implemented for NEFSC surveys. Future takes, if they occur, would likely be fewer than the estimated numbers since the estimates are based on a conservative approach to ensure accounting for the maximum level of potential take. The estimated potential takes in research gear for all species would be equal to or below 10 percent of PBR and would be considered to have minor magnitudes of effect on the population level for all species. Adverse interactions with research gear would likely continue to occur rarely but could occur anywhere the NEFSC conducts fisheries research; impacts would likely be dispersed over time and space. The impact of these potential takes, if they occurred, would be considered minor adverse for all species.

The overall effects of the Status Quo Alternative on marine mammals would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.2.5 Effects on Birds

This section describes the effects of the Status Quo NEFSC research activities on seabirds. Seabirds occur throughout the year in all research areas concurrent with NEFSC research activities. The potential effects of research vessels, survey gear, and other associated equipment on seabirds include:

- Injury or mortality due to ship strikes and entanglement in gear
- Changes in food availability due to survey removal of prey and discards
- Contamination or degradation of habitat

Injury and Mortality Due to Ship Strikes and Entanglement in Gear

There are several potential mechanisms for NEFSC research activities to cause injury or mortality to seabirds. Many seabirds are attracted to fishing vessels in order to forage on bait, offal, discards, and natural prey disturbed by the fishing operation. This attraction to fishing vessels creates the opportunity for birds to inadvertently collide with cables or lines and other structures on the vessel as well as being caught in the fishing gear. Bird strikes are probably most numerous during the night and during storms or foggy conditions when bright deck lights are on, which can cause the birds to become disoriented (NMFS 2004). However, such collisions with gear or vessels are hard to detect, especially without a dedicated research effort to monitor bird interactions.

In some parts of the world, mortality of seabirds in commercial fishing gear, especially longlines and gillnets, is a major conservation concern for albatross, gulls, and other species that follow commercial fishing vessels. Diving birds are vulnerable to getting caught in gill nets and other fishing gear near the surface as it is being set or hauled in.

In the Northeast region, commercial fisheries using gillnets, longlines, trawls, and dredges have all been documented to take various species of seabirds and a number of species are considered to have potential population-level effects as a result (Table 3.2.7) (Zollett 2009).

NOAA (2013) reports that the Observer Program recorded 2,828 seabirds caught in commercial fisheries in the Northwest Atlantic between 1989 and 2005. Shearwaters and petrels were the most commonly caught, followed by loons, gulls, cormorants, and the northern gannet. The fisheries that were most responsible for these bycatches were the more common fisheries in the Northeast, with the largest numbers of seabirds taken in the bottom otter trawl fishery followed by the sea scallop dredge, drift gillnet, and midwater paired otter trawl fisheries.

Fisheries research surveys use several gear types that have been demonstrated to result in seabird mortality in commercial fisheries of the Northeast, including long lines and gill nets (Zollett 2009). However, there are no records of any ship strikes or entanglements in fishing gear during NEFSC conducted or funded fisheries research activities. This may be due in part to the short tow and set times for research activities relative to typical commercial fishing efforts, and also to the much smaller number of vessels and gear sets involved in research. On NOAA vessels or chartered vessels, any seabirds caught during survey efforts would be recorded. It is usually very difficult to detect seabird collisions with gear or vessels but there are no records of any bird mortalities due to ship strikes during NEFSC conducted fisheries research activities. There is still a potential for this to occur, but is likely to be a relatively rare event. Although it is less likely that commercial fishing vessels participating in cooperative or independent research surveys would record or report any incidental catches of seabirds if they occurred, given the lack of seabird catches on NOAA ships over time and the similar types of sampling efforts in cooperative research, it is likely that any incidental catches of seabird would be rare events and affect small numbers of birds.

Changes in Food Availability

Fishing activities can adversely affect seabirds through changing the abundance or distribution of their prey species. A recent study (Cury et al. 2011) examined data from the past 45 years and all of the world's oceans and found that when prey abundance (small fish and invertebrates) dropped below one third of maximum documented biomass, seabird reproductive success declined significantly. This held true for species all over the world. Many factors influence the abundance and distribution of seabird prey, including strong roles for oceanographic and weather fluctuations, but commercial fisheries are also a factor. Although it is very difficult to demonstrate the indirect effects of fishing for other species and size classes on the availability of prey for seabirds, directed fishing on small schooling fish (e.g., sardines and anchovies) and invertebrates (e.g., krill) have played major roles in driving seabird prey populations below the "one third" limit in many areas (Cury et al. 2011).

Fishing activities may also have beneficial effects on seabirds by providing offal and discards that would otherwise be unavailable to birds. In some areas with intensive fishing efforts, offal may provide a substantial portion of the total food consumed by scavenging species such as gulls (Tasker and Furness 1996). However, while scavenging may benefit individual birds, it also places them in danger from entanglement and incidental mortalities in fishing gear.

The short duration of fisheries research tows, the dispersal of research effort over wide areas of sea, and the relatively small number of research surveys over time makes it very unlikely that the abundance or distribution of seabird prey would be affected by research activities. This is especially true for the small size classes of fish and pelagic invertebrates favored by most seabirds because of their large biomasses and the minimal amounts taken in research samples (Sections 4.2.3 and 4.2.7). For the same reasons, the amount of food made available through research activities is unlikely to have more than temporary and highly localized beneficial effects on seabirds.

Contamination or Degradation of Habitat

For the same reasons described for fish (Section 4.2.3) and marine mammals (Section 4.2.4), potential effects on seabirds from accidental discharges of fuel or other contaminants from NEFSC research vessels are possible but unlikely to occur in the near future. If an accidental discharge does occur, it would likely be a rare event and the potential volume of material would likely be small and localized. The potential impacts to seabirds would be similarly short-term, localized, and likely affect a small number of animals. The overall impact of accidental contamination of seabirds would therefore be considered minor adverse. This type of potential effect on seabirds will not be discussed further in this analysis.

4.2.5.1 Conclusion

The effects of NEFSC-affiliated fisheries research on seabirds include the potential for injury and mortality in fishing gear and ship strikes, changes in food availability, and contamination or degradation of habitat. There have been no reported captures of seabirds in NEFSC research gear or incidents of ship strikes in the past. Given the occurrence of seabird bycatch in commercial fisheries in the Northeast region, such effects could occur in the future under the Status Quo Alternative but would likely be rare and minor in magnitude. For reasons similar to those described for marine mammals above, the overall risk of NEFSC fisheries research causing changes in food availability for seabirds or contamination in the marine environment is considered minor adverse.

The overall effects on seabirds from NEFSC research activities under the Status Quo Alternative would likely be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1.

4.2.6 Effects on Sea Turtles

This section describes the types of effects of the Status Quo Alternative on five different species of ESA-listed sea turtles: leatherback, Kemp's ridley, green, loggerhead, and hawksbill sea turtles. Direct and indirect effects of research vessels, survey gear, navigational and fish-finding sonar, and other associated equipment on sea turtles include:

- Disturbance/change in behavior due to physical movements and sounds
- Injury or mortality due to ship strikes
- Injury or mortality due to interactions with fishing gear
- Contamination or degradation of habitat

The overlap of research activities with the presence of sea turtles can result in incidental takes of these ESA-listed species. NMFS has conducted section 7 consultations on NEFSC fisheries research that used trawl and dredge gear, and issued Biological Opinions (BiOps) on the effects of fisheries research on sea turtles (NMFS 2008c, 2012b). NMFS has also conducted section 7 consultations for sea turtles on the NEAMAP cooperative research program (NMFS 2009c, 2013). All of these BiOps have concluded that the fisheries research surveys may adversely affect, but are not likely to jeopardize the continued existence of these species. The BiOps contained mandatory reasonable and prudent measures that the NEFSC must follow to minimize effects of incidental take on sea turtles. These measures also require monitoring and reporting to document the characteristics of sea turtles encountered and provide data that may help develop more effective measures to avoid future interactions. These reasonable and prudent measures are therefore included as part of the proposed research activities under the Status Quo Alternative as described in Section 2.2.1, and the analysis of effects on sea turtles takes them into account.

<u>Disturbance and Changes in Behavior Due to Physical Movements and Sound Sources</u>

There is a potential for research activities to negatively affect or disturb sea turtles and cause changes in behavior, primarily through the physical presence of marine vessels and fishing gear combined with operational sounds from engines, hydraulic gear, and acoustical devices used for navigation and research.

Little is known about hearing in sea turtles, but the available information suggests that their underwater hearing capabilities are quite limited both in functional hearing bandwidth and in absolute hearing sensitivity. The limited data suggest that sea turtles probably have functional hearing sensitivity between about 100 Hz and 1.2 kHz (Ketten and Bartol 2005, Dow Piniak et al. 2012), which is well below the frequencies of acoustic instruments used in fisheries research. The higher frequency sounds are unlikely to be audible to sea turtles and therefore unlikely to have adverse effects on sea turtles.

Sea turtles may be disturbed or displaced from their normal behavior or movements by passing vessels or fishing gear in the water. Given the small number of NEFSC research vessels and their dispersal over a wide area, these types of disturbances would be temporary in nature, lasting only a few minutes as the research vessel passes, and are therefore likely to have no more than negligible effects on turtle foraging success or survival.

<u>Injury or Mortality Due to Ship Strikes</u>

The two main mechanisms for research activities to cause injury or mortality to sea turtles are through ship strikes and interactions with fishing gear. Sea turtles come to the surface to breathe, and also to rest, making them susceptible to ship strikes. Because it is often difficult for vessels underway to see turtles, there is little data available on the frequency of ship strikes on sea turtles. Bridge crew on NEFSC research cruises routinely watch for floating obstacles while underway and would take measures to avoid collisions with sea turtles if they could. There have been no reported incidents of ship strikes by NMFS

research vessels or by cooperative research vessels, although there is the possibility that such strikes have occurred without notice by the crew.

Injury or Mortality Due to Interactions with Fishing Gear

There are many factors that may contribute to the likelihood of sea turtles interacting with fishing gear, including capture or entanglement in various nets, collisions with dredge or other mobile gear, and getting hooked by longline gear. Some of the variables involve details of the fishing gear; the type and size of hooks and the bait used for longline surveys and the use of turtle excluder devices on nets and deflector gear on dredges. Other variables involve the distribution and abundance of sea turtles in the area which may be related to the presence of prey sources, seasonal migration patterns, and oceanographic features. Sea turtles are usually uncommon north of the MAB and migrate toward southern waters for the winter so the overlap of NEFSC fisheries research and sea turtles is not uniform over time and space. The primary risk of interactions with sea turtles is for NEFSC research activities that occur in non-winter months in the southern parts of the NEFSC research area, i.e., the MAB and south of Cape Hatteras (Figure 4.2-4 and Table 4.2-14).

The gear types with documented bycatch of sea turtles include gillnets, longlines, trawls, traps/pots, dredges, and seines (Zollett 2009). Loggerhead sea turtles are often hooked by longline gear as a result of depredation (i.e. when they attempt to eat bait), while leatherback sea turtles are more likely to become entangled in the gear (NMFS 2008c). A turtle that was hit by bottom trawl gear or a scallop dredge could suffer fractures to the carapace as a result of being struck (NMFS 2007a). Turtles may also be captured in trawl nets or dredge bags where they may drown or be further injured or killed when the catch and heavy gear are dumped on the vessel deck (NMFS 2008c).

One of the most important factors determining the likelihood of mortality for turtles caught in fishing gear is the length of time they are held underwater (Henwood and Stuntz 1987, Epperly et al. 2002, and Sasso and Epperly 2006). According to a study conducted by the National Research Council, "death rates [of sea turtles incidentally captured in trawls] are near zero until tow times exceed 60 minutes, then they rise rapidly with increasing tow times to around 50 percent for tow times in excess of 200 minutes" (NRC 1990). While long tow times are common in commercial fisheries, all of the long-term NEFSC fisheries research surveys using trawl and dredge gear (Table 2.2-1) have protocols with tow times less than 30 minutes long, much less than the 60 minute threshold described above, and thus all turtles caught in these research tows have been released alive (Table 4.2-14). Some NEFSC-affiliated short-term cooperative research projects (Table 2.2-2) use longer tow times but none of these projects have reported adverse interactions with sea turtles.

Two NEFSC-affiliated bottom trawl surveys have captured sea turtles in the past: the NEFSC BTS and the Northeast Area Monitoring and Assessment Program (NEAMAP) Near Shore Trawl Program. Sea turtles have also been incidentally captured during the Apex Predators longline survey and the Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) Longline and Gillnet Surveys. Table 4.2-14 provides details on 75 sea turtles incidentally caught in NEFSC-affiliated surveys in the past ten years (2004 through 2013). All sea turtles captured in trawl or gillnet gear were released in good to excellent condition and swam off on their own power. All sea turtles hooked on longline gear either shed the hook before being landed or had the hooks removed without any gear attached with three exceptions; one mortality (a leatherback), one Kemp's ridley that swallowed the hook and was released after the hook was removed at an on-shore facility, and one Kemp's ridley that was released without removing the hook. Table 4.2-15 provides a summary of the number of sea turtles captured or hooked in different research gears and in different LMEs over this period and Table 4.2-16 provides the capture rates for each species and gear type based on the historical data.

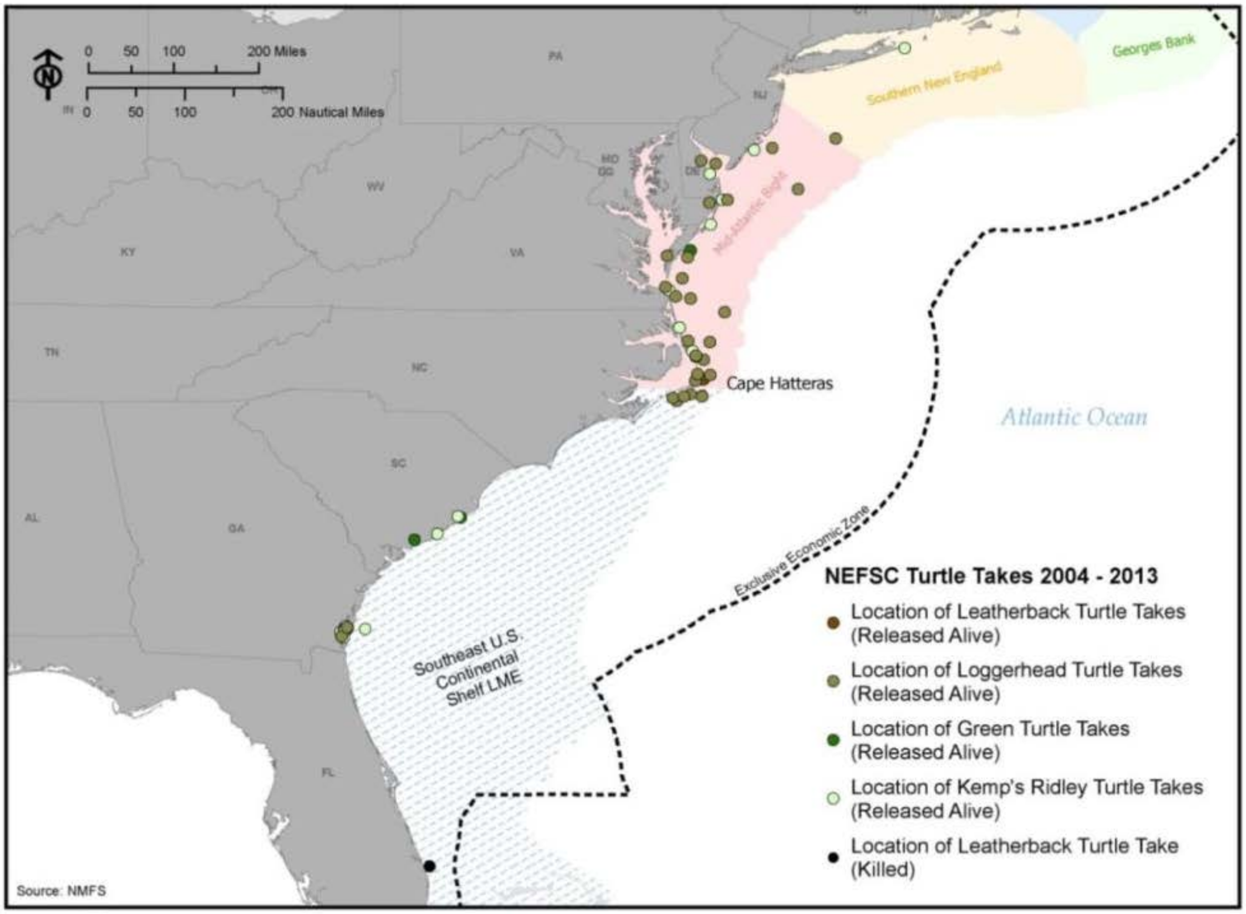


Figure 4.2-4 Location of Sea Turtle Takes during NEFSC Research from 2004 through 2013

Table 4.2-14 Historical Takes of Sea Turtles during NEFSC-Affiliated Research from 2004 through 2013

All sea turtles were released in good to excellent condition and without any gear attached except for one mortality (a leatherback) and two other hooked turtles as noted.

Survey Name	Species Taken	Gear Type	Date (Time) Taken	LME	# Killed	# Released Alive	Total Taken
2013							
Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN)	Kemp's ridley	Longline	16 Apr. (11:00 am)	SE	0	1	1
COASTSPAN	Kemp's ridley	Longline	16 Apr. (not recorded)	SE	0	1	1
2012							
Northeast Area Monitoring and Assessment Program (NEAMAP) - Fall	Loggerhead	Bottom trawl	22 Oct. (1:10 pm)	NE	0	1	1

Survey Name	Species Taken	Gear Type	Date (Time) Taken	LME	# Killed	# Released Alive	Total Taken
NEAMAP - Fall	Kemp's ridley	Bottom trawl	20 Oct. (4:33 pm)	NE	0	1	1
NEAMAP - Fall	Kemp's ridley	Bottom trawl	14 Oct. (10:34 am)	NE	0	1	1
NEAMAP - Fall	Kemp's ridley	Bottom trawl	2 Oct. (10:15 am)	NE	0	1	1
NEFSC Standard Bottom Trawl Surveys (BTS) - Fall	Loggerhead	Bottom trawl	28 Sep. (5:34 pm)	NE	0	1	1
BTS - Fall	Loggerhead	Bottom trawl	13 Sep. (12:16 pm)	NE	0	2	2
COASTSPAN	Kemp's ridley	Gillnet	10 Jul. (not recorded)	SE	0	1	1
COASTSPAN	Kemp's ridley	Gillnet	29 Jun. (not recorded)	SE	0	1	1
COASTSPAN	Green	Gillnet	31 May (not recorded)	SE	0	1	1
COASTSPAN	Kemp's ridley	Gillnet	16 May (not recorded)	SE	0	1	1
COASTSPAN	Kemp's ridley	Longline	15 May (11:15 am)	SE	0	1	1
COASTSPAN	Green	Gillnet	8 May (not recorded)	SE	0	1	1
NEAMAP - Spring	Loggerhead	Bottom trawl	3 May (6:55 pm)	NE	0	1	1
NEAMAP - Spring	Loggerhead	Bottom trawl	29 Apr. (10:24 pm)	NE	0	1	1
NEAMAP - Spring	Loggerhead	Bottom trawl	27 Apr. (12:09 pm)	NE	0	1	1
COASTSPAN	Kemp's ridley	Longline	27 Apr. (10:30 am)	SE	0	1	1
2011							
NEAMAP - Fall	Loggerhead	Bottom trawl	26 Oct. (7:29 am)	NE	0	1	1
NEAMAP - Fall	Loggerhead	Bottom trawl	24 Oct. (7:55 am)	NE	0	2	2
NEAMAP - Fall	Kemp's ridley	Bottom trawl	24 Oct. (7:55 am)	NE	0	1	1
NEAMAP - Fall	Kemp's ridley	Bottom trawl	24 Oct. (11:16 am)	NE	0	1	1
BTS - Fall	Loggerhead	Bottom trawl	13 Sep. (1:37 am)	SE	0	1	1
COASTSPAN	Kemp's ridley	Longline	7 Jun. (10:55 am)	SE	0	1	1
COASTSPAN	Kemp's ridley	Longline	7 Jun. (9:48 am)	SE	0	1	1
COASTSPAN	Kemp's ridley	Longline	17 May (9:35 am)	SE	0	1[1]	1
COASTSPAN	Kemp's ridley	Longline	17 May (7:24 am)	SE	0	1	1
NEAMAP - Spring	Loggerhead	Bottom trawl	25 Apr. (2:22 pm)	NE	0	1	1
2010							
NEAMAP - Fall	Kemp's ridley	Bottom trawl	24 Oct. (11:16 am)	NE	0	1	1
NEAMAP - Fall	Loggerhead	Bottom trawl	19 Oct. (12:20 pm)	NE	0	1	1
NEAMAP - Fall	Kemp's ridley	Bottom trawl	11 Oct. (3:06 pm)	NE	0	1	1
COASTSPAN	Kemp's ridley	Longline	18 Aug. (9:29 am)	SE	0	1[2]	1
COASTSPAN	Green	Gillnet	19 Jul. (not recorded)	SE	0	1	1
COASTSPAN	Loggerhead	Longline	7 Jul. (10:11 am)	SE	0	1	1
COASTSPAN	Kemp's ridley	Longline	6 Jul. (7:04 am)	SE	0	1	1
COASTSPAN	Kemp's ridley	Longline	4 Jun. (10:15 am)	SE	0	1	1
COASTSPAN	Green	Gillnet	28 May (not recorded)	SE	0	1	1
NEAMAP - Spring	Loggerhead	Bottom trawl	22 Apr. (8:25 am)	NE	0	1	1
2009							
NEAMAP - Fall	Green	Bottom trawl	22 Oct. (8:45 am)	NE	0	1	1

Survey Name	Species Taken	Gear Type	Date (Time) Taken	LME	# Killed	# Released Alive	Total Taken
NEAMAP - Fall	Kemp's ridley	Bottom trawl	14 Oct. (6:25 pm)	NE	0	1	1
BTS - Fall	Leatherback	Bottom trawl	17 Sep. (1:32 pm)	NE	0	1	1
COASTSPAN	Loggerhead	Longline	20 Jun. (not recorded)	NE	0	1	1
COASTSPAN	Kemp's ridley	Longline	13 May (1:22 pm)	SE	0	1	1
COASTSPAN	Kemp's ridley	Longline	22 Apr. (8:47 am)	SE	0	1	1
COASTSPAN	Kemp's ridley	Longline	22 Apr. (7:48 am)	SE	0	1	1
2008							
BTS - Fall	Loggerhead	Bottom trawl	14 Sep. (7:23 pm)	NE	0	1	1
BTS - Fall	Loggerhead	Bottom trawl	12 Sep. (3:46 pm)	NE	0	1	1
COASTSPAN	Kemp's ridley	Longline	9 Sep. (10:44 am)	SE	0	1	1
COASTSPAN	Kemp's ridley	Longline	8 Jul. (10:56 am)	SE	0	1	1
NEAMAP - Spring	Loggerhead	Bottom trawl	25 Apr. (11:10 am)	NE	0	2	2
BTS - Spring	Loggerhead	Bottom trawl	23 Mar. (3:25 pm)	SE	0	1	1
BTS - Spring	Loggerhead	Bottom trawl	23 Mar. (12:45 pm)	SE	0	1	1
BTS - Spring	Loggerhead	Bottom trawl	23 Mar. (8:43 am)	SE	0	2	2
BTS - Spring	Loggerhead	Bottom trawl	23 Mar. (8:25 am)	SE	0	2	2
2007							
BTS - Fall	Loggerhead	Bottom trawl	21 Sep. (1:29 pm)	NE	0	1	1
BTS - Fall	Loggerhead	Bottom trawl	9 Sep. (3:30 am)	NE	0	1	1
COASTSPAN	Kemp's ridley	Longline	26 Apr. (7:46 am)	SE	0	1	1
Apex Predators	Loggerhead	Longline	18 Apr. (3:10 am)	SE	0	1	1
Apex Predators	Leatherback	Longline	18 Apr. (3:10 am)	SE	1	1	2
BTS - Spring	Loggerhead	Bottom trawl	11 Feb. (9:30 am)	NE	0	1	1
2006							
COASTSPAN	Kemp's ridley	Longline	22 Sep. (9:03 am)	SE	0	1	1
BTS - Spring	Loggerhead	Bottom trawl	13 Mar. (8:45 pm)	NE	0	1	1
BTS - Spring	Loggerhead	Bottom trawl	12Mar. (5:57 pm)	SE	0	1	1
2005							
BTS - Fall	Loggerhead	Bottom trawl	24 Sep. (11:10 pm)	NE	0	1	1
COASTSPAN	Kemp's ridley	Longline	30 Aug. (9:22 am)	SE	0	1	1
COASTSPAN	Kemp's ridley	Gillnet	23 Jun. (not recorded)	NE	0	1	1
COASTSPAN	Loggerhead	Longline	21 Jun. (not recorded)	NE	0	1	1
2004							
BTS - Fall	Loggerhead	Bottom trawl	23 Sep. (4:05 pm)	NE	0	1	1
COASTSPAN	Loggerhead	Longline	18 Aug. (7:21 am)	SE	0	1	1
				Total	**1**	**74**	**75**

1. Turtle swallowed hook. Animal was brought back to office and handed off to the State sea turtle biologist. It was transported to the Sea Turtle Center on Jekyll Island. The hook was removed and the animal was released at a later date.
2. Incident report indicates that hook was not removed from turtle (line cut close to mouth). Employee was concerned about removing hook and damaging animal. Stressed importance of bringing animal back in to HQ if release and subsequent mortality is questionable.

Table 4.2-15 Summary of Sea Turtle Takes by Gear Type and LME during NEFSC-Affiliated Research 2004 through 2013

Species	Bottom Trawl		Longline		Gillnet		Total	
	NE LME	SE LME	NE LME	SE LME	NE LME	SE LME	NE LME	SE LME
Loggerhead	23	8	2	3			25	11
Kemp's ridley	8			19	1	3	9	22
Green	1					4	1	4
Leatherback	1			2			1	2

Table 4.2-16 Sea Turtle Capture Data and Capture Rates in NEFSC-affiliated Research from 2004 through 2013

Capture/hooking rates are presented on a per-unit-effort basis in order to provide a means to estimate future takes of sea turtles in research projects. Hawksbill turtles occur primarily in tropical waters and have not been captured incidentally by any past NEFSC fisheries research projects. All except one leatherback turtle were released alive. Note that COASTSPAN surveys are conducted by research partners funded in part by and collaborating with the NEFSC.

Survey	Loggerhead		Kemp's Ridley		Green		Leatherback		Total Captures
	Captures	Capture rate	Captures	Capture rate	Captures	Capture rate	Captures	Capture rate	
NE LME									
Bottom Trawl Surveys									
BTS - Spring (200 tows/yr @ 20 min/tow x 10 yr = 667 tow-hr)		0.0135 turtles per tow-hr (t/t-h)	0		0		0		**9**
NEAMAP - Spring (150 tows/yr @ 20 min/tow x 10 yr = 500 tow-hr)	7	0.014 t/t-h	0		0		0		**7**
BTS - Fall (200 tows/yr @ 20 min/tow x 10 yr = 667 tow-hr)	10[1]	0.015 t/t-h					1	0.0015 t/t-h	**11**
NEAMAP - Fall (150 tows/yr @ 20 min/tow x 10 yr = 500 tow-hr)		0.01 t/t-h		0.016 t/t-h		0.002 t/t-h			**14**
Longline Surveys									
COASTSPAN Longline[2] (small: 130 sets/yr x 50 hooks/set @ 30 min/set x 10 yr = 32,500 hook-hr; large: 130 sets/yr x 25 hooks/set @ 2 hr/set x 10 yr = 65,000 hook-hr; Total = 97,500 hook-hr)	2	0.00002 turtles per hook-hour (t/h-h)	0		0		0		**2**
Gillnet Surveys									
COASTSPAN Gillnet (12 sets/yr @ 3 hr/set x 10 yr = 360 set-hr)	0		1	0.00278 turtles per set-hr (t/s-h)					**1**

Survey	Loggerhead		Kemp's Ridley		Green		Leatherback		Total Captures
	Captures	Capture rate	Captures	Capture rate	Captures	Capture rate	Captures	Capture rate	
SE LME									
Longline Surveys									
Apex Predator Longline (biannual, 3 yr total: 71 sets/yr x 300 hooks/set @ 3 hr/set x 3 yr = 191,700 hook-hr)	1	0.000005 t/h-h	0		0		2	0.00001 t/h-h	**3**
COASTSPAN Longline (small: 225 sets/yr x 50 hooks/set @ 30 min/set x 10 yr = 56,250 hook-hr; large: 225 sets/yr x 25 hooks/set @ 2 hr/set x 10 yr = 112,500 hook-hr; Total = 168,750 hook-hr)	2	0.000012 t/h-h	19	0.000113 t/h-h	0		0		**21**
Gillnet Surveys									
COASTSPAN Gillnet (40 sets/yr @ 3 hr/set x 10 yr = 1,200 set-hr)	0		3	0.0025 t/s-h	4	0.0033 t/s-h	0		**7**
Total captures for all gear and areas 2004-2013	**36 loggerhead turtles**		**31 Kemp's ridley turtles**		**5 green turtles**		**3 leatherback turtles**		**75 turtles**

1. Turtles captured in the BTS surveys are all tallied in the NE LME because the numbers of tows south of Cape Hatteras is relatively small and varies from year to year due to the stratified random design. The numbers of BTS sample sites that were actually south of Cape Hatteras each year were not analyzed.

2. COASTSPAN surveys use two gear protocols: the small juvenile shark gear uses 50 hooks per set and the set duration is for 30 minutes. The large juvenile/adult shark gear uses 25 hooks per set and the set duration is for 2 hours.

Table 4.2-17 Estimated Future Takes of Sea Turtles under the Status Quo Alternative

No hawksbill turtles are expected to be incidentally caught during NEFSC fisheries research activities.

Survey	Research effort per year	Species	Capture rate	Estimated captures per year	Serious Injury and Mortality (SI&M) rate	Estimated SI&M per year
SOUTHERN NEW ENGLAND AND MID-ATLANTIC BIGHT						
Bottom trawls						
BTS – Spring 200 tows @ 20 min/tow	67 trawl-hour (t-h)	Loggerhead	0.0135 t/t-h	0.9	0	0
BTS – Fall 200 tows @ 20 min/tow	67 t-h	Loggerhead	0.015 t/t-h	1.0	0	0
		Leatherback	0.0015 t/t-h	0.1	0	0
NEAMAP– Spring (southern portion) 150 tows @ 20 min/tow	50 t-h	Loggerhead	0.014 t/t-h	0.7	0	0
NEAMAP – Fall (southern portion) 150 tows @ 20 min/tow	50 t-h	Loggerhead	0.01 t/t-h	0.5	0	0
		Kemp's ridley	0.016 t/t-h	0.8	0	0
		Green	0.002 t/t-h	0.1	0	0
Habitat Mapping Survey [1] 54 tows @ 30 min/tow	27 t-h	Loggerhead	0.015 t/t-h	0.4	0	0
		Kemp's ridley	0.016 t/t-h	0.4	0	0
Short-term research projects [2] Numbers and tow times vary up to 3 hr, totals from Table 2.2-2	325 t-h	Loggerhead	0.015 t/t-h	4.9	0.20 [3]	0.98
		Kemp's ridley	0.016 t/t-h	5.2	0.20	1.04
Longline Surveys						
Apex Predator Bottom Longline Coastal Shark Survey [4] 29 sets/yr @ 300 hooks/set and 3 hr soak	26,100 hook-hour (h-h)	Loggerhead	0.00002 t/h-h	0.5	0.1	0.05
COASTSPAN [5] Small: 3,250 h-h Large: 6,500 h-h	9,750 hook-hr (h-h)	Loggerhead	0.00002 t/h-h	0.2	0.1	0.02
Gillnet surveys [6]						
COASTSPAN 12 SETS/YR @ 3 HR/SET	36 set-hour (s-h)	Kemp's ridley	0.00278 t/s-h	0.1	0.1	0.01
NEFOP TRAINING CRUISES 40 sets/yr @ 12-24 hr/set	720 s-h	Kemp's ridley	0.00278 t/s-h	2.0	0.2	0.4

Survey	Research effort per year	Species	Capture rate	Estimated captures per year	Serious Injury and Mortality (SI&M) rate	Estimated SI&M per year
SOUTHEAST US CONTINENTAL SHELF LME						
Longline Surveys						
Apex Predator Longline 71 sets/yr x 300 hooks/set @ 3 hr/set	63,900 h-h	Loggerhead	0.000005 t/h-h	0.3	0.1	0.03
		Leatherback	0.00001 t/h-h	0.6	0.1	0.06
COASTSPAN Small: 5,625 h-h Large: 11,250 h-h	16,875 h-h	Loggerhead	0.000012 t/h-h	0.2	0.1	0.02
		Kemp's ridley	0.000113 t/h-h	1.9	0.1	0.19
Gillnet surveys						
COASTSPAN 40 sets/yr @ 3 hr/set	120 s-h	Kemp's ridley	0.0025 t/s-h	0.3	0	0
		Green	0.0033 t/s-h	0.4	0	0

1. Survey conducted in summer in central part of MAB and has had no history of catching turtles; in lieu of past capture data, the highest capture rate for a project using a similar gear type (BTS – Fall for loggerhead and NEAMAP – Fall for Kemp's ridley) is used to provide conservative estimates of future captures for the two most frequently caught species.
2. Estimation based on fishing effort during short-term cooperative research projects in the past five years that have occurred in Southern New England and Mid-Atlantic Bight. In lieu of past capture data, the highest capture rate for a project using a similar gear type (BTS – Fall for loggerhead and NEAMAP – Fall for Kemp's ridley) is used to provide conservative estimates of future captures for the two most frequently caught species.
3. Short-term projects have used a range of trawl times depending on their research purposes, including one project with trawl duration of three hours. However, the remaining short-term projects used trawl durations of 90 minutes or less. Protocols for future short-term projects have not been established so this estimate is based on a relatively high mortality rate consistent with tows of 90 minutes (Sasso and Epperly 2006).
4. Capture rate used for estimations of future takes taken from COASTSPAN surveys in lieu of historical data from Apex Predator surveys in the NE LME. The Apex Predator surveys have been conducted every other year. Estimated captures are per year for years when the study is conducted
5. COASTSPAN surveys use two gear protocols: the small juvenile shark gear uses 50 hooks per set and the set duration is for 30 minutes. The large juvenile/adult shark gear uses 25 hooks per set and the set duration is for 2 hours..
6. Mortality rates are based on nominal research set durations and Figure 2 in Murray (2009). However, longline and gillnet sets in the COASTSPAN and Apex Predators surveys are continually monitored so any hooked or entangled turtles would likely be detected and released well before they drown.

Captures and Mortality in Trawl Gear

The BiOps covering past NEFSC-conducted research (NMFS 2008c, 2012b) analyzed the frequency of turtle captures during BTS surveys conducted since 1963. The capture rate for Spring BTS surveys was 0.002 turtles per tow hour, and for Fall BTS surveys was 0.006 turtles per tow hour. All of these turtles were loggerheads, except for one leatherback caught in 2009, and all were released alive in good to excellent condition. These takes occurred primarily in the MAB, but a few occurred in SNE (Figure 4.2-4). The capture rates for the BTS in the past ten years have been somewhat higher than these long-term averages, but turtle captures still occur infrequently. Capture rates in the NEAMAP surveys are similar to the capture rates in the BTS surveys (Table 4.2-14). The NEAMAP surveys use the same gear and protocols as the BTS surveys except that they occur in shallower, nearshore waters. Given the past history of captures and the short tow times (20 minutes) for research trawls, all of these turtles would likely be released alive and in good condition.

Under the Status Quo Alternative five other long-term research programs use bottom trawl gear similar to that used by the BTS (Table 2.2-1), as have numerous short-term cooperative research projects (Table 2.2-2) None of these other research efforts have reported any captures of sea turtles, so there is no historical capture rate data on which to base an estimate of future takes. In order to provide a conservative

estimate of potential future takes from these surveys, the highest capture rates from similar surveys are used.

All except one of the long-term surveys (Habitat Mapping Survey) occur in more northerly areas or during the winter when turtle interactions are unlikely. The Habitat Mapping Survey includes 27 tow hours of trawling effort per year. Due to the short tow times (30 minutes) used in this survey, all turtles would likely be released alive and in good condition.

The short-term projects in the SNE and MAB that have used bottom trawl gear have averaged about 325 tow hours per year in the past five years. These projects are typically conducted with protocols closer to commercial fishing conditions than the BTS, with many projects using tow times of 60 to 90 minutes and one project using tow times of three hours. This raises the potential for sea turtle injury and mortality due to forced submersion. Sasso and Epperly (2006) analyzed data from commercial bottom trawl fisheries and found the proportion of captured turtle mortalities increased greatly for tow times in excess of one hour, with considerably higher mortality rates for trawls occurring in the winter. While many future short-term research trawl projects may use tow times less than an hour, and most will likely be conducted in non-winter months, this Final PEA will provide a conservative estimate of future mortality by assuming a mortality rate of 20 percent, which corresponds to trawl times of 90 minutes in non-winter months or shorter tows in winter (Sasso and Epperly 2006).

Table 4.2-17 provides calculations of estimated captures and mortalities for all trawl projects under the Status Quo Alternative that are likely to interact with sea turtles. Table 4.2-18 provides a summary of those estimates rounded up to next highest whole number of turtles. Most of the estimated captures and all of the serious injuries and mortalities are associated with short-term cooperative research surveys due to greater overall trawl effort and longer tow times. For all NEFSC-affiliated research trawls:

- Up to nine loggerhead turtles may be captured per year and one of those takes may be lethal.
- Up to seven Kemp's ridley turtles may be captured per year and two of those takes may be lethal.
- Up to one each of green and leatherback turtles may be captured per year with a remote chance of mortalities.

Table 4.2-18 Summary of Estimated Future Takes of Sea Turtles

Numbers of estimated captures/hookings and serious injuries and mortalities (SI&M) totaled from Table 4.2-17 (in parentheses), rounded up to the next highest whole number of sea turtles.

Gear type	Trawl		Longline		Gillnet		Totals	
Species	Captures per year	SI&M per year	Captures per year	SI&M per year	Captures per year	SI&M per year	Captures per year	SI&M per year
Loggerhead	(8.4) 9 turtles	(0.98) 1 turtle	(1.2) 2 turtles	(0.12) 1 turtle	0	0	11 turtles	2 turtles
Kemp's ridley	(6.4) 7 turtles	(1.04) 2 turtles	(1.9) 2 turtles	(0.6) 1 turtle	(2.4) 3 turtles	(0.4) 1 turtle	12 turtles	4 turtles
Green	(0.1) 1 turtle	0	0	0	(0.4) 1 turtle	0	2 turtles	0
Leatherback	(0.1) 1 turtle	0	(0.6) 1 turtle	(0.06) 1 turtle	0	0	2 turtles	1 turtle
Totals	18 turtles	3 turtles	5 turtles	3 turtles	4 turtles	1 turtle	27 turtles	7 turtles

Captures and Mortality in Longline Gear

There are four long-term research projects that use longline gear under the Status Quo Alternative (Table 2.2-1). The Apex Predator Bottom Longline Coastal Shark and the Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) surveys have components in both the NE LME and SE LME. The Apex Pelagic Shark Survey has been discontinued. The Apex Predators Pelagic Nursery Grounds Shark study involves opportunistic sampling of sharks caught during commercial swordfish trips and takes place in northern waters where there are fewer sea turtles and any interactions with the fishing gear are covered under commercial fishing regulations. There are no short-term research projects that have used longline gear in the SNE or MAB (Table 2.2-2).

Loggerhead turtles have been captured in both the COASTSPAN and Apex Predators surveys, but Kemp's ridley turtles have only been caught in COASTSPAN surveys and leatherbacks have only been caught in Apex Predators surveys (Table 4.2-14). There is a risk of catching any one of these species in future longline surveys but estimates of future captures are based on past records for each survey. No other turtle species have been taken on NEFSC longline surveys; although interactions with other green or hawksbill turtles are possible, they would likely be rare occurrences.

For longline surveys, the mortality rate depends on how the turtle was captured (entangled vs. hooked and location of hook) and its condition when released (with gear trailing or all gear removed). Ryder et al. (2006) provides a criteria table showing a range of mortality rates based on injury category and release condition from 1 to 95 percent. The purpose of the longline research surveys is to tag and release sharks so the lines are continually monitored, therefore any turtles captured are expected to be released fairly quickly (within 30 minutes). All the longline researchers have been trained and certified in sea turtle avoidance and handling procedures and carry the gear needed to safely release/unhook turtles. Therefore, all turtles captured in the future are expected to be released with all gear removed. For the purposes of this Final PEA analysis, it is assumed that turtles caught in longline gear in the future will be hooked in locations classified as category II injuries and would have an estimated mortality rate of 10 percent for hardshell turtles and 15 percent for leatherback turtles (Ryder et al. 2006).

Table 4.2-17 provides calculations of estimated captures and serious injuries and mortalities for all longline projects under the Status Quo Alternative that are likely to interact with sea turtles. Table 4.2-18 provides a summary of those estimates rounded up to next highest whole number of turtles. For all NEFSC-affiliated research longline projects:

- Up to two loggerhead turtles may be captured per year and one of those takes may be lethal.
- Up to two Kemp's ridley turtles may be captured per year and one of those takes may be lethal.
- Up to one leatherback turtle may be captured per year with a small chance of mortality.

Captures and Mortality in Gillnet Gear

There are two long-term NEFSC research projects using gillnet gear (Table 2.2-1), the COASTSPAN survey, with components both north and south of Cape Hatteras, and the Northeast Fishery Observer Program (NEFOP) training cruises. There were no short-term cooperative research projects that used gillnet gear in the SNE or MAB (Table 2.2-2). The COASTSPAN gillnet surveys have captured one Kemp's ridley turtle north of Cape Hatteras and a total of seven Kemp's ridley and green turtles south of Cape Hatteras (Table 4.2-14). Fisheries observers in the MAB have documented takes of loggerhead, Kemp's ridley, green, and leatherback sea turtles in commercial sink gillnet gear, although loggerheads are by far the most common species taken (Murray 2009). Capture rates for sea turtles in commercial gillnet fisheries in the MAB have been calculated based on the number of fishing trips and weight of landed fish (Murray 2009), but neither of these variables can be applied to estimating incidental take in research activities.

There is a high risk of injury for sea turtles captured in commercial gillnet gear because of long soak times and prolonged forced submersion. Murray (2009) examined sea turtle mortality in commercial gillnet gear in the mid-Atlantic as a function of several variables, including soak duration. Gillnet sets that were less than 20 hours in duration resulted in captures but no serious injuries or mortalities. Mortality rates increased to 27 percent with soak times up to 40 hours and 70 percent with soak times up to 100 hours (Murray 2009). The COASTSPAN gillnet efforts involve much smaller nets than commercial sets and soak for only three hours. In addition, COASTSPAN scientists continually monitor the nets and are trained in sea turtle handling techniques; all sea turtles captured by COASTSPAN surveys are therefore expected to be released alive and in good condition. The NEFOP training cruises use commercial gillnet gear and protocols. Even though these training cruises have not reported sea turtle mortalities in the past, this Final PEA uses the mortality rate for commercial fisheries of similar duration to provide a conservative estimate of future mortalities from similar projects conducted under the Status Quo Alternative. Mortality rates are based on research soak durations and Figure 2 in Murray (2009).

Table 4.2-17 provides calculations of estimated captures and serious injuries and mortalities for all gillnet projects under the Status Quo Alternative that are likely to interact with sea turtles. Table 4.2-18 provides a summary of those estimates rounded up to next highest whole number of turtles. All of the mortalities are associated with the NEFOP gillnet training cruises due to their relatively long (12 to 24 hour) soak times. For all NEFSC-affiliated research gillnet projects:

- Up to three Kemp’s ridley turtles may be captured per year and one of those takes may be lethal.
- Up to one green turtle may be captured per year with a remote chance of mortality.

Captures and Mortality in Dredge Gear

Captures of sea turtles in commercial scallop dredge gear, primarily loggerheads but also Kemp’s ridley, has been a conservation concern for many years (Murray 2011). Mortality rates in observed scallop fisheries had been up to 80 percent for observed captures from 2006 to 2010 (Upite et al. 2013). However, the Northeast Fishery Management Council determined that the maximum mortality rate for scallop fisheries employing a Turtle Deflector Dredge (TDD) would be 28 percent (NEFMC 2011) and NMFS has recently required all Atlantic scallop fisheries using dredges 10.5 feet in width or greater to start using TDDs (77 FR 20728, 6April 2012). The NEFSC scallop surveys use a combination of commercial scallop gear, i.e., TDDs with turtle chains in accordance with regional fishing regulations, and an eight foot wide New Bedford type dredge for consistency with past NEFSC surveys which have provided the basis for scallop stock assessments (Table 2.2-1). The NEFSC has never captured sea turtles in any of their surveys using various scallop dredge gear. In addition, the NEFSC conducts a surfclam/ocean quahog survey with hydraulic-jet dredge gear (Table 2.2-1). This survey also has no record of sea turtle takes.

The lack of historical takes from research fishing and the substantial differences between research surveys and commercial fisheries makes it difficult to provide quantitative estimates of potential future takes of sea turtles in research dredge gear. Given the continued use of fishing gear with documented adverse interactions with sea turtles, there is a risk of future interactions during NEFSC research activities, both captures in the dredge gear and unobserved collisions with sea turtles on the sea floor that may cause injuries. However, based on the lack of observed research takes, the short tow times (15 minutes for most tows), and the relatively small number of research tows (less than 450 scallop tows and 150 surfclam/quahog tows per year compared to tens of thousands of commercial dredge tows), the risk of future adverse interactions with sea turtles is small, and interactions would likely be rare occurrences.

Contamination or Degradation of Habitat

Bottom trawl and dredging gear contact the bottom and can disrupt the ocean floor and benthic sediment. This can disturb or damage important foraging habitats for sea turtles, and cause turbidity in the water that

would make it difficult for turtles to locate prey. However, surveys conducted by NEFSC research programs impact very small areas of the ocean floor relative to the entire area and relative to the footprint of commercial fisheries (see Section 4.2.2), and, due to the stratified random design of many surveys, typically do not occur in the same geographic location from year to year. The proposed critical habitat for the Northwest Atlantic Ocean DPS of loggerhead sea turtle (78 FR 43006, 18 July 2013) includes marine waters around Cape Hatteras that may be affected by NEFSC-affiliated research activities, including bottom trawls. The number of research trawls in the proposed area would vary from year to year, but would likely be limited to a small number of tows (tens, not hundreds), each of which would last about 20 minutes and impact about 0.0135 square miles. The impacts of research gear on benthic habitat, including the proposed critical habitat for loggerheads, are therefore small in magnitude and temporary in duration.

For the same reasons described for fish (Section 4.2.3) and marine mammals (Section 4.2.4), potential effects on sea turtles from accidental discharges of fuel or other contaminants from NEFSC research vessels are possible but unlikely to occur in the near future. If an accidental discharge does occur, it is likely to be a rare event and the potential volume of material is likely to be small and localized. The potential impacts to sea turtles would be similarly short-term, localized, and likely affect a small number of animals. The overall impact of accidental contamination of sea turtles would therefore be considered minor adverse. This type of potential effect on sea turtles will not be discussed further in this analysis.

4.2.6.1 Conclusion

NEFSC fisheries research activities conducted under the Status Quo Alternative involve a relatively small number of research vessels, short deployments of fishing gear, and sample sites dispersed over a wide area. Behavioral disturbances of sea turtles from research vessels or fishing gear would be temporary in nature, lasting only a few minutes as the research vessel passes, and are therefore likely to have negligible effects on turtle foraging success or survival. The potential for research vessels to degrade turtle habitat through benthic disturbance or contamination from accidental spills and discharges would likely be minor in magnitude, infrequent or rare, and localized.

Historical takes of sea turtles in NEFSC research gear have been primarily in the Southern New England and Mid-Atlantic Bight areas, where the overlap of sea turtle habitat and NEFSC-affiliated research occurs, with a small number of takes in the Southeast U.S. Continental Shelf LME. Sea turtles have been incidentally caught in NEFSC-affiliated research gear in the past, including bottom trawls, longline gear, and gillnets, but almost all of these turtles have been released alive in good to excellent condition. Future incidental captures of sea turtles in these research gear types are certain but it is likely that most of these turtles will be released in good condition because of the short tow and set durations of most NEFSC research activities and the presence of trained turtle-handling personnel on research crews. There is a potential for serious injury and mortality of sea turtles in research gear, especially those relatively few cooperative research activities that have protocols (i.e., tow durations greater than one hour or long soak times) similar to commercial fishing conditions. The Final PEA uses a number of assumptions to provide a conservative estimate of future captures/hookings of sea turtles, including an estimate for serious injury and mortality up to two loggerhead, four Kemp's ridley and one leatherback sea turtles per year, primarily in short-term cooperative research projects. Only one known mortality has occurred in the past ten years out of 75 captured/hooked sea turtles so this estimated mortality level is unlikely to occur. This level of mortality for these species, if it occurred, would be small in magnitude relative to the overall size of these populations.

The overall effects of the Status Quo Alternative on ESA-listed sea turtles would likely be small in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse on all species of sea turtles according to the criteria in Table 4.1-1.

4.2.7 Effects on Invertebrates

This section describes the general types of effects of the Status Quo Alternative on invertebrate species. The potential effects of research vessels, survey gear, and other associated equipment on invertebrates include:

- Mortality from fisheries research activities
- Physical damage to infauna and epifauna
- Changes in species composition
- Contamination or degradation of habitat

Mortality from Fisheries Research Activities

Fisheries research in the NEFSC research areas typically target commercially important invertebrates, including sea scallops, clams, lobsters, squid, and shrimp. Most research mortality of these species occurs during targeted surveys, but also results from by-catch during other research surveys, such as bottom trawl surveys. In addition, benthic invertebrates can be crushed by fishing gear that contacts the sea floor, such as bottom trawls and dredges. There is decreased crush injury to invertebrates in locations where the substrate consists of sand, silt and/or mud (Hiddink et al. 2006).

The NEFSC bottom trawl and dredge surveys that are important for monitoring benthic invertebrate populations (Table 2.2-1) are distributed throughout the four LME subareas and occur in all seasons, with lowest effort in winter (Appendix B). Survey results over the years indicate that invertebrate abundance is not uniform among or within the LME subareas. Concentrations of different species reflect differences in sediment composition, depth, temperature, food availability, and other factors (NEFSC 2011a). The catch of invertebrate species in research surveys varies substantially within each LME subarea, with higher catch rates in samples from good habitat areas and very low or no catch in other samples. These surveys provide important data to determine biomass estimates, reproductive potential, and distribution of commercially valuable invertebrate stocks, which are necessary for fisheries managers to maintain healthy populations and rebuild overfished/depressed stocks. These surveys also sample closed areas to monitor the status of stocks for which the areas have received protection in the form of fishery restrictions.

Some of the short-term cooperative research projects funded by or otherwise affiliated with the NEFSC are focused on commercial invertebrate fisheries such as scallops (Table 2.2-2). Some do not catch invertebrates or impact benthic habitat (e.g., video camera projects); while others have substantial catches in an effort to compare the efficiency of different gear types or new bycatch reduction methods. As is the case with cooperative research projects focusing on fish species, it is difficult to predict what projects will be funded in the future, and therefore how much of different invertebrate species may be caught. Proposals are developed every year to address current issues and each proposal must be screened for scientific validity and compete with other proposals for funding. The following analysis considers the catch data from the cooperative research projects from 2008-2012 to represent the status quo baseline and to estimate future catch due to these types of projects. The combined catch from NEFSC conducted surveys and short-term cooperative research projects provide the estimated catch from all NEFSC affiliated fisheries research activities.

The impact of mortality from fisheries research depends on the magnitude of the research catch relative to the overall biomass or population level of the species. Measuring these relative effects is difficult because there are very few species for which total populations have been estimated with any degree of certainty. To assess the magnitude of mortality effects in this Final PEA, the amount of invertebrates caught in NEFSC research is compared to the amount caught in commercial fisheries, which is well known. Because commercial harvest limits are set at a fraction of estimated population, the magnitude of research catches relative to overall population levels would be much less than what is indicated in the

comparisons with commercial landings. The Final PEA does not attempt to analyze the effects of research mortality on each of the hundreds of species caught in the various surveys; only species that are caught most frequently (total catch over one ton), and those species that are overfished or where overfishing is occurring are analyzed. Table 4.2-19 shows the average annual weight of the most frequently caught invertebrate species in the past five years (2008-2012) from NEFSC-affiliated research surveys and cooperative research projects. These average annual research catches are compared to the average annual commercial landings of target species in the Northeast Region (2008-2012), to give an indication of the relative size of research catches. Research impacts on invertebrates include direct catches from surveys targeting invertebrates and catches incidental to other surveys. Research landings were well below 1 percent of commercial landings for all major invertebrate species caught in research surveys. For these species, the magnitude of research mortality is very small relative to the fisheries and even smaller relative to the estimated populations of these invertebrates.

Table 4.2-19 Relative Size of NEFSC-Affiliated Research Catch of Invertebrates Compared to Commercial Catch (Landings)

Species are listed in descending order of total research catch by weight. Only species/groups with total catch greater than one ton (2,000 pounds) are listed.

Species	Status of the Stock[1]	Average NEFSC research catch per year (tons) (2008-2012 data)	Average cooperative research catch per year (tons) (2008-2012 data)	Total average NEFSC affiliated research catch per year (tons) (2008-2012)	Average commercial landings per year (tons)[2] (2008-2012)	Average research catch compared to commercial landings (percentage)
Sea scallop	Not overfished	45.42	16.82	62.28	28,371.25	0.22%
Long-finned squid (*Loligo spp.*)	Unknown	6.37	6.38	12.75	10,940.43	0.12%
American lobster	GOM and GB not overfished; SNE overfished and depleted	10.65	0.18	10.84	58,187.64	0.02%
Ocean quahog	Not overfished	10.08	0	10.08	14,384.04	0.07%
Horseshoe crab	NA	3.76	<0.01	3.76	753.98	0.50
Atlantic Surfclam	Not overfished	3.41	0	3.41	22,007.62	0.02%
Sea stars	NA	1.08	1.42	2.50	NA	NA
Northern (*Pandalus*) shrimp	Not overfished	2.38	0	2.38	4,481.99	0.05%

1. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Second quarter 2013 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm
2. Source: Commercial catch data from NMFS Office of Sustainable Fisheries website: http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index

Physical Damage to Infauna and Epifauna

NEFSC bottom trawl surveys and other bottom contact gear can impact infauna and epifauna invertebrates in sand, silt, and gravel substrates. Infauna live in the seafloor or within structures that are on the seafloor and include clams, tubeworms, and burrowing crabs that usually construct tubes or burrows and commonly occur in deeper and subtidal waters. Epifauna, including mussels, crabs, starfish, sponges, and corals live on the surface of the seafloor or on structures on the seafloor such as rocks,

pilings, or vegetation. They either attach to these surfaces or range freely over them by crawling or swimming. Fishing gear that contacts the seafloor can disturb infauna and epifauna by crushing them, burying them, removing them, or exposing them to predators, and thus can reduce complexity and species diversity (Collie et al. 2000, Morgan and Chuenpagdee 2003). The level of biological damage to infauna and epifauna can vary from very minimal with infrequent disturbance to severe with repeated disturbance in the same areas (Stevenson et al. 2004). Since most research surveys are conducted with randomly selected sample sites every year, the potential for repeated disturbance to an area is very low.

Organisms such as cold water corals create structure on the seafloor that may provide important habitat for many organisms, including fish (Auster and Langton 1999, Stevenson et al. 2004). Cold water corals are generally slow growing, long-lived, and fragile, which makes them particularly vulnerable to damage. Bottom contact fishing gear can break or disrupt corals, thereby reducing the structural complexity of habitat, which may lead to reductions in the species diversity of the corals and other animals that utilize this habitat (Freiwald et al. 2004, Heifetz et al. 2009).

The removal of structural organisms may only be reversible through natural recovery that may occur over hundreds of years (Freiwald et al. 2004). Cold-water corals such as *Lophelia pertusa* and *Madrepora oculata* are known to exist in the NE LME although their exact distribution and abundance are poorly understood (CORIS 2010). Potential effects on organisms that produce structure would be independent of what season the research was conducted because the organisms are not mobile and could take long periods to recover.

Bottom trawl and dredge surveys are only conducted on suitable benthic substrates, e.g. sand, silt or gravel bottoms with few large rocks or sharp surfaces that may damage the gear. Rocky areas that are more likely to support corals are avoided by using sonar to examine the bottom contours before surveys are conducted. In addition, two closed areas with known concentrations of hard corals, Lydonia Canyon and Oceanographer Canyon (Figure 3.1-3), would not be surveyed with bottom contact gear under the Status Quo. NEFSC research activities cause damage to corals and other organisms that produce structure in benthic habitats outside of the known deep-sea coral zones. However, the magnitude and geographic extent of potential impacts to benthic organisms due to NEFSC research activities would be considered minor given the very limited amount of area swept during research surveys (see Table 4.2.2). Such impacts could be long-term for some species such as slow-growing corals but temporary or short-term for other species.

<u>Changes in Species Composition</u>

Massive removals of marine invertebrate species from an ecosystem could potentially alter community structure and predator-prey relationships at possibly unsustainable levels (Donaldson et al. 2010). Commercially important invertebrate species are managed under FMPs with the management intent to harvest at rates that promote optimal yield, with an increasing emphasis on taking ecosystem considerations into account when setting harvest levels. In commercial fisheries, bycatch is either returned to the sea or landed if it has adequate commercial value and is allowed by the appropriate FMP. Bycatch can be minimized through gear and operational modifications, including localized fishing closures.

Studies conducted in the North Sea found that chronic commercial trawling reduced benthic biomass by approximately 50 percent (Hiddink et al. 2006). Species richness and the functional composition of benthic communities were also impacted. Species most affected by the trawling were permanently attached species, larger bodied and longer-lived species, and filter-feeders, while scavengers, burrowers, and short-lived and small species were not significantly affected (Hiddink et al. 2006, Tillin et al. 2006). Despite large reductions in infauna and epifauna biomass in intensively trawled areas, the mean trophic level of the benthic communities and trophic relationships within the communities were relatively unchanged (Jennings et al. 2001). The study concluded that trophic structure of intensively trawled

benthic invertebrate communities may be a robust feature of the North Sea ecosystem. Contrary to the intensive and chronic bottom trawling conducted by commercial fisheries in localized regions of high catch probability, NEFSC research bottom trawl and dredge surveys are of short duration, generally of randomized design, are rarely repeated in the same location over time, and are collectively much smaller in scale. They are, therefore, likely to have only minor and short-term effects on benthic communities.

Contamination or Degradation of Habitat

Fishing activities involving gear that contacts the sea floor (i.e., bottom trawls and dredges) physically disturbs benthic habitats used by invertebrate species. Such effects can include furrowing and smoothing of the sea floor (Morgan and Chuenpagdee 2003). Physical effects to the sea floor from fishing gear increase with increasing frequency and duration. In addition, bottom trawl activities can locally increase turbidity which may interfere with feeding activities of filter-feeding organisms.

However, many research surveys conducted by the NEFSC and cooperative research programs are stratified random designs, meaning the exact location of a survey trawl or dredge tow is randomly determined each year within an area of interest. Repeated trawls in the same location are rare or infrequent. Research tows are also limited to 15-30 minutes so the footprint of each tow is very small. An analysis of the area involved in bottom trawl and dredge surveys in Section 4.2.1 indicates that research surveys in the Status Quo Alternative would cover much less than 0.1 percent of each LME subarea each season, even in the most heavily sampled seasons. Recovery time from trawl surveys in the soft-bottom environments they target is estimated to be less than two years (Jennings et al. 2001). Therefore, effects to invertebrate habitats from research surveys are expected to be minor in magnitude and short-term in duration, especially compared to the magnitude of habitat disturbance caused by commercial fishing operations.

The potential for research vessels to cause degradation of benthic and pelagic habitat through contamination would only be through accidental spills and discharges, which would likely be limited in magnitude, rare, and localized for the reasons described in Section 4.2.3.

4.2.7.1 Conclusion

NEFSC-affiliated fisheries research conducted under the Status Quo Alternative could have direct and indirect effects on many invertebrate species through mortality, physical damage to infauna and epifauna, changes in species composition, and contamination or degradation of habitat.

For all invertebrate species targeted by commercial fisheries and managed under Fishery Management Plans, mortality due to research surveys and projects is much less than one percent of commercial and recreational harvest and is considered to be minor in magnitude for all species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities and the risk of altering benthic community structure would be minimal. Disturbance of animals and benthic habitats from research activities would be temporary and minor in magnitude for all species. As described in Section 4.2.1, the potential for accidental contamination of marine habitats from accidental spills from research vessels is considered unlikely and would be minor in magnitude and temporary or short-term in duration. The overall direct and indirect effects of the Status Quo Alternative on invertebrates would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the impact criteria in Table 4.1 1.

In contrast to these adverse effects, NEFSC-affiliated research also provides long-term beneficial effects for managed invertebrate species throughout the Northeast region through its contribution to sustainable fisheries management. The NEFSC conducts stock assessment, habitat research, and bycatch reduction research for several invertebrate species (i.e., lobsters, scallops, Loligo squid, and quahogs) that are important for commercial and recreational fisheries. Scientific information from the NEFSC on the status and trends of plankton and many other invertebrate species is also crucial for understanding the health of

the marine environment and is incorporated into ecosystem-based management models. The beneficial effects of the oceanographic and fisheries time-series data provided by NEFSC research programs are especially valuable for tracking long-term trends in the marine environment important to invertebrate populations.

4.2.8 Effects on the Social and Economic Environment

Section 3.3 describes the interaction of the NEFSC with the social and economic environment of the Northeast coastal U.S. This section describes the effects of NEFSC-affiliated fisheries and ecosystem research conducted under the Status Quo Alternative on socioeconomic resources of the Northeast region. Major factors that could be influenced by the NEFSC research program include:

- Collection of scientific data used in sustainable fisheries management
- Economic support for fishing communities
- Collaborations between the fishing industry and fisheries research
- Fulfillment of legal obligations specified by laws and treaties

Collection of Scientific Data used in Sustainable Fisheries Management

The NEFSC fisheries research program has the most potential to affect the social and economic environment through its contribution to the fisheries management process. The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act, establishes a collaborative fisheries management process with key roles for NOAA Fisheries, the regional Fishery Management Councils, and the Interstate Marine Fisheries Commissions. These entities jointly develop Fishery Management Plans (FMP) for the Nation's fishery resources through extensive discussions with states, tribes, other federal agencies, the commercial fishing industry, public interest groups, universities, and the general public, and through partnerships with international science and management organizations. Under the MSA, FMPs must contain conservation and management measures which prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery. The MSA defines optimum yield as:

> (A) the amount of fish which 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.

Among other considerations, FMPs must also contain provisions to conserve essential fish habitat, minimize bycatch and the mortality of bycatch, and provide for the sustained participation of fishing communities while minimizing adverse economic impacts on them, to the extent practicable and consistent with conservation aims and requirements. In carrying out Congress's mandate under the MSA, NOAA Fisheries is responsible for ensuring that management decisions involving fishery resources are based on the highest quality, best available scientific information on the biological, social, and economic status of the fisheries.

Under the Status Quo Alternative, the long-term, standardized resource surveys conducted by the NEFSC and its cooperative research partners, as summarized in Table 2.2-1, provide a rigorous scientific basis for the development of fisheries stock assessments and federal fishery management actions in the Northeast region. The extended time-series of data helps identify trends that inform fisheries management planning.

This information is essential to establishing annual species-specific sustainable harvest limits on an optimal yield basis. Many Status Quo research surveys also provide important comparative information on open, managed, and closed fishing areas, such as the differences between recovery rates, biodiversity, and species density that is vital to assessing the success of fisheries management measures. NEFSC fisheries research also provides information on ecosystem characteristics that is essential to management of commercial fisheries. Climate change and increase in ocean acidification have the potential to impact the population and distribution of marine species. Long-term, predictable marine research provides information on changes to and trends regarding the marine ecosystem that must be considered by fisheries managers. In addition to the long-term NEFSC research surveys, short-term research projects conducted by cooperative research partners, as described in Table 2.2-2, address strategic issues important to the commercial fishing industry, such as the development and monitoring of current and emerging fisheries, habitat characterization and conservation, development of ecosystem management methods, and ways to reduce bycatch of non-target species. The scientific information provided by the NEFSC is therefore used not just for current management decisions, but also to conserve resources and anticipate future trends, ensure future fishing utilization opportunities, and assess the effectiveness of the agency’s management efforts.

The fisheries management process can be contentious when fisheries stocks are relatively scarce and resources must be rationed and allocated among competing commercial, recreational, and environmental interests. Past overfishing practices have led to depleted stocks and, under mandates from the MSA to establish harvest limits to halt overfishing and rebuild depleted stocks, the fishery management process has imposed significant reductions in harvest limits for some fisheries in order to rebuild stocks of overfished species. These reductions in harvest limits have resulted in adverse economic impacts on certain sectors of the fishing industry with associated adverse social impacts on fishing communities. However, after decades of overfishing and diminishing yields, fish stocks in the Northeast region are generally in recovery, due in part to management decisions made with the input from NEFSC fisheries research activities. Rebuilding stocks of important commercial and recreational species would result in long-term beneficial effects on the economies and social relations and cultural institutions of many fishing communities along the Atlantic coast. Scientific data provided through the long-term and short-term fisheries research conducted and associated with the NEFSC has played an important role in the development of fisheries and conservation policies through informing the fisheries management process.

Economic Support for Fishing Communities

One of the ways the NEFSC research activities support the social and economic environments is through its role in supporting commercial and recreational fisheries management in the Northeast. In 2011, commercial fishermen in the Northeast landed 902 million pounds of finfish and shellfish, earning $1.6 billion in landings revenue. Overall, commercial fishing (exclusive of imports) generated 4.5 million jobs, $740 million in sales, and $258 million in value added. In that same period, 3.7 million recreational anglers (over 90 percent of whom were residents of a regional coastal county) took 22.1 million trips. Overall, recreational fishing generated 35.4 million jobs, $4.9 billion in sales, $1.7 billion in income, and $2.6 billion in value added (NMFS 2013b). In addition, the majority of commercial and recreational fishermen value fishing as much for the activity itself and the part it plays in their way of life and cultural traditions as they do for the money they earn (Holland and Ditton 1992, Pollnac and Poggie 2008, Smith and Clay 2010). In some cases, fishermen will even subsidize fishing with income from another job in order to stay on the water (Veltre and Veltre 1983, Doeringer et al. 1986). Further, recreational fishing can also include some subsistence fishing, potentially based on ethnicity, gender or location (Toth and Brown 1997, Steinback et al. 2009).

Within this context, social and economic data collection and analysis in the Northeast allows for determination of the relative social and economic impacts of a set of proposed management alternatives. This type of information is also important for compliance with Executive Order (EO) 12898 on

environmental justice, which directs agencies to assess actions that may disproportionately affect low income and minority populations. Where conservation outcomes are similar, NMFS attempts to choose alternatives with the most positive or, at a minimum, least negative social and economic impact on fishermen, the fishing industry, related shoreside industries, and fishing communities.

Another way the NEFSC contributes to the social and economic environments is through direct expenditures on fisheries research. The NEFSC's annual spending fluctuates, but has averaged about $60 million in the 2008-2012 period (NEFSC Operations Management and Information Staff pers. comm. 2013). This spending has direct and indirect beneficial economic effects on the communities and ports in the Northeast Region through expenditures in support of NOAA vessels, chartered vessels, and research facilities as well as providing employment and contracted services that contribute to local economies. Some commercial fishing operations are compensated for participation in cooperative research projects through grants or shares in fishing quotas that they sell on the market. Other cooperative research partners, including state agencies, universities, and commercial fishing associations, receive funding through the NEFSC which supports their employees, research vessels, and facilities and therefore supports a large number of local economies. Altogether, the NEFSC currently spends approximately $15.7 million annually in support of the fisheries research activities covered in the Status Quo Alternative, not including capital costs of vessels and facilities (NEFSC Operations Management and Information Staff pers. comm. 2013). This includes ship time, staff time, equipment, materials, logistics costs, and contracts. Funding for cooperative research programs has fluctuated widely in the past and was strongly influenced by congressional earmarking during budget appropriations. The average amount of money distributed through the various cooperative research efforts administered through the NEFSC has averaged about $5 million in recent years. Similarly, in addition to benefits of social and economic research to the fisheries management enterprise, NEFSC supplies contracts and grants to individual social science researchers and to academic and other institutions throughout the Northeast that conduct social science research on how humans impact and are impacted by ecosystems, climate change, interactions with protected species, wind energy development, and other issues.

Another indirect benefit to commercial and recreational fishermen is the cash rewards offered for capture of tagged fish (e.g., Atlantic cod and yellowtail flounder tagging projects). Fishermen who capture tagged fish are rewarded monetarily through tagging programs for reporting the capture, and/or returning the tag or whole fish to the survey sponsor. These types of programs also help foster a positive relationship between research, industry, and recreational fishermen, and provide incentives to the general public to participate in fisheries research programs.

The magnitude of the economic impacts of NEFSC fisheries research activities must be placed in the context of regional and local economies according to the impact criteria in Table 4.1-1. While the contribution of research-related employment and purchased services is undoubtedly important and beneficial for many individuals and families, the total sums spent for research are very small compared to the value of commercial and recreational fisheries in the area as well as the overall economy of those communities. The contribution of NEFSC research is relatively larger for some communities where the research is centered (i.e., Woods Hole) and may be considerate moderate in magnitude for those communities but the overall direct impact would be minor in magnitude for most communities. These direct impacts would be certain to occur under the Status Quo Alternative, would affect numerous communities throughout the region, and would be long-term and beneficial. Overall, the beneficial economic impacts of NEFSC fisheries research activities would be considered minor to moderate according to the impact criteria in Table 4.1-1.

There are certainly indirect impacts of fisheries research to the economic status of fishing communities but these impacts are filtered through a long and complicated fisheries management environment. It is not possible to assign a monetary value to these indirect impacts although, as stated before, these impacts are generally considered beneficial to fishing communities through their contribution to sustainable fisheries management. In any case, fisheries management decisions by the Fishery Management Councils and

NMFS are subject to their own NEPA compliance processes where these types of economic impacts are analyzed in depth so they will not be assessed in this Final PEA.

Collaborations between the Fishing Industry and Fisheries Research

Cooperative research is an important element in establishing communication, trust, and information exchanges between scientists, fisheries managers, and the fishing industry. Cooperative research is used to: a) increase the precision and expand the scope of resource surveys; b) provide supplemental information about fishing operations; c) incorporate fishing expertise into the design and implementation of research; and d) build mutual understanding and respect among scientists and people in the fishing industry. Collaboration in the development of new gear and techniques encourages participation in developing sustainable fishing practices and contributes to a broader understanding of management for marine resources.

Under the Status Quo Alternative, the relationships that are being built between scientists and the fishing industry through the cooperative research programs would continue to serve as a vehicle for sharing knowledge and building mutual understanding and respect. Several NEFSC-affiliated fisheries research programs, such as the deepwater biodiversity surveys, provide opportunities for undergraduate and graduate students to participate in and gain valuable practical experience in marine research. As more members of the fishing industry become engaged in the research programs that ultimately feed into the development of fisheries management measures, there will be an increased level of public education and awareness about the basis for fishery regulatory changes. The participation of highly experienced and resourceful members of the fishing industry also leads to valuable advances in conservation engineering, which in turn results in more efficient fishing and fewer adverse effects on the marine environment.

Fulfillment of Legal Obligations Specified by Laws and Treaties

Chapter 6 provides a list of laws and treaties applicable to the NEFSC fisheries research program. These obligations include the 1996 amendment to the MSA, which requires assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities (NMFS 2007b). The NEFSC fisheries research programs help fulfill these obligations under the MSA for the Northeast Region. In addition, research conducted by the NEFSC and cooperating partners on highly migratory species helps fulfill U.S. treaty obligations for conservation and management of these species under the International Convention for the Conservation of Atlantic Tunas.

4.2.8.1 Conclusion

NEFSC-affiliated fisheries and ecosystem research conducted under the Status Quo Alternative would provide a rigorous scientific basis for fisheries managers to set optimum yield fishery harvests while protecting the recovery of overfished resources and ultimately rebuilding these stocks to appropriate levels. It also contributes directly and indirectly to local economies, promotes collaboration and positive relationships between NMFS and other researchers as well as with commercial and recreational fishing interests, and helps fulfill NMFS obligations to communities under U.S. laws and international treaties.

The direct and indirect effects of the Status Quo Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be felt throughout the Northeast region. According to the impact criteria established in Table 4.1-1, the direct and indirect effects of the Status Quo Alternative on the social and economic environment would be minor to moderate and beneficial.

4.3 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 2 - PREFERRED ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 2 – Preferred Alternative on the physical, biological, and social environment. Under this Alternative, the NEFSC would conduct a new suite of research activities and implement new mitigation measures in addition to the Status Quo program to comply with the requirements of the MMPA and ESA compliance process. The new suite of research activities is a combination of past research and additional, new research. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under Alternative 2 is presented below in Table 4.3-1.

Table 4.3-1 Alternative 2 Summary of Effects

Resource	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
SECTION #	**4.3.1**	**4.3.2**	**4.3.3**	**4.3.4**	**4.3.5**	**4.3.6**	**4.3.7**	**4.3.8**
Effects Conclusion	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to Moderate *beneficial*

4.3.1 Effects on the Physical Environment

The effects of the Preferred Alternative on the physical environment would be similar to those of the Status Quo Alternative (Section 4.2.1). The additional mitigation measures for protected species proposed under the Preferred Alternative would not change the effects of the research activities on physical properties of the environment. The changes to the suite of research activities conducted under the Preferred Alternative would result in minimal changes to the physical effects to the benthic environment relative to the Status Quo Alternative. Therefore, the overall effects of The Preferred Alternative on the physical environment would be minor in magnitude, dispersed over a large geographic area, of moderate duration or long-term but would not be repetitive in the same location, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.3.2 Effects on Special Resource Areas and Essential Fish Habitat

The effects of the Preferred Alternative on special resource areas would be similar to those of the Status Quo Alternative (Section 4.2.2). The additional mitigation measures for protected species proposed under the Preferred Alternative would not change the effects of the research activities on the physical components of the environment or most biological components; they would only tend to decrease effects on protected species. The changes to the suite of research activities conducted under the Preferred Alternative would result in minimal changes to the physical and biological effects to special resource areas and Essential Fish Habitat (EFH) relative to the Status Quo Alternative. Therefore, the overall effects of The Preferred Alternative on special resource areas would be minor in magnitude, dispersed over a large geographic area, of moderate duration or long-term but not repeated in the same location year to year, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1. As was the case for the Status Quo Alternative, the scientific data generated from NEFSC research activities under the Preferred Alternative would also have beneficial effects on special resource areas, including National Marine Sanctuaries, through their contribution to science-based conservation management practices.

4.3.3 Effects on Fish

NEFSC-affiliated fisheries research conducted under the Preferred Alternative would have the same types of effects on fish species as described for the Status Quo Alternative (Section 4.2.3) through mortality, disturbance, and changes in habitat. There are small changes in the long-term research projects conducted under the Preferred Alternative (Table 2.3-1), including the addition of some pelagic trawls and NE Observer Program training cruises, but most of the additional projects would deploy primarily plankton nets and oceanographic instruments. The Preferred Alternative does not include any additional long-term surveys that would result in meaningful increases in catch of any ESA-listed species, target species, HMS, or other fish species compared to the Status Quo Alternative. However, the Preferred Alternative includes an estimated scope of short-term cooperative research projects that is substantially greater than what was conducted under the Status Quo Alternative and therefore has the potential to increase catch of all fish species. The following analysis will discuss the effects of the Preferred Alternative on ESA-listed fish and target species through mortality; effects on highly migratory species and all other effects are as described for the Status Quo Alternative (Section 4.2.3).

The estimated level of future short-term cooperative research effort with different gear types (Table 2.3-2) is based on research goals established by the New England Fishery Management Council, Northeast Consortium Cooperative Research Program, Commercial Fisheries Research Foundation, and the various Research Set-Aside programs (Section 2.2), as interpreted by the NEFSC Cooperative Research Partners Program. It is an optimistic projection in that future funding for these types of projects is assumed to be sufficient to accommodate most research goals. However, actual funding levels in the future, and therefore the level of research effort, could be substantially less than estimated. It is difficult to estimate future catch of fish and invertebrates in these cooperative research programs given three conditions: 1) funding levels from Congress are variable and uncertain, 2) research projects are developed each year based on emerging information needs from various commercial fisheries, and 3) research proposals are subject to annual reviews and competition for existing funds. The nature of future research protocols and objectives is therefore unknown. In addition, many of the future cooperative research projects would likely be funded through the research set-aside programs that allocate a certain percentage of the Annual Catch Limit or days-at-sea for commercial fisheries to support research projects. The harvest from these projects is sold on the open market and accounted for under the various FMPs so the research does not necessarily add to the amount of fish and invertebrates that would otherwise be caught.

4.3.3.1 ESA-listed Species

There are four marine fish species in the project area currently listed under the ESA, the Atlantic salmon, shortnose sturgeon, and smalltooth sawfish are listed as endangered and the Atlantic sturgeon is listed as threatened or endangered depending on its location. The Atlantic sturgeon has five distinct population segments (DPS) within the NEFSC research area; the Gulf of Maine DPS is listed as threatened while the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered. The NEPA context for impacts to these species is considered important due to their status as ESA species.

Directed research on ESA-listed species requires permitting under section 10 of the ESA, which is subject to its own NEPA analysis, and is not covered under this Final PEA. The following discussion involves effects on ESA-listed species incidental to the purpose of NEFSC-affiliated fisheries research.

<u>Mortality from Fisheries Research Activities</u>

Only two Atlantic salmon have been captured during the NEFSC annual fishery surveys; one in the NEFSC BTS in 1977 and the second during the spring 2012 BTS. Both fish were captured along the coastline of Maine. There have been no records of Atlantic salmon takes in short-term cooperative research projects under the Status Quo. Future NEFSC research activities on NOAA vessels and cooperative research surveys could encounter Atlantic salmon but it would likely be a rare occurrence

with minimal magnitude of effect and, therefore, would be considered a minor adverse effect according to the criteria in Table 4.1-1.

To date, there have been no documented cases of shortnose sturgeon takes in the NEFSC bottom/midwater trawl or sea scallop dredge surveys or similar commercial fisheries. Future catch of this species in NEFSC research is possible but would likely be a rare event and the effect of fishery research activities on this species through direct mortality is therefore considered minor adverse.

Atlantic sturgeon have been caught on an infrequent but regular basis during the standard NEFSC BTS and both portions of the NEAMAP bottom trawl surveys, as described in Section 4.2.3.1. All of these fish were released alive and in apparent good condition. Two short-term cooperative research projects have recorded catches of one Atlantic sturgeon each but the disposition of the fish (mortality, injury, or released alive) were not recorded. Both of these fish were caught before Atlantic sturgeon were listed under the ESA in 2012. The analysis of potential future takes under the Status Quo Alternative used catch rates from these surveys (fish caught per trawl) and the number of annual bottom trawls in the different surveys to estimate future takes. Because of the great diversity of potential locations, timing, and protocols for future short-term cooperative research projects, factors that could affect catch rates, data from the NEAMAP surveys was used to approximate catch rates for these types of research projects. Table 4.3-2 follows the same format as the analysis for the Status Quo Alternative (Section 4.2.3.1) except it uses the applicable values for bottom trawl effort under the Preferred Alternative.

Table 4.3-2 Estimated Future Takes of Atlantic Sturgeon under the Preferred Alternative

Research Activity	Trawls per year	Capture rate (sturgeon per trawl)	Estimated annual captures	Estimated Atlantic sturgeon takes per year (rounded up)
BTS	800	0.00379	3.03	4
NEAMAP (ME-NH)	200	0.01083	2.17	3
NEAMAP (VIMS)	300	0.07556	22.67	23
Other long-term research using bottom trawl gear	910	0.00379	3.45	4
Short-term cooperative research using bottom trawl gear	1700	0.04967	84.44	85
Total estimated Atlantic sturgeon takes per year in NEFSC-affiliated bottom trawl gear				**119**

Table 4.3-2 provides estimates of Atlantic sturgeon take for each set of research activities and the overall total for NEFSC-affiliated fisheries research. Based on this analysis, up to 119 Atlantic sturgeon per year could be captured incidentally during NEFSC-affiliated research using bottom trawl gear under the Preferred Alternative. This estimate is considered conservative in that it exceeds past recorded takes and actual take levels would likely to be less than the estimate. Most Atlantic sturgeon caught would be expected to be released alive and in good condition based on past experience. Given the continued use of fishing gears that have caused mortality of sturgeon in commercial fisheries, and since some cooperative research projects may include research protocols similar to commercial fishing conditions, there is a potential for NEFSC-affiliated fisheries research to cause mortality of sturgeon in the future. However, given the substantially shorter tow times and other differences between most research and commercial fishing, such incidents would likely be rare.

No other long-term or short-term research projects have reported any interactions with Atlantic sturgeon using gillnets or any other gear. However, gillnets are used for several long-term research projects, including COASTSPAN Gillnet Surveys and NEFOP Observer Gillnet Training Trips. The COASTSPAN surveys use short set times (3 hours) and continuously run the net to collect target species

(sharks) and release all other species quickly. Based on past experience, the potential for capturing sturgeon in COASTSPAN surveys is low and the potential for mortality is negligible. The observer training trips and projected short-term cooperative research projects using sinking gillnets are relatively small and captures of Atlantic sturgeon would likely be rare events.

Several past short-term cooperative research projects have used gillnet gear for research in association with commercial fisheries that have caught Atlantic sturgeon in the past. One past project, "Bycatch Reduction Engineering Program (BREP) monkfish gillnet – sturgeon", was a pilot project to begin examining factors that could affect bycatch of Atlantic sturgeon in a commercial fishery. That project continued after Atlantic sturgeon were listed under the ESA in 2012 but it required a section 10 permit under the ESA; coordination moved to the NEFSC Protected Species Branch and the project was covered under directed research permits issued under the ESA (NMFS 2013c). Such directed research on ESA-listed species is not covered in this Final PEA under the Preferred Alternative. Any future proposed projects that had a reasonable chance of adverse interactions with ESA-listed species would either be covered under directed research permits or, if the effects were incidental to the intent of the research, would receive additional scrutiny (section 7 consultation) to ensure that the research does not harm the stock before it is issued a research permit.

Overall, the potential effects of incidental bycatch of Atlantic sturgeon during NEFSC-affiliated fisheries research conducted under the Preferred Alternative would be low in magnitude, distributed over a wide geographic area, and temporary or short-term (for fish captured and released); the effects are considered minor adverse according to the criteria in Table 4.1-1.

4.3.3.2 Target and Other Fish Species

Mortality from Fisheries Research Activities

As noted in the ESA-listed species section above, the number of short-term cooperative research bottom trawls estimated to occur under the Preferred Alternative would be up to 1700 trawls per year with various bottom trawl configurations. This is almost three times the average level of effort under the Status Quo Alternative (614 bottom trawls per year). The estimated level of effort with other gears is also higher than the corresponding gear effort under the Status Quo. Given the uncertainties about the scope and nature of short-term cooperative research projects discussed above, there is no way to translate this programmatic increase in research fishing effort into quantitative estimates of catch without making some assumptions. For the purposes of this Final PEA analysis, the resulting catch in the short-term cooperative research segment of the total NEFSC-affiliated catch will be assumed to be 300 percent of the Status Quo Alternative. This level of catch is likely to be substantially higher than what might actually occur and therefore provides a conservative estimate of the impacts of research. Table 4.3-3 provides the same analysis of research catch relative to commercial and recreational fisheries harvests as the Status Quo Alternative (Table 4.2-8), but multiplies the catch from short-term cooperative research by three. The combined estimated catch from the long-term and short-term surveys/projects is then compared to the recent commercial and recreational harvest levels as was done for the Status Quo Alternative analysis.

Table 4.3-3 Comparison of Estimated Fish Caught under the Preferred Alternative Compared to Commercial Catch (Landings) and Recreational Catch

Species are listed in descending order of total research catch by weight. Only species with total catch greater than one ton (2000 pounds) and those that are overfished or where overfishing is occurring are listed

Species	Stock status[1]	Average NEFSC research catch per year (tons) (2008-2012)	Estimated cooperative research catch per year (tons)	Estimated Total average NEFSC affiliated research catch per year (tons)	Average commercial catch per year in Northeast Region (tons)[2] (2008-2011)	Average recreational catch estimate per year for Atlantic Coast[3] (tons) (2008-2012)	Total average annual commercial and recreational catch (tons)	Average NEFSC research catch compared to commercial and recreational catch (percentage)
Spiny dogfish	Not overfished	97.3	94.5	191.8	6,918.2	NA	6,918.2	2.77%
Undetermined skate	NA	0	165	165	NA	NA	NA	NA
Little skate	Not overfished	24.1	2.4	26.5	4,481.8	NA	4,481.8	0.59%
Butterfish	Not overfished	13.6	26.7	40.3	663.0	NA	663.0	6.08%
Winter skate	Not overfished	19.0	6.3	25.3	NA	NA	NA	NA
Silver hake (whiting)	Not overfished	13.9	3.6	17.5	8,193.7	NA	8,193.7	0.21%
Atlantic croaker	Unknown	13.9	0	13.9	7,843.9	2,318.3	10,162.2	0.14%
Atlantic herring	Not overfished	13.2	0.3	13.5	89,754.8	NA	89,754.8	0.02%
Scup	Not overfished	7.1	11.1	18.2	4,867.6	2,079.5	6,947.1	0.26%
Summer flounder (fluke)	Not overfished	2.3	22.5	24.8	6,111.2	3,1773	9,288.5	0.27%
Haddock	GOM: approaching overfished/ overfishing; GB: Not overfished	9.0	1.8	10.8	7,631.1	NA	7,631.1	0.14%

Species	Stock status[1]	Average NEFSC research catch per year (tons) (2008-2012)	Estimated cooperative research catch per year (tons)	Estimated Total average NEFSC affiliated research catch per year (tons)	Average commercial catch per year in Northeast Region (tons)[2] (2008-2011)	Average recreational catch estimate per year for Atlantic Coast[3] (tons) (2008-2012)	Total average annual commercial and recreational catch (tons)	Average NEFSC research catch compared to commercial and recreational catch (percentage)
Smoothhound (smooth dogfish)	Unknown	8.3	3.9	12.2	1,412.4	NA	1,412.4	0.86%
Acadian redfish	Not overfished	9.3	0.1	9.4	1,731.4	NA	1,731.4	0.54%
Weakfish	Unknown	7.7	0.1	7.8	150.7	125.6	276.6	2.82%
Spot	Unknown	7.2	0.3	7.5	2,000.6	1,144.3	3,144.9	0.24%
Winter flounder (blackback)	GOM: Unknown; GB: Not overfished; SNE/MAB: Overfished	3.6	8.7	12.3	2,268.4	120.4	2,388.8	0.51%
Clearnose skate	Not overfished	6.3	0.1	6.4	NA	NA	NA	NA
Red hake	Not overfished	4.7	4.5	9.2	663.7	NA	663.7	1.39%
Atlantic cod	GOM and GB: Overfished/ overfishing	4.2	3.6	7.8	9,275.2	15,79.1	10,854.2	0.07%
Yellowtail flounder	Cape Cod/GOM & GB: Overfished/ overfishing; SNE/MAB: Not overfished	2.5	5.7	8.2	1,767.0	NA	1,767.0	0.46%
Goosefish (monkfish)	Not overfished	3.9	1.2	5.1	9,928.6	NA	9,928.6	0.05%
Striped bass	Not overfished	3.6	1.8	5.4	3,732.9	12,351.0	16,083.8	0.03%
White hake	Not overfished	3.1	1.2	4.3	2,132.9	NA	2,132.9	0.20%

Species	Stock status[1]	Average NEFSC research catch per year (tons) (2008-2012)	Estimated cooperative research catch per year (tons)	Estimated Total average NEFSC affiliated research catch per year (tons)	Average commercial catch per year in Northeast Region (tons)[2] (2008-2011)	Average recreational catch estimate per year for Atlantic Coast[3] (tons) (2008-2012)	Total average annual commercial and recreational catch (tons)	Average NEFSC research catch compared to commercial and recreational catch (percentage)
Fourspot Flounder	Unknown	2.0	3.6	5.6	7.9	NA	7.9	70.89%
Spotted Hake	Unknown	2.6	0.3	2.9	NA	NA	NA	NA
Barndoor skate	Not overfished	2.2	0.9	3.1	NA	NA	NA	NA
Atlantic mackerel	Unknown	2.3	0.6	2.9	15,087.3	828.9	15,087.3	0.02%
Alewife	Unknown	2.3	0.1	2.4	830.1	NA	830.1	0.29%
Kingfish (*Menticirrhus spp.*)	Unknown	2.3	0.1	2.4	NA	798.2	798.2	0.30%
American plaice	Not overfished	2.2	0.3	2.5	1,460.2	NA	1,460.2	0.17%
Cownose ray	Unknown	2.0	0.6	2.6	45.5	NA	NA	NA
Longhorn Sculpin	Unknown	1.9	0.6	2.5	NA	NA	NA	NA
Bluefish	Not overfished	1.2	1.8	3.0	3,183.9	7,372.2	10,556.2	0.03%
Windowpane flounder (sand dab)	GOM & GB: Overfished/ overfishing; SNE & MAB: not overfished	1.0	2.1	3.1	74.2	NA	74.2	4.18%
Northern searobin	Unknown	1.2	1.8	3.0	49.6	NA	49.6	6.05%
Spiny butterfly ray	Unknown	1.5	0	1.5	NA	NA	NA	NA

Species	Stock status[1]	Average NEFSC research catch per year (tons) (2008-2012)	Estimated cooperative research catch per year (tons)	Estimated Total average NEFSC affiliated research catch per year (tons)	Average commercial catch per year in Northeast Region (tons)[2] (2008-2011)	Average recreational catch estimate per year for Atlantic Coast[3] (tons) (2008-2012)	Total average annual commercial and recreational catch (tons)	Average NEFSC research catch compared to commercial and recreational catch (percentage)
Striped anchovy	Unknown	1.4	0.1	1.5	NA	NA	NA	NA
Bullnose ray	Unknown	1.3	0	1.3	NA	NA	NA	NA
Pollock	Not overfished	1.0	0.6	1.6	8,214.1	1,016.8	9,231.2	0.02%
Roughtail stingray	Unknown	1.0	0.6	1.6	NA	NA	NA	NA
Black sea bass	Not overfished	0.7	1.2	1.9	1,006.3	1,402.0	2,408.3	0.08%
Bluntnose stingray	Unknown	1.1	0.3	1.4	NA	NA	NA	NA
Ocean pout	Overfished	0.8	0.1	0.9	2.8	NA	2.8	32.14%
Witch flounder (grey sole)	Overfished/ overfishing	0.7	0.1	0.8	986.1	NA	986.1	0.08%
Blueback herring	Unknown	0.7	0	0.7	11.1	NA	11.1	6.31%
Thorny skate	Overfished	0.6	0.1	0.7	NA	NA	NA	NA
Atlantic halibut	Overfished	0.2	0.6	0.8	34.0	NA	34.0	2.35%
Atlantic wolffish	Overfished	<0.01	0.9	0.9	31.4 4	NA	31.4	2.90%
Cusk	Unknown	<0.1	0.1	0.1	46.8	NA	46.8	0.85%

1. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Second quarter 2013 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm
2. Source: Commercial catch data from NMFS Office of Sustainable Fisheries website: http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index
3. Source: Recreational catch data from NOAA Fisheries Marine Recreational Information Program website: http://www.st.nmfs.noaa.gov/recreational-fisheries/index
4. Commercial catch data for Atlantic wolfish only available for 2008-2010; information in table is an average catch over those three years.

Table 4.3-3 shows the estimated average annual catch (by weight) based on the most frequently caught fish species from NEFSC-conducted surveys (2008-2012 data) and short-term cooperative research projects under the Preferred Alternative. These estimated research catches are compared to the average annual commercial landings of target species (2008-2011 data) to give an indication of their relative size. In addition, for species that are frequently caught by recreational anglers, estimates of average annual recreational catches are also provided for comparison. These data indicate that for most species the average amount of fish killed in NEFSC-affiliated research is less than one percent of commercial and recreational landings. For these species, the magnitude of research mortality is small relative to the fisheries and even smaller relative to the estimated populations of these fish.

The most frequently caught species in NEFSC research, spiny dogfish, is very abundant and a substantial number are landed commercially. However, they are also often caught as bycatch in commercial fisheries and discarded rather than brought to market (Sosebee and Rago 2006). The data on commercial landings is therefore small compared to total numbers of dogfish caught. Given the large bycatch for this species, scientific data provided by NEFSC surveys are important to monitor the status of the species, which is currently not considered overfished.

For a few species which do not have a large commercial market, such as butterfish, weakfish, fourspot flounder, northern searobin, and blueback herring, the research catch exceeds one percent of commercial catch. For most of these species, commercial landings are greatly diminished from historical fisheries for various reasons. They currently do not have directed fisheries, so landings data do not reflect population status. NEFSC surveys, which are important for monitoring the stocks, catch a broader size/age class of the stock rather than just marketable size fish.

NEFSC surveys and cooperative research projects catch stocks of species that are considered overfished or in regions where overfishing is occurring, including regional stocks of haddock, winter flounder, Atlantic cod, yellowtail flounder, windowpane flounder, ocean pout, witch flounder, thorny skate, Atlantic halibut, and Atlantic wolfish (Table 4.2-8). In general, the type of programmatic analysis presented in this section indicates that research activities have minimal impact on these populations and therefore pose little conservation concern. However, this programmatic analysis is based on average catch levels over a five-year period, with all fishery management regions combined, and comparisons with an area-wide harvest metric from a particular year. This approach precludes the assessment of potential effects of research on overfished stocks or where overfishing is occurring in one or more fishery management regions. The status and trends of such stocks can change rapidly, either increasing or decreasing, and average catch per unit effort can vary dramatically from year to year with change in abundance. In addition, research catch in one fishery management region where a species is not overfished (e.g., yellowtail flounder in the SNE), could be problematic if it was conducted in a region where the stock is overfished (e.g., yellowtail flounder in the GOM) and the commercial fisheries have been curtailed to help the overfished stock rebuild.

Most research activities conducted by the NEFSC are multi-species surveys that cover large areas, involve minimal sampling, and do not target overfished species. Research catches in these surveys are generally very small for uncommon species. However, many of the short-term cooperative research projects are focused on a particular species or group of fish (e.g., flounders) and could catch substantial amounts of targeted fish in a relatively small area, e.g., studies comparing different configurations of commercial fishing gear. Such research directed at an overfished stock could theoretically account for a substantial portion of the Annual Catch Limit for that stock or other fishery management metric (e.g., overfishing level) and could interfere with the rebuilding plan for that stock.

Research data is necessary for monitoring the status of overfished stocks and other stocks of conservation concern and to determine if management objectives for rebuilding those stocks are being met. Under the Preferred Alternative, scientific research proposals for both long-term and short-term projects require scientific research permits or experimental fishing permits. The potential impacts of those proposed

projects are assessed for each stock, including overfished stocks, before those permits are issued. Fisheries managers typically consider the estimated amount of research catch from all projects along with other sources of mortality (e.g., bycatch in other fisheries and predation) before setting commercial fishing limits to prevent overfishing of stocks or to help overfished stocks rebuild. This type of annual review of research proposals would continue to occur in the future under the Preferred Alternative. Any future proposed projects targeting overfished stocks, or projects likely to have substantial bycatch of an overfished stock, would receive additional scrutiny on a stock by stock basis to ensure minimal impact on the stock before a research permit is issued. These permitting reviews would also determine whether the proposed projects were consistent with the NEPA analysis presented in the Final PEA or whether additional NEPA analysis was required (see Section 2.3.5).

Table 4.3-3 indicates that, while mortality to fish species is a direct effect of the NEFSC surveys and cooperative research projects, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of fish taken in commercial and recreational fisheries, which are just fractions of the total populations for these species.

4.3.3.3 Highly Migratory Species

The projected increase in short-term cooperative research effort under the Preferred Alternative would not target highly migratory species and would be expected to have minimal impacts on these species relative to the Status Quo. Impacts to these species would be primarily from long-term research surveys, which would be essentially the same as under the Status Quo Alternative (Section 4.2.3.3). Under the Preferred Alternative, NEFSC and cooperative research surveys would continue to catch HMS sharks intentionally and incidental to surveys targeting other species, but mortality would likely be low in magnitude, infrequent, and distributed over a wide geographic area; the effects of mortality on HMS shark species from NEFSC fisheries research under the Preferred Alternative would be considered minor adverse according to the criteria in Table 4.1-1.

4.3.3.4 Conclusion

The overall effects of the Preferred Alternative on fish would be similar to those discussed under the Status Quo Alternative (Section 4.2.3) and would likely be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1. In addition to these adverse effects, the Preferred Alternative would contribute to long-term beneficial effects on managed fish species throughout the Northeast region through the contribution of NEFSC-affiliated fisheries research to sustainable fisheries management. Data from NEFSC-affiliated research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks. The beneficial effects of the time-series data provided by NEFSC research programs are especially valuable for long-term trend analysis for commercially harvested fish and, combined with other oceanographic data collected during fisheries research, provide the basis for monitoring changes to the marine environment important to fish populations.

4.3.4 Effects on Marine Mammals

The direct and indirect effects of the Preferred Alternative on marine mammals are very similar to those described for the Status Quo (Section 4.2.5). Differences between the alternatives include:

- Improved and formalized protected species training, awareness, and reporting procedures to facilitate and improve implementing mitigation measures.
- Discontinuation of three projects and the addition or expansion of seven others, plus anticipated changes in short-term cooperative research projects (Tables 2.3-1, 2.3-2)

The following analysis draws heavily on the analysis provided under the Status Quo Alternative (Section 4.2.5), but focuses on differences that may result from the new research elements and mitigation measures added under the Preferred Alternative.

The Preferred Alternative is the NEFSC research program and suite of mitigation measures that were described in the MMPA LOA application (Appendix C). The analysis of effects in the LOA application was based primarily on the history of past effects under status quo conditions, including mitigation measures as they were implemented at the end of 2013. However, the nature of the status quo conditions has changed in the last ten years in terms of the specific research being conducted and the implementation of mitigation measures for protected species interactions. The NEFSC regularly assesses their effects on the marine environment and explores ways to effectively reduce adverse interactions while fulfilling their mission to collect scientific information for fisheries and natural resource management. The Status Quo Alternative, therefore, reflects the mitigation equipment and procedures as they were implemented through the end of 2013, while the Preferred Alternative includes ongoing efforts to develop new mitigation measures.

[Note: The NEFSC submitted its LOA application to NMFS Office of Protected Resources (OPR) in December 2014 based on the information presented in the Draft PEA, including the analysis of effects on marine mammals presented below. However, during the rulemaking process, the NEFSC had an additional incidental take of a gray seal during a bottom trawl survey (April 2, 2015). This information, along with some additional information and technical corrections that affected the NEFSC take request, were submitted to OPR as an addendum to the LOA application and are attached to this Final PEA as Appendix E. This supplemental information was incorporated into the proposed rule by OPR on July 9, 2015 (80 FR 39542), with addendums to the proposed rule published on 6 August, 2015 (80 FR 46939) and 17 August, 2015 (80 FR 49196). The reduced take request for bottlenose dolphin stocks was an administrative decision to analyze these stocks in the SEFSC EA and LOA application, which is currently being developed.]

The Preferred Alternative includes the same suite of mitigation measures described under the Status Quo Alternative with the following modifications to reduce the risk of adverse interactions with protected species (Section 2.2.1). As described in Section 2.3.1, the NEFSC is required to make improvements to its protected species training, awareness, and reporting procedures under the Preferred Alternative in order to facilitate and improve the implementation of mitigation measures described under the Status Quo Alternative. Required measures include:

- The NEFSC would initiate procedures to facilitate communication between Chief Scientists and vessel captains about protected species interactions during research surveys in order to improve decision-making regarding avoidance of adverse interactions. The intent would be to draw on the collective experience of people who have been making those decisions, provide a forum to exchange information about what worked or did not work, apply lessons learned and improve upon future decisions regarding avoidance practices. The NEFSC would coordinate among its staff and vessel captains and with those from other fisheries science centers with similar experience.
- Development of a formalized protected species training program for all crew members that would be required for all NEFSC-affiliated research projects, including cooperative research partners. NEFSC Chief Scientists and appropriate members of NEFSC research crews would be trained using the same monitoring, data collection, and reporting protocols for protected species as is required by the Northeast Fisheries Observer Program. This would formalize and standardize the information provided to all crew that might experience protected species interactions during research activities.
- For all NEFSC-affiliated research projects and vessels, instructions and protocols for avoiding adverse interactions with protected species would be reviewed and, if needed, made fully

consistent with NEFOP training materials and any guidance on decision-making that arises from training opportunities. Informational placards and reporting procedures would be reviewed and updated as necessary for consistency and accuracy. The NEFSC would incorporate specific language into its contracts that specifies all training requirements, operating procedures, and reporting requirements for protected species that would be required for all charter vessels and cooperating research partners.

The potential effects of the Preferred Alternative on marine mammals involve adverse interactions with research vessels, survey gear, sonar and other active acoustic devices, and other associated equipment, including:

- Disturbance and behavioral responses due to acoustic equipment
- Injury or mortality due to ship strikes and entanglement in gear
- Changes in food availability due to research survey removal of prey and discards
- Contamination from discharges

These mechanisms of potential effects are discussed under the Status Quo Alternative (Section 4.2.4), most of which will not be repeated here. The mechanism in the first bullet, acoustic disturbance, would be the same for the Preferred Alternative as it is for the Status Quo Alternative because there are no new acoustic sound sources that would be introduced and no new mitigation measures would be required that would address potential effects due to acoustic disturbance. Although every species of marine mammal in the research area may be exposed to sounds from active acoustic equipment used in NEFSC research, many of the acoustic sources are likely not audible to most species and the those sources that are audible would likely cause temporary and minor changes in behavior for nearby animals as the ships pass through a given area. The overall effects from acoustic disturbance are considered minor adverse for all species in the NEFSC research area. The potential effects from changes in food availability and contamination were also considered to be minor adverse for all species of marine mammals and will not be discussed further. The following discussion will therefore focus on the potential effects from entanglement or incidental capture in fishing gear used in NEFSC research, especially with regard to any differences changes between the Status Quo Alternative and the Preferred Alternative.

4.3.4.1 ESA-listed Species

The endangered marine mammal species in the NEFSC research area include North Atlantic right, humpback, fin, sei, blue, and sperm whales. All of these species are under the jurisdiction of NMFS in regards to compliance with the MMPA and ESA. Due to their very low numbers within the NEFSC research area and a tendency to occur primarily in waters outside of the NEFSC research area, blue, sperm, and sei whales rarely coincide with NEFSC fisheries research vessels and any potential effects are unlikely.

There have been no entanglements or takes of ESA-listed marine mammals in NEFSC fisheries research and the LOA application does not include any estimated Level A harassment (injury), serious injury, or mortality takes of these species during the next five years. Given the mitigation measures in place and the lack of historical takes, the NEFSC would not expect to have any adverse gear interactions with ESA-listed cetaceans in research surveys under the Preferred Alternative.

4.3.4.2 Other Cetaceans

This section describes impacts to cetaceans that are not ESA-listed. The minke whale is the only baleen whale species included in this section. The remaining cetaceans are toothed whale species (i.e., odontocetes), including two species of pilot whales, six species of dolphins, and harbor porpoise.

The analysis of historical takes and estimated takes for cetaceans in the LOA application is the same as presented under the Status Quo Alternative (Section 4.2.4). The NEFSC anticipates the new research and training programs included in the Preferred Alternative would further reduce risks of adverse interactions with marine mammals. However, any attempt to quantitatively estimate how much these enhancements would reduce potential interactions would be speculative so the effects analysis for the Preferred Alternative is based on the estimated marine mammal takes in the LOA application (Appendix C).

The estimated average Level A harassment and serious injury and mortality take in the NEFSC LOA application for the next five years is one or two per year for each of the cetacean species considered here, primarily in trawl and longline gear but bottlenose dolphins and harbor porpoise include potential takes in gillnet gear. These levels of serious injury or mortality, if they occurred, would be less than one percent of PBR for most species for which takes are requested (Table 4.2-13). For white-beaked dolphin, PBR equals 10 animals per year so the requested take of one animal, if it occurred, would equal ten percent of PBR. According to the impact criteria described in Table 4.1-1, this level of mortality for white-beaked dolphin and all other species considered here, if they occurred, would be considered minor in magnitude. These potential mortalities would be rare or infrequent events. Any actual take would occur in a localized area, but since cetaceans generally travel through large geographic areas, the potential loss of an animal would affect more than a localized population. The overall impact of the potential takes of these species, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

4.3.4.3 Pinnipeds

Gray seals and harbor seals are the most numerous of the pinnipeds in the NEFSC survey area, with seasonal shifts in abundance and distribution and the potential to overlap with NEFSC fisheries research. Harp and hooded seals are infrequently seen in the survey areas. The likelihood of coinciding with NEFSC fisheries research surveys is, therefore, low.

The analysis of historical takes and estimated takes for pinnipeds in the LOA application is the same as presented in the Status Quo Alternative (Section 4.2.4). The NEFSC anticipates the new research and training programs included in the Preferred Alternative would further reduce risks of adverse interactions with research activities. The Final PEA, however, bases effects analysis on the estimated takes in the LOA application (Appendix C).

The NEFSC LOA application (Appendix C) includes estimations of the number of harbor seals, and gray seals that may interact with research gear based on two recorded historical takes in research gear, similarities among species, and historical takes in commercial fisheries operating in similar areas and using similar gear types (Table 4.2-13). The NEFSC does not think this many pinnipeds will actually be taken in the next five years, but used a conservative estimation procedure to account for a maximum level of potential take.

The estimated annual Level A harassment and serious injury and mortality take of two harbor seals, if it occurred, would be less than 0.1 percent of PBR and would be considered minor in magnitude. Although PBR is presently undetermined for gray seals, the requested take of two gray seals per year, if it occurred, would also likely be well below 10 percent of any potential PBR level for this abundant species. Given the low historic number of seal interactions with research gear and the implementation of mitigation measures, future mortalities of pinnipeds would be considered rare or infrequent and unlikely to occur at this estimated rate under the Preferred Alternative. Any actual take would occur in a localized area, but these animals travel over large geographic areas so the potential loss of an animal would affect more than a localized population. The overall impact of potential takes of harbor seals and gray seals in NEFSC research gear, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

4.3.4.4 Conclusion

Under the Preferred Alternative, the potential direct and indirect effects on marine mammals through acoustic disturbance, potential changes in prey availability, and contamination or degradation of habitat would be similar to those described for the Status Quo Alternative (Section 4.2.4) and would be considered minor adverse for all species.

The numbers of marine mammals estimated to be taken in future NEFSC-affiliated research under the Preferred Alternative are based on the historical capture of six cetaceans (three short-beaked common dolphins and one each of bottlenose dolphin, harbor porpoise, and minke whale) and two pinnipeds (gray seal and harbor seal) during NEFSC research surveys and NEFOP Observer training trips from 2004 through 2013. The available historic data and other data on mortalities in commercial fisheries using similar gear were used to estimate the potential for combined level A harassment takes and serious injuries and mortalities under the Preferred Alternative, which include a suite of mitigation measures currently implemented for NEFSC surveys and several new training and communication programs intended to improve the effectiveness of the existing mitigation measures used to protect marine mammals and other protected species. It is not possible to quantify how much these new measures would reduce impacts to marine mammals but they would help reduce such impacts relative to the Status Quo Alternative. Future takes, if they occur, would likely be fewer than the estimated numbers since the estimates are based on a conservative approach to ensure accounting for the maximum level of potential the take. The estimated potential takes in research gear for all species would be equal to or below 10 percent of PBR and would be considered to have minor magnitudes of effect on the population level for all species. Adverse interactions with research gear would likely continue to occur infrequently but could occur anywhere the NEFSC conducts fisheries research; impacts would likely be dispersed over time and space. The impact of these potential takes, if they occurred, would be considered minor adverse for all species.

The overall effects of the Preferred Alternative on marine mammals would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.3.5 Effects on Birds

The effects of the Preferred Alternative on birds would be very similar to those described for the Status Quo Alternative (Section 4.2.5). The additional mitigation measures for protected species proposed under the Preferred Alternative may raise awareness about potential interactions with seabirds and strengthen reporting practices in general but they are unlikely to change the actual effects of NEFSC research activities on seabirds, which would be minor. The changes to the suite of research activities conducted under the Preferred Alternative would also result in minimal changes to the effects on seabirds relative to the Status Quo Alternative. The overall effects of the Preferred Alternative on seabirds would likely be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.3.6 Effects on Sea Turtles

The Preferred Alternative would have the same types of effects on sea turtles as those described for the Status Quo Alternative (Section 4.2.7). Direct and indirect effects of NEFSC research activities on sea turtles may include: disturbances or changes in sea turtle behavior due to physical movements and sounds, injury or mortality due to ship strikes, entanglement in gear, and contamination or degradation of sea turtle habitat.

The scope of NEFSC fisheries research activities under the Preferred Alternative is similar to that described for the Status Quo Alternative except for the following:

- The addition of several long-term activities using gear types that pose a risk of interacting with sea turtles, and
- Expected changes in the scope of short-term research projects using those gear types.

The primary difference between these alternatives in their effects on sea turtles is the risk of adverse gear interactions (capture and entanglement). Unless otherwise noted below, all other effects on sea turtles are the same as described in Section 4.2-7. Table 4.3-4 provides quantitative estimates of sea turtle captures and mortalities under the Preferred Alternative based on gear types used and deployment details such as tow times and soak durations. This table includes the same long-term research activities as Table 4.2-15 (Status Quo Alternative), but with the addition of the new research activities as described in Table 2.3-1. The nature and scope of short-term research projects are somewhat different than the Status Quo Alternative and are described in Table 2.3-2. The risk analysis is organized by gear type as described below.

Table 4.3-4 Estimated Future Takes of Sea Turtles under the Preferred Alternative

Survey	Research effort per year	Species	Capture rate	Estimated captures per year	Serious Injury and Mortality (SI&M) rate (turtles per capture)	Estimated SI&M per year
SOUTHERN NEW ENGLAND AND MID-ATLANTIC BIGHT						
Bottom trawls						
BTS – Spring (southern portion) 200 tows @ 20 min/tow	67 trawl-hours (t-h)	Loggerhead	0.0135 t/t-h	0.9	0	0
BTS – Fall (southern portion) 200 tows @ 20 min/tow	67 t-h	Loggerhead	0.015 t/t-h	1.0	0	0
		Leatherback	0.0015 t/t-h	0.1	0	0
NEAMAP– Spring (southern portion) 150 tows @ 20 min/tow	50 t-h	Loggerhead	0.014 t/t-h	0.7	0	0
NEAMAP – Fall (southern portion) 150 tows @ 20 min/tow	50 t-h	Loggerhead	0.01 t/t-h	0.5	0	0
		Kemp's ridley	0.016 t/t-h	0.8	0	0
		Green	0.002 t/t-h	0.1	0	0
Habitat Mapping Survey [1] 54 tows @ 30 min/tow	27 t-h	Loggerhead	0.015 t/t-h	0.4	0	0
		Kemp's ridley	0.016 t/t-h	0.4	0	0
Short-term research projects [2] For projects from Table 2.3-2 with short tow times, assume average 25 minute tows	492 t-h	Loggerhead	0.015 t/t-h	7.4	0	0
		Kemp's ridley	0.016 t/t-h	7.9	0	0

Survey	Research effort per year	Species	Capture rate	Estimated captures per year	Serious Injury and Mortality (SI&M) rate (turtles per capture)	Estimated SI&M per year
Short-term research projects For projects from Table 2.3-2 with longer tow times, assume average 60 minute tows	250 t-h	Loggerhead	0.015 t/t-h	3.8	0.05	0.19
		Kemp's ridley	0.016 t/t-h	4.0	0.05	0.20
Longline Surveys						
Apex Predator longline surveys [3] 29 sets/yr @ 300 hooks/set and 3 hr soak	26,100 hook-hours (h-h)	Loggerhead	0.00002 t/h-h	0.5	0.1	0.05
COASTSPAN [4] Small: 3,250 h-h Large: 6,500 h-h	9,750 h-h	Loggerhead	0.00002 t/h-h	0.2	0.1	0.02
NEFOP longline training cruises 15 sets/yr @ 600 hooks/set and 2 hr soak	18,000 h-h	Loggerhead	0.00002 t/h-h	0.4	0.1	0.04
Gillnet surveys [5]						
COASTSPAN 12 sets/yr @ 3 hr/set	36 set-hours (s-h)	Kemp's ridley	0.00278 t/s-h	0.1	0.1	0.01
NEFOP gillnet training cruises 40 sets/yr @ 12-24 hr soak (assume avg 18 hr)	720 s-h	Kemp's ridley	0.00278 t/s-h	2.0	0.2	0.4
Short-term research projects 139 sets/yr @ 1 hr/set	130 s-h	Kemp's ridley	0.00278 t/s-h	0.4	0	0
SOUTHEAST US CONTINENTAL SHELF LME						
Longline Surveys						
Apex Predator Longline 71 sets/yr x 300 hooks/set @ 3 hours/set	63,900 h-h	Loggerhead	0.000005 t/h-h	0.3	0.1	0.03
		Leatherback	0.00001 t/h-h	0.6	0.1	0.06
COASTSPAN Small: 5,625 h-h Large: 11,250 h-h	16,875 h-h	Loggerhead	0.000012 t/h-h	0.2	0.1	0.02
		Kemp's ridley	0.000113 t/h-h	1.9	0.1	0.19
Gillnet surveys						
COASTSPAN 40 sets/yr @ 3 hr/set	120 s-h	Kemp's ridley	0.0025 t/s-h	0.3	0	0
		Green	0.0033 t/s-h	0.4	0	0

1. Survey conducted in summer in central part of MAB and has had no history of catching turtles; in lieu of past capture data, the highest capture rate for a project using a similar gear type (BTS – Fall for loggerhead and NEAMAP – Fall for Kemp's ridley) is used to provide conservative estimates of future captures for the two most frequently caught species.
2 . Table 2.3-2 summarizes anticipated scope of short-term research projects using bottom trawl gear. These projects are divided by tow duration to facilitate estimates of potential mortalities (Sasso and Epperly 2006). In lieu of past capture data, the highest capture rate for a project using a similar gear type (BTS – Fall for loggerhead and NEAMAP – Fall for Kemp's ridley) is used to provide conservative estimates of future captures for the two most frequently caught species.
3 . Capture rate used for estimations of future takes taken from COASTSPAN surveys in lieu of historical data from Apex Predator surveys in the NE LME. The Apex Predator surveys have been conducted every other year. Estimated captures are per year for years when the study is conducted
4 . COASTSPAN surveys use two gear protocols: the small juvenile shark gear uses 50 hooks per set and the set duration is for 30 minutes. The large juvenile/adult shark gear uses 25 hooks per set and the set duration is for 2 hours..
5. Mortality rates are based on nominal research set durations and Figure 2 in Murray (2009). However, longline and gillnet sets in the COASTSPAN and Apex Predators surveys are continually monitored so any hooked or entangled turtles would likely be detected and released well before they drown.

Table 4.3-5 Estimated Future Takes of Sea Turtles under the Preferred Alternative

Numbers of estimated captures/hookings and serious injuries and mortalities totaled from Table 4.3-4 (in parentheses), rounded up to the next highest whole number of sea turtles.

Gear type	Trawl		Longline		Gillnet		Totals	
Species	**Captures per year**	**SI&M per year**	**Captures per year**	**SI&M per year**	**Captures per year**	**SI&M per year**	**Captures per year**	**SI&M per year**
Loggerhead	(14.7) 15 turtles	(0.19) 1 turtle	(1.6) 2 turtles	(0.16) 1 turtle	0	0	**17 turtles**	**2 turtles**
Kemp's ridley	(13.1) 14 turtles	(0.2) 1 turtle	(1.9) 2 turtles	(0.19) 1 turtle	(2.8) 3 turtles	(0.41) 1 turtle	**19 turtles**	**3 turtles**
Green	(0.1) 1 turtle	0	0	0	(0.4) 1 turtle	0	**2 turtles**	**0**
Leatherback	(0.1) 1 turtle	0	(0.6) 1 turtle	(0.06) 1 turtle	0	0	**2 turtles**	**1 turtle**
Totals	**31 turtles**	**2 turtles**	**5 turtles**	**3 turtles**	**4 turtles**	**1 turtle**	**40 turtles**	**6 turtles**

Captures and Mortality in Trawl Gear

The Preferred Alternative includes the addition of two research activities that use mid-water (pelagic) trawl gear, the NEFOP mid-water trawl training cruises and the Northeast Integrated Pelagic Survey. Although there is a slight risk of interactions with pelagic foraging juveniles of hard-shelled species and leatherback turtles, these gear types have not been the subject of as much conservation concern for sea turtles as bottom trawl fisheries, and NMFS does not anticipate any adverse interactions of sea turtles with this type of gear (NMFS 2012b).

The estimated trawl effort for future short-term projects under the Preferred Alternative (Table 2.3-2) is expected to involve more trawls than the same type of projects under the Status Quo Alternative (Table 2.2-2). Many of these trawls are expected to be of short duration (i.e., 20 to 30 minutes), which greatly reduces the risk of mortality from forced submersion. Short-term conservation engineering projects usually involve protocols closer to commercial fishing conditions so these projects have been separated in Table 4.3-4 to account for longer tow times (assuming an average of 60 minutes per tow) and associated higher SI&M rates. The risk assessment for these projects uses the same capture rates and tow-duration-based mortality rates as used for the Status Quo Alternative. However, overall estimates of captures are greater for the Preferred Alternative than the Status Quo due to higher estimated research trawl effort for

short-term cooperative research projects under the Preferred Alternative. Given the reliance of these types of projects on future funding, it is not certain that these levels of research fishing will actually occur.

Table 4.3-4 provides calculations of estimated captures and mortalities for all trawl projects under the Preferred Alternative that are likely to interact with sea turtles. Table 4.3-5 provides a summary of those estimates rounded up to next highest whole number of turtles. Most of the estimated captures and all of the serious injuries and mortalities are associated with short-term cooperative research surveys due to greater overall trawl effort and longer tow times for some projects. For all NEFSC-affiliated research trawls:

- Up to 15 loggerhead turtles may be captured per year and one of those takes may be lethal.
- Up to 14 Kemp's ridley turtles may be captured per year and one of those takes may be lethal.
- Up to one each of green and leatherback turtles may be captured per year with a remote chance of mortalities.

Captures and Mortality in Longline Gear

The Preferred Alternative includes one additional project involving longline gear, the Northeast Fisheries Observer program longline training cruises. This project would involve commercial fishing vessels and gear but would make longline sets of much shorter duration than typical in commercial fisheries. The addition of these limited number of longline sets would incrementally increase the risk of capturing sea turtles compared to the Status Quo Alternative.

Table 4.3-4 provides calculations of estimated captures and serious injuries and mortalities for all longline projects under the Preferred Alternative that are likely to interact with sea turtles. Table 4.3-5 provides a summary of those estimates rounded up to next highest whole number of turtles. For all NEFSC-affiliated research longline projects:

- Up to two loggerhead turtles may be captured per year and one of those takes may be lethal.
- Up to two Kemp's ridley turtles may be captured per year and one of those takes may be lethal.
- Up to one leatherback turtle may be captured per year with a small chance of mortality.

Captures and Mortality in Gillnet Gear

The difference between the Preferred Alternative and the Status Quo Alternative in gillnet effort is the addition of short-term research projects, some of which would occur in the SNE and MAB (Table 2.3-2). These short-term cooperative research projects will increase the number of gillnet sets under the Preferred Alternative but the sets would be made for short durations (60 minutes or less) so the risk of sea turtle captures in gillnet gear increases, but the risk of serious injury or mortality does not increase relative to the Status Quo Alternative.

Table 4.3-4 provides calculations of estimated captures and serious injuries and mortalities for all gillnet projects under the Preferred Alternative that are likely to interact with sea turtles. Table 4.3-5 provides a summary of those estimates rounded up to next highest whole number of turtles. All of the mortalities are associated with the NEFOP gillnet training cruises due to their relatively long (12 to 24 hour) soak times. For all NEFSC-affiliated research gillnet projects:

- Up to three Kemp's ridley turtles may be captured per year and one of those takes may be lethal.
- Up to one green turtle may be captured per year with a remote chance of mortality.

Captures and Mortality in Dredge Gear

The potential for captures or interactions of sea turtles with NEFSC research dredge gear is the same under the Preferred Alternative as it is under the Status Quo. The lack of historical takes from research fishing and the substantial differences between research surveys and commercial fisheries makes it difficult to provide quantitative estimates of potential future takes of sea turtles in research dredge gear. Given the continued use of fishing gear with documented adverse interactions with sea turtles, there is a risk of future interactions during NEFSC research activities, both captures in the dredge gear and unobserved collisions with sea turtles on the sea floor that may cause injuries. However, based on the lack of observed research takes, the short tow times (15 minutes for most tows), and the relatively small number of research tows (less than 450 scallop tows and 150 surfclam/quahog tows per year compared to tens of thousands of commercial dredge tows), the risk of future adverse interactions with sea turtles is small, and interactions would likely be rare occurrences.

Contamination or Degradation of Habitat

The potential for impacts to sea turtle habitats would be the same under the Preferred Alternative as described under the Status Quo in section 4.2.6.

4.3.6.1 Conclusion

The effects of the Preferred Alternative on sea turtles through disturbance, changes in prey availability, and contamination or degradation of habitat would be similar to those described for the Status Quo Alternative (Section 4.2.6) and would be considered minor adverse. The Preferred Alternative includes several new training and communication programs intended to improve the effectiveness of the existing mitigation measures used to protect sea turtles and other protected species. It is not possible to quantify how much these new measures would reduce impacts to sea turtles but they would help reduce such impacts relative to the Status Quo Alternative.

The primary difference between the Preferred Alternative and the Status Quo Alternative in terms of adverse sea turtle interactions involves the estimates of future captures and injury/mortality of sea turtles in research gear. The Final PEA uses historic capture rates (captures per tow or set) and mortality rates from commercial fishing operations (based on the duration of tows and sets) to estimate future captures and mortalities under the Preferred Alternative. The research effort from long-term research surveys and projects is very similar under the Preferred Alternative as the Status Quo Alternative but the scope and nature of anticipated short-term research projects undertaken by cooperative research partners would be somewhat different. The presumed suite of short-term research projects under the Preferred Alternative would include more tows or sets using bottom trawl and gillnet gear. Most of these projects would use relatively short tow times or soak durations (30 minutes or less). The result is that more turtles are estimated to be captured in these gears under the Preferred Alternative but the risk of serious injury and mortality is expected to be slightly lower than under the Status Quo Alternative. The Final PEA uses a number of assumptions to provide a conservative estimate of future captures/hookings of sea turtles under the Preferred Alternative, including an estimate for serious injury and mortality up to two loggerhead, three Kemp's ridley and one leatherback sea turtles per year, primarily in short-term cooperative research projects. Only one known mortality has occurred in the past ten years out of 75 captured/hooked sea turtles so this estimated mortality level is unlikely to occur. This level of mortality for these species, if it occurred, would be small in magnitude relative to the overall size of these populations.

The overall effects of the Preferred Alternative on ESA-listed sea turtles would likely be small in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.3.7 Effects on Invertebrates

NEFSC-affiliated fisheries research conducted under the Preferred Alternative would have the same types of effects on invertebrate species as described for the Status Quo Alternative (Section 4.2.7) through mortality, disturbance, and changes in habitat. As described for the effects on fish above (section 4.3.3), the main difference between the Status Quo and Preferred Alternatives in regard to catch levels is the projected increase in short-term cooperative research effort under the Preferred Alternative. As was the case for fish, the following analysis will focus on the resulting effects of the Preferred Alternative on invertebrate species through mortality; other effects on invertebrates are as described for the Status Quo Alternative (Section 4.2.7).

The estimated level of future short-term cooperative research effort with different gear types (Table 2.3-2) is an optimistic projection based on adequate funding to address most of the research goals established by different fishery management groups and cooperative research partners. Actual funding levels in the future, and therefore the level of research effort, could be substantially less than estimated. Given this uncertainty in funding as well as uncertainty about the objectives and protocols of future short-term cooperative research projects, it is difficult to estimate future catch of invertebrates in these cooperative research programs. As described in the fish section, the number of cooperative research bottom trawls and dredge tows projected to occur under Preferred Alternative would be several times larger than the average level of effort under the Status Quo Alternative. For the purposes of this Final PEA analysis, the resulting catch of invertebrates in the short-term cooperative research segment of the total NEFSC-affiliated catch will be assumed to be 300 percent of the Status Quo Alternative. This level of catch is likely to be substantially higher than what might actually occur and therefore provides a conservative estimate of the impacts of research. Table 4.3-6 provides the same analysis of research catch relative to commercial fisheries harvests as the Status Quo Alternative (Table 4.2-8), but multiplies the catch from short-term cooperative research by three. The combined estimated catch of invertebrates from the long-term and short-term surveys/projects is then compared to the recent commercial harvest levels as was done for the Status Quo Alternative analysis.

Table 4.3-6 Relative Size of NEFSC-Affiliated Research Catch of Invertebrates Compared to Commercial Catch (Landings)

Species are listed in descending order of total research catch by weight. Only species/groups with total catch greater than one ton (2,000 pounds) are listed.

Species	Status of the Stock[1]	Average NEFSC research catch per year (tons) (2008-2012 data)	Estimated cooperative research catch per year (tons)	Total estimated NEFSC affiliated research catch per year (tons)	Average commercial landings per year (tons)[2] (2008-2012)	Estimated research catch compared to commercial landings (percentage)
Sea scallop	Not overfished	45.42	50.46	95.88	28,371.25	0.34%
Long-finned squid (*Loligo spp.*)	Unknown	6.37	19.14	25.51	10,940.43	0.23%
American lobster	GOM and GB not overfished; SNE overfished and depleted	10.65	0.54	11.19	58,187.64	0.02%
Ocean quahog	Not overfished	10.08	0	10.08	14,384.04	0.07%
Horseshoe crab	NA	3.76	0.01	3.77	753.98	0.50%
Atlantic Surfclam	Not overfished	3.41	0	3.41	22,007.62	0.02%
Sea stars	NA	1.08	4.26	5.34	NA	NA

Species	Status of the Stock[1]	Average NEFSC research catch per year (tons) (2008-2012 data)	Estimated cooperative research catch per year (tons)	Total estimated NEFSC affiliated research catch per year (tons)	Average commercial landings per year (tons)[2] (2008-2012)	Estimated research catch compared to commercial landings (percentage)
Northern (*Pandalus*) shrimp	Not overfished	2.38	0	2.38	4,481.99	0.05%

1. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Second quarter 2013 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm

2. Source: Commercial catch data from NMFS Office of Sustainable Fisheries website: http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index

Table 4.3-6 shows the estimated average annual catch (by weight) based on the most frequently caught invertebrate species from NEFSC-conducted surveys (2008-2012 data) and short-term cooperative research projects under the Preferred Alternative. These estimated research catches are compared to the average annual commercial landings of target species (2008-2012 data) to give an indication of their relative size. These data indicate that for all species the average amount of invertebrates killed in NEFSC-affiliated research is less than one percent of commercial landings. This magnitude of research mortality is small relative to the fisheries and even smaller relative to the estimated populations of these species.

The overall effects of the Preferred Alternative on invertebrates would likely be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1. In addition to these adverse effects, the Preferred Alternative would contribute to long-term beneficial effects on managed invertebrate species throughout the Northeast region through the contribution of NEFSC-affiliated fisheries research to sustainable fisheries management. Data from NEFSC-affiliated research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks. The beneficial effects of the time-series data provided by NEFSC research programs are especially valuable for long-term trend analysis for commercially harvested invertebrates and, combined with other oceanographic data collected during fisheries research, provide the basis for monitoring changes to the marine environment important to invertebrate populations.

4.3.8 Effects on the Social and Economic Environment

The NEFSC-affiliated research program under the Preferred Alternative includes the addition or expansion of several long-term surveys and the discontinuation of several long-term surveys conducted under the Status Quo Alternative. In addition, short-term cooperative research projects would use the same types of fishing gears but have greater levels of effort than the Status Quo Alternative and the particular goals and objectives of those projects could be different under the Preferred Alternative. These differences in the NEFSC fisheries research program under the Preferred Alternative are not expected to measurably increase or decrease socioeconomic effects compared to the Status Quo Alternative (see Section 4.2.8).

NEFSC-affiliated fisheries and ecosystem research conducted under the Preferred Alternative would provide a rigorous scientific basis for fisheries managers to set optimum yield fishery harvests while protecting the recovery of overfished resources and ultimately rebuilding these stocks to appropriate levels. It would also contribute directly and indirectly to local economies, promotes collaboration and positive relationships between NMFS and other researchers as well as with commercial and recreational fishing interests, and help fulfill NMFS obligations to communities under U.S. laws and international treaties.

The direct and indirect effects of the Preferred Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be felt throughout the Northeast region. According to the impact criteria established in Table 4.1-1, the direct and indirect effects of the Preferred Alternative on the social and economic environment would be minor to moderate and beneficial.

4.4 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 3 – MODIFIED RESEARCH ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 3 – Additional Mitigation Alternative on the physical, biological, and social environment. Under this Alternative, the NEFSC would conduct a new suite of research activities and implement new mitigation measures in addition to the Status Quo program. The new suite of research activities is a combination of past research and additional, new research, as described for the Preferred Alternative. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under Alternative 3 is presented below in Table 4.4-1.

Table 4.4-1 Alternative 3 Summary of Effects

Resource	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
Section #	**4.4.1**	**4.4.2**	**4.4.3**	**4.4.4**	**4.4.5**	**4.4.6**	**4.4.7**	**4.4.8**
Effects Conclusion	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to Moderate *beneficial*

4.4.1 Effects on the Physical Environment

The effects of the Modified Research Alternative on the physical environment would be similar to those of the Status Quo Alternative (see Section 4.2.1). Additional mitigation measures for protected species required under the Modified Research Alternative would not change the effects of the research activities on physical properties of the environment with the potential exception of the spatial/temporal restrictions on NEFSC research activities intended to reduce adverse impacts to protected species. This type of mitigation measure could potentially reduce the overall level of research effort somewhat or alter where and when that research occurred. However, specific restrictions have not been proposed and the overall effects on the physical environment are assumed to be essentially the same as those described under the Status Quo Alternative. Therefore, the overall effects of the Modified Research Alternative on the physical environment would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.2 Effects on Special Resource Areas and Essential Fish Habitat

The effects of the Modified Research Alternative on special resource areas would be similar to those of the Status Quo Alternative (see Section 4.2.2). Most of the additional mitigation measures for protected species proposed under the Modified Research Alternative would not change the effects of the research activities on the physical components of the environment or most biological components; they would only tend to decrease effects on protected species. The exception is the potential for spatial/temporal restrictions on NEFSC research activities intended to reduce adverse impacts on protected species. These restrictions could be placed on particular gear types of concern or in particular areas of concern such as federal and state Marine Protected Areas (MPAs) or Essential Fish Habitat (EFH). An MPA is defined by EO 13158 as “any area of the marine environment that has been reserved by federal, state, tribal, territorial, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein.” They include: state MPAs, National Wildlife Refuges, National Park Service MPAs, and National Marine Sanctuaries (see Section 3.1.2.4). EO 13158 also includes the following

directive: "To the extent permitted by law and to the maximum extent practicable, each federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA."

MPAs within the NEFSC fisheries research area include Stellwagen Bank National Marine Sanctuary, areas closed to certain fishing gears (e.g., Lydonia Canyon, Oceanographer Canyon, and Veatch Canyon), and numerous smaller protected areas (NOAA 2010a). Some MPAs have permit systems for activities that would otherwise be prohibited, such as scientific research with bottom trawl gear, and the NEFSC routinely applies for such permits if a particular research activity may adversely affect the MPA. These permits may restrict the level of effort, gear types used, locations, and other conditions of the activity as well as having monitoring and reporting requirements. The Status Quo therefore already includes the potential prohibition or restriction of NEFSC research activities in MPAs. Any spatial/temporal restrictions on NEFSC fisheries research in MPAs or areas closed to commercial fishing due to EFH conservation under the Modified Research Alternative would decrease or minimize the potential for direct adverse impacts to special resource areas relative to The Status Quo Alternative, which were considered minor.

MPAs are, by definition, managed more carefully than other special resource areas and depend more heavily on scientific data about their status to sustain the habitats and resources they are designed to protect. As was the case for the Status Quo Alternative, the scientific data generated from NEFSC research activities under the Modified Research Alternative could have beneficial effects on special resource areas, including National Marine Sanctuaries, through their contribution to science-based conservation management practices. This is why many MPAs include exemptions or permit processes for scientific research. Indirect effects resulting from spatial/temporal restrictions on research in MPAs could include adverse impacts resulting from a lack of the data needed to support science-based management of MPAs. The magnitude and duration of the indirect adverse effects would depend on how extensive the restrictions on research became and how long such restrictions lasted.

Specific spatial/temporal restrictions on NEFSC research have not been proposed under the Modified Research Alternative; the overall level of research effort and therefore effects on the marine environment are assumed to be essentially the same as those described under the Status Quo Alternative. Therefore, the overall effects of the Modified Research Alternative on special resource areas would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.3 Effects on Fish

Under the Modified Research Alternative, the NEFSC would implement additional mitigation measures for protected species while conducting the same scope of research as described under the Preferred Alternative. Most of the additional mitigation measures would be unlikely to affect the amount of fish caught for research purposes. The exceptions are the modified move-on rule, the suspension of trawl operations at night or periods of low visibility, the potential for spatial/temporal restrictions on NEFSC-affiliated research in areas considered important to protected species, and the potential for incorporation of marine mammal or sea turtle excluder devices in research trawls.

The modified move-on rule would require the NEFSC to monitor for marine mammals for a 30 minute period before trawl gear was deployed. If any marine mammals were sighted anywhere from the ship in that time period, no gear would be deployed. This measure would result in a substantial extension of the time it takes to complete trawl surveys. For the NEFSC BTS, about 800 tows are attempted per year (Table 2.2-1). The addition of a 30 minute monitoring period before each tow, and perhaps more time if marine mammals are sighted, would add a minimum of 16.7 days to the BTS survey each year, which would compromise the ability of the survey to be completed within its seasonal limits. At an average cruising speed of 10 knots, this minimum waiting period would reduce the distance that could be traveled between sampling stations by about 4,000 nautical miles compared to the typical status quo time period,

thereby either extending the time required to complete the survey or reducing the geographical extent of the survey. In addition, at about $25,000 per day operating cost for the R/V *H.B. Bigelow*, this extended monitoring period would cost at least $417,500, not including salaries for staff. Given budget limitations, this increased cost would likely lead to cutbacks on the numbers of stations sampled each year, with a resulting decrease in the amount of fish caught during research. Similar effects would likely occur for other trawl surveys. While this reduction in effort would reduce mortality and disturbance impacts on fish, it would also reduce the quality of data used to inform stock assessments, compromise the statistical continuity of time-series data sets, and have potentially adverse indirect effects on fisheries management decisions. The magnitude of these effects on any given species of fish cannot be determined due to great uncertainty about budget decisions and loss of data implications, but the effects would likely be adverse to the mission of various NEFSC research programs to provide the "best available" scientific data for fisheries management purposes as required under the MSA.

Another potential measure would require the NEFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize interactions with protected species that would be difficult to detect by visual monitoring. This would have huge budgetary and logistical implications for completing the research similar to but even more extensive than those described above for the 30 minute monitoring period. Such a rule would prevent the NEFSC from meeting its scientific objectives for fisheries management under the MSA.

Spatial/temporal restrictions could reduce research fishing and hence impacts on fish in some locations. However, researchers may respond to spatial/temporal restrictions by redirecting research efforts to other locations if such movements are consistent with research goals and do not compromise time-series data sets. If so, overall research efforts could remain the same. The Modified Research Alternative does not specify particular spatial/temporal restrictions but it is assumed for the Final PEA analysis that overall research effort and therefore impacts to fish would be very similar under the Modified Research Alternative as they are for the Preferred Alternative, although they may occur in somewhat different locations and times.

The incorporation of marine mammal or sea turtle excluder devices in research trawls could affect the numbers, species, and size/age classes of fish caught in the trawls. These potential changes in the catchability of research trawls would have critical implications for the scientific validity of the research and could compromise the integrity of time-series data used to inform fisheries stock assessments. Any such gear changes would require extensive and expensive testing and calibration studies across the range of habitats, depths, spatial areas, and seasons of the survey to test potential impacts under all survey conditions before they could be implemented. For this reason, the NEFSC is not proposing to add excluder devices or other gear modifications to its research protocols under the Preferred Alternative. It is not possible to estimate what the effects may be for any species of fish if such changes were mandated under the Modified Research Alternative.

It is assumed for this Final PEA analysis that overall impacts to fish under the Modified Research Alternative would be substantially the same as those described under the Preferred Alternative. These effects would be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1. As was the case with the Status Quo and Preferred Alternatives, the Modified Research Alternative would also contribute to long-term beneficial effects on managed fish species throughout the Northeast region through the contribution of NEFSC-affiliated fisheries research to sustainable fisheries management.

4.4.4 Effects on Marine Mammals

The Modified Research Alternative includes the same scope of research as the Preferred Alternative, including the same mitigation measures currently implemented or to be implemented, and intended to reduce potentially adverse interactions with marine mammals and other protected species. The Modified

Research Alternative differs from the Preferred Alternative in that it also includes a suite of mitigation measures that the NEFSC did not propose to implement as part of the proposed action in the NEFSC LOA application (Appendix C). The NEFSC considers the suite of mitigation measures to be implemented under the Preferred Alternative to represent the most effective and practicable means to reduce the risk of adverse interactions with protected species without adversely affecting the scientific integrity of its research programs. However, NMFSs Office of Protected Resources (OPR) must consider a broad range of mitigation measures under the MMPA authorization and ESA consultation processes, and these additional measures are considered in this alternative. These additional mitigation measures focus on reducing the likelihood of mortality or injury from interaction with fisheries research gear (Level A harassment and serious injury and mortality take), particularly trawl and longline gear, and are described in Section 2.4 of this Final PEA. They involve:

- The use of additional personnel and equipment/technologies to improve detection of marine mammals, especially at night or other low-visibility conditions.
- Modification of the move-on rule to require a 30 minute monitoring period before deployment of trawl gear.
- Operational restrictions on survey activities at night or other low-visibility conditions.
- The use of additional acoustic or visual deterrents to keep marine mammals away from research gear.
- Gear modifications, including marine mammal excluder devices on trawl nets
- Temporal or geographic restrictions to avoid known concentrations of marine mammals or federal and state MPAs.
- Use of decoy vessels to distract marine mammals away from research sets.

None of the additional mitigation measures directly concern the reduction of noise from vessels or acoustic devices (Level B harassment take), reducing the numbers of fish and invertebrates caught in research samples, or reducing the risk of accidental contamination from spills. The analyses of effects through these mechanisms (disturbance or changes in habitat quality) are the same as described for the Status Quo and Preferred Alternatives and will not be discussed further. The following analysis will therefore focus on the potential for the additional mitigation measures to reduce the risk of Level A harassment, injury, serious injury, and mortality through entanglement in fishing gear or ship strikes.

Scientists at the NEFSC continually review their procedures to see if they can do their work more efficiently and with fewer incidental effects on the marine environment, including effects on marine mammals. Many of the additional mitigation measures included in this alternative have been discussed and considered in the past by NEFSC scientists; however, any changes to operational procedures or the equipment used during surveys must also be considered from the standpoint of how they affect the integrity of the scientific data collected, the cost of implementing equipment or operational changes, and the safety of the vessel and crew. It is not possible at this time to quantify how much any one of these measures (or some combination of them) may reduce the risk of future takes relative to the Status Quo or Preferred Alternatives. Any revisions to the estimated takes of each species to directly compare with the Status Quo or Preferred Alternatives would be based on speculation. This analysis will therefore provide a qualitative discussion of the potential for each additional mitigation measure to reduce takes and other effects on marine mammals as well as how each measure may affect practicability, data integrity, and other aspects of the survey work.

4.4.4.1 Trawl Surveys

Many NEFSC surveys use bottom trawl gear and pelagic (mid-water) trawl gear (see Tables 4.2-1 and 4.3-1). Many short-term cooperative research projects also use various trawl gears (see Tables 4.2-2 and

4.3-2) and would also be subject to compliance with the following mitigation measures through their contractual obligations to the NEFSC.

Monitoring Methods

Visual observations (using bridge binoculars as needed) by the officer on watch, Chief Scientist (CS) or other designated scientist, and crew standing watch are currently the primary means of detecting protected species in order to avoid potentially adverse interactions. However, there are other detection methods that have been tested or used in commercial fisheries, naval exercises, and geotechnical exploration that could be considered. These additional types of detection methods would be intended to be used in specific circumstances, such as operating at night or in low visibility conditions.

Visual surveillance by dedicated Protected Species Observers (PSO)

This measure would require the NEFSC to use trained protected species observers whose dedicated job is to detect the presence of marine mammals and other protected species within the survey area and communicate their presence to ship operations personnel. Considerations include the use of dedicated observers for all surveys or during trawl surveys of particular concern.

Under the Status Quo Alternative, the officer on watch (or other designated member of the scientific party), and crew standing watch on the bridge visually scan for marine mammals (and other protected species) during all daytime operations. Bridge binoculars are used as necessary to survey the area upon arrival at the station, during reconnaissance of the trawl line to look for potential hazards (e.g., presence of commercial fishing gear, sonar sweeps to check if bottom topography is suitable for trawling, etc.), and while the gear is deployed. If any marine mammals are sighted by the bridge or deck crew prior to or after setting the gear, the bridge crew and/or Chief Scientist are alerted as soon as possible. Currently, not all crew members have received formal training in marine mammal identification or marine mammal mitigation procedures, although they are briefed on what they are looking for and may have considerable experience with the task. However, the Preferred Alternative does include a new program to refine and formalize the training and decision-making process for all Chief Scientists, bridge crew, and deck crew that may be assigned to the observer post in the future. This new program would provide the same types of training for all appropriate crew members as PSOs trained for that specific task. This training would be provided by the commercial fisheries Observer Program staff at NMFS using the same course materials and reporting forms as used to train PSOs for applicable commercial fisheries. The difficulty in having crew members assigned only to PSO duties is that most vessels have limited carrying capacity for personnel and any berths given to PSOs would mean a reduction in personnel available to help with other research or vessel duties. This could compromise crew safety or the amount of research that could be conducted. For many cooperative research projects and long-term surveys using contracted commercial fishing vessels, there is no additional space on the vessels for personnel other than essential crew. By providing formal PSO training for crew already trained in other skills, the NEFSC believes it can provide the same quality of visual monitoring for marine mammals and other protected species as would occur with dedicated PSOs while maintaining the flexibility to fulfill all other crew duties.

Use of underwater video systems to monitor trawl gear

Underwater video technology may allow the NEFSC to determine the frequency of marine mammal interactions with the trawl gear and evaluate the effectiveness of MMEDs or other efforts to mitigate entanglement interactions. Underwater video systems have been used for these purposes in several fisheries, both in the U.S. and abroad (Northridge 2003, Lyle and Willcox 2008, Dotson et al. 2010). Northridge (2003) describes a twin camera system used to monitor the grid and escape hole of an MMED and quantify the frequency and outcome of marine mammal interactions with trawl gear. Video images were carried by cable from the cameras to the wheelhouse for continuous display and recording (Northridge 2003). Similarly, Lyle and Willcox (2008) used a low-light black and white digital camera

with a 90 degree wide-angle lens coupled to a commercially available hard drive unit to monitor interactions involving marine mammals and other megafauna.

Underwater video equipment may provide useful information about the efficacy of additional mitigation measures but the video equipment itself is unlikely to influence bycatch rates of protected species. In order to directly reduce takes of marine mammals, a video system to detect marine mammals underwater would have to be linked to a means of avoiding entanglement in gear. However, ships with deployed trawl nets cannot "swerve" to avoid a marine mammal for two reasons: 1) all marine mammals can swim faster than the tow speed so trying to move gear away from an animal that is likely attracted to fish in the net ould be ineffective, and 2) changing the vessel direction suddenly risks tangling the gear, making it difficult and dangerous to retrieve, delaying retrieval and making the risk of marine mammal entanglement worse.

Use of passive acoustic monitoring

Passive acoustic monitoring involves the detection of animals by listening for the sounds that they produce (Barlow and Gisiner 2006). Use of passive acoustic monitoring may aid in the detection of marine mammals present in survey areas, and could potentially be used to inform decisions about when to implement appropriate modifications of fishing operations to prevent interactions with marine mammals. Marine mammal calls can be reliably detected using hydrophones mounted on ships, autonomous underwater gliders, buoys, moorings, or bottom-founded installations. However, not all marine mammals vocalize and the vocalization rates of marine mammals may vary in a complex fashion depending upon environmental factors, including long periods of silence (Barlow and Gisiner 2006). While detection of a marine mammal call indicates the presence of a marine mammal, the absence of marine mammal calls does not necessarily indicate the absence of marine mammals. In addition, if the intent is to locate marine mammals so that they can be avoided, hydrophones in multiple locations combined with real-time processing are required to allow triangulation of the acoustic signal. This may be more practicable for planning large-scale activities at a set time and place rather than directing specific locations for research sampling, which involves continuous movement of a vessel from widely spaced sampling stations. Taking the time to set up a triangulated hydrophone system in an area prior to each 20 minute trawl would greatly lengthen the time and cost of collecting a certain amount of sample data. In summary, passive acoustic monitoring may be useful for detecting underwater marine mammals that could potentially interact with research activities but it would have substantial costs in terms of the research data collected and it would not guarantee the avoidance of all adverse interactions; passive acoustic monitoring inevitably overlooks those marine mammals that are not vocalizing and marine mammals may move into an area after trawl gear is deployed and still be at risk.

Use of aircraft or unmanned aerial or underwater gliders to expand detection of marine mammals

Currently, surveys using manned aircraft are routinely conducted to obtain unbiased estimates of marine mammal populations and their distributions. Aerial surveys provide reliable information about marine mammal populations because they are able to cover large areas over relatively short periods of time. In addition, airborne survey platforms generally do not influence the distribution or behavior of the marine mammals being counted, whereas many species of marine mammals are either attracted to or avoid seagoing vessels (Barlow and Gisiner 2006). The usefulness of manned aerial surveys for detection of marine mammals that could interact with fisheries research activities is limited by the range that the aircraft may travel from shore, flight time constraints, weather conditions, poor visibility in rough seas, logistical difficulties in matching a fast-moving airplane with a slow-moving research vessel, and considerable expense that would likely decrease the amount of ship-based research that could be conducted. Aerial surveys may be more practicable for planning large-scale activities at a set time and place rather than directing specific locations for research sampling, which involves continuous movement of a vessel from widely spaced sampling stations. Even with this capacity, the risk of marine mammal

interactions would remain because any marine mammals that are not near the surface would not be detectable by airborne observers and, as with other extended detection methods, marine mammals may move into an area after trawl gear is deployed but before it is retrieved.

Unmanned aerial vehicles have the potential to overcome many of the limitations associated with manned aerial surveys for detection of marine mammals. Unmanned aerial systems range from inexpensive lightweight radio-controlled aircraft to complex autonomous aircraft developed for military applications. Unmanned aerial systems could be launched and retrieved from the research vessel, stream video data to observers onboard or at a shore station, and provide near-real-time data of marine mammals in proximity to fisheries research activities. Several systems are commercially available that have the ability to remain airborne for up to 24 hours and can be operated up to 93 miles from the control station. Several tests have successfully used unmanned aerial vehicles for marine mammal detection (NOAA 2006). However, these systems can only be operated in mild to moderate wind conditions, with increasing wind speeds strongly reducing their range and making recovery difficult.

Advantages associated with the use of unmanned aerial systems include ability to operate in areas far from shore, long flight times, increased safety of observers who can monitor the data from the ship or a shore based location, and decreased expense relative to surveillance conducted from manned aircraft. Unmanned aerial technologies are rapidly evolving; over the next five to 10 years, increased video resolution and advanced sensors are likely to increase the utility of these systems for monitoring marine mammals. However, approval from additional regulatory agencies, including the Federal Aviation Administration, would be required for operation of unmanned aerial vehicles for marine mammal monitoring or research purposes. Federal Aviation Administration approval has been very difficult to obtain, even in areas with very little air traffic, which currently limits the potential for using these systems over large areas.

Autonomous underwater gliders are highly successful platforms for the collection of oceanographic data and environmental characterization. Gliders offer an attractive platform for marine mammal detection due to their relatively low cost, low power consumption, and the ability to cover large areas of ocean during long-term deployments (Olmstead et al. 2010). Gliders have been used to locate and identify marine mammals using passive acoustic technology, and the U.S. Navy is conducting additional research and development using autonomous underwater gliders to support efforts to mitigate impacts from marine mammal interactions (Hildebrand et al. 2009). The use of underwater gliders to provide mitigation options for research activities is limited by the same issues as described above for other passive acoustic detection systems.

Use of infrared technologies

Infrared (IR) sensors may be useful for detection of marine mammals under certain circumstances. IR sensors used for marine mammal detection generally measure the spatial distribution of mid-wavelength IR radiation (three to five micrometers). IR emissivity of an object in this waveband is closely correlated to the object’s surface temperature, such that IR sensor arrays can detect slight variations in temperature across relatively large areas. This technology, also known as ‘thermal imaging’, could be useful to augment visual detection of marine mammals, particularly in conditions with low ambient light when visual detection of marine mammals would be difficult. IR image data also lends itself to automated image processing. With additional research and development, it is possible that an automated marine mammal detector could be designed to recognize the IR ‘signatures’ of certain marine mammals. However, several major drawbacks currently preclude such use of IR detection for automated marine mammal detection.

First, because emitted IR radiation is absorbed in the first few millimeters of water surrounding an object, IR technology is only able to detect animals at the surface, and only those parts that are above the surface of the water. Since water is virtually opaque to IR radiation, IR detection of marine mammals is also

complicated by the thin film of water that covers the dorsal surfaces of marine mammals at the sea surface. The temperature measured by an IR sensor is the temperature of the water on the surface of the animal, which may only be a couple degrees above the surface water temperature (Cuyler et al. 1992, Kasting et al. 1989). Under ideal conditions (flat calm seas and close proximity to the IR detector), this slight temperature difference can be detected. However, waves cause the measured temperature of the sea surface to be much more variable and the thermal signature of the animal can easily be masked (Graber et al. 2011).

Second, the likelihood of detecting a temperature signature from a marine mammal falls off quickly with distance from the detector. In tests under ideal conditions, the ability of an IR system to detect killer whales, which present a large portion of their body and a tall dorsal fin above the surface of the water, was very poor beyond 330 feet (Graber et al. 2011). The ability of an IR system to detect much smaller targets like dolphins and porpoises would presumably be much less than it is for killer whales. Finally, considerable effort and time is required to process the video data so that the thermal signatures of animals can be distinguished from the surrounding water. This greatly reduces the effectiveness of the technique for real-time monitoring tied to potential mitigation. In summary, the logistical difficulties of using IR detectors in a real-life context on a research vessel would be overwhelming and currently preclude this potential tool as a practical element of mitigation.

Use of night vision devices

Like IR imaging devices, night vision devices may be used for detecting marine mammals at or above the water surface in low-light conditions. Unlike IR sensors, night vision devices operate by amplifying the signal produced when visible light interacts with a detector. Although night vision devices could potentially improve an observer’s ability to detect a marine mammal under low light conditions, previous studies have shown that the effective range of detection for marine mammals using night vision devices is only about 330 feet (Calambokidis and Chandler 2000, Barlow and Gisner 2007). These devices work best when there is a little light on the water (from the moon or nearby land sources) but they must be directed away from deck lights because they are too bright. This means they could not be used to monitor trawl gear as it is being deployed or retrieved because of the deck lights used for crew safety. They also have a very narrow field of view, making broad area searches inefficient and unreliable, and if sea conditions are rough the many reflections off waves make it very difficult to distinguish objects in the water. Some observers found the devices disorienting and uncomfortable and all observers said it was very difficult to estimate distances while using the night vision devices (Calambokidis and Chandler 2000). Failure to detect marine mammals using such devices would not decrease the uncertainty about whether marine mammals are actually in the immediate area or not and would thus offer no help in deciding whether to deploy trawl gear or not.

<u>Operational Restrictions</u>

The modification of the move-on rule to require a 30 minute monitoring period would be intended to improve the chances of seeing marine mammals present in the sampling area before gear was deployed, thus reducing the risk of incidental capture or entanglement in research gear. This measure is based on the fact that marine mammals typically spend most of their time under water and are difficult to see. Further, it is based on the premise that extending the monitoring period to allow them time to surface and be seen by ship-board observers improves the chances of avoiding adverse gear interactions. While this measure is reasonable from the perspective of observing marine mammals under good conditions, its effectiveness would vary considerably depending on lighting conditions and sea state, with essentially no potential for reducing interactions at night or other conditions of poor visibility, which occur frequently. In addition, the link between seeing marine mammals and reducing the risk of adverse gear interactions is dependent on some assumptions that may not be supported by the experience of NEFSC researchers. The measure assumes that visually spotting animals is directly correlated to gear interactions (i.e., animals are seen

before they are caught and, conversely, animals are not caught when they were not seen previously). While NEFSC research activities have a small number of marine mammal interactions on which to base any conclusions, this assumption is not supported by experienced scientists from the NEFSC.

Of the few marine mammals that have been caught in the BTS over it's more than 50 year history, most incidents occurred when no animals had been seen prior to hauling the net on board (Galbraith pers. com. 2014). In contrast, dolphins are often attracted to vessels for bow riding and are often seen around the ship but they appear to be very savvy around fishing nets and are rarely caught. The type of marine mammals seen and their behavior in relation to the ship and gear are currently part of the ship-board judgment about whether any marine mammals present are in danger of interactions with research trawls. The NEFSC believes that adding a set monitoring period in which no marine mammals could be seen before gear is deployed would circumvent the experience of its scientists and ship crews in avoiding interactions and would not reduce the risk of incidentally taking marine mammals.

Another concern for the NEFSC is the potential for this mitigation measure to bias its data by forcing it to abandon sampling stations that are "hotspots" for marine life. Marine mammals and other predators are often drawn to areas and oceanic conditions where fish and invertebrate prey are concentrated. Region-wide, multi-species surveys such as the BTS are designed to assess the distribution and abundance of many species through randomized sampling of many dispersed sites. The validity of statistical methods used to expand sampling results into inferences about the range-wide population status of these species depends on the random sampling of "hotspots" as well as sites with lower densities of animals. If these surveys could not sample in areas rich in marine life, as indicated by the presence of marine mammals, even if the marine mammals did not appear to be at risk of interaction with the research gear, the sampling results would not accurately reflect the variability in abundance for different species and the ability of the NEFSC to provide the "best available" scientific data for fisheries management purposes would be compromised. This type of ecological information is also important to agencies and other institutions concerned about the health of the marine environment important to marine mammals themselves.

Another potential mitigation measure would require the NEFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize interactions with marine mammals that would be difficult to detect by visual monitoring. At least three of the four marine mammals taken in NEFSC research trawls occurred during hours of darkness or in early morning conditions so this measure has the potential to reduce the risk of interactions with marine mammals. However, restrictions on trawling at night would seriously hinder the ability of the NEFSC to complete their sampling protocol. If survey vessels had to stand down when they encountered fog or rough seas, survey periods would have to be extended or fewer stations would have to be sampled to accommodate such delays. This would mean substantially higher costs and/or decreased quality of data. Although visual monitoring is a reasonable and practicable precaution to undertake for trawl surveys, it does not ensure that marine mammals would be detected or that entanglement could be prevented even if they are detected.

Acoustic and Visual Deterrents

This measure would require the NEFSC to use additional acoustic deterrents, such as pingers on trawl gear or recordings of predator (e.g., killer whale) vocalizations to deter interactions with trawl gear. This measure would also require the NEFSC to use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope) to reduce marine mammal interactions with the gear. Research and development of these acoustic and visual deterrent techniques were considered high priority needs in the 2011 Atlantic Trawl Gear Take Reduction Strategy research needs and priorities (NMFS 2011b).

Acoustic pingers have been shown to be effective in deterring some marine mammals, particularly harbor porpoises, from interacting with gillnet gear (Nowacek et al. 2007, Carretta and Barlow 2011). There are,

however, few studies testing their efficacy when used with trawl gear. Studies of acoustic deterrents in a trawl fishery in Australia concluded that pingers are not likely to be effective in deterring bottlenose dolphins, as they are already aware of the gear due to the noisy nature of the fishery (Stephenson and Wells 2008, Allen et al. 2014). Acoustic deterrents were also ineffective in reducing bycatch of common dolphins in the U.K. bass pair trawl fishery (Mackay and Northridge 2006). Although acoustic deterrents may be effective in preventing bycatch in gillnets, their efficacy in preventing bycatch in trawl nets is currently uncertain. A primary reason for this is that the noise associated with trawl gear (chains, ropes, trawl doors) is sufficiently loud that any acoustic device used would have to be louder than that generated by the ship and fishing gear which could, in turn, cause auditory damage or exclusion of cetaceans from important habitat (Zollett 2005). Underwater broadcasting of pre-recorded predator sounds (e.g. killer whale calls) to scare animals away from the fishing operation has been suggested as a potential mitigation measure but Jefferson and Curry (1996) concluded that this technique was largely ineffective for reducing marine mammal interactions with commercial fisheries based on their review of multiple studies.

Several methods have been suggested to help protected species visually detect fishing gear and avoid entanglement. Increasing acoustic reflectivity of nets through the addition of materials such as barium sulphate or acoustic reflectors has been tested, with varying degrees of success, in several set-net fisheries (Mooney et al. 2004, Rowe 2007). The applicability and efficacy in trawl fisheries is currently unknown. Similarly, nets could be illuminated with phosphorescent or luminescent materials and, ultimately, reduce the potential for entanglement. Wang et al. (2013) tested the efficacy of illuminating nets used in a Mexican bottom set-net fishery with ultraviolet (UV) light-emitting diodes to reduce sea turtle bycatch. UV net illumination significantly reduced green sea turtle bycatch without impacting target fish catch rates. Applicability in trawl fisheries and efficacy in deterring marine mammals with similar technology are, however, currently unknown.

Gear Modifications

The NEFSC and its cooperating partners conduct a number of trawl surveys and research activites in the Northeast region. Two of these surveys, the NEFSC BTS (4-bridle, 3-seam bottom trawl net) and the Atlantic Herring Survey (Hydroacoustic Midwater Rope Trawl), have caught marine mammals in the past (three short-beaked common dolphins and a minke whale). Marine mammal excluder devices have been developed for several types of trawl nets and at least one device is being used by the Southwest Fisheries Science Center (SWFSC) during fisheries research with the Nordic 264 midwater trawl. In addition, the SWFSC is developing a marine mammal excluder device for the modified Cobb midwater trawl (SWFSC 2013). These devices are similar to turtle excluder devices and are designed to allow fish to pass through the bars of the excluder while marine mammals are guided to an escape hatch built into the net. The challenge with developing an excluder device is to minimize the impact on the fishing performance of the net while effectively reducing captures of marine mammals in the net. The shape, size, design, and positioning of an excluder device in the net can substantially impact the fishing performance of the net (Dotson et al. 2010).

An important factor to consider when developing excluder devices or any other gear modifications is to determine how the device or gear modification impacts the scientific objectives of the research. In the case of the SWFSC survey that now uses a marine mammal excluder device on the Nordic 264 trawl, the relevent objective of the survey is to collect a sample of individual fish for a variety of measurements and to examine their reproductive status. The reduced efficiency of the modified net in catching fish therefore does not substantially interfere with the scientific objective of the research. However, the scientific objective of the NEFSC surveys using trawl gear is to estimate overall population abundance and distribution of numerous species across large geographic areas. Reductions in catchability of one or more fish species or size classes of fish, or increasing the variability of catch rates under different ocean conditions, could compromise the validity of the research survey and disrupt time-series data sets used to inform stock assessments. Given the value of these long time-series data sets for tracking ecosystem

changes (one of which extends over 50 years) and the potentially huge economic implications for fisheries management of highly valuable commercial fisheries, any potential changes to research gear or protocols that may introduce uncertainty and bias into survey results must be thoroughly examined and planned years in advance of their implementation.

When any potential changes are made to research gear or protocols that may affect catchability or selectivity, it is standard practice to conduct a calibration experiment to quantitatively compare the prior fishing gear/system with the revised fishing gear/system. These calibration experiments must be conducted across the range of habitats, depths, spatial areas, and seasons of the survey to test potential impacts under all survey conditions. The transition from the now retired R/V *Albatross IV* to the new research vessel R/V *Henry B. Bigelow* provides an example of how serious any survey change must be considered. Planning for the transition of the research vessel used to conduct the NEFSC BTS began in 2002, the calibration experiment was completed in 2008, and the transition to the new survey vessel was achieved in 2009. The NEFSC conservatively estimates the cost of this transition to be in the $7 million to $9 million range.

The NEFSC has not attempted to develop marine mammal excluder devices for any of the bottom or midwater trawls it uses for research. Such an effort would require a substantial effort to design and test potential excluder devices for specific nets and survey objectives. Given the infrequency of adverse interactions between marine mammals with this type of research gear, the scientific uncertainties it could introduce into the time-series data, and the economic cost of conducting calibration experiments to validate such gear modifications, the NEFSC is not proposing to conduct such gear modification research in the near future.

Temporal or Geographic Restrictions

Spatial/temporal restrictions can be a direct way of reducing adverse impacts to protected species if there are known overlaps in time and space of the survey's footprint with concentrations of protected species. This measure would require the NEFSC to identify areas and times that are most likely to result in adverse interactions with marine mammals (e.g., areas of peak abundance) and to avoid, postpone, or limit their research activity to minimize the risk of such interactions with marine mammals. This may include limits on specific locations, physical or oceanographic features, biologically important times, and/or gear types.

While the rationale for such restrictions is clear, the methods for identifying appropriate places and times for effective restrictions are not. The NEFSC has been conducting marine mammal surveys in the northeast region for many years to monitor the changing patterns of marine mammal abundance and distribution. These patterns of abundance are dynamic and often correlated to particular oceanographic conditions, which vary among seasons and years, so marine mammal survey information from the previous year or even the previous month may not reflect actual conditions when it is time to deploy trawl gear. It might be possible to conduct aerial surveys or passive acoustic surveys in an area prior to conducting trawls, but such surveys require time to process data before actual density information is available.

Even if recent marine mammal survey data is available, there is an open question about what standards of density should be used for limiting research. This is important to the potential effectiveness of such restrictions because it is not clear if marine mammal density is a key factor in the risk of catching animals in a research trawl. Marine mammals can all swim much faster than an active trawl tow (two to four knots) so they can easily avoid such gear if they perceive it and choose to move. This is true no matter how many animals are in a given area. The risk of entanglement is likely influenced much more by the attraction of marine mammals to fish caught in the trawl or disturbed by it as the trawl passes by, which in turn may be influenced by the overall availability of prey and the nutritional status of the marine mammals. Even if there are only a few marine mammals in an area, the risk of entanglement could be

high if they are very hungry and strongly attracted to fish in a trawl. Conversely, the risk of entanglement could be quite small even if there are many marine mammals in an area if they have been foraging successfully and are inclined to avoid the disturbance of a trawl operation.

In any case, under the Status Quo and Preferred Alternatives, the “move-on” rule would be applied if any marine mammals are sighted from the vessel prior to deploying trawl gear and appear to be at risk of interactions with the gear. If an area has a high density of marine mammals, they would likely be sighted during the trawl reconnaissance period prior to setting the gear and the station could be moved away or abandoned if they were considered at risk of gear interactions.

A special case of spatial/temporal restrictions would be for the NEFSC to avoid trawl survey work within federal and state MPAs (see Section 3.1.2). While the NEFSC has conducted survey work within some MPAs under the authority of special use permits, these permits primarily provide authority to scientifically sample fish in areas that are otherwise closed to fishing and do not concern the incidental take of marine mammals. The only areas that are protected specifically for marine mammals are Stellwagen Bank National Marine Sanctuary and the North Atlantic right whale critical habitat areas. The NEFSC would continue to apply for special use permits to sample in MPAs as necessary to meet the scientific needs of their surveys and, if the managing agencies of any MPAs prohibit such sampling, the NEFSC would avoid those areas. However, as described above, the same concerns about the effectiveness of spatial/temporal restrictions as a mitigation measure would apply to MPAs. They may or may not have high concentrations of marine mammals relative to the surrounding areas but, given the uncertainty about what factors contribute to high risk of entanglement in trawl gear and the imposition of the “move-on” rule, the potential for actually reducing incidental take by avoiding certain areas is not clear. Such avoidance also comes at the cost of not sampling in areas that are important to different fish species or that were established to promote recovery of depleted stocks. Scientific sampling is often the only reliable way to track the status of these stocks and the effectiveness of the MPA in fulfilling its established goals.

4.4.4.2 Longline Gear

The Apex Predator shark surveys, COASTSPAN surveys, and various cooperative research projects use longline gear and would be subject to the following additional mitigation measures.

Monitoring Methods

The potential to use additional monitoring methods during longline surveys mostly involves the same considerations discussed with trawl surveys above. However, the potential to use dedicated PSOs is restricted primarily by vessel and crew size considerations. Longline surveys are conducted on much smaller vessels than trawl surveys and the size of the crew is typically only a few people. Under the status quo, at least one member of the crew is charged with watching for protected species before the gear is set. This person is usually driving the boat and watching for other hazards such as commercial fishing gear while the other crew members are preparing the longline gear for deployment. Dedicated PSOs would not be distracted by other vessel or research gear duties and would thus offer an advantage in monitoring for protected species. However, given the current size of vessels and crews used for these surveys, the inclusion of a crew member dedicated to only one task would compromise the ability of the remaining crew to conduct the survey safely.

Operational Procedures

This measure would require use of a decoy research vessel playing pre-recorded longline fishing sounds to distract marine mammals away from research longline sets. There have been no attempts to test the effectiveness of this method but it is likely that cetaceans would quickly learn to tell the difference between decoys and actual fishing operations (Gillman et al. 2006). Although the potential effectiveness is not clear, the additional cost of chartering another vessel to serve as a decoy would certainly compromise the research budget and restrict the amount of data that could be collected. In addition, a

second vessel and broadcast fishing sounds would add to the amount of noise introduced to the marine environment, potentially increasing the number of animals taken by disturbance (Level B takes) everywhere the survey was conducted.

Acoustic Deterrents

This measure would require the NEFSC to use deterrents such as acoustic pingers or recordings of predator (e.g., killer whales) vocalizations to deter interactions with longline gear. Although no marine mammals have been taken in longline gear during NEFSC fisheries research, takes of marine mammals on longline surveys in other regions involved animals hooked while depredating fish caught on the gear. Tests of the use of acoustic deterrents to mitigate depredation showed varying results. Signals emitted by pingers may decrease interactions of toothed whales with longlines by interrupting echolocation signals. Depredation by dolphins in the Mediterranean Sea appeared to decrease in response to some pingers, although distance from fishing vessels was not affected (Buscaino et al. 2011). Tests of similar devices in the tuna longline fishery off Hawaii indicate that the pingers probably reduced depredation rates (Nishida and McPherson 2011). Fixed frequency (10 kHz) acoustic pingers affixed to longlines in the South Pacific and Indian Oceans had a deterrent effect compared to random frequency (5-160 kHz) small pingers (Huang 2011). Adding pingers to the longline could also serve to attract animals rather than deter them (the “dinner bell” effect) (Jefferson and Curry 1996). As with trawl gear, attempts to scare animals off by playing killer whale recordings are likely to prove ineffective. In a draft review paper, Hamer et al. (2010) note that, although the use of predator playback has not been well studied, it may only work over short distances and individuals would likely habituate to the sounds. There is also the potential that introduction of these acoustic devices could deter or attract the target species, thereby compromising the continuation of the time-series data set.

Visual Deterrents

This measure would require the NEFSC to use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope, or marked lines) to make the longline gear more detectable thereby reducing the likelihood of hooking or entangling a marine mammal. This measure would theoretically reduce rates of interaction or entanglement for animals that have trouble detecting the fishing gear in order to avoid it (Gillman et al. 2006). Similarly, phosphorescent or luminescent material can be incorporated into fishing gear to emit light underwater at wavelengths that are visible to protected species. However, it is not clear that such measures to enhance the acoustic or visual appearance of trawl nets would have the same effect on all species. For some species that are attracted to the fish caught on the longline, efforts to increase the visibility of a longline set may increase the potential for interactions rather than decrease those risks. In addition, devices added to longline gear to increase their visibility may deter or attract the target species, thereby invalidating the continuation of the time-series data set.

4.4.4.3 Conclusion

Under the Modified Research Alternative, the NEFSC would implement additional mitigation measures for protected species while conducting the same scope of research as described under the Preferred Alternative. Of the potential techniques and procedures considered under this alternative to improve monitoring of trawl gear, three techniques appear to offer some promise in helping to detect marine mammals in conjunction with the current visual monitoring protocol. These include the use of underwater video technology, passive acoustic monitoring, and unmanned aerial or underwater surveillance vehicles. However, all three techniques have substantial limitations in terms of conditions under which they may be useful (e.g. weather and sea state), the logistics of incorporating them into sampling procedures (e.g. timing of deployment, crew responsibilities, and data processing), and how they might be incorporated into actual marine mammal take-avoidance decisions like the “move-on” rule. These three techniques may warrant further examination to explore these limitations and to see how they may be applied under

actual survey conditions if the technology advances and is improved. The other technological approaches considered, infra-red imaging and use of night vision devices, have severe limitations to their usefulness in a real-world situation and therefore offer no advantages for actual mitigation.

The use of dedicated and trained personnel to monitor for protected species would occur under the Preferred Alternative once the crew and scientists of research surveys complete the new protected species training program. Currently, at least one member of the trawl survey crew or scientific party would be dedicated to monitoring for protected species before research gear is deployed. Given the new protected species training program for all crew members under the Preferred Alternative, the use of dedicated PSOs for monitoring during trawl operations would offer no advantage to what would occur under the Preferred Alternative.

Operational restrictions such as not allowing trawls to be set at night or in poor visibility conditions would certainly reduce the risk of taking marine mammals. However, part of their effectiveness may be due to reduced overall sampling effort rather than because marine mammals are more likely to be caught under those conditions. Such restrictions would have a serious impact on the ability of the NEFSC to collect certain kinds of research data and would have impacts to the cost and scope of research that could be conducted. The spatial/temporal restrictions that were considered to avoid high densities of marine mammals are similar in that they would reduce risk of take by reducing overall sampling effort but also strongly impact the ability of the NEFSC to pursue certain scientific goals.

The use of additional acoustic and visual deterrents may warrant further investigation if new devices enter the market and are demonstrated to be effective. However, the effectiveness of the devices considered in this alternative appears to be species specific; mitigation advantages for some species may lead to higher risk for other species. The effectiveness of these techniques may also decrease with time as animals habituate to various devices and techniques.

The analysis of additional measures considered to decrease the risk of marine mammal takes in longline gear is similar to trawl gear. Longline surveys are conducted on much smaller vessels with limited crew. One member of the crew, usually the person driving the boat, is tasked with monitoring for protected species but may have other duties as well. Dedicated PSOs could offer an advantage for monitoring in these situations but the lack of crew space is limiting; all crew members have multiple tasks that are necessary for safe navigation and to conduct the survey. Decoy vessels, acoustic deterrents, and visual deterrents are all unlikely to provide consistent mitigation value and may increase the risk for certain species. New variations on these techniques may be developed in the future that address some of these concerns.

In conclusion, some elements of the Modified Research Alternative (e.g., dedicated PSOs) could offer mitigation advantages compared to the Status Quo Alternative. However, the Modified Research Alternative does not appear to offer a substantial reduction in the risk of adverse interactions with marine mammals compared to the Preferred Alternative other than through reducing overall fishing effort. The impacts of the Modified Research Alternative on marine mammals would therefore be similar to the impacts of the Preferred Alternative, which were considered minor adverse under the criteria described in Table 4.1-1. Some concepts and technologies considered in the Modified Research Alternative are promising and NMFS would evaluate the potential for implementation if they become more practicable.

4.4.5 Effects on Birds

The effects of the Modified Research Alternative on birds would be very similar to those described for the Status Quo Alternative (Section 4.2.5) and the Preferred Alternative (Section 4.3.5). The exceptions involve two potential additional mitigation measures intended to reduce impacts on protected species. The Modified Research Alternative includes potential spatial/temporal restrictions on where and when NEFSC-affiliated research could occur. Such restrictions may reduce impacts on sea birds in certain areas such as marine protected areas if such closures were determined to be effective mitigation measures.

However, specific determinations about potential research restrictions have not been made and it is assumed that the overall research effort would be very similar under the Modified Research Alternative as it would be under the Status Quo Alternative. Overall effects on seabirds would therefore be similar even if research was conducted in somewhat different places and times.

Another additional mitigation measure under the Modified Research Alternative would be for the NEFSC to deploy streamer lines on longline gear to reduce the risk of catching seabirds. Deploying streamer lines on each side of the baited longline to discourage seabirds from diving on baited hooks has proven effective in reducing seabird bycatch in some Pacific fisheries (Melvin et al. 2001). This measure would reduce the already-low risk to seabirds from NEFSC's longline surveys but given the lack of historical interactions of birds in this type of research gear, the practical effects on birds would likely be minimal. If seabird interactions with longline gear are documented in the future, the NEFSC will revisit whether use of streamer lines is warranted given the tradeoffs between the potential conservation benefit and changes to research protocols that might affect time-series data.

The overall effects of NEFSC research activities on birds under the Modified Research Alternative would likely be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.6 Effects on Sea Turtles

The Modified Research Alternative would include the same scope of research activities as the Preferred Alternative but those activities would be conducted under different operating procedures and gears in order to mitigate, to the greatest possible extent, any potentially adverse impacts on protected species, including sea turtles. Most of these additional mitigation measures are being considered in this Final PEA in order to address marine mammal protection issues under the MMPA (see Section 4.4.4) but many of them may have implications for avoiding potentially adverse interactions with sea turtles, including:

- The use of dedicated protected species observers and additional equipment/technologies to improve monitoring.
- Operational restrictions on research activities in low visibility conditions.
- The use of acoustic and visual deterrents on selected gear types.
- Gear modifications, including turtle excluder devices on trawl nets.
- The incorporation of high-resolution, high-speed video cameras into trawl nets with open cod ends.
- Temporal or geographic restrictions to avoid known concentrations of marine mammals or federal and state MPAs.

None of the additional mitigation measures involve reducing the number of research vessels or samples taken during research, how much fish and invertebrates are caught in research samples, or reducing the risk of accidental contamination from spills. The analyses of effects through these mechanisms (disturbance or changes in habitat quality) are the same as described for the Status Quo and Preferred Alternatives and will not be discussed further. The following analysis will therefore focus on the potential for the additional mitigation measures to reduce the risk of injury, serious injury, and mortality of sea turtles through entanglement or hooking in fishing gear.

Scientists at the NEFSC regularly review their procedures to see if they can do their work more efficiently and with fewer incidental effects on the marine environment, including effects on sea turtles. In fact, many of the short-term cooperative research projects considered in this Final PEA are designed to test ways to reduce bycatch of non-target species in commercial fisheries. Although some of the additional mitigation measures included in this alternative may have been discussed and considered in the past by

NEFSC scientists, any changes to operational procedures or the equipment used during surveys must also be considered from the standpoint of how they affect the integrity of the scientific data collected, the cost of implementing equipment or operational changes, and the safety of the vessel and crew. It is not possible to quantify how much any one of these measures (or some combination of them) may reduce the risk of future takes relative to the Status Quo or Preferred Alternatives. Any revisions to the estimated takes of each species to directly compare with the Status Quo or Preferred Alternatives would be based on speculation. This analysis will therefore provide a qualitative discussion of the potential for each additional mitigation measure to reduce takes and other effects on sea turtles.

<u>Monitoring Methods</u>

Visual observations (using bridge binoculars as needed) by the officer on watch, Chief Scientist (CS) or other designated scientist, and crew standing watch are currently the primary means of detecting protected species in order to avoid potentially adverse interactions. However, there are other detection methods that have been tested or used in commercial fisheries, naval exercises, and geotechnical exploration that could be considered.

Visual surveillance by dedicated Protected Species Observers (PSO)

This measure would require the NEFSC to use trained PSOs whose dedicated job is to detect the presence of protected species within the survey area and communicate their presence to ship operations personnel. Considerations include the use of dedicated observers for all surveys or during surveys with gear types and protocols of particular concern.

For long-term trawl surveys under the Status Quo Alternative, at least one member of the crew is dedicated to observe for protected species prior to deploying trawl gear. For long-term longline surveys (COASTSPAN and Apex Predators), there is a 30 minute observation period before setting gear and a move-on rule if sea turtles (or marine mammals) are sighted by the observer and are considered to be at risk of interacting with the gear. During longline surveys on small vessels with only a few crw members (e.g., COASTSPAN), all personnel have multiple duties in addition to looking for protected species (e.g., finding an appropriate set location, driving the boat, and preparing the gear for deployment). Currently, not all crew members have received formal training in protected species identification or mitigation procedures, although they are briefed on what they are looking for and may have considerable experience with the task. However, the Preferred Alternative does include a new program to refine and formalize the training and decision-making process for all Chief Scientists, bridge crew, and deck crew that may be assigned to the observer post in the future. This new program would provide the same types of training for all appropriate crew members as PSOs trained for that specific task. This training would be provided by the commercial fisheries Observer Program staff at NMFS using the same course materials and reporting forms as are used to train PSOs for applicable commercial fisheries.

The difficulty in having crew members assigned only to PSO duties is that most vessels have limited carrying capacity for personnel, and any berths given to PSOs would mean a reduction in personnel available to help with other research or vessel duties. This could compromise crew safety or the amount of research that could be conducted. By providing formal PSO training for crew already trained in other skills, the NEFSC believes it can provide the same quality of visual monitoring for sea turtles and other protected species as would occur with dedicated PSOs while maintaining the flexibility to fulfill all other crew duties.

Use of underwater video systems to monitor fishing gear

The NEFSC (and other Fisheries Science Centers) have used underwater video systems extensively to help study the benthic environment (Tables 2.2-1 and 2.2-2) and to monitor the performance of different types of fishing gear, including the efficacy of turtle excluder devices on trawl and dredge gear (Gearhart 2010). They have also been used to study depredation of longline gear by sea turtles and marine

mammals. Video monitoring systems can provide real-time information about the species and size classes of fish and other organisms (i.e., sea turtles and marine mammals) that are captured or avoid the fishing net or dredge, although cloudy water often limits the usable range of camera systems such that only portions of the fishing gear may be monitored at a time or visibility in front of towed gear is limited. Video camera systems are a powerful tool for studying the marine environment and fishing technologies but their use for direct mitigation of adverse interactions with sea turtles and other protected species is problematic.

In order to directly reduce takes of sea turtles, a video system to detect sea turtles underwater would have to be linked to a means of avoiding entanglement in gear. However, ships with deployed trawl nets or dredge gear cannot stop suddenly or "swerve" to avoid a sea turtle because quickly changing the vessel speed or direction risks tangling the gear, making it difficult and dangerous to retrieve, delaying retrieval and potentially making the risk of sea turtle entanglement worse. In addition, sampling protocols would be needlessly compromised if tows were interrupted every time a sea turtle or marine mammal was seen in the vicinity of the fishing gear. Sea turtles are probably able to detect approaching fishing gear at a distance and swim away, but they may also be attracted to fish and other species disturbed by the passing gear. It would therefore be difficult to determine in real time whether a given turtle was actually in danger of being captured or was just using the gear as a foraging opportunity. Given this uncertainty about appropriate and safe responses to video camera information and the infrequency of sea turtle captures in NEFSC research fishing, with only rare cases of serious injury or mortality, the NEFSC does not consider the use of video systems to monitor and avoid potentially adverse sea turtle interactions to be effective, safe, or to outweigh the loss of scientific data due to the disruption of research protocols. However, the NEFSC would continue to use video technologies to study the effectiveness of fishing gear modifications and fishing methods to reduce adverse interactions with sea turtles.

An alternative strategy would be to incorporate high-resolution, high-speed video cameras into trawl nets with open cod ends for the purpose of sampling fish without capturing them. The idea is that fish entering the trawl could be identified and counted through review of the video images but they would pass through the open cod end. This technique would potentially allow any incidentally captured sea turtles to pass through the open cod end as well. Such an approach would be appropriate for swept area surveys designed to determine the density of fish, but it would not be appropriate for surveys designed to determine the reproductive condition of adult fish or the growth rates of fish (e.g., NEFSC BTS and NEAMAP Surveys) as these measurements require the dissection of specimens. It would also be inappropriate for surveys targeting very small fish because species identification often requires microscopic analysis. Although this technique holds promise for reducing the risk of sea turtle interactions, the NEFSC is not proposing to conduct any surveys with trawl gear under the Modified Research Alternative that would be appropriate for an open cod end.

Use of other monitoring technologies

Passive acoustic monitoring involves the detection of animals by listening for the sounds that they produce. This technology is not expected to be effective for detection or avoidance of sea turtles because sea turtles vocalize only during copulation and nesting, and are the least vocal of living reptiles (Cook and Forrest 2005). Autonomous underwater gliders are highly successful platforms for the collection of oceanographic data and they have been used to detect the presence of marine mammals (Hildebrand et al. 2009) but their success in monitoring for these species is tied to the use of passive acoustics, which is ineffective for sea turtles. Infrared (IR) detection is unlikely to improve the ability to detect and avoid sea turtles in the water because water is effectively opaque to IR radiation. Although turtles come to the surface to breathe, only a very small area of a turtle is exposed above the sea surface. In addition, because turtles are ectothermic (cold-blooded) reptiles, temperature differences between the turtle and the surrounding water would be minimal and difficult to detect using IR-sensing devices. Similarly, sea turtles in the water would be extremely difficult to detect using night-vision technology.

Operational Restrictions

Operational restrictions proposed under the Modified Research Alternative would require the NEFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize adverse interactions with protected species, including sea turtles, which would be impossible to detect by visual monitoring under low-visibility conditions. However, most of the sea turtles that have been caught in NEFSC BTS and NEAMAP trawl surveys since 2004 have been taken in daylight hours (Table 4.2-14). The elimination of night trawls would therefore do little to reduce the risk of catching sea turtles and would compromise the ability of the NEFSC and its research partners to effectively conduct its research program.

Acoustic and Visual Deterrents

Several methods have been suggested to help protected species detect the presence of fishing gear with the expectation that these methods would help animals avoid entanglement. The effectiveness of visual deterrents for mitigation of sea turtle interactions with fishing gear is uncertain. Some data suggest that the use of luminescent lightsticks and LEDs may decrease rates of green sea turtle bycatch in gillnet gear (Wang et al. 2009). In contrast, results from other studies demonstrate that sea turtles are attracted to underwater illumination (Wang et al. 2007, Southwood et al. 2008). Thus, the efficacy of such mitigation measures could be different under different conditions and for different species, and should be examined on a case-by-case basis.

NEFSC-affiliated cooperative research projects involving commercial vessels and gear currently deploy acoustic pingers on gillnets in areas where they are required by commercial fisheries, but they are intended to deter marine mammals rather than sea turtles. Southwood et al. (2008) examined the potential for using acoustic deterrents for sea turtles on longline gear, but concluded that any such devices would likely also deter the target fish species, have the potential for sea turtles to habituate to or be attracted to the sound, and add to the level of anthropogenic sounds in the ocean without a reasonable chance of success in reducing incidental take of turtles.

Gear Modifications

The NEFSC has long supported research on the development of turtle excluder devices and other gear modifications to reduce the impacts of commercial fisheries on sea turtles. NEFSC-affiliated cooperative research projects that are conducted by fishing industry-related research partners currently employ all such devices on their research projects in situations where fisheries regulations require them for specific gears and areas. Some projects have received scientific research permits to test variations in excluder devices that are not covered in fishing regulations.

However, the NEFSC BTS and other large trawl efforts (e.g., NEAMAP and Benthic Habitat Surveys) do not use turtle excluder devices on their trawl nets. The reason such gear modifications have not been made are similar to those described for potential marine mammal mitigation in Section 4.4.4; relatively low rates of sea turtle captures in trawl research gear with no historic mortalities, extensive scientific uncertainties introduced into the time-series data, and the economic cost of conducting calibration experiments to validate such gear modifications.

Since 2004, the NEFSC BTS and NEAMAP surveys have collectively caught 31 loggerhead turtles, eight Kemp's ridleys turtles, one green turtle, and one leatherback turtle in bottom trawl gear (an average of about four turtles per year, Table 4.2-15). The tow duration for these surveys is 20 minutes so any captured turtle would likely be brought to the surface before it could drown. All of the turtles caught in research trawl gear to date have been released alive and in apparently good condition. Captured turtles are measured, sampled for genetic material, scanned for PIT tags, and tagged with a PIT tag by a qualified biologist if they do not already have one. All tagging and sampling of live turtles is done in compliance with 50 CFR 222.310 and 223.206. The tagging and sampling activities contribute to the scientific

understanding of sea turtle biology at sea. The incorporation of sea turtle excluder devices into the research protocols for the NEFSC BTS and NEAMAP surveys (or other existing research projects using bottom trawl gear) would introduce a great deal of scientific uncertainty into the time-series data by changing the catchability of many fish species, which would compromise the validity of the surveys and their use in the stock assessment process. Given these factors and the high cost of conducting calibration experiments, the NEFSC is not proposing to conduct such gear modification research in the near future. However, if new trawl research surveys or projects are developed in the future where capture of sea turtles may occur, the NEFSC would consider the incorporation of sea turtle excluder devices into the new research protocols, which would not be affected by the time-series data concerns or calibration study costs described for existing research.

Temporal or Geographic Restrictions

Time-area restrictions are one of the most direct means of reducing adverse impacts to protected species if there are known overlaps in time and space of the fisheries research footprint with concentrations of those species. The implementation of spatial/temporal closures to restrict fishing activities at times and places turtles are most likely to be present in the highest numbers has been shown to be effective in reducing impacts to sea turtles in the Pacific Islands region (Kobayashi and Polovina 2005). Spatial/temporal restrictions proposed as mitigation measures under the Modified Research Alternative could potentially alter the distribution and overall level of impacts to sea turtles resulting from NEFSC research activities. The identification of specific sea turtle migratory pathways or high-residence areas and times is essential for the establishment of effective spatial/temporal restrictions to reduce adverse interactions with sea turtles. NMFS has recently proposed to designate critical habitat for the Northwest Atlantic Ocean DPS of loggerhead sea turtle (78 FR 43006, 18 July 2013), which includes migration corridors and wintering areas in marine waters around Cape Hatteras, North Carolina as well as many coastal areas south of Cape Hatteras. These areas would be good candidates for consideration of fishing closures. Other areas for consideration under the Modified Research Alternative include Marine Protected Areas (MPA) and National Marine Sanctuaries.

The NEFSC recognizes the potential for this type of mitigation but is not proposing to implement such spatial/temporal restrictions on its research program for several reasons:

- Many of these areas may be important to commercial fish stocks as well as sea turtles and avoidance of scientific sampling in times and places important to different fish species would limit the NEFSC's effectiveness in fulfilling its stock assessment mission under the MSA.
- Some MPAs have been established to help promote recovery of depleted fish stocks and provide refugia for other species. Scientific sampling is often the only reliable way to track the status of these stocks and the effectiveness of the MPA in fulfilling its established goals.
- Sea turtle interactions with NEFSC research gear are relatively infrequent and the risk of serious injury or mortality very small given current research protocols (short tow and set durations) and mitigation measures. The formalization of crew training for all NEFSC and cooperative research partners under the Preferred Alternative, including safe handling procedures for captured sea turtles, would likely reduce this risk even further.

4.4.6.1 Conclusion

Under the Modified Research Alternative, the NEFSC would implement additional mitigation measures for protected species while conducting the same scope of research as described under the Preferred Alternative. Several methods are considered under the Modified Research Alternative that would attempt to improve monitoring for sea turtles with the expectation that this would help researchers avoid potentially adverse interactions with fishing gear. The technology-based methods all have substantial limitations on their potential to detect sea turtles and there are serious concerns about the logistics of how

to incorporate them into effective mitigation procedures. However, the NEFSC would continue to explore the potential application of these and emerging technologies for sea turtle monitoring as they are developed. Given the new protected species training and mitigation workshops and updated written materials for each vessel proposed under the Preferred Alternative, the use of PSOs under the Modified Research Alternative does not appear to offer any advantages relative to Preferred Alternative.

The use of visual deterrents for different types of fishing gear holds promise in theory but needs to be tested in specific situations as its effectiveness for deterring turtles without reducing catch rates for targeted fish species appears to be inconsistent. Turtle excluder devices and other gear modifications present similar opportunities for reducing impacts on turtles but also have substantial implications for scientific objectives and compatibility with previous time-series data sets (see discussion in Section 4.4.4). Any such gear modifications would need to be thoroughly tested through calibration experiments before they could be implemented.

Operational restrictions such as not allowing trawls to be set in poor visibility conditions could reduce the risk of taking sea turtles. However, part of their effectiveness may be due to reduced overall sampling effort rather than because sea turtles are more likely to be caught under those conditions. Such restrictions would have a serious impact on the ability of the NEFSC to collect certain kinds of research data and would have impacts to the cost and scope of research that could be conducted. Spatial/temporal restrictions to avoid high densities of sea turtles could also reduce the risk of incidentally capturing sea turtles but it would also likely increase the cost of research, thereby reducing overall sampling effort and strongly impacting the ability of the NEFSC to pursue certain scientific goals. Given the relatively small impacts on sea turtles under the Status Quo or Preferred Alternatives, the NEFSC does not consider such operational restrictions to be practicable.

The overall effects of the Modified Research Alternative on ESA-listed sea turtles would likely be less than the Preferred Alternative, which were considered small in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and therefore minor adverse according to the impact criteria in Table 4.1-1.

4.4.7 Effects on Invertebrates

The effects of the Modified Research Alternative on invertebrates would be very similar to those described for the Status Quo Alternative (Section 4.2.7). The exception involves one potential additional mitigation measure intended to reduce impacts on protected species, none of which are invertebrates. The Modified Research Alternative includes potential spatial/temporal restrictions on where and when NEFSC-affiliated research could occur. Spatial/temporal restrictions may reduce impacts on invertebrates in certain areas such as marine protected areas if such closures were determined to be effective mitigation measures. Such restrictions could also reduce overall research fishing effort in important habitats and limit the ability of the NEFSC to sample commercial invertebrate stocks as prescribed in their research plans. However, specific determinations about potential research restrictions have not been made and it is assumed that the overall research effort would be very similar under the Modified Research Alternative as it would be under the Preferred Alternative. Overall effects on invertebrates would therefore be similar even if research was conducted in somewhat different places and times.

Overall impacts to invertebrates under the Modified Research Alternative would likely be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.8 Effects on the Social and Economic Environment

The effects of the Modified Research Alternative on the social and economic environment depend on the extent that additional mitigation measures would be implemented. Some of the mitigation measures require additional equipment than is currently used and the addition of trained protected species observers

to the crew, which could increase spending on wages, rentals, and equipment. However, on surveys conducted on relatively small vessels with limited crew space, the inclusion of crew dedicated to protected species monitoring would decrease the number of crew available to conduct research, thereby decreasing the amount of research that could be conducted in a given time period and potentially creating safety concerns. Other measures such as 30 minute marine mammal monitoring periods and spatial/temporal restrictions could curtail research operations in areas important for stock assessment and fishery management purposes. Spatial/temporal restrictions may reduce some operational costs if surveys are reduced in scope, with a resulting loss of scientific information, but may also increase survey expenses if surveys need to be extended in time to compensate for restricted data collection opportunities.

The scientific value of data collected with changes in research protocols due to additional mitigation measures has not been evaluated because the number of unresolved variables would make any such analysis speculative. It is therefore uncertain if an altered NEFSC fisheries research program under the Modified Research Alternative would contribute a similar value to fisheries management as the Status Quo Alternative. However, it is probable that some of the additional mitigation measures included in the Modified Research Alternative, if implemented, would decrease the ability of the NEFSC to provide comparable levels or quality of scientific information to the fisheries management process. While these conditions may reduce the scientific value of NEFSC research relative to the Status Quo Alternative, the overall contribution of NEFSC research to the socioeconomic environment would likely be similar to those described for the Status Quo Alternative (Section 4.2.8).

The direct and indirect effects of the Modified Research Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be felt throughout the Northeast Region. According to the impact criteria established in Table 4.1-1, the direct and indirect effects of the Modified Research Alternative on the social and economic environment would be minor to moderate and beneficial.

4.5 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 4 – NO RESEARCH ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 4 – the No Research Alternative – on the physical, biological, and social environment. Under the No Research Alternative, NEFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this Final PEA in marine waters of the Atlantic. This moratorium on fieldwork would not extend to research that is not in scope of this Final PEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents. NMFS would need to rely on other data sources, such as fishery-dependent data (i.e., harvest data), and state or privately supported data collection programs to fulfill its responsibility to manage, conserve, and protect living marine resources in the U.S.

The potential direct and indirect effects of implementing Alternative 4 were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under this Alternative are presented below in Table 4.5-1.

Table 4.5-1 Alternative 4 Summary of Effects

Resource	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
Section #	**4.5.1**	**4.5.2**	**4.5.3**	**4.5.4**	**4.5.5**	**4.5.6**	**4.5.7**	**4.5.8**
Effects Conclusion	Minor *adverse*	Minor *adverse*	Moderate *adverse*	Minor *adverse*	Minor *adverse*	Moderate *adverse*	Moderate *adverse*	Moderate *adverse*

4.5.1 Effects on the Physical Environment

Under the No Research Alternative, the NEFSC would no longer conduct or fund fisheries and ecosystem research involving fieldwork in marine waters of the Atlantic. This would eliminate the potential for direct adverse impacts to the physical environment from NEFSC-affiliated fisheries research, although such impacts may continue through research activities conducted and funded by other entities.

The research conducted by the NEFSC includes assessments of fisheries and marine habitat that are used to inform a wide range of plans, policies, and resource management decisions. Many of the plans, polices and decisions that are partially based upon NEFSC data are concerned with conservation of ecological properties of the environment and maintenance of the habitat that sustains living resources in the Atlantic. FMPs developed for the region are partially based on scientific advice derived from NEFSC data. These FMPs strategically limit impacts to physical habitat such as disturbance of benthic habitat and removal of organisms that produce seafloor structure. Without a relatively continuous input of NEFSC data, especially time-series data extending over 50 years, management authorities would lose some of the information necessary to establish management measures in a meaningful fashion. It would also substantially reduce the capacity of NMFS to monitor and investigate changes to the physical environment and water quality due to coastal developments, marine industrial activities, and climate change among other factors.

The loss of information on physical resources under the No Research Alternative would affect a number of different federal and state resource management agencies to various degrees. The NEFSC research program is not the only source of information available to these resource managers but the No Research Alternative could lead to changes in some management scenarios based on greater uncertainty. Given the potential for resource management agencies to compensate for this loss of information to some extent,

and the preference to avoid rapid, major changes in management strategies, the potential magnitude of effects on the physical environment would likely vary from minor to moderate and be limited in geographic extent in the near future. Under the No Research Alternative, the overall impact of these indirect effects on physical resources would be considered adverse and minor according to the criteria in Table 4.1-1.

4.5.2 Effects on Special Resource Areas and Essential Fish Habitat

The No Research Alternative would result in the elimination of the minor adverse direct impacts to special resource areas described in Section 4.2.2 for the Status Quo Alternative. However, the beneficial effects of NEFSC research on the conservation management of special resource areas would also be lost under the No Research Alternative.

The loss of scientific information about these areas would make it difficult for fisheries managers to assess the habitats, resources, and ecosystem functions that closed areas, MPAs, and National Marine Sanctuaries are designed to protect through the implementation of sound science-based management practices. Furthermore, a loss of input from NEFSC research would handicap the maintenance and effective management of existing EFH, HAPC, and closed areas, and would encumber the designation of additional special resource areas in the future. The loss of information about special resource areas under the No Research Alternative would have various implications for different federal and state resource management agencies. The NEFSC research program is not the only source of information available to these resource managers but it could lead to changes in some management scenarios based on greater uncertainty (e.g., greater restrictions on commercial fisheries in MPAs). If the NEFSC discontinued collecting information on special resource areas, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment could become less effective. The indirect effects of these potential management implications would likely vary among the many special resource areas considered. Given the potential for resource management agencies to compensate for this loss of information to some extent and the tendency to avoid rapid, major changes in management strategies, the potential magnitude of effects on special resource areas would likely vary from minor to moderate and be limited to a few local areas within the Atlantic in the near future. Under the No Research Alternative, the overall impact of these indirect effects on special resource areas would be considered adverse and minor according to the impact criteria described in Table 4.1-1.

4.5.3 Effects on Fish

Under the No Research Alternative, there would be no direct effects of NEFSC-affiliated research on fish because the NEFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research. The lack of at-sea research activities would eliminate the risk of mortality from fisheries research activities, disturbance and changes in behavior due to the presence of vessels and research gear, and potential contamination from vessel discharges. However, the loss of scientific information about fish populations and their habitats, especially commercially valuable species, would make it increasingly difficult for fisheries managers to effectively monitor stock status, set commercial harvest limits, or develop fishery regulations to recover depleted stocks or protect vulnerable stocks, especially as information used in stock assessments gets older and less reliable. For non-commercial species, the absence of new fieldwork conducted and funded by the NEFSC would interrupt time-series data sets important for tracking ecosystem-level changes due to fishing impacts, climate change, ocean acidification, and other factors. The loss of this information would increase uncertainty about future trends which may be important to natural resource managers, although the impact of this uncertainty on particular fish species is unknown.

The conservation and management of fishery resources is a core mission for NMFS and is listed among the ten National Standards set forth in the MSA. In carrying out Congress's mandate under the MSA, NMFS is responsible for ensuring that management decisions involving fishery resources are based on the

highest quality, best available scientific information on the biological, social, and economic status of the fisheries. In the Northeast, this is achieved through the work of the NEFSC, which provides supporting scientific information that NMFS uses as the basis for their fisheries management actions. In addition to assessing the status of stocks and examining potential effects of commercial fishing activities, NMFS uses NEFSC research data in the development and implementation of FMPs. The ability to acquire scientific information is essential to the agency's responsibility to manage our nation's fishery resources.

Without NEFSC fisheries research, NMFS would need to rely on other data sources, such as fishery-dependent harvest data and state or privately supported fishery-independent data collection surveys or programs. It is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by the NEFSC.

Although other data sources are available to support resource management decisions, the No Research Alternative would be expected to result in increased uncertainty and changes in some management scenarios. If the NEFSC discontinued collecting information on fish stocks, management authorities would lose important information needed to establish sustainable harvest limits and other management measures in a meaningful fashion, and current conservation measures in place to rebuild overfished stocks and protect ecological properties of the environment would become less effective. The indirect effects of these potential management implications would likely vary among fisheries management areas and the different fish stocks assessed by the NEFSC. There are too many unknown variables to estimate what the indirect effects of this loss of information would mean to any particular fish stock. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid major changes in management strategies, the potential magnitude of effects on fish stocks would likely vary from minor to moderate but the effects could be regional in geographic scope and have long-term effects. Through these indirect effects on future management decisions, the overall impact on commercially important fish stocks would be considered moderate adverse for the areas surveyed by the NEFSC according to the criteria in Table 4.1-1.

4.5.4 Effects on Marine Mammals

Under the No Research Alternative, the NEFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this Final PEA in marine waters of the U.S. Atlantic coast. This would eliminate the potential for direct effects of NEFSC fisheries research on marine mammals through disturbance, injury and mortality in research gear, changes to prey fields, and contamination of the marine environment. This moratorium on fieldwork would not include research outside the scope of this Final PEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents.

In addition to conducting fisheries research, many NEFSC cruises are used as "ships of opportunity" for at-sea observational surveys of seabirds, sea turtles, and marine mammals. Some surveys have had observers consistently, such as the Ecosystem Monitoring Survey and the Atlantic Herring Survey, while other cruises have taken observers when bunk space was available. Observers are expert in species identification and follow strict data collection protocols that cover all taxa seen at the surface. Data from these systematic transects are compiled in databases maintained by the U.S. Geological Survey, Bureau of Ocean Energy Management, and other research institutions (e.g., Fujioka et al. 2014) and are incorporated into multi-agency research programs such as the Atlantic Marine Assessment Program for Protected Species (see http://www.nefsc.noaa.gov/read/protspp/mainpage/AMAPPS/index.html). Data collection and analyses are often conducted by graduate students from the City University of New York and are used to support ecosystem modeling efforts developed by NMFS, USFWS, BOEM, and cooperating academic institutions. These types of long-term data sets have been used to assess: foraging hotspots for marine predators, changes in species distribution in relation to oceanographic features and climate change, interactions and overlap with forage fish and zooplankton, and interactions and overlap with

fisheries including the potential for by-catch (Williams 2006, Renner et al. 2013, Silva et al. 2014). In addition, the data may help to select the most appropriate locations for wind farm leasing sites and other energy production activities. Given the difficulty in getting long-term funding for dedicated surveys, these fairly consistent data collection opportunities on long-term NEFSC fisheries research cruises are valuable contributions to multidisciplinary ecosystem research efforts.

Under the No Research Alternative, the use of NEFSC research cruises as ships of opportunity would be eliminated. While these opportunistic transects are not the primary source of information about the status of marine mammals, they do contribute to NMFS annual marine mammal stock assessments in the Atlantic and other databases on the abundance and distribution of marine mammals that are used for various research and management purposes. Oceanographic and fisheries data collected by the NEFSC is also important for monitoring the ecological status of the environment important to marine mammals, including designated critical habitat for endangered North Atlantic right whales. While there would be no direct effects on marine mammals due to adverse interactions with ships and scientific gear, the loss of observational and ecological information important to marine mammals would indirectly and adversely affect resource management decisions concerning the conservation of marine mammals, especially as time went on and uncertainty about the status of the marine environment increased. There are too many unknown variables to estimate the magnitude of effects this lack of information would mean to any particular stock of marine mammal. However, given the fact that information provided by observations from ships of opportunity are not the only source of information on marine mammals, especially as directed research on marine mammals would not be affected, the potential impacts on marine mammals would likely be minor in magnitude over the next five years. These indirect effects could have short-term to long-term effects on management of marine mammal species that interact with fisheries and have impacts over a large geographic area. Through these indirect effects on future management decisions, the overall impact of the No Research Alternative on marine mammals would be adverse and minor according to the criteria in Table 4.1-1.

4.5.5 Effects on Birds

The No Research Alternative would result in the elimination of the minor adverse direct impacts to seabirds through disturbance, entanglement in gear, changes to prey fields, and contamination of the marine environment for all species of birds (Section 4.2.5). However, as discussed in the marine mammal section above, some of the NEFSC projects that would be eliminated under this alternative include seabird observations made from NEFSC research vessels which provide scientific data on the abundance and distribution of seabirds in the Atlantic. This information contributes to ecosystem modeling and resource management issues important to seabirds. Oceanographic and fisheries data collected by the NEFSC is also important for monitoring the ecological status of the environment important to seabirds. While there would be no direct effects on seabirds, the loss of observational and ecological information important to seabirds would adversely affect resource management decisions concerning the conservation of seabirds. Although NMFS does not have regulatory jurisdiction over birds, the scientific contribution from the NEFSC observational research on seabirds is used, at least partially, to support fishery management decisions, USFWS conservation efforts, energy development siting considerations, and international treaties. If the NEFSC discontinued collecting ecological and observational information on seabirds, long-term data sets contributing to the quality of information about seabird trends could be disrupted and adversely affect the ability of state and federal agencies to make informed decisions about seabirds and the marine environment, especially as time went on and uncertainty about the status of various populations of birds increased. Given the fact that the seabird-related data from NEFSC fisheries research cruises is not the only source of information available to federal and state resource managers, and the potential for resource managers to compensate for this loss of information to some extent on other vessels of opportunity, the No Research Alternative would be expected to have an adverse and minor indirect effect on seabirds in the NEFSC research area.

4.5.6 Effects on Sea Turtles

The No Research Alternative would result in the elimination of the potential minor adverse direct impacts to sea turtles from NEFSC research activities through disturbance, injury and mortality in research gear, changes to prey fields, and contamination of the marine environment (Section 4.2.6). This moratorium on fieldwork would not include research outside the scope of this Final PEA, such as directed research on sea turtles covered under separate research permits and NEPA documents.

As discussed in the marine mammal and bird sections above, some of the NEFSC projects that would be eliminated under this alternative include sea turtle observations made from NEFSC research vessels which provide scientific data on the abundance and distribution of sea turtles in the Atlantic. This information contributes to ecosystem modeling and resource management issues important to sea turtles. The elimination of NEFSC research activities would also substantially reduce the collection of oceanographic and fisheries data important for monitoring the ecological status of the environment important to sea turtles. NEFSC-affiliated fisheries research, including conservation engineering projects in partnership with the fishing industry, supports the management and conservation of sea turtle populations and the habitats and ecosystems that sustain them. An important example is the role NEFSC-affiliated research has played in the establishment of regulations mandating the use of turtle chains and turtle deflector dredges in the scallop fishery, circle hooks in longline fisheries, and the development of turtle excluder devices for some trawl fisheries. Another example is the contribution of NEFSC research to decisions regarding designated critical habitat for loggerhead sea turtles and other species. These management measures strategically reduce impacts to sea turtles and protect habitats important to their recovery and are partially dependent on periodic input of NEFSC data. The loss of scientific information important to understanding sea turtle ecology and fisheries mitigation measures under The No Research Alternative would affect federal and state resource management agencies to various degrees. Without the input of NEFSC data relevant to sea turtle ecology, management authorities would lose important information needed to establish new management measures in a meaningful fashion, current conservation measures could become less effective, and the ability of managers to track long-term ecological trends important to ESA-listed sea turtles, such as climate change and ocean acidification, would be greatly diminished.

There are too many unknown variables to estimate what the indirect effects of this loss of information and associated management implications would mean to any particular sea turtle species but all of them are considered important resources because of ESA-listing. Under the No Research Alternative, the loss of information currently provided by NEFSC research activities would be expected to have adverse and moderate indirect effects on ESA-listed sea turtles in the Atlantic.

4.5.7 Effects on Invertebrates

Under the No Research Alternative, there would be no direct effects of NEFSC-affiliated research on invertebrates through mortality, benthic habitat disturbance, or potential contamination from vessel discharges. However, the loss of scientific information about invertebrates, particularly commercially valuable species, would impede the ability of fisheries managers to effectively assess and monitor stocks, set harvest limits, or develop necessary regulations to protect vulnerable stocks. For non-commercial species, the absence of new fieldwork conducted and funded by the NEFSC would interrupt time-series data sets important for tracking ecosystem-level changes due to fishing impacts, climate change, ocean acidification, and other factors. The loss of this information would increase uncertainty about future trends which may be important to natural resource managers, although the impact of this uncertainty on particular invertebrate species is unknown.

As described in Section 4.5.3 for fish, the conservation and management of marine invertebrate resources is a core mission for NMFS under the MSA and needs to be based on the best available scientific information. In addition to assessing the status of invertebrate stocks and examining potential effects of

commercial fishing activities, NMFS uses NEFSC research data to develop and implement FMPs. The ability to acquire scientific information is essential to the agency's responsibility to manage our nation's fishery resources.

Without NEFSC-affiliated fisheries research, NMFS would need to rely on other data sources such as fishery-dependent harvest data and state or privately supported fishery-independent data collection surveys or programs. It is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by the NEFSC.

Although other data are available to support resource management decisions, the interruption or cessation of long-term data series on commercially valuable invertebrate stocks could lead to increased uncertainty and changes in some management scenarios. Management authorities would lose important information needed to establish sustainable harvest limits and help conserve and restore benthic habitats. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid major changes in management strategies, the potential magnitude of effects on invertebrate stocks would likely vary from minor to moderate but the effects could be regional in geographic scope and have long-term effects. Through these indirect effects on future management decisions, the overall impact on commercially important invertebrate stocks would be considered moderate adverse according to the impact criteria in Table 4.1-1.

4.5.8 Effects on the Social and Economic Environment

Section 3.3 describes the interaction of the NEFSC with the social and economic environment of the Northeast coastal U.S. This section describes the effects of the No Research Alternative on socioeconomic resources of the Northeast Region. Major factors that would be affected by the cessation of fieldwork associated with the NEFSC fisheries research program include:

- Collection of scientific data used in sustainable fisheries management
- Economic support for fishing communities
- Collaborations between the fishing industry and fisheries research
- Fulfillment of legal obligations specified by laws and treaties

<u>Collection of Scientific Data used in Sustainable Fisheries Management</u>

Under the No Action Alternative, the NEFSC would not conduct or fund fisheries research involving the deployment of vessels or fishing gear in marine waters of the U.S. Atlantic coast. Without the scientific data for updated stock and habitat assessments provided by NEFSC-affiliated research, scientists and fisheries managers would have to rely on other data sources, such as commercial and recreational fisheries harvest data and fisheries-independent research conducted and funded by state agencies, academic institutions, or other independent research organizations. Organizations that have participated in cooperative research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding. This would have a direct adverse effect on the statistical confidence of stock assessments and other scientific information important to fisheries management. Without federal fisheries-independent research, areas closed to fishing for various conservation reasons, such as stock or habitat recovery, would be without the primary scientific data used to monitor the effectiveness of those conservation measures and the recovery of depleted species.

The use of fishery-dependent data alone may severely limit the ability of managers to evaluate and make predictions about the status of some stocks because harvest data do not sample early age classes and therefore provide little data on potential recruitment to harvestable stocks. Uncertainty about stock assessments would increase over time as knowledge of population structures diminish. This, in turn, could

require use of ever more precautionary approaches, which could reduce commercial and recreational fishing opportunities, and therefore associated income, through such means as reduced fishing quotas or target catch levels and/or extended closures of fishing areas. The redistribution of research effort to non-NMFS entities would also require new lines of communication with the Fishery Management Councils, new data review processes, and new procedures for integrating separate research results into the regional perspective. Cessation of fisheries research conducted and funded by the NEFSC would gradually undermine the statistical basis for use of more sophisticated management models, leading to reliance on less sophisticated and more conservative fishery management.

Another potential result of greater uncertainty in the scientific basis for fisheries management is that fisheries managers may overestimate overfishing levels and set harvest limits too high for some species, resulting in overfishing and depletion of fish stocks. The initial effect of this would be to increase the revenues from commercial fishing and its related industries. However, over time, the depletion of fish stocks would result in lower catches and therefore reduced incomes. Further, quotas that are lower than objectively necessary mean not only losses to the fishing industry, fisheries dependent shoreside industries and fishing families and communities, but also losses to the Nation through foregone revenue from missed harvesting opportunities. And even with a precautionary approach, in the absence of objective data, quotas may still be set too high, meaning the long-term yield from the fishery would be driven down due to unsustainable harvest levels. This would result in both a conservation loss and a long-term economic loss to the Northeast Region and the Nation.

The absence of federal fishery-independent research surveys and the long-term data sets they provide would eliminate the primary set of trend information used to monitor broad changes in the marine ecosystem. Climate change and ocean acidification have the potential to impact the population and distribution of many marine species. Long-term, scientifically robust research that provide**s** information on changes to and trends in the marine ecosystem, and on human impacts from and adaptations to those changes and trends, would be greatly diminished if the NEFSC ceased conducting and funding fisheries and ecosystem fieldwork.

The end result could be an undermining of confidence in the fisheries management program. This could lead to less cooperation and exchange of important information and data. Without this cooperation the interstate commissions and Fishery Management Councils would find it more difficult to sustain the support of the individual states, potentially undermining the fisheries management process. The No Research Alternative clearly does not enable collection and development of adequate, timely, high quality scientific information comparable to that provided by the NEFSC under any of the three research alternatives. In NMFS view, the inability to acquire scientific information essential to developing fisheries management actions that must prevent overfishing and rebuild overfished stocks would ultimately imperil the agency's ability to meet its mandate to promote healthy fish stocks and fully restore the nation's fishery resources.

<u>Economic Support of Fishing Communities</u>

The NEFSC currently spends approximately $15.7 million annually in support of fisheries research that support local economies in the form of employment, services, chartered vessels, fees, taxes, equipment, and fuel. Cooperative research grants and research set-aside programs account for substantial additional charter services. Under the No Research Alternative, this financial contribution to local economies and the resulting support of the social environment would cease. A number of people currently employed to conduct fisheries research either as federal employees or contractors would likely lose their jobs and the number of support services required for the NEFSC would decrease substantially. It is unlikely that state agencies or other funding sources would be able to completely compensate for this loss of federal funding to support fisheries research by state agencies, academic institutions, and industry groups.

While the loss of research-related employment and purchased services would be important and adverse for many individuals and families, the total sums spent for research are very small compared to the value of commercial and recreational fisheries in the area as well as the overall economy of those communities. The lost economic contribution of NEFSC research would be relatively larger for some communities where the research is centered (i.e., Woods Hole) and may be considerate moderate in magnitude for those communities but the overall direct impact of that loss would be minor in magnitude for most communities. These direct adverse economic impacts would be certain to occur under the No Research Alternative, would affect numerous communities throughout the region, and could be felt for several years. Overall, the direct economic impacts of the No Research Alternative would be considered minor to moderate and adverse according to the impact criteria in Table 4.1-1.

Collaborations between the Fishing Industry and Fisheries Management

Over time, the No Research Alternative would cause an adverse indirect effect on the social and economic environment by degrading the relationships that has been established between scientists and fishing groups through working together on cooperative research programs. This deterioration in trust and cooperation would likely get worse if commercial fisheries were managed more conservatively because of higher uncertainty resulting from less reliable information to feed into fisheries management. It is not clear what impacts this would have on particular economic or regulatory issues but an atmosphere of distrust often complicates and slows down public decision-making processes such as those used to develop fisheries regulations and harvest allocations. This type of effect could last for many years and would therefore be considered a long-term, adverse effect.

Fulfillment of Legal Obligations Specified by Laws and Treaties

The cessation of field work associated with the NEFSC research programs considered in this Final PEA would compromise the ability of NMFS to fulfill its obligations under various U.S. laws and international treaties (Chapter 6). NMFS manages finfish and shellfish harvest under the provisions of several major statutes, including the MSA, MMPA, ESA, and the Atlantic Tuna Conventions Act. Fulfilling the obligations of these statutes requires NMFS to provide specific research data and scientific expertise to support legal reviews and management decision-making processes. The cessation of field research would substantially erode the value of scientific advice provided to these various processes and increase uncertainty about the effects of conservation and management measures on fishing communities as well as NMFS ability to provide socioeconomic analyses required for fisheries regulatory actions. It would also compromise the U.S. partnership and collaboration with other agencies, entities, and countries that collect, analyze, and share complementary data for management of highly migratory species and other international resources.

4.5.8.1 Conclusion

The direct and indirect effects of The No Research Alternative on the social and economic environment would be subject to a great deal of uncertainty depending on the response of many entities to the cessation of NEFSC fisheries research and the ensuing uncertainty in the fisheries management process. The impacts on the economies of local communities would be adverse, minor to moderate in magnitude depending on the community, long-term in duration, and would be felt throughout the Northeast region. The loss of research related to highly migratory species would compromise the ability of the U.S. to comply with its international treaty obligations. The loss of cooperative research programs would also cause deterioration in the relationships between NMFS scientists and fisheries managers with the fishing industry and public, with decreasing public trust in fisheries management regulations. The overall direct and indirect effects of the No Research Alternative on the social and economic environment would be minor to moderate in magnitude, felt across a broad geographic area, and long-term and would therefore be considered moderate adverse according to the impact criteria established in Table 4.1-1.

4.6 COMPARISON OF THE ALTERNATIVES

The following discussion compares and contrasts the direct and indirect impacts of the four alternatives on each resource area. The first three alternatives are much more similar to each other than to Alternative 4 because they all involve robust and extensive fisheries research programs affiliated with the NEFSC, either through active participation in the conduct of the research, or by funding cooperative research partners. Alternative 4 is quite different from the other alternatives in that it does not include additional fieldwork conducted or funded by the NEFSC.

Alternative 1, the No Action/Status Quo Alternative, includes the research program as it existed from 2008-2013, although some of the surveys/projects conducted in that period have not been conducted recently or were short-term projects that were not intended to be continued in the future. The mitigation measures for protected species under Alternative 1 are those that were in place at the end of 2013.

Alternative 2, the Preferred Alternative, includes the suite of research surveys/projects that are currently being conducted and anticipated to be conducted in the foreseeable future, including an estimated range of short-term cooperative research projects using different gear types. It also includes the current suite of mitigation measures for protected species and several proposed improvements to protected species mitigation training and reporting procedures. These new efforts are intended to improve the consistency and effectiveness of how the NEFSC and its research partners implement mitigation measures to reduce adverse interactions on protected species.

Alternative 3, the Modified Research Alternative, is the same set of research activities as Alternative 2 but it includes a range of additional mitigation measures for protected species that are not included in Alternative 2. These additional mitigation measures include operational restrictions as well as the potential incorporation of gear modifications into research protocols. Many of these additional mitigation measures would impact the collection of fisheries and ecosystem research data or require expensive and extensive testing before they could be implemented, and are therefore not part of the Preferred Alternative.

Under Alternative 4, the No Research Alternative, the NEFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this Final PEA. Under the No Research Alternative, it is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by the NEFSC. NMFS would need to rely on other data sources, such as fishery-dependent data (e.g., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its responsibility to manage, conserve and protect living marine resources in the U.S.

The effects of the alternatives on each resource category were assessed using an impact assessment criteria table to distinguish between major, moderate, and minor effects. The analysis shows that all three of the research alternatives could directly and indirectly impact the physical and biological environments in similar ways, and that the effects would be minor and adverse. In addition, the three research alternatives would have indirect beneficial effects on many biological resources and special resource areas through their contribution of scientific information to various resource management and conservation processes. The three research alternatives would also have minor to moderate beneficial effects on the social and economic environment of fishing communities by providing the scientific information needed for sustainable fisheries management and by providing funding, employment, and services. The No Research Alternative, in contrast, would eliminate the direct adverse effects of the research alternatives on the marine environment, but would have moderate indirect adverse effects on the social and economic environment through long-term and widespread adverse impacts on sustainable fisheries management. Table 4.6-1 provides a summary of impact determinations for each resource by alternative.

Table 4.6-1 Summary of Environmental Effect Conclusions for Each Alternative

Topic	Alternative 1 (Status Quo)	Alternative 2 (Preferred)	Alternative 3 (Modified Research)	Alternative 4 (No Research)
Physical Environment	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Special Resource Areas	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Fish	Minor *adverse*	Minor *adverse*	Minor *adverse*	Moderate *adverse*
Marine Mammals	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Birds	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Sea Turtles	Minor *adverse*	Minor *adverse*	Minor *adverse*	Moderate *adverse*
Invertebrates	Minor *adverse*	Minor *adverse*	Minor *adverse*	Moderate *adverse*
Social and Economic Environment	Minor to Moderate *beneficial*	Minor to Moderate *beneficial*	Minor to Moderate *beneficial*	Moderate *adverse*

4.6.1 Summary of Effects on the Physical Environment

Under the three research alternatives, direct impacts to benthic habitats would occur through the use of several bottom-contact fishing gears (primarily trawl and dredge gears). The Final PEA includes an analysis of the total footprint of NEFSC-affiliated research on benthic habitat. Under Alternative 1, NEFSC-affiliated research directly impacts a small percentage of the sea floor each year with bottom trawls and dredges; about 0.09% of the GOM, 0.16% of the GB, 0.09% of the SNE, and 0.11% of the MAB is affected in an average year. No NEFSC surveys or research projects using bottom-contact gear are conducted south of the MAB. Most of the bottom trawls and dredges occur in mud/silt or sand/gravel benthic habitats, and any disturbances to such substrates would be expected to recover within 18 months due to the action of ocean currents and natural sediment transport and deposition. In many areas where there is significant natural disturbance (e.g., relatively shallow sandy areas), physical features of the seafloor could recover in a matter of days. Water quality could be affected through disturbance of bottom sediments, causing temporary and localized increases in turbidity. Given the spill response equipment and emergency training required of all research vessels by Coast Guard regulations regarding safety and pollution prevention, and the experience of NOAA Corps and charter captains and crew, the potential for accidental fuel spills or other contamination from research vessels is considered small and any incidents would be rare. The overall effects on benthic habitat and water quality are considered small in magnitude, short-term in duration, and localized in geographic scope and are therefore considered minor adverse under all three of the research alternatives, as they would all have similar impacts on the physical environment. Under the No Research Alternative, there would be no direct impacts on the physical environment from NEFSC-affiliated fisheries and ecological research. However, the loss of scientific information generated by NEFSC research would contribute to greater uncertainty about the effects of climate change, ocean acidification, commercial fisheries impacts, and other external factors on benthic ecosystems. Indirect effects could occur through less scientifically informed decisions by resource management agencies. The loss of information from the NEFSC would likely affect a large geographic area but would be minor in magnitude given other potential sources of scientific research data. Impacts to

the physical environment would therefore be considered minor adverse under the No Research Alternative.

4.6.2 Summary of Effects on Special Resource Areas and Essential Fish Habitat

Under the three research alternatives, direct impacts to Essential Fish Habitat (EFH), Habitat Areas of Particular Concern (HAPCs), areas closed to commercial fishing, Marine Protected Areas, and National Marine Sanctuaries would occur through the use of bottom-contact fishing gears on the environment and the mortality of fish and invertebrates. As described for the physical environment, the effects of NEFSC-affiliated research on benthic habitat are considered small in magnitude, short-term to long-term in duration depending on the substrate, not repetitive in the same sites year to year, and dispersed over a wide geographic range. There is a potential, however, for trawl and dredge surveys to have a greater adverse impact in certain year-round special resource areas with more vulnerable bottom habitats that have been closed for longer periods of time. An analysis is presented on the proportion of research sampling and biomass removals made within Stellwagen Bank National Marine Sanctuary. The annual number of research trawls conducted within the Sanctuary and the removals of fish and invertebrates for scientific purposes are relatively small, therefore any adverse effects on the Sanctuary would be temporary and minor. Impacts to special resource areas under Alternative 2 would be very similar to the impacts under Alternative 1. Alternative 3 includes the potential for spatial/temporal restrictions on NEFSC-affiliated research as a means to reduce impacts on protected species. This provision may reduce impacts on certain areas if such closures were determined to be effective mitigation measures. However, specific determinations about potential research restrictions have not been made and it is assumed that impacts to special resource areas under Alternative 3 would be very similar to those under Alternatives 1 and 2.

Under the No Research Alternative, there would be no direct impacts on special resource areas from NEFSC-affiliated fisheries and ecological research. However, the indirect effects on resource management agencies and conservation plans for protected areas due to the loss of scientific information would be similar to that described for the physical environment and would be considered minor adverse.

4.6.3 Summary of Effects on Fish

The NEFSC conducts and funds stock assessment and habitat research for many commercially valuable and recreationally important fish species, providing the scientific basis for sustainable fisheries management. NEFSC research also provides critical information on oceanographic conditions and the status of other fish species that are not harvested but which play key roles in the marine food web, providing the scientific basis for NMFS goal of ecosystem-based management, as outlined in NOAA Fisheries Strategic Plan (NOAA 1997). Under the three research alternatives, relatively small adverse impacts to fish populations are expected as a result of on-going research activities.

Captures in surveys is a potential impact for some ESA-listed species (Atlantic sturgeon and Atlantic salmon). Only two Atlantic salmon have been captured in NEFSC surveys since 1977, so impacts to this species are expected to occur rarely and be minor adverse. Atlantic sturgeon have been caught on a regular basis in the NEFSC BTS and the similar NEAMAP bottom trawl surveys conducted by cooperative research partners. However, research protocols in these surveys include short tows (20 minutes at target depth) and all Atlantic sturgeon caught in the past have been released alive and in apparently good condition. Atlantic sturgeon have also been caught on a periodic basis in short-term cooperative research projects. Since Atlantic sturgeon were listed under the ESA in 2012, research intended to reduce the bycatch of sturgeon in commercial gillnet fisheries has required directed research permits under section 10 of the ESA and is not covered under this Final PEA. The Final PEA analysis provides estimates of future Atlantic sturgeon incidental take based on past capture rates in bottom trawl surveys and estimated numbers of trawls conducted under the different alternatives. The level of long-term and short-term research effort with bottom trawl gear could result in take of up to 65 sturgeon under

Alternative 1 and up to 119 sturgeon under Alternative 2, with the difference attributable to the increase in short-term cooperative research under Alternative 2. This species would likely continue to be caught in the future but mortality would likely be rare and overall effects are considered minor adverse.

For most species targeted by commercial fisheries and managed under Fishery Management Plans, mortality due to research surveys and projects is much less than one percent of commercial and recreational harvest and is considered to have minor adverse effects for all species under Alternative 1 (Table 4.2-8). For a few species which do not have a large commercial market due to various market conditions or past overfishing, the research catch exceeds one percent of commercial catch but is still very small relative to the population of each species. For highly migratory species (almost exclusively sharks), and species that are not managed under FMPs, research catch is also relatively small and considered to have minor adverse effects on the populations of all species. The Final PEA uses an average level of catch and bycatch over the status quo period to determine the impacts of research on fish species based on their current or recent stock status and conservation concerns. However, the status of fish stocks varies over time and by fishery management region. If a future project proposes to conduct research on a fish or invertebrate stock that is overfished or depleted at the time, or if it would occur in areas and with gear that would likely result in substantial bycatch of overfished stocks, the potential effects of the proposed research project could be much greater than estimated in this Final PEA and could conflict with rebuilding plans or present other conservation concerns. These future research projects may require additional NEPA analyses before they are issued research permits.

In contrast to the adverse effects of research on fish, NEFSC research also provides long-term beneficial effects on target species populations through its contribution to sustainable fisheries management.

The suite of research programs conducted under Alternatives 2 and 3 are similar but not the same as Alternative 1; several past surveys/projects have been discontinued or modified and several new research programs are anticipated to begin in the near future. In addition, the nature and scope of the short-term cooperative research programs funded through the NEFSC could be different than they have been in the past due to changing priorities in the fishing industry and changing fishery management concerns. The estimated level of future short-term cooperative research effort with different gear types (Table 2.3-2) is substantially greater than the average annual effort described for Alternative 1. These estimates are an optimistic projection based on adequate funding to address most of the research goals established by different fishery management groups and cooperative research partners. However, actual funding levels in the future, and therefore the level of research effort, could be less than estimated. It is difficult to estimate future catch of fish and invertebrates in these cooperative research programs given three conditions: 1) funding levels from Congress are variable and uncertain, 2) research projects are developed each year based on emerging information needs from various commercial fisheries, and 3) research proposals are subject to annual reviews and competition for existing funds. Given these uncertainties, the Final PEA assumes that the increase in short-term cooperative research effort would result in a 300 percent increase in fish and invertebrate catch in the short-term cooperative research segment of the total NEFSC-affiliated catch. This level of catch is likely to be substantially higher than what might actually occur and therefore provides a conservative estimate of the impacts of research. Table 4.3-3 provides the same analysis of research catch relative to commercial and recreational fisheries harvests for Alternative 2 as was presented for Alternative 1 (Table 4.2-8), but multiplies the catch from short-term cooperative research by three. The analysis indicates that overall research catch levels would still be relatively small in magnitude and the overall conclusion about the effects of NEFSC-affiliated research on fish mortality are the same for Alternatives 1 and 2.

Another potential difference with regard to research catch of fish is the potential for spatial/temporal restrictions on NEFSC-affiliated research under Alternative 3. If particular areas and times were determined to be important to avoid as a means to reduce impacts on protected species, research fishing and hence impacts on fish could be reduced in some locations. However, researchers may respond to spatial/temporal restrictions by redirecting research efforts to other locations such that overall research

effort remains the same. Alternative 3 does not specify particular spatial/temporal restrictions but it is assumed for the Final PEA analysis that overall research effort and therefore impacts to fish under Alternative 3 would be very similar to those under Alternative 2, although they may occur in somewhat different locations.

Under the No Research Alternative, there would be no direct adverse impacts on fish from NEFSC-affiliated fisheries research. However, the loss of scientific information for fisheries management could impact fish stocks through increasing uncertainty in fisheries management decisions, which could lead to potential overfishing on some stocks, uncertainty about the recovery of overfished stocks, and increasing uncertainty about the efficacy of fishing regulations designed to protect fish stocks and habitat from overfishing. Inappropriate management decisions could have minor to moderate magnitudes of effects on given stocks, depending on how fisheries managers responded to the loss of scientific information from the NEFSC. These indirect effects would likely be long-term and occur over a large geographic area. The overall impacts to fish stocks under Alternative 4 are therefore considered moderate adverse.

4.6.4 Summary of Effects on Marine Mammals

The Final PEA analyzes several types of potential effects of NEFSC fisheries research on marine mammals, including ship strikes, contamination of the marine environment, removal of marine mammal prey, and incidental take through use of active acoustic instruments and interactions with research gear. Given the same basic scope of research effort in all three research alternatives (although some details would be different), and the use of the same vessels and research gear, the potential effects from all of these factors except incidental take by entanglement or capture in research gear are considered the same for the three research alternatives. The differences regarding incidental take by entanglement, capture, or hooking in research gear are further described below.

All research vessels comply with existing laws to reduce the risk of ship strikes (i.e., vessel speed restrictions in certain places and times to minimize the risk of collisions with large whales). No ship strikes have been reported during any past NEFSC research activities and, given the presence of bridge crew watching for marine mammals during transits, slow cruising speeds, and the small number of research cruises, ship strikes with marine mammals during NEFSC research activities would be unlikely to occur in the future.

NEFSC-affiliated fisheries research removes very small amounts of fish, invertebrates, and plankton relative to the amount estimated to be consumed by marine mammals every year. These research removals are distributed broadly throughout the research area in numerous brief, small sampling efforts. These small removals are unlikely to affect the prey availability or foraging success of any marine mammals.

All NOAA vessels and NEFSC chartered vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, which prohibits discharges of potentially harmful substances into the marine environment. In addition, all NOAA vessels are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills occurring and increase the chance that they would be responded to and contained quickly. Accidental spills of noxious compounds from research vessels could occur but would likely be rare, temporary, and localized and would be unlikely to have any adverse effects on marine mammals.

All three research alternatives would use the same type of acoustic instruments for reconnaissance and scientific mapping/survey purposes. These devices produce sounds that may be detected by marine mammals and cause changes in their behavior which would constitute Level B harassment under the MMPA. None of the NEFSC acoustic equipment is likely to present risks of hearing loss or injury to any marine mammal. The NEFSC LOA application (attached to the Final PEA as Appendix C) includes estimates of Level B harassment takes through the use of acoustic instruments in the NEFSC research

area using the scope of research and mitigation measures described in Alternative 2, which is assumed to be the same amount of Level B harassment that would take place under Alternatives 1 and 3 (see Table 4.2-12). The analysis is based on sound characteristics of the instruments, the distance research vessels travel with these instruments engaged, calculations of volumes of water ensonified to 160 decibels (root mean square) or more (NMFS current recommended threshold for Level B harassment from the active acoustic equipment considered in this Final PEA), and density estimates for each marine mammal species in the research area. The numbers of Level B takes for each species are small and the potential effects are likely to be temporary. The overall impact of acoustic disturbance to marine mammals under any of the three research alternatives is therefore considered to be minor adverse. As described earlier, Alternative 3 includes potential spatial/temporal restrictions that may lead to differences in where and when effects on marine mammals occur relative to Alternatives 1 and 2.

The primary difference between the alternatives regarding marine mammals involves incidental take through entanglement, capture, or hooking in fisheries research gear, and the mitigation measures used to reduce the risk of those interactions. Incidental take of marine mammals in research gear includes animals captured, hooked, or entangled in fishing gear but released without serious injury (Level A harassment under the MMPA), and incidental capture, hooking, or entanglement resulting in serious injury or mortality. The MMPA requires applicants for regulations and subsequent LOAs to estimate the number of each species of marine mammal that may be incidentally taken by harassment or serious injury and mortality during the proposed action. Because it is impossible to predict whether a future interaction would lead to serious injury or mortality or whether the animal may be released with only non-serious injury, the NEFSC has combined its estimates for Level A harassment and serious injury and mortality in its LOA application.

The estimated take numbers are based on the historical capture of six cetaceans (three short-beaked common dolphins and one each of bottlenose dolphin, harbor porpoise, and minke whale) and two pinnipeds (one gray seal and one harbor seal) during NEFSC research surveys and NEFOP Observer training trips from 2004 through 2013. Past marine mammal captures have occurred using gill nets (3 captures), mid-water trawls (3 captures), bottom trawl (1 capture), and fyke net (1 capture). Of the eight animals captured, only the minke whale was released alive (but later determined to have been seriously injured). Take estimates for species that have not been caught in NEFSC research gear in the past are based on their similarity to species that have been taken by the NEFSC and by incidental take in analogous commercial fisheries. The NEFSC considers the estimation method used in the LOA application to be conservative in that it would likely overestimate the number of animals that would be caught in the future in order to ensure accounting for a precautionary amount of potential take. The Final PEA uses the estimated takes in the LOA application to assess the impacts on marine mammals for all three research alternatives (see Table 4.2-13). Given the likelihood that these are overestimates, the actual effects from injury, serious injury or mortality could be substantially less than described. For almost all species of marine mammals considered to have potential interactions with NEFSC fisheries research, the requested number of Level A harassment, serious injury, and mortality takes would be equal to or less than 10 percent of their respective Potential Biological Removal (PBR) and are therefore considered minor in magnitude (Table 4.2-13). These takes, if they occurred, would likely be rare or infrequent events, would be distributed over large geographic areas, and would be considered to have overall minor adverse effects on the population of each species. The potential exceptions are for stocks with very small or unknown PBR values, i.e. one coastal stock of bottlenose dolphin, where one or two takes could be moderate in magnitude relative to PBR. Given the very limited research effort in southern nearshore areas and the mitigation measures in place for the research, the NEFSC considers the chance of taking animals from this small stock of bottlenose dolphins to be highly unlikely.

The main difference between the alternatives in regard to marine mammals is the mitigation measures that would be implemented to reduce the risk of marine mammal interactions with research gear. The Final PEA does not attempt to quantify the effectiveness of the different mitigation measures considered in the

different alternatives; the analysis provides a qualitative description of how such measures could reduce the risk of interactions with marine mammals and how their incorporation into scientific protocols may impact the fisheries research programs.

Alternative 1 represents the Status Quo conditions as they existed up through 2013, although the implementation of mitigation measures has not been static over the past ten years. The NEFSC has been working to implement the additional training, monitoring, and reporting elements of the Preferred Alternative since the DPEA went public in December 2014, anticipating what would likely be required by the MMPA rule-making process. Since 2016, Status Quo conditions remain the same but with expanded mandatory incidental take reporting and mitigation measures. Alternative 1 mitigation measures for marine mammals include at least one member of the ships' crew or scientific party designated to monitor for marine mammals before any research fishing gear (trawls, gillnets, longlines, etc.) are deployed. Except for a few research projects conducted from small boats with limited crew, these designated monitors would be dedicated to this task and would not be responsible for other tasks while looking for marine mammals (or other protected species). If any marine mammals are sighted around the vessel before setting the gear, the vessel could be moved away from the animals to a different section of the sampling area if the animals appear to be at risk of interaction with the gear; this protocol is called the move-on rule. The crew standing watch would continue to monitor the waters around the vessel while the gear is in the water and, if any marine mammals are sighted that appear to be in danger of interacting with the gear, the gear may be removed from the water immediately or other appropriate actions taken to reduce the risk. Standard tow and set durations have also been reduced to minimize the risk of serious injuries and drowning. Fyke nets used for research have been fitted with marine mammal excluder devices. All cooperative research projects conducted from commercial fishing vessels and using commercial fishing gear (often modified as part of the research) comply with all marine mammal take reduction plan gear requirements for the given area and fishery.

Alternative 2 includes these same mitigation measures but adds a new program for its Chief Scientists and vessel captains to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. Alternative 2 also includes new training requirements for all crew members on protected species protocols to formalize and standardize the information provided to all crew that might experience protected species interactions during research activities. Written cruise instructions, protocols, and information signage on the research vessel regarding avoidance of adverse interactions with protected species would be reviewed and, if found insufficient, made fully consistent with the protected species training materials and any guidance on decision-making that arises out of the two new training programs described above. The NEFSC would expect these new required procedures to facilitate and improve the implementation of the mitigation measures described under Alternative 1.

Alternative 3 includes the same mitigation measures as Alternative 2 but also includes a number of other potential mitigation measures that the NEFSC has not proposed to implement in its LOA application. These include a number of alternative methods for monitoring for protected species (e.g., use of dedicated Protected Species Observers, night-vision goggles and passive acoustic devices for periods of low visibility), gear modifications such as marine mammal excluder devices for trawl gear, modification of the move-on rule to require a 30 minute monitoring period during which no marine mammals could be sighted, elimination of night-time trawls, and spatial/temporal restrictions on where and when research could occur. The analysis describes how these potential mitigation measures could reduce adverse impacts to marine mammals. However, some of these additional mitigation measures would also have a serious adverse impact on the ability of the NEFSC to collect certain kinds of research data, would compromise the scientific value of time-series data, and would have impacts on the cost and scope of research that could be conducted. Some concepts and technologies considered in Alternative 3 are promising as a means to reduce risks to marine mammals and NMFS would evaluate the potential for implementation if they become more practicable.

Under the No Research Alternative, no direct adverse impacts to marine mammals from NEFSC-affiliated fisheries research (i.e., takes by gear interaction and acoustic disturbance) would occur. However, many of the NEFSC research projects that would be eliminated under this alternative contribute valuable ecological information important for marine mammal management, especially for ESA-listed species and stocks considered depleted under the MMPA. The loss of information on marine mammal habitats would indirectly affect resource management decisions concerning the conservation of marine mammals, especially as time went on and uncertainty about the status of the marine environment increased. There are too many unknown variables to estimate the specific effects this lack of information could have on any particular stock of marine mammals but the No Research Alternative would likely have minor adverse effects for some species.

4.6.5 Summary of Effects on Birds

There have been no known adverse interactions with seabirds during NEFSC research activities; there are no records of birds being hooked or caught in research gear or ship strikes. All three of the research alternatives include the use of fishing gear (i.e., trawls, gillnets, and longlines) that have had substantial incidental catch of seabirds in Northeast commercial fisheries. However, research gear is generally smaller than commercial gear and research protocols are quite different than commercial fishing practices. In particular, fisheries research uses much shorter duration trawls/sets than commercial fisheries and no bait/offal is thrown overboard while research gear is in the water, thereby greatly reducing the attraction of seabirds to research vessels. Based on this historical lack of interactions and research protocols, incidental take of seabirds in research gear is unlikely. The Final PEA also considers the potential for fisheries research to affect the habitat quality of seabirds through removal of prey and water contamination and, as described above for marine mammals, concludes that these effects would be minor adverse for all species. The overall effects on seabirds are therefore considered minor adverse under all three research alternatives. One potential mitigation measure under Alternative 3 would be for the NEFSC to deploy streamer lines on longline gear to reduce the risk of catching seabirds. If seabird interactions with longline gear are documented in the future, the NEFSC would evaluate whether use of streamer lines is warranted given the tradeoffs between the potential conservation benefit and changes to research protocols that might affect time-series data.

Some NEFSC surveys take bird biologists on board when there is bunk space available to conduct transect surveys for bird distribution and abundance in the NEFSC research area. This information is used by NMFS, the U.S. Fish and Wildlife Service, and other international resource management agencies to help with bird conservation issues and is considered to have indirect beneficial effects on birds.

Under the No Research Alternative, the risk of direct adverse effects on seabirds from NEFSC research would be eliminated, but there could be potential long-term minor adverse indirect impacts to seabirds because resource management authorities would lose ecological information about the marine environment important to seabird conservation.

4.6.6 Summary of Effects on Sea Turtles

The Final PEA analyzes the same direct and indirect effects of NEFSC fisheries research on sea turtles as described for marine mammals. The potential for ship strikes, removal of prey, and contamination of marine habitat would be similar to the risks described for marine mammals; these effects are considered minor adverse for all species under all three research alternatives. Sea turtles hearing range is apparently well below the frequencies of acoustic instruments used in fisheries research so turtles are unlikely to detect these sounds or be affected by them. As was the case with marine mammals, the primary effect of concern for sea turtles is the incidental capture or hooking in research gear.

There have been 75 sea turtles incidentally captured during NEFSC-affiliated research since 2004, all but one of which have been released alive. The Final PEA uses capture rate data from these historical takes,

which occurred with different types of fishing gear (bottom trawls, longline gear, and gillnets), to estimate how many sea turtles may be captured with each gear type given the different estimated fishing efforts with each gear type under the three research alternatives. The analysis also includes an estimate of potential serious injury and mortality (SI&M) for each species based on data from analogous commercial fisheries in the Atlantic and the research protocols (e.g., tow duration). All estimates were rounded up to the next whole number of turtles even if they were a small fraction and therefore tend to provide a conservative estimate of how many turtles may be affected. Future incidental captures of sea turtles in several gear types are certain, but it is likely that most of these turtles would be released in good condition because of the short tow and set durations of most NEFSC research activities and the presence of trained turtle-handling personnel on many research crews.

The estimated takes for Alternative 1 include: up to 11 loggerhead turtles (2 SI&M), 12 Kemp's ridley turtles (4 SI&M), 2 green turtles (0 SI&M), and 2 leatherback turtles (1 SI&M) (Table 4.2-17). Most of these takes and all of the SI&M takes are estimated to occur in short-term cooperative research projects that use gear and protocols closer to commercial fisheries than NEFSC-conducted fisheries research. The estimated takes for Alternative 2 are somewhat greater than for Alternative 1 because of anticipated changes in the scope and type of short-term cooperative research projects that may be funded through the NEFSC. The actual level of funding that would be available for these projects is not known so the Final PEA provides an optimistic estimate of what may be funded in order to account for the maximum amount of adverse interactions that may occur. The estimated takes for Alternative 2 include: up to 17 loggerhead turtles (2 SI&M), 19 Kemp's ridley turtles (3 SI&M), 2 green turtles (0 SI&M), and 2 leatherback turtles (1 SI&M) (Table 4.3-2). Alternative 3 would include the same scope of research as Alternative 2, so the estimated takes of sea turtles are the same except for the potential for additional mitigation measures to reduce those takes.

The same mitigation measures described above for marine mammals also apply to sea turtles. Because sea turtles are smaller and harder to see on the water than most marine mammals, visual monitoring is probably less effective for detecting sea turtles before gear is deployed. However, the same monitoring and move-on protocols are followed for sea turtles as they are for marine mammals. The new protected species training and mitigation workshops and updated written materials for each vessel proposed under Alternative 2 would cover sea turtle identification, avoidance, and handling procedures. The NEFSC expects these new procedures to facilitate and improve the implementation of the mitigation measures compared to Alternative 1. Alternative 3 includes a number of potential mitigation measures that could address sea turtle interactions, including the use of turtle excluder devices on trawl nets. However, as described for marine mammal mitigation measures, the alteration of scientific protocols or research gear can compromise the validity of time-series data and must be adopted only after careful planning and extensive testing, which is very expensive and time consuming.

The overall effects of the three research alternatives on ESA-listed sea turtles would likely be small in magnitude, temporary or short-term in duration, disbursed over a large geographic area, and considered to have minor adverse effects on all species of sea turtles. In contrast to these adverse effects, NEFSC research also provides long-term beneficial effects for sea turtles through research on sea turtle bycatch reduction in commercials fisheries and contributions to knowledge about the marine environment important to sea turtle conservation.

As with marine mammals and seabirds, the No Research Alternative would eliminate the risk of direct adverse effects on sea turtles from NEFSC research. However, there could be minor adverse indirect impacts due to the loss of NEFSC-affiliated research on bycatch reduction and ecological information important to sea turtle conservation.

4.6.7 Summary of Effects on Invertebrates

The NEFSC conducts stock assessment and habitat research for several important invertebrate species (i.e., lobsters, scallops, Loligo and Illex squid, surfclams, and quahogs) that are important for commercial and recreational fisheries. The scope and methodologies used to assess these stocks would be similar for all three research alternatives and, similar to the situation described for valuable fish species, the magnitude of mortality due to research sampling would be small relative to commercial harvests (Table 4.2-19). This would be true even with the expanded scope of short-term cooperative research projects under Alternative 2 (Table 4.3-6). The footprint of bottom-contact gear used in research is also relatively small in magnitude and impacts to benthic infauna and epifauna would be temporary. The NEFSC conducts research in several areas closed to commercial fishing with bottom-contact gear, but much of this effort is conducted using video camera technologies and is the primary means for NMFS to monitor the recovery of scallop stocks, benthic habitat, and the efficacy of fisheries conservation measures. Under the three research alternatives, minor adverse impacts to invertebrates are expected from NEFSC research activities. NEFSC research is also important for the scientific and sustainable management of these valuable fisheries, helping to prevent overfishing on the stocks, and therefore has beneficial indirect effects on the species.

As described for effects on fish, another difference between the research alternatives concerning invertebrates is the potential for spatial/temporal restrictions under Alternative 3, which could reduce overall research effort or cause changes in specific locations where that research occurs or when it occurs. Without further details on such restrictions, it is assumed that overall effects on invertebrates would be very similar to Alternatives 1 and 2.

Under the No Research Alternative, direct adverse impacts to invertebrates would be eliminated. As was the case with commercially important fish species, the loss of stock assessment and marine environment information could indirectly result in moderate adverse effects on commercially targeted invertebrate species through increasing uncertainty in the fishery management process.

4.6.8 Summary of Effects on the Social and Economic Environment

The effects of NEFSC fisheries and ecosystem research on the social and economic environment are expected to be very similar under all three research alternatives. Each of these alternatives would include important scientific contributions to sustainable fisheries management for some of the most valuable commercial and recreational fisheries along the U.S. Atlantic Coast, which benefits commercial and recreational fisheries and the communities that support them. These industries have large economic footprints, generate billions of dollars' worth of sales and thousands of commercial fishing-related jobs, and provide millions of people across the country with highly valued seafood. Millions of recreational fishers also participate and support fishing service industries. NEFSC fisheries research activities would also have minor to moderate beneficial impacts to the economies of fishing communities through direct employment, purchase of fuel, vessel charters, and supplies. Continued NEFSC fisheries research is important to build trust and cooperation between the fishing industry and NMFS scientists and fisheries managers. The overall effects of NEFSC-affiliated research would be long-term, distributed widely across the Northeast region, and would be considered minor to moderately beneficial to the social and economic environment for all three research alternatives.

The impacts of the No Research Alternative would be the inverse of the three research alternatives. It would likely have minor to moderate adverse impacts on the social and economic environment through greater uncertainty in fisheries management, which could lead to more conservative fishing quotas (i.e., underutilized stocks and lost opportunity) or an increased risk of overfishing, followed by reductions in commercial and recreational fisheries harvests. The lack of scientific information would also compromise efforts to rebuild overfished stocks and monitor the effectiveness of no-fishing conservation areas. These impacts would adversely affect the ability of NMFS to comply with its obligations under the MSA. It

would also eliminate research-associated federal spending on charter vessels, fuel, supplies, and support services in various communities. The No Research Alternative would also have long-term adverse impacts on the scientific information the NEFSC contributes to meet U.S. obligations for living marine resource management under international treaties.

5.1 INTRODUCTION AND ANALYSIS METHODOLOGY

The Council on Environmental Quality (CEQ) defines cumulative impact as:

> *"The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 Code of Federal Regulations [CFR] 1508.7).*

Cumulative effects are assessed by aggregating the potential direct and indirect effects of the proposed action with the impacts of past, present, and reasonably foreseeable future actions in the vicinity of the project. The ultimate goal of identifying potential cumulative effects is to provide for informed decisions that consider the total effects (direct, indirect, and cumulative) of the project alternatives. As suggested by the CEQ handbook, *Considering Cumulative Effects Under the National Environmental Policy Act* (1997), the following basic types of cumulative effects are considered:

- Additive – the sum total impact resulting from more than one action,
- Countervailing – adverse impacts that are offset by beneficial impacts, and
- Synergistic – when the total impact is greater than the sum of the effects taken independently.

Cumulative effects may result from the incremental accumulation of similar effects or the synergistic interaction of different effects. Repeated actions may cause effects to build up over time, or different actions may produce effects that interact to produce cumulative impacts greater than (or less than) the sum of the effects of the individual actions.

As directed by CEQ's National Environmental Policy Act (NEPA) regulations (40 CFR 1502.16), this chapter discusses direct and indirect impacts on specific physical, biological, and social resources in combination with varying levels of effects, ranging from minor to major. While the effects of individual actions may be only minor, substantial cumulative effects may result from multiple actions occurring in the same geographic area. The implementing regulations of NEPA require analysis of cumulative effects in order to alert decision makers of the full consequences of all actions affecting a resource component and assess the relative contribution of the proposed action and alternatives.

Chapter 3 of this Final Programmatic Environmental Assessment (Final PEA) provides baseline information on the physical, biological, and social components of the environment that may be affected by Northeast Fisheries Science Center (NEFSC) research activities. Chapter 4 provides an analysis of the direct and indirect effects on these resources of the four alternatives considered in this Final PEA. Because the first three alternatives involve the continuation of NEFSC research activities (referred to collectively as the research alternatives) and contribute similar effects to the cumulative effects on most resources, they are generally considered together in the following cumulative effects analysis. The contribution of the No Research Alternative to cumulative effects is quite different and is considered separately for each resource.

5.1.1 Analysis Methodology

The cumulative effects analysis methodology is similar to the effect assessment methodology for direct and indirect effects in Section 4.1. It consists of the following steps:

1. Define the geographic area and timeframe. These may vary between resource components.
2. Identify external actions[12], including:
    a. Past actions that have already occurred and resulted in lasting effects (see Chapter 3),
    b. Present actions occurring within the same timeframe as the proposed action and alternatives (see Chapter 3), and
    c. Reasonably foreseeable future actions (RFFAs), which are planned and likely to occur (see Table 5.1-1).
3. Evaluate the direct and indirect effects of the proposed action and alternatives along with the adverse and beneficial effects of external actions and rate the cumulative effect using the effects criteria table (Table 4.1-1).
4. Assess the relative contributions of the alternatives to the cumulative effects.

5.1.2 Geographic Area and Timeframe

This cumulative effects analysis considers external actions that influence the geographic areas where NEFSC-affiliated research activities occur; these areas include primarily the Northeast U.S. Continental Shelf Large Marine Ecosystem (LME), but also the Southeast U.S. Continental Shelf LME (Figures 3.1-1 and 3.1-2) as described in Section 3.1.1. Some actions that originate outside of the NEFSC Research Areas, such as discharge of pollutants, or actions that influence populations of highly migratory species, could potentially contribute to cumulative effects within the geographic areas of interest; such actions are considered in the analysis of cumulative effects. Other actions considered in the analysis of cumulative effects may be geographically widespread, such as those that could potentially result in climate change or ocean acidification. Although discussions of past actions primarily focus on the last five years, the availability of existing information and the period of time that must be considered to understand the baseline conditions vary between resource components. All analyses project five years into the future from the date this Final PEA is finalized.

5.1.3 Reasonably Foreseeable Future Actions

Table 5.1-1 summarizes the RFFAs external to NEFSC fisheries research that are likely to occur in the next five years and the resources they are likely to affect. This information has been collected from a wide variety of sources, including recent NEPA documents covering the Northeast marine environment, federal and state fishery agency websites and documents, United States (U.S.) Navy websites and documents, and a variety of documents concerning industrial developments such as Liquefied Natural Gas import terminals, offshore wind farms, ocean current energy projects, dredging, and ocean disposal. Wildlife management documents such as endangered species recovery plans and take reduction plans for sea turtles and marine mammals were also consulted to identify conservation concerns for different species and habitats.

[12] External actions are human activities other than NEFSC-affiliated fisheries research activities and natural occurrences that have resulted or will result in effects to the resource components that comprise the affected environment.

Deciding whether to include actions that have already occurred, are ongoing, or are reasonably foreseeable in the cumulative impacts analysis depends on the resource being analyzed. Past, ongoing, and future actions must have some known or expected influence on the same resources that would be affected by the alternatives to be included in the cumulative impacts analysis. CEQ refers to this as the cause-and-effect method of connecting human activities and resources or ecosystems. The magnitude and extent of the effect of an action on a resource or ecosystem depends on whether the cumulative impacts exceed the capacity of the resource/ecosystem to sustain itself and remain productive over the long-term.

CEQ guidelines state that "it is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful." In general, actions can be excluded from the analysis of cumulative impacts if:

- The action is outside the geographic boundaries or time frame established for the cumulative impacts analysis.
- The action would not affect resources that are the subject of the cumulative impacts analysis.
- The action is not planned or is not reasonably foreseeable (e.g., it is not yet formally proposed, planned, permitted, authorized, or funded).

This page intentionally left blank.

Table 5.1-1 Reasonably Foreseeable Future Actions (RFFAs) and Potential Effects on Different Resources in the Northeast Marine Environment

Blank cells indicate no effects on that resource.

Action	Effect on Physical Environment	Effect on Special Resource Areas	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
Other (non-NEFSC) Scientific Research	• Presence of additional vessel traffic • Sea floor disturbance • Generation of Marine debris	• Habitat disturbance • Contamination (Spills, Discharges)	• Habitat disturbance • Removal of individuals and biomass • Behavioral disruptions	• Behavioral displacement • Loss/injury from ship strikes • Noise responses	• Loss from avian by-catch • Potential for ship collisions (lighting attraction)	• Loss/injury from ship strikes	• Loss or displacement due to habitat disturbance • Removal of individuals and biomass	• Increased understanding of environment leading to better resource management
Federal and State Managed Fisheries	• Presence of additional vessel traffic • Sea floor disturbance • Generation of marine debris	• Habitat disturbance • Contamination (Spills, Discharges) • Generation of marine debris	• Removal of managed targeted fisheries species • By-catch removal of non-target species • Habitat disturbance • Behavioral disruption • Loss from capture by derelict gear	• Loss/injury from ship strikes • Loss/injury from entanglement/hooking • Noise responses • Altered or reduced prey resources • Behavioral displacement	• Loss from avian by-catch • Potential for ship collisions (lighting attraction) • Alteration or reduction of prey resources	• Loss/injury from ship strikes • Loss/injury from entanglement/hooking with fishing gear	• Direct loss or displacement due to bottom trawling • Indirect loss or displacement due to habitat disturbance	• Provision of jobs and economic opportunity • Provision of food and industrial raw materials • Cost of operations and gear requirements • Need for catch limits for resource management • Need for time/area closures for resource management
Other Fishing Operations (Commercial Fishing, Charter, recreational)	• Presence of additional vessel traffic • Sea floor disturbance • Generation of marine debris	• Habitat disturbance • Contamination (Spills, Discharges) • Generation of marine debris	• Removal of managed targeted fisheries species • By-catch removal of non-target species • Habitat disturbance • Behavioral disruption • Loss from capture by derelict gear	• Loss/injury from ship strikes • Loss/injury from entanglement/hooking • Noise responses • Altered or reduced prey resources • Behavioral displacement	• Loss from avian by-catch • Potential for ship collisions (lighting attraction) • Alteration or reduction of prey resources	• Loss/injury from ship strikes • Loss/injury from entanglement/hooking with fishing gear	• Direct loss or displacement due to bottom trawling • Indirect loss or displacement due to habitat disturbance	• Provision of jobs and economic opportunity • Provision of recreational opportunities • Provision of food
Military Operations	• Contamination of water and sediment • Generation of marine debris, including munitions	• Contamination • Generation of marine debris, including munitions	• Noise effects (stress, altered behavior, auditory damage) • Mortality near detonation • Loss/injury from contamination • Contamination of fish for human consumption	• Loss/injury from ship strikes • Noise effects (stress, altered behavior, auditory damage) • Behavioral disturbance • Displacement • Injury/loss due to ingestion or entanglement in marine debris • Mortality near detonation	• Loss/injury due to entanglement in marine debris • Potential for loss from ship collisions (lighting attraction) • Behavioral disturbance • Mortality near detonation • Displacement	• Noise effects (stress, altered behavior, auditory damage) • Loss/injury from ship strikes • Loss/injury from ingestion/entanglement in marine debris • Mortality near detonation	• Injury/loss due to contamination • Mortality near detonation	• Temporary and localized disruption of fishing due to operations • Maintaining National Defense
Liquid Natural Gas (LNG) Terminals	• Increased turbidity (construction phase) • Sea floor disturbance • Presence of additional vessel traffic • Provision of new underwater structures • Localized changes in water temperature	• Contamination • Increased turbidity • Sea floor disturbance	• Loss/injury from contamination • Construction related habitat disturbance • Provision of new structured habitat • Contamination of fish for human consumption	• Loss/injury from ship strikes • Noise effects (construction, vessel) • Behavioral disturbance • Loss/injury from contamination • Loss/injury due to ingestion/entanglement in marine debris • Loss/injury due to entanglement in buoy chains • Alteration or reduction of prey resources	• Loss/injury from contamination • Loss from structure or ship collision (lighting attraction) • Loss/injury due to ingestion/entanglement in marine debris • Alteration or reduction of prey resources	• Loss/injury from ship strikes • Noise effects (construction, vessel) • Behavioral disturbance • Loss/injury from contamination • Loss/injury due to ingestion/entanglement in marine debris • Alteration or reduction of prey resources	• Habitat disturbance • Increased risk from invasive species due to long-distance shipping activity • Loss/injury from contamination • Creation of new hard substrate habitats on structures	• Fishing exclusion zones may displace fisheries • Provision of new jobs • Increased capacity for inexpensive fuel transport and handling

Action	Effect on Physical Environment	Effect on Special Resource Areas	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
Vessel Traffic (Shipping)	• Contamination of water and sediment	• Increased risk from invasive species due to long-distance shipping activity • Contamination	• Loss due to competition or predation from invasive species • Loss/injury from contamination • Noise effects (stress, altered behavior)	• Loss/injury from ship strikes • Displacement • Noise effects (stress, altered behavior) • Behavioral disturbance • Loss/injury due to ingestion/entanglement in marine debris	• Loss/injury from contamination • Noise effects (stress, altered behavior) • Loss/injury due to ingestion/entanglement in marine debris • Ship collision (lighting attraction)	• Loss/injury from contamination • Noise effects (stress, altered behavior) • Loss/injury due to ingestion/entanglement in marine debris	• Loss due to competition or predation from invasive species • Loss/injury from contamination	• Provision of jobs and economic opportunity
Vessel Traffic (Other)	• Contamination of water and sediment	• Increased risk from invasive species due to long-distance shipping activity • Contamination	• Loss due to competition or predation from invasive species • Loss/injury from contamination • Noise effects (stress, altered behavior)	• Loss/injury from ship strikes • Displacement • Noise effects (stress, altered behavior) • Behavioral disturbance • Loss/injury due to ingestion/entanglement in marine debris	• Loss/injury from contamination • Noise effects (stress, altered behavior) • Loss/injury due to ingestion/entanglement in marine debris • Ship collision (lighting attraction)	• Loss/injury from contamination • Noise effects (stress, altered behavior) • Loss/injury due to ingestion/entanglement in marine debris	• Loss due to competition or predation from invasive species • Loss/injury from contamination	
Ocean Disposal and Discharges	• Sea floor disturbance • Sedimentation • Toxic contamination • Eutrophication	• Contamination • Disturbance of benthic habitats • Sea floor disturbance • Sedimentation	• Bioaccumulation of contaminants • Loss/injury from contamination • Habitat disturbance	• Bioaccumulation of contaminants • Loss/injury from contamination • Loss/injury from ship strike • Alteration or reduction of prey resources • Habitat disturbance	• Bioaccumulation of contaminants • Loss/injury from contamination • Alteration or reduction of prey resources • Habitat disturbance	• Bioaccumulation of contaminants • Loss/injury from contamination • Alteration or reduction of prey resources • Habitat disturbance	• Bioaccumulation of contaminants • Loss/injury from contamination • Habitat disturbance	• Potential indirect impact on subsistence resources
Dredging	• Sea floor disturbance • Increased turbidity • Contamination (discharges)	• Sea floor disturbance • Increased turbidity	• Loss of habitat due to sea floor disturbance • Displacement due to turbidity	• Noise effects (stress, altered behavior) • Loss/injury from ship strikes • Habitat disturbance/alteration • Alteration or reduction of prey resources	• Noise effects (stress, altered behavior) • Habitat disturbance/alteration • Alteration or reduction of prey resources	• Mortality by entrainment in dredge • Habitat disturbance/alteration	• Direct loss or displacement due to bottom trawling • Indirect loss or displacement due to habitat disturbance • Loss/displacement due to turbidity	
Sand and Gravel Mining	• Sea floor disturbance • Turbidity • Contamination (discharges)	• Sea floor disturbance • Turbidity	• Sea floor disturbance • Turbidity	• Noise • Ship strikes • Habitat disturbance • Altered or reduced prey resources	• Noise • Habitat disturbance • Altered or reduced prey resources	• Mortality • Habitat disturbance	• Sea floor disturbance • Turbidity • Benthos disturbance or mortality	• Jobs and purchase of services
Geophysical/ Geotechnical Activities	• Sea floor disturbance	• Sea floor disturbance	• Habitat disturbance • Noise effects from acoustic surveys	• Noise effects from acoustic surveys • Ship strikes • Behavioral disturbance	• Potential for ship collisions (lighting attraction) • Behavioral disturbance	• Ship strikes • Behavioral disturbance	• Habitat disturbance • Localized benthos disturbance	• Jobs and purchase of services

Action	Effect on Physical Environment	Effect on Special Resource Areas	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
Offshore Wind Farms and Ocean Current Energy Projects	• Localized sea floor disturbance during construction	• Localized sea floor disturbance during construction	• Localized disruption of benthos during construction • Fish mortality from impingement or entrainment in ocean current projects	• Localized noise (acoustic harassment) during construction • Possible displacement	• Localized collision with turbine blades	• Localized entrainment in ocean current projects	• Localized sea floor disruption	• Noise during construction • Jobs and purchase of services • Renewable energy • Visual effects
Sea Turtle Conservation Measures						• Decreased injury and mortality		• Cost to fisheries • Gear modifications
Marine Mammal Conservation Measures				• Decreased injury and mortality				• Cost to fisheries • Gear modifications • Displacement • Time/area closures
Habitat Omnibus Amendment	• Enhanced habitat protection	• Minimize habitat effects	• Enhanced habitat protection					• Cost to fisheries • Gear modifications • Time/area closures
Climate Change	• Sea level rise, saltwater infusion in estuaries and coastal habitats • Increased erosion and siltation • Increased water temperatures • More extreme storm events	• Sea level rise, saltwater infusion in estuaries and coastal habitats • Increased erosion and siltation • Increased water temperatures • More extreme storm events	• Unknown ecosystem level changes, variable effects on different species	• Unknown ecosystem level changes, variable effects on different species	• Unknown ecosystem level changes, variable effects on different species	• Unknown ecosystem level changes, variable effects on different species	• Unknown ecosystem level changes, variable effects on different species	• Rising water levels in coastal areas • Potential changes in fisheries due to ecosystem changes • New regulations on greenhouse gas emissions • Incentives for higher vessel fuel efficiency
Ocean Acidification	• Increased pCO^2 • Decreased pH	• Decreased calcification among food web organisms • Change in primary production	• Potential adverse effects on prey, availability of nutritional minerals • Potential direct adverse effects on growth, reproduction, development	• Potential adverse effects on prey, availability of nutritional minerals	• Potential adverse effects on prey, availability of nutritional minerals	• Potential adverse effects on prey, availability of nutritional minerals	• Decreased calcification, shell hardening impaired • Potential adverse effects on prey, availability of nutritional minerals	• Potential effects on fisheries, especially for invertebrate species

This page intentionally left blank.

5.2 CUMULATIVE EFFECTS ON THE PHYSICAL ENVIRONMENT

Activities external to NEFSC fisheries research that could potentially affect the physical environment within the NEFSC research area may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and include:

- Sea floor disturbance
- Increased turbidity and re-suspension of sediments
- Presence of new underwater structures
- Effects of climate change such as increased water temperatures and sea level rise

5.2.1 External Factors in the NEFSC Research Area

The physical environment of the Atlantic Ocean along the U.S. coast has been affected by human activity since humans first arrived in the New England and Mid-Atlantic areas. Until recent times, however, the magnitude of the effects was limited. With the advent of substantial coastal development and exploitation of resources from the ocean environment, cumulative impacts on the physical environment have increased. Within the NEFSC research area, the physical environment continues to experience impacts resulting from both natural and anthropogenic factors, including climate change, ocean acidification, seafloor disturbance from commercial fisheries, substrate disturbance from geophysical/ geotechnical activities, contamination from spills and discharges, presence of vessel traffic, and marine debris. Sources of effects to the physical environment from RFFAs are identified in Table 5.1-1.

Past activities that disturbed the seafloor were generally limited to fishing activities and the laying of underwater cables for communications systems. While the effects of fishing activities could be major, they were generally limited to a few heavily fished areas. Current activities that disturb the seafloor include not only more modernized commercial fishing (mainly trawling and dredging), but other heavy industrial activities such as channel dredging, and construction of various near shore and offshore developments. These activities cause re-suspension of sediments into the water column, changes in bathymetric contours, and permanent loss of benthic habitat. Large areas of the seafloor in the Northeast U.S. Continental Shelf LME are subject to repeated physical disruption from commercial fishing. However, much of this fishing takes place on sedimentary substrates which recover in relatively short time periods due to natural water currents and sedimentation (Stevenson et al. 2004). Other types of disturbance such as off-shore developments tend to have longer-term effects but affect smaller areas. Proposed development of large, offshore energy projects have the potential for long-term effects, but impacts would likely be limited to the areas immediately adjacent to the projects. Such projects would be evaluated for environmental effects, including cumulative effects, before they would be permitted by the appropriate federal agency.

The ocean has been used as a disposal area for shore generated waste for decades. There are numerous offshore marine disposal areas mapped off the Northeast and Mid-Atlantic coasts. These sites contain everything from contaminated dredge spoils, household and industrial waste, to nuclear waste. For any activity that disturbs the sediments in offshore areas, such as trawling or dredging, re-suspension of these contaminants in the water column is a potential resultant effect. However, the areas occupied by the dump sites are identified and clearly marked on navigational maps as areas to be avoided.

Contamination from spills and discharges can accumulate in the seafloor and marine life and have a toxic effect on the plants, animals and humans through the food chain (National Oceanic and Atmospheric Administration [NOAA] 2010d). There are huge numbers of potential sources of both direct and indirect marine contamination, including tankers and other marine vessels, military operations, ocean dumping,

airborne deposition, and runoff from industrial and agricultural sources on land. Some chemical compounds, such as polychlorinated biphenyl (PCB) and pesticides, can persist for many years while others, such as petroleum products, breakdown relatively quickly. In a similar situation, marine debris can affect the physical environment (NOAA 2010e) but most of these effects are manifested through biological systems, which are discussed in other sections of this document. Pollution is a long-term and widespread issue in the marine environment, although it varies substantially in intensity on a local basis. In recent years there has been a concerted national and international effort to reduce pollution of ocean environments through restrictions on discharges and design features of ocean-going vessels that reduce the probability and severity of spills. As a result, although the historic problems remain, recent issues have either been localized and limited or, if large and widespread, like the 2010 Deepwater Horizon oil release in the Gulf of Mexico, have generated significant cleanup and mitigation responses. Broadly speaking therefore, the cumulative effects of pollution and contamination on water quality of the NEFSC research area is expected to be minor to moderate and adverse from sources external to fisheries research.

Climate change may affect the marine environment in a variety of ways, including changes in sea level, changes in water temperatures, extreme weather events, and alteration of ocean currents. These changes and others are expected to continue over the reasonably foreseeable future and could aggregate with the effects of industrial activity to impact the physical environment. These changes contribute in turn to changes in the population and distribution of marine fish, mammals, seabirds, and turtles; changes in the population and distribution of fishery resources harvested in commercial fisheries, with related socioeconomic effects; and changes in FMPs to address potential climate change effects.

In addition to changes in air and water temperatures, a related effect of climate change is increased acidification in the ocean caused by dissolved carbon dioxide (CO_2). Changes in the acidity of the world's oceans are expected to continue and accelerate over the reasonably foreseeable future (United States Geological Survey [USGS] 2011). Ocean acidification can harm organisms that build shells of calcium carbonate, including calcareous phytoplankton and zooplankton, corals, bryozoans, mollusks, and crustaceans. These organisms provide shellfish resources for humans, play vital roles in marine food webs, and add to the physical structure of the ocean floor (NEA 2010). Although the dynamics of climate change and the potential magnitude and timing of its effects are poorly understood, there is general acknowledgement that the potential impacts resulting from climate change could be substantial.

5.2.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on the physical environment in the Northeast are discussed in sections 4.2.1, 4.3.1, and 4.4.1. Direct and indirect effects to benthic habitat (seafloor disturbance) and removal of organisms that produce structure would be minor and adverse. Since no dumping of waste material would be authorized for NEFSC fisheries and ecosystem research activities under the research alternatives, there would be no contribution to cumulative effects from intentional waste disposal at sea. There is the potential for accidental spills to occur. However, given the high degree of emphasis placed on safety and emergency preparedness on NOAA Corps vessels and Coast Guard requirements for training and safety equipment on commercial vessels, the magnitude of these potential spills is likely to be very small and the contribution of fisheries research to the cumulative effects of contamination is considered minor.

Although CO_2 emissions from NEFSC fisheries research vessels would contribute to atmospheric CO_2 levels, the contribution would be minor compared to other natural and anthropogenic CO_2 sources. When aggregated with the impacts of past, present, and reasonably foreseeable future actions in the vicinity of the NEFSC research area, NEFSC fisheries and ecosystem research activities would make a minor additive contribution to cumulative adverse effects on the physical environment under each of the research alternatives.

Fisheries research programs contribute to the understanding of changes in the physical environment, including those associated with climate change and ocean acidification. Continued fisheries research programs with long-term data sets are essential to understanding changes in the physical and biological environment, and allowing NMFS to take appropriate management actions. NEFSC fisheries research therefore makes a beneficial contribution to cumulative effects on the physical environment.

5.2.3 Contribution of the No Research Alternative

The No Research Alternative would eliminate the risk of direct adverse impacts to physical resources within the NEFSC research area resulting from NEFSC fisheries and ecosystem research activities. However, many of the NEFSC projects that would be eliminated under this alternative generate a great deal of information that, when combined with research conducted by other branches of NOAA and other agencies and institutions not included in this Final PEA, is used to monitor the effects of climate change, ocean acidification, and other changes in the physical environment. It may also be used by resource managers to limit fishing-related impacts to physical habitat such as disturbance of benthic habitat from dredging and other bottom-contact gear. Without the input of NEFSC data, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect physical properties of the environment would become less effective. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty and changes in some management scenarios. Through these indirect effects on future management decisions, the contribution of this alternative to adverse cumulative impacts on physical resources would be minor to moderate depending on how well other agencies would be able to compensate for the loss of NEFSC fisheries and ecosystem research.

5.3 CUMULATIVE EFFECTS ON SPECIAL RESOURCE AREAS AND ESSENTIAL FISH HABITAT

Activities external to NEFSC fisheries research that could potentially affect special resource areas in the Atlantic include commercial and recreational fisheries, commercial shipping, ocean disposal and discharges, dredging, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Contamination resulting from spills or discharges
- Habitat disturbances
- Increased risk of invasive species introductions resulting from long-distance shipping activity
- Effects of climate change such as increased water temperatures and sea level rise
- Effects of ocean acidification such as decreased calcification among food web organisms and
- Changes in primary production

5.3.1 External Factors in the NEFSC Research Area

As described in Section 3.2, Special Resource Areas include Essential Fish Habitat (EFH), Habitat Areas of Particular Concern (HAPC), Closed Areas, and Marine Protected Areas (MPAs), including National Marine Sanctuaries (NMS). The cumulative effects of activities that disturb the seafloor in special resource areas are similar to those discussed for the physical environment in Section 5.2.1. Cumulative impacts to biological resources within special resource areas are discussed in Sections 5.4 through 5.8. The effects of proposed offshore projects in the Atlantic related to oil and gas development, offshore wind power developments, dredging, military operations, and geophysical exploration, would be considered as part of the federal permitting process. Contributions to cumulative effects from such activities would be limited by permit conditions and mitigation measures required by permitting agencies. Adverse impacts from commercial fishing operations, especially with bottom contact fishing gears, would be substantial in heavily fished areas and would affect EFH and HAPC areas to various degrees, but would not be as great in permanent closed areas or some marine reserves that are closed to commercial fishing. In some cases, temporary closed areas have been designated to allow the recovery of areas that were heavily affected by commercial fisheries in the past.

The contribution of NEFSC fisheries and ecosystem research to the cumulative effects of marine contaminants in special resource areas are the same as those discussed for the physical environment in Section 5.2.3 and are considered minor adverse.

5.3.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on special resource areas in the Atlantic are discussed in sections 4.2.2, 4.3.2, and 4.4.2. A relatively small amount of fisheries research using bottom contact gear would occur in most special resource areas under the research alternatives, resulting in a minor adverse contribution to the cumulative effects on these areas. While there are no intentional discharges of pollutants from fisheries research vessels there is potential for accidental spills to occur. However, the magnitude of these potential spills is likely to be very small and the contribution of fisheries research to the cumulative effects of contamination is considered minor.

NEFSC fisheries research programs contribute to understanding the status of special resource areas, including changes to EFH associated with climate change and ocean acidification as well as the recovery of closed area habitats from fishing. Continued fisheries research programs with long-term data sets are essential to understanding changes in the physical and biological environment within special resource

areas, which by definition have special management needs. NEFSC fisheries research therefore has a beneficial contribution to cumulative effects on special resource areas in addition to the minor adverse effects.

5.3.3 Contribution of the No Research Alternative

The No Research Alternative would result in elimination of any direct impacts from NEFSC fisheries research to special resource areas that could potentially occur under each of the research alternatives. However, the NEFSC fisheries and ecosystem research activities proposed under the research alternatives would generate information important to resource managers to monitor species and habitat recovery, environmental changes, and the effectiveness of conservation measures for special resource areas. This type of information is especially important for management of these special resource areas because most of them have been designated to protect and conserve natural resources that are susceptible to natural fluctuations and anthropogenic impacts. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty and changes in some management scenarios that may affect a few local areas. Through these indirect effects on future management decisions, the contribution of this alternative to cumulative impacts on special resource areas, including National Marine Sanctuaries, would be minor adverse.

5.4 CUMULATIVE EFFECTS ON FISH

Activities external to NEFSC fisheries research that could potentially affect fish species in the NEFSC fisheries research areas include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, other scientific research, military operations, climate change, and ocean acidification. These activities and potential effects are summarized in Table 5.1-1 and include:

- Injury or mortality due to directed catch or bycatch in commercial and recreational fisheries
- Habitat disturbances
- Changes in distribution and food availability due to climate change or habitat degradation

5.4.1 Endangered Species Act (ESA) Listed Species

5.4.1.1 External Factors in the NEFSC Research Area

ESA-listed fish species in the research area include the Atlantic salmon, shortnose sturgeon, Atlantic sturgeon, and smalltooth sawfish. The past, present, and reasonably foreseeable future activities, external to NEFSC fisheries research, that have or are likely to have the greatest effect on endangered fish in the region are intentional and incidental mortalities in commercial and recreational fisheries, habitat alterations, especially for anadromous species, and periodic short-term and longer term climate changes.

Commercial harvests of Atlantic salmon peaked during the late 1800s before steadily declining through the first half of the 20th century. All state and federal commercial salmon fisheries closed in New England in 1989, pursuant to the Fishery Management Plan for Atlantic Salmon (NEFMC 1987). Atlantic salmon continued to decline. Impacts from the following are among the factors likely affecting the decline and lack of recovery: pollution, habitat degradation, sedimentation, changing land-use patterns and development, water withdrawals for irrigation, aquaculture, agriculture, and forestry. Although the State of Maine adopted regulations prohibiting all angling for sea-run salmon in 1999, incidental take and poaching remain concerns (NMFS and USFWS 2005).

Over a century of fishing for sturgeon contributed to the decline of both Atlantic and shortnose sturgeon populations along the U.S. east coast. Overharvesting in commercial fisheries and pollution were primary reasons for listing shortnose sturgeon as endangered under the Endangered Species Conservation Act of 1969. Directed harvest has been prohibited since listing (NMFS 1998). Habitat degradation or loss from dams, construction, dredging, and pollutant discharges, and mortality from impingement on cooling water intake screens, dredging, and bycatch in other fisheries are considered primary threats to shortnose sturgeon survival (NMFS 1998).

Historically, Atlantic sturgeon populations declined due to overexploitation through commercial harvests. Currently, incidental catches in fisheries, vessel strikes (in the Delaware and James Rivers), decreased water quality, water availability, dams, lack of protective regulatory mechanisms, and dredging are the most significant threats to Atlantic sturgeon (77 FR 5880 and 77 FR 5914; February 6, 2012). The Atlantic Sturgeon FMP was implemented in 1990. Amendment 1 to the FMP closed remaining Atlantic sturgeon fisheries in U.S. state waters in 1998. In 1999, NMFS passed complementary prohibitions for Atlantic sturgeon in or from the U.S. EEZ. Commercial fisheries for Atlantic sturgeon, however, still exist in Canadian waters (NMFS 2012b). Fisheries bycatch in U.S. waters is the primary threat currently affecting all 5 DPSs of Atlantic sturgeon. The NEFSC estimated an average of 3,118 Atlantic sturgeon encounters per year in commercial gillnet and trawl fisheries from 2006 to 2010 based on observed fisheries. Mortality rates in gillnets are approximately 20 percent, except for monkfish gear which is approximately 27 percent, and mortality rates in otter trawl gear are approximately 5 percent (NEFSC 2011b, cited in NMFS 2012b). Similar estimates are not available for Southeast fisheries or for state fisheries (NMFS 2012b). Several conservation measures aimed at decreasing threats to Atlantic sturgeon

are ongoing, including convening a recovery team and drafting a recovery plan, research on fishing gear modifications to reduce bycatch, and preparation of ESA Section 10 Habitat Conservation Plans to decrease effects of several state fisheries on Atlantic sturgeon (NMFS 2013d).

Smalltooth sawfish have been adversely affected by the cumulative effects of bycatch in various fisheries, especially in gill nets, and loss of habitat (NMFS 2013d). Juvenile sawfish use shallow habitats with a lot of vegetation, such as mangrove forests, as important nursery areas. Many such habitats have been modified or lost due to development of the waterfront in Florida and other southeastern states (NMFS 2013d). In the Northwest Atlantic, a number of states, including Georgia, South Carolina, and Florida, have prohibited most gillnets and entangling nets in state waters (NMFS 2002, 2009e). The gillnet ban in Florida has had a beneficial impact on the recovery of smalltooth sawfish which are extremely vulnerable to capture in gillnets. As the recovery of the smalltooth sawfish extends beyond Florida's waters, gillnets could become a serious threat to the success of recovery efforts (NMFS 2009d).

The environmental effects of climate change could be extensive in geographic area and long-term in duration and could therefore have major cumulative effects on fish species. Some fish species are likely to benefit from changes in the marine environment while others could experience adverse effects. Atlantic salmon in the Gulf of Maine are at the southern end of the species' range, plus this is a species that is highly sensitive to increased temperatures. Tolerance to climate change may depend, in part, on impacts from other threats (NMFS 2005). Anadromous fish species (e.g., salmon and sturgeon) may also be affected by changes in river ecology due to altered precipitation, sea-level rise, and water temperature (NMFS 2012b, NMFS 2013d). The nature and magnitude of potential climate change effects are, however, very difficult to predict with certainty.

The activities external to NEFSC fisheries research affecting ESA-listed fish would likely continue into the foreseeable future (Table 5.1-1). The level of impact would depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

5.4.1.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on ESA-listed fish are discussed in sections 4.2.3, 4.3.3, and 4.4.3. The three research alternatives considered in this Final PEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. The take level of Atlantic salmon is exceedingly small (one each in 1977 and 2012) and there have been no documented takes of shortnose sturgeon or smalltooth sawfish in NEFSC-affiliated fisheries research activities. Atlantic sturgeon have been caught infrequently during bottom trawl surveys (NEFSC BTS and NEAMAP) but, due to the short tow times and careful handling procedures, all of these sturgeon have been and would likely continue to be released alive with no incidence of mortality. Two Atlantic sturgeon mortalities occurred incidental to short-term cooperative research projects using otter trawl gear. One of those projects used one hour tow durations while the other had tow times of 40 minutes, both of which are longer than most NEFSC fisheries research tows (see Section 4.2.3.1). No other short-term cooperative research projects have reported interactions with Atlantic sturgeon using trawl gear, gillnets, or any other fishing gear. Given the continued use of fishing gears that have caused mortality of sturgeon in commercial fisheries, there is a potential for NEFSC-affiliated fisheries research to cause mortality of sturgeon in the future, although such incidents would likely be rare events given the generally shorter tow times used in research compared to commercial fisheries.

When considered in conjunction with commercial and recreational fisheries, and aggregated with other past, present, and reasonably foreseeable future activities affecting ESA-listed fish in the NEFSC research areas, the contribution of NEFSC fisheries research activities to cumulative effects would be minor and adverse.

5.4.1.3 Contribution of the No Research Alternative

Under the No Research Alternative, the NEFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research in marine waters of the U.S. Atlantic coast considered in the scope of this Final PEA, so would not directly contribute to cumulative effects on ESA-listed species in this region. Although directed research on ESA-listed species is not considered in the scope of this Final PEA, the absence of NEFSC fisheries research surveys on other fish stocks and environmental conditions important to ESA-listed species would have an adverse impact on the ability of resource managers to monitor the recovery of these species, track the health of their habitats, and implement effective fishery regulations and other conservation strategies for these species. Ceasing or interrupting long-term data series on oceanography, abundance and distribution of various species, and diet studies (e.g., 50 years of NEFSC BTS) would have long-term adverse effects on the ability of scientists to monitor and model effects of ecosystem changes important to ESA-listed species. The indirect effects of the No Research Alternative could, therefore, impact ESA-listed species through a lack of information essential for informed decision making and conservation of the species, their prey, and their habitats. The indirect contribution of the No Research Alternative to cumulative effects on ESA-listed species is difficult to ascertain, but would likely have moderate adverse impacts on conservation management of these species.

5.4.2 Target and Other Species

5.4.2.1 External Factors in the NEFSC Research Area

By definition, target species are those managed for recreational and commercial fisheries. The other species considered here are generally not targeted by commercial or recreational fishers but may be caught in substantial numbers as bycatch. These recreational and commercial fisheries are the primary past, present, and reasonably foreseeable future activities that have or are likely to have the greatest effect on these species external to NEFSC fisheries research. The numerous target species in the NEFSC research area are managed by NMFS with directives from the NEFMC, ASMFC, MAFMC in compliance with their respective fisheries management plans (FMPs) (Table 3.2-1). Other species that may be caught during research surveys are often monitored as part of ecosystem-based management efforts even if they are not subject to stock assessments. The analysis of effects in Chapter 4 focused on those species most frequently caught in NEFSC fisheries research activities and species that are considered overfished or where overfishing is occurring (Table 4.2-8). The cumulative effects analysis takes a similar approach.

Eight of the target species encountered during NEFSC surveys are considered overfished or approaching an overfished status (Table 3.2-1, NOAA Fisheries 2013). This includes the GOM and GB stocks of Atlantic cod, the GOM stock of haddock (subject to overfishing and approaching an overfished status), ocean pout, white hake, windowpane flounder (GB and GOM stocks), witch flounder (Northwest Atlantic coast stock), yellowtail flounder (all stocks except the SNE/Mid-Atlantic stock), and thorny skate. A stock that is subject to overfishing is one with a harvest (mortality) rate that is too high to produce the stock's maximum sustainable yield (MSY). A stock that is overfished is one whose biomass level is sufficiently depleted to jeopardize the stock's ability to produce MSY (NMFS 2012b). Three stocks (Acadian redfish, silver hake, and monkfish) are considered rebuilt. The remaining species and stocks are either of unknown status or not overfished (Table 3.2-1).

Atlantic cod has been an important component of New England fisheries for centuries. Both the GB and GOM stocks are currently considered overfished. U.S. commercial and recreational fisheries for cod are managed under the NEFMC's Northeast Multispecies FMP and numerous amendments to the FMP. Management measures include spatial/temporal closures, gear restrictions, size limits, permit moratoria, days-at-sea restrictions, trip limits, and target fishing mortality rates. The U.S. and Canada implemented a formal quota sharing agreement in 2004 for cod in the transboundary eastern Georges Bank cod management unit (Mayo et al. 2006). Total catches (commercial, recreational, and discards) of GOM cod ranged from 5,500 to 12,500 tons from 2006-2010, most of which was from commercial landings

(NEFSC 2012, Table 4.2-8). In 2012, NMFS implemented a temporary rule to reduce overfishing of GOM cod through a total annual catch limit of 7385 tons for the 2012 fishing year (77 FR 19944, April 3, 2012). Combined U.S. and Canada fishery mortality of eastern GB Atlantic cod was 1143 tons in 2011, 76 tons of which were discards (Transboundary Resources Assessment Review Committee (TRAC) 2012).

Other commercially important species include the principal pelagics, Atlantic herring and Atlantic mackerel. Herring are managed collaboratively by the NEFMC and ASMFC and Atlantic mackerel is managed by the MAFMC. Both species were heavily exploited by offshore distant water fleets during the 1960s-1970s that resulted in stock collapses in the late 1970s (Mayo et al. 2006). After the collapse of offshore herring stocks, the herring fishery focused on the nearshore waters of the GOM. Herring recovered in the late 1980s and the offshore fishery resumed thereafter. Commercial landings in the northeast region exceeded an average of 85,900 tons in 2012 and the stock is not overfished. Atlantic mackerel landings decreased from an average of 385,808 tons during 1970-1976 to less than 55,115 tons during 1978-1984. Stock size and landings, however, increased since recovery in the late 1980s and early 1990s (Mayo et al. 2006). Commercial landings of Atlantic mackerel in the Northeast Region were 17,344 tons in 2012. The stock is not overfished.

The activities external to NEFSC fisheries research affecting target species would likely continue into the foreseeable future (Table 5.1-1). The level of impact would depend on the application and efficacy of fishery management plans and habitat protection measures. Natural population fluctuations and periodic short-term and longer term climate changes also affect population viability and stock sizes. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

5.4.2.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on target and other fish are discussed in sections 4.2.3, 4.3.3, and 4.4.3. Mortality of target and other species due to NEFSC fisheries research represents a small fraction of that taken by commercial and recreational fisheries. The average annual catch of target species during NEFSC fisheries research surveys (Table 4.2-8) is generally much less than 1 percent of the annual average commercial landings of these species, except for a few species that have very small commercial markets. Of those species that are listed as overfished or where overfishing is occurring, NEFSC-affiliated research catch is also comparatively small, with the exception of ocean pout. NEFSC-affiliated research has caught an average of 1760 pounds of ocean pout per year, which is about 32 percent of annual average commercial landings. However, the commercial market for ocean pout crashed in the 1970s when overfishing was occurring and NMFS believes discards of ocean pout are currently larger than landed fish brought to market (Wigley and Col 2006). Given, the unknown numbers of discards for this overfished species, research surveys provide the only reliable way to monitor the recovery of the population and the small numbers of ocean pout caught during research are likely minor relative to the population.

The comparisons made in Table 4.2-8 indicate that, while mortality to fish species is a direct effect of the NEFSC surveys and cooperative research projects, the magnitude of this mortality is very small relative to other sources of mortality and the overall populations of these species.

When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting target and other fish species in the Northeast Region, the contribution of NEFSC fisheries research activities to the adverse cumulative effects on these species would be minor under all three research alternatives. The NEFSC-affiliated fisheries research program also makes a beneficial contribution to cumulative effects on fish through their role in providing scientific information to the commercial fisheries management process which strives to maintain sustainable populations. The beneficial value of fisheries research to a range of future

management challenges from fishing to climate change is quite substantial and helps to address a range of adverse cumulative effects.

5.4.2.3 Contribution of the No Research Alternative

Under the No Research Alternative, the NEFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research in the Atlantic so would not directly contribute to cumulative effects on fish species in this region. In the absence of research surveys, important scientific information would not be collected about the status of fish stocks used for fisheries and conservation management, including trends in abundance, recruitment rates, and the amount of fish being harvested relative to overfishing metrics. This lack of data would make it much more difficult for fisheries managers to effectively monitor the status of stocks, develop fishery regulations, and rebuild depleted stocks. Ceasing or interrupting long-term data series on oceanography, abundance and distribution of various species, and diet studies (e.g., 50 years of NEFSC BTS research) would have long-term adverse effects on the ability of scientists to monitor and model effects of ecosystem changes. The lack of information and increasing uncertainty about the status of fish stocks and their habitats would have serious implications for fisheries management. The indirect effects of the No Research Alternative could, therefore, impact fish stocks through a lack of information essential for prudent decision making and conservation of fish, their prey, and their habitats. The indirect contribution of the No Research Alternative to cumulative effects on target and other species is difficult to ascertain, but would likely have moderate adverse impacts on the long-term monitoring ability of NMFS or other agencies and the management capabilities for numerous economically and ecologically important species.

5.4.3 Highly Migratory Species

5.4.3.1 External Factors in the NEFSC Research Area

NEFSC-affiliated research surveys on highly migratory species (HMS) focus on sharks. In the Atlantic, NMFS manages seventy-two species of sharks (excluding spiny dogfish) under the Consolidated HMS Fishery Management Plan (FMP) (NMFS 2006c). Although the Consolidated HMS FMP also includes swordfish, billfish, and tuna, sharks are emphasized here.

Commercial and recreational harvests of HMS along the U.S. Atlantic coast are the primary external factors affecting HMS in the NEFSC research areas. Harvests are by gillnet, longline, and hand gear (rod and reel, handline, bandit gear) (NOAA 2012c). Total commercial landings in 2011 included 780 tons of Atlantic large coastal sharks, 292 tons of small coastal sharks, and 155 tons of pelagic sharks (NMFS 2012c). Catch reported in the U.S. Atlantic Pelagic Longline fishery in 2011 included 3,694 pelagic sharks kept, 43,778 pelagic sharks discarded, 130 large coastal sharks kept, and 6,085 large coastal sharks discarded. The number of Atlantic large coastal sharks recreationally harvested in 2011 was 60,883, over 35,000 of which were requiem sharks (NOAA 2012c). Recreationally harvested Atlantic pelagic sharks numbered 5,199 in 2011. Seventeen were porbeagles, 111 were unclassified, and the remainder were mako sharks. The recreational harvest of Atlantic small coastal sharks in 2011 (109,287) consisted of blacknose (2,281), bonnethead (57,023), finetooth (67), and Atlantic sharpnose sharks (49,916) (NOAA 2012c). In 2011, approximately 3,500 sharks were caught on observed sink gillnet trips targeting sharks. Just over 3,100 of those were spiny dogfish. Sharks are also caught incidental to gillnet fisheries targeting Spanish mackerel, Atlantic croaker, and mixed teleosts. The number discarded alive, discarded dead, or kept varies by species (NOAA 2012c).

The activities external to NEFSC fisheries research affecting HMS fish would likely continue into the foreseeable future (Table 5.1-1). The level of impact would depend on the application and efficacy of current and proposed mitigation measures and management schemes. The potential effects of climate variability are unpredictable but are also likely to impact these species and to continue into the foreseeable future.

5.4.3.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on HMS sharks are discussed in sections 4.2.3, 4.3.3, and 4.4.3. Most of the sharks caught in NEFSC fisheries and ecosystem research activities are tagged and released alive. A small number of sharks are killed each year for scientific sampling purposes and incidental to other research activities (Tables 4.2-6 and 4.2-7). The magnitude of these shark mortalities is very small relative to commercial catches. Future mortality would likely continue to be low and infrequent and a small fraction of that taken through commercial and recreational fisheries. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting HMS sharks in the Northeast Region, the contribution of NEFSC fisheries research activities to cumulative effects on HMS sharks would be minor adverse under all three research alternatives.

5.4.3.3 Contribution of the No Research Alternative

Under the No Research Alternative, the NEFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research in the Atlantic so would not directly contribute to cumulative effects on HMS in this region. In the absence of these research surveys, including coastal shark surveys conducted by state agencies using funding from NMFS, important scientific information would not be collected about the status of stocks used for fisheries and conservation management, including trends in abundance, recruitment rates, and the amount of fish being harvested relative to overfishing metrics. These surveys provide scientific advice, data, and analyses directly to NMFS HMS Management Division and to the Southeast Data Assessment and Review (SEDAR) process run by the South Atlantic Fishery Management Council. Information from the SEDAR process is used to develop and amend the Consolidated Atlantic Highly Migratory Species FMP. The lack of information and increasing uncertainty about the status of shark stocks, habitats, ecology, and life history would have serious implications for shark fishery management. The indirect effects of the No Research Alternative could, therefore, impact shark stocks through a lack of information essential for informed decision making and conservation of species, their prey, and their habitats. The indirect contribution of the No Research Alternative to cumulative effects on HMS is difficult to ascertain, but impacts to long-term monitoring and management capabilities for HMS would likely be moderate adverse.

5.5 CUMULATIVE EFFECTS ON MARINE MAMMALS

Activities external to NEFSC fisheries research that may potentially affect marine mammals in the NEFSC research areas include commercial and recreational fisheries, Liquefied Natural Gas (LNG) terminals and carriers, vessel traffic, ocean discharges, dredging, sand and gravel mining, near shore construction (including wind farms and ocean current projects), geological and geophysical activities, and military operations. These activities and potential effects are summarized in Table 5.1-1 and include:

- Disturbance/behavioral changes or physical effects from anthropogenic noise (e.g., marine vessels of all types, military readiness operations, navigational equipment, construction, seismic surveys)
- Injury or mortality due to vessel collisions, entanglement in fishing gear, and contamination of the marine environment
- Changes in food availability due to prey removal, ecosystem change, or habitat degradation

5.5.1 ESA-Listed Species

5.5.1.1 External Factors in the NEFSC Research Area

The species included here – North Atlantic right, humpback, fin, sei, blue, and sperm whales – experienced substantial population declines as a result of overexploitation through commercial whaling (Perry et al. 1999, National Marine Fisheries Service [NMFS] 2006d). Despite gaining international protection from whaling in 1935, the North Atlantic right whale population remains critically endangered today (NMFS 2005). Commercial harvests of sperm whales ended worldwide in 1986 (NMFS 2006b). Humpback whales and blue whales were protected in 1966 (Reeves et al. 1998, Perry et al. 1999). Fin whales and sei whales were hunted off eastern Canada until the 1970s (Perry et al. 1999), with commercial takes in the North Atlantic ending in 1987 (NMFS 2010e). Northwest Atlantic humpback whales appear to be increasing and showing signs of recovery from whaling, while information is insufficient to determine population status and trends of fin, blue, sei, or sperm whales. Conservation concerns and threats to recovery are outlined in the respective recovery plans for each of these species.

Vessel collisions are considered threats for all six species, and are of particular concern for North Atlantic right, humpback, and fin whales. As discussed in Section 4.2.5, between 2006 and 2010, there were 57 confirmed ship strikes involving baleen whales, 27 of which were fatal, along the U.S. east coast and Canadian Maritime provinces (Henry et al. 2012). Of these, 13 (five fatal) involved North Atlantic right whales, 21 (10 fatal) were humpbacks, and eight (six fatal) were fin whales (Henry et al. 2012). Ship strikes were the cause of 35 percent of the right whale deaths between 1970 and 1999. Concern over right whale vulnerability to vessel collisions led to several mitigation measures, including Seasonal Management Areas and Dynamic Management Areas that are triggered by North Atlantic right whale sightings (Silber and Bettridge 2010). A study of vessel usage of Seasonal Management Areas in 2009 recorded over 28,000 transits, with the highest number (7,651) at the New York-New Jersey port entrance. Over 50 percent of all transits were cargo ships, followed by tankers and tugs (Silber and Bettridge 2010). The largest port in New England is Boston Harbor. The number of deep-draft (tankers, container ships, LNG carriers) vessel transits into and out of Boston averaged 2,257/yr from 2000-2005. The number of transits calculated for Boston Harbor in 2005 grew to 39,000 when cruise ships, whale-watching vessels, dredges, barges, LNG deep water port vessels, ocean going fishing trawlers, and lobster boats were included along with the deep-draft vessels (National Marine Sanctuary Program [NMSP] 2008). These numbers do not reflect the full extent of vessel traffic in Northeast regional waters but provide a sense of the large potential for vessel collisions with ESA listed whales.

All of these vessels also contribute to noise in the marine environment through engines, propellers, and sonar equipment which may cause changes in whale behavior or interfere with their communication

through masking. Acoustic masking, as described in Section 4.2.5, can impact communication, particularly that of low frequency baleen whales. Communication masking by ship noise is difficult to quantify, but appears more severe for right whales than for singing fin or humpback whales, as right whale calls are not as loud as fin and humpback songs (Clark et al. 2009). North Atlantic right whales may have lost as much as 63 to 67 percent of their communication space compared to historically quieter conditions in the Stellwagen Bank National Marine Sanctuary (Hatch et al. 2012). In addition, there is evidence that exposure to low-frequency ship noise induces chronic stress in North Atlantic right whales (Rolland et al. 2012). Research within the Stellwagen Bank National Marine Sanctuary off the Massachusetts coast revealed that tankers contributed twice the acoustic noise to the area as cargo ships and 100 times that of research vessels (Hatch et al. 2008). Anthropogenic noise and acoustic disturbance are listed as potential threats to ESA-listed whales in their Recovery Plans, although with unknown effects and a great deal of uncertainty.

Military operations along the eastern seaboard and offshore waters are also potential sources of behavioral and habitat disturbance, injury, and mortality. Operations occur throughout several range complexes and testing ranges from Maine to Florida within the Atlantic Fleet Training and Testing Area (DON 2013). Sonar, active acoustic sources, airguns, weapons firing, explosives, and vessel and aircraft noise could result in Level A or Level B harassment of some marine mammals, and vessel collisions and explosives could result in injury or mortality. The Navy coordinated with NMFS and USFWS, through consultation and permitting processes, on mitigation measures (DON 2013).

Entanglement and hooking in fishing gear is another high ranking concern in the Northeast region. This may be impeding recovery of North Atlantic right and humpback whales and, to a lesser degree, fin and blue whales whose large size leaves them more likely to break through gear rather than become entangled (Reeves et al 1998, NMFS 2010e). From 1990 to 2010, there were 74 confirmed right whale entanglements in weirs, gillnets, lines and buoys (Waring et al. 2013). Between 2006 and 2010, right whales experienced 33 confirmed entanglements, four of which were fatal and five were serious injuries. Humpbacks were the most commonly observed entangled whale, with 101 entanglements (nine were fatal, 20 were serious injuries), and fin whales were observed entangled on 15 occasions (two were fatal, two were serious injuries) (Henry et al. 2012). An estimated 89 percent of entanglements of North Atlantic right whales and humpback whales were with pot or gillnet gear (Johnson et al. 2005). Humpback and fin/sei whales occasionally interact with purse seine gear; in 2008, there were incidences of one entanglement each in herring purse seines, but the whales were released alive (Waring et al. 2013). Entanglement in the pelagic driftnet fishery in the early 1990s contributed to mortality of right, humpback, and sperm whales. The pelagic driftnet fisheries for swordfish and tuna were prohibited in 1999 (64 FR 4055, 64 FR 29089).

The Atlantic Large Whale Take Reduction Plan (ALWTRP) (NMFS 2010b) was developed to help mitigate incidental serious injury and mortality of North Atlantic right, humpback, fin, and minke whales in Gulf of Maine and Mid-Atlantic lobster trap/pot fisheries, the Mid-Atlantic gillnet fishery, the Gulf of Maine sink gillnet fishery, and the South Atlantic shark gillnet fishery. Despite numerous amendments and revisions since going into effect, risk of serious injury and mortality of large whales continues. Sufficient data are not currently available to quantify the relative impact of the ALWTRP on annual entanglement rates, while data do indicate that entanglements continue to pose a threat to large whales, suggesting the need for further modifications (NMFS 2013a).

Effects of habitat degradation and climate change on prey availability are listed as conservation concerns in the Recovery plans, yet are difficult to discern and evaluate (NMFS 2010e, NMFS 2006c, NMFS 1991). Climate change impacts on ESA-listed species are possible through changes in habitat and food availability and resulting range shifts. Migration, feeding, and breeding locations influenced by ocean currents and water temperature could be impacted, which could, ultimately, affect productivity of ESA-listed species. In the case of North Atlantic right whales, federally conducted, funded, or permitted

activities that could affect their prey or habitat, such as dredging or disposal, would be subject to ESA section 7 consultations (NMFS 2005).

The potential effects of commercial fisheries on prey availability are not clear. Right whales, blue whales, and sei whales are unlikely to directly compete with or be directly affected by commercial fisheries, since they primarily consume zooplankton. However, removals of large volumes of plankton-eating fish, such as Atlantic herring, could affect prey availability and cetacean distribution as was surmised to have occurred in the Gulf of Maine (GOM) and Northeast Shelf ecosystems in the 1970s (Kenney et al. 1996). The Atlantic herring fishery is the primary fishery currently targeting species also taken by fin and humpback whales in the GOM.

With the exception of the historical sources of population decline (e.g., commercial whaling), all of the aforementioned effects are likely to continue into the foreseeable future (Table 5.1-1). The level of impact would depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

5.5.1.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on ESA-listed marine mammals are discussed in sections 4.2.5, 4.3.5, and 4.4.5. The three research alternatives considered in this Final PEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. Although ESA-listed marine mammals continue to face serious cumulative effects in the Northeast, contribution to these effects from NEFSC fisheries research activities is comparatively small. There have been no reported vessel collisions or entanglements of ESA-listed marine mammals involving NEFSC vessels or gear, and the volume of ship traffic generated by NEFSC fisheries research is miniscule compared to the number of other vessels transiting the area. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels causing serious injury or mortality to ESA-listed species due to ship strikes is considered possible but the potential risk is minor.

The potential effects from use of active acoustic devices for research activities would have rare or infrequent and temporary behavioral avoidance effects on ESA-listed marine mammals. Relative to the volume of other ship traffic and anthropogenic sources of acoustic disturbance, the contribution of noise from NEFSC fisheries and ecosystem research would be minor. For example, Level B acoustic harassment takes due to geological and geophysical exploration activities estimated for the Mid-Atlantic and South Atlantic Planning Area includes up to 224 North Atlantic right whales and 1,131 humpback whales (BOEM 2014), compared to 11 and 5, respectively, estimated for NEFSC fisheries and ecosystem research (see Table 4.2-12).

There have been no known adverse interactions or takes of ESA-listed marine mammals during NEFSC fisheries research and Level A takes of ESA-listed species are not anticipated. Incidental take in external commercial fisheries and the volume of ship strikes from external sources far exceed any known or potential takes by NEFSC fisheries research, none of which are ESA-listed species. Prey removal during fisheries research is very small and likely inconsequential to prey availability for any marine mammal species, particularly the planktivorous North Atlantic right whales, sei whales, and blue whales. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the Northeast Region, the contribution of NEFSC fisheries research activities to cumulative effects on ESA-listed marine mammals would be minor adverse under all three research alternatives.

5.5.1.3 Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for NEFSC fisheries research. The NEFSC would continue to conduct marine mammal research in the Atlantic under MMPA section 10 directed research permits. However, it would no longer use acoustic equipment or deploy various nets and hook-and-line gear to sample marine mammal prey fields or other oceanographic parameters. This would eliminate the risk of direct impacts due to entanglement, capture, or hooking on research gear and Level B harassment from acoustic disturbance and would therefore not directly contribute to these types of adverse cumulative effects on ESA-listed marine mammals in this region. Indirectly, however, the loss of information obtained through NEFSC fisheries and ecosystem research, either directly or indirectly, on marine mammal feeding ecology, oceanographic components of their habitat, status of prey stocks, and fisheries interactions could impact management decisions regarding the recovery of ESA-listed and other depleted species and analysis of long-term trends affecting the marine ecosystem. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but could impact long-term monitoring and management capabilities for many ESA-listed marine mammals in the region. Given the fact that the NEFSC is not the only source of this type of ecological and oceanographic data, the potential impact of this information loss for management purposes could be compensated by other research programs, at least in part. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the NEFSC research areas, the contribution of the No Research Alternative to cumulative effects on ESA-listed marine mammals would be minor adverse.

5.5.2 Other Cetaceans

5.5.2.1 External Factors in the NEFSC Research Area

The cetacean species included in this section are not listed as threatened or endangered. They are all subject to similar types of effects from external activities as described above for ESA-listed species. With the exception of minke whales, the non-ESA listed cetaceans in the Northeast are odontocetes. Habitats are wide ranging, as are preferred prey items. Population status and trends are generally unknown due to insufficient data for making such determinations. It is therefore difficult to assess population level effects of past and present actions and RFFAs. Interactions with commercial fisheries, however, are likely to have the greatest effect on most of these species and are generally well-documented.

There are several commercial fisheries within the NEFSC research area with reported takes of non-ESA listed cetaceans. Entanglement in the pelagic driftnet fishery in the early 1990s contributed to mortality of several species, including Risso's dolphin, pilot whale, short-beaked common dolphin, spotted dolphin, bottlenose dolphin, and harbor porpoise. The pelagic driftnet fisheries for swordfish and tuna were prohibited in 1999 (64 FR 4055, 64 FR 29089). U.S. observed fisheries in which incidental takes of non-ESA-listed cetaceans currently occur include the Northeast and Mid-Atlantic gillnet fisheries, the pelagic longline fishery, the Northeast and Mid-Atlantic mid-water trawl fisheries, and the Northeast and Mid-Atlantic bottom trawl fisheries (Garrison and Stokes 2012, Orphanides 2011, Waring et al. 2013, Zollett 2009). Among the affected species taken in these commercial fisheries are a number also listed as potential takes by the NEFSC in Table 4.2-13, including minke whale, harbor porpoise, Atlantic white-sided dolphin, short-beaked common dolphin, bottlenose dolphin, Risso's dolphin, and long and short-finned pilot whales. Documented interactions with species listed in Table 4.2-13 are also reported in the Bay of Fundy herring weir fishery (minke whale, harbor porpoise, white-sided dolphin), the GOM Atlantic herring purse seine fishery (minke whale, harbor porpoise, white-sided dolphin, bottlenose dolphin), the Northeast/Mid-Atlantic American lobster trap/pot fishery (minke whale), the Mid-Atlantic haul/beach seine (bottlenose dolphin), NC long haul seine (bottlenose dolphin), and the Atlantic blue crabtrap/pot fishery (bottlenose dolphin) (Waring et al. 2013). Of primary concern with harbor porpoise is the level of bycatch in the Northeast sink gillnet and Mid-Atlantic gillnet fisheries, where combined takes

averaged 786 per year 2006-2010. Total takes from all U.S. and Canadian fisheries combined averaged 835 harbor porpoise, which exceeds PBR (706) for this stock (Waring et al. 2013).

Several take reduction plans were developed to mitigate bycatch. These include the Harbor Porpoise Take Reduction Plan (HPTRP), the Bottlenose Dolphin Take Reduction Plan (BDTRP), the Atlantic Trawl Gear Take Reduction Strategy (ATGTRS), and the Atlantic Pelagic Longline Take Reduction Plan (APLTRP). The initial HPTRP helped reduce bycatch of harbor porpoise to below PBR levels, although it did not achieve the goal of a zero mortality rate. In addition, the consequence closure strategy appears ineffective and is undergoing reconsideration (NERO 2013). Lack of compliance may hinder achieving TRP goals. Such was the case with the pelagic longline fishery where reports indicated less than 50 percent compliance with mainline length in 2012 (PLTRP 2012). NMFS continues to work with the fishing industry to revise and improve the plans and to increase efficacy toward the goal of reducing bycatch.

Military operations along the eastern seaboard and offshore waters are also potential sources of behavioral and habitat disturbance, injury, and mortality. Operations occur throughout several range complexes and testing ranges from Maine to Florida within the Atlantic Fleet Training and Testing Area (DON 2013). Sonar, active acoustic sources, airguns, weapons firing, explosives, and vessel and aircraft noise could result in Level A or Level B harassment of some marine mammals, and vessel collisions and explosives could result in injury or mortality. The Navy coordinated with NMFS and USFWS, through ESA and MMPA consultation and permitting processes, on mitigation, monitoring, and reporting measures (DON 2013).

The primary actions that could affect prey availability are climate change and fisheries removals. Among the managed species targeted as prey are Atlantic herring, Atlantic menhaden, mackerel, short-finned squid and long-finned squid. Insufficient information on abundance and prey preferences for most of the cetaceans discussed here preclude adequately assessing the effects that these removals would have on these cetacean populations. Climate change impacts are difficult to predict, but would likely affect non ESA-listed cetaceans through changes in habitat and food availability in a manner similar to that described for ESA-listed species.

The activities external to NEFSC fisheries research affecting cetaceans are likely to continue into the foreseeable future (Table 5.1-1). The level of impact would depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

5.5.2.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on non ESA-listed cetaceans are discussed in sections 4.2.5, 4.3.5, and 4.4.5. The three research alternatives considered in this Final PEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. The contribution of NEFSC fisheries research activities to cumulative effects on non-ESA-listed species is likely to be small. Incidental take in external commercial fisheries far exceeds any known or potential Level A takes by NEFSC fisheries research (Tables 4.2-8 and 4.2-10). The estimated average annual take by NEFSC in the next five years is well below 10 percent of PBR for most species, and less than one percent for most species for which takes are requested. For white-beaked dolphin, the requested take of one animal per year, if it occurred, would equal ten percent of PBR. According to the impact criteria described in Table 4.1-1, this level of mortality for white-beaked dolphin and all other species considered here, if they occurred, would be considered minor in magnitude.

The potential effects from use of active acoustic devices for research activities would likely involve infrequent and temporary behavioral disturbance and avoidance effects, particularly for the mid- and high-frequency hearing odontocetes. Relative to the volume of other ship traffic and anthropogenic

sources of acoustic disturbance, the contribution of noise from NEFSC fisheries and ecosystem research would be minor.

Although there is some overlap in prey of non ESA-listed cetaceans and the species collected during NEFSC fisheries research surveys (e.g., herring), the total amount sampled is minimal compared to overall biomass and commercial fisheries removals. Prey removal during fisheries research is very small and likely inconsequential to prey availability for any marine mammal species. The contribution of research catches to the effects on marine mammals through competition for prey is therefore considered minor adverse.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed cetaceans in the NEFSC research area, the contribution of NEFSC-affiliated fisheries research to cumulative effects on cetaceans would be primarily through rare gear interactions and would be minor adverse under all three research alternatives.

5.5.2.3 Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for NEFSC fisheries research. The NEFSC would continue to conduct marine mammal research in the Atlantic under MMPA section 10 directed research permits. However, it would no longer use acoustic equipment or deploy various nets and hook-and-line gear to sample marine mammal prey fields or other oceanographic parameters. This would eliminate the risk of direct impacts due to entanglement, capture, or hooking on research gear and Level B harassment from acoustic disturbance and would therefore not directly contribute to these types of adverse cumulative effects on cetaceans in this region. Indirectly, however, the loss of information obtained through NEFSC fisheries and ecosystem research, either directly or indirectly, on marine mammal feeding ecology, oceanographic components of their habitat, status of prey stocks, and fisheries interactions could impact management decisions regarding the conservation of cetaceans and analysis of long-term trends affecting the marine ecosystem. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but could impact long-term monitoring and management capabilities for many cetaceans in the region. Given the fact that the NEFSC is not the only source of this type of ecological and oceanographic data, the potential impact of this information loss for management purposes could be compensated by other research programs, at least in part. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting cetaceans in the NEFSC research areas, the contribution of the No Research Alternative to cumulative effects on cetaceans would be minor adverse.

5.5.3 Pinnipeds

5.5.3.1 External Factors in the NEFSC Research Area

Gray seals and harbor seals are the most numerous of the pinnipeds in the NEFSC survey area. Populations are increasing, ranges are expanding, and they continue to exhibit seasonal shifts in abundance and distribution. Harp and hooded seals are infrequently seen in the survey areas, although recent extralimital range expansions make them occasional visitors to the area and potentially vulnerable to anthropogenic effects similar to those described above for cetaceans.

The coastal distribution of pinnipeds may leave them vulnerable to effects of near shore activities (coastal development, vessel traffic, fishing, dredging), but unlikely to be affected by more oceanic or offshore activities, such as pelagic fishing, shipping and offshore military exercises. There are no reports of vessel collisions resulting in injury or mortality in the Northeast region. Acoustic disturbance and behavioral changes could occur during coastal construction projects, such as the proposed Cape Wind farm in Nantucket Sound.

Entanglement in fishing gear and bycatch in commercial fisheries occur with regularity in the Northeast and Mid-Atlantic regions and are the primary known causes of mortality and serious injury for pinnipeds in this area. Gillnets are responsible for most observed and reported bycatch, but bottom trawl, mid-water trawl, herring weir, and seine fisheries also contribute (Zollett 2009). From 2006 to 2010, the average annual mortality of harbor seals incidental to commercial fisheries was 332, 280 of which were in the Northeast sink gillnet fishery and 50 were in the Mid-Atlantic sink gillnet fishery (Waring et al. 2013). Gray seal incidental mortality from 2006 to 2010 was greater, with an annual average of 853 seals, 794 of which were in the Northeast sink gillnet and 53 in the Mid-Atlantic sink gillnet fisheries (Waring et al. 2013).

Perturbations to coastal habitats through dredging, construction, commercial fishing, and climate change could alter the prey upon which pinnipeds in the region depend. However, prey availability does not currently appear to be a limiting factor for pinniped populations that are continuing to increase in abundance in the northeast region (Baraff and Loughlin 2000).

Climate change impacts are difficult to predict, but may affect non ESA-listed pinnipeds through changes in habitat and food availability.

The activities external to NEFSC fisheries research affecting pinnipeds are likely to continue into the foreseeable future (Table 5.1-1). The level of impact would depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

5.5.3.2 Contribution of the Research Alternatives

Direct and indirect effects of the NEFSC research alternatives on pinnipeds are discussed in sections 4.2.5, 4.3.5, and 4.4.5. The three research alternatives considered in this Final PEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. The contribution of NEFSC fisheries research activities to cumulative effects on pinnipeds is likely to be small. Incidental take in external commercial fisheries far exceeds any known or potential Level A takes by NEFSC fisheries research (Tables 4.2-8 and 4.2-10). The historical take of two pinnipeds (one harbor seal and one gray seal) demonstrates the rarity of such interactions. The estimated average annual take by NEFSC in the next five years is less than 0.1 percent of PBR for harbor seals. PBR is unknown for gray seals, but past and foreseeable takes are likely substantially below levels at which population effects would occur. Potential effects of active acoustic devices used in research activities would be considered minor throughout the NEFSC research areas during all seasons.

Although there is some overlap in prey of pinnipeds and the species collected during NEFSC fisheries and ecosystem research surveys (e.g., herring, mackerel, flatfish), the total amount sampled is minimal compared to overall biomass and commercial fisheries removals. Prey removal during fisheries research is very small and likely inconsequential to prey availability for any pinnipeds. The contribution of research catches to the effects on pinnipeds through competition for prey is therefore considered minor adverse.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting pinnipeds in the NEFSC research areas, the contribution of the NEFSC-affiliated fisheries research to cumulative effects would be primarily through gear interactions and occasional behavioral disturbance and would be minor adverse under all three research alternatives.

5.5.3.3 Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for NEFSC fisheries research. The NEFSC would continue to conduct marine mammal research in the Atlantic under MMPA section 10 directed research permits. However, it would no longer use acoustic equipment or deploy various nets and hook-and-line gear to sample marine mammal prey fields or other oceanographic

parameters. This would eliminate the risk of direct impacts due to entanglement, capture, or hooking on research gear and Level B harassment from acoustic disturbance and would therefore not directly contribute to these types of adverse cumulative effects on pinnipeds in this region. Indirectly, however, the loss of information obtained through NEFSC fisheries and ecosystem research, either directly or indirectly, on marine mammal feeding ecology, oceanographic components of their habitat, status of prey stocks, and fisheries interactions could impact management decisions regarding the conservation of pinnipeds and analysis of long-term trends affecting the marine ecosystem. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but could impact long-term monitoring and management capabilities for many pinnipeds in the region. Given the fact that the NEFSC is not the only source of this type of ecological and oceanographic data, the potential impact of this information loss for management purposes could be compensated by other research programs, at least in part. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting pinnipeds in the NEFSC research areas, the contribution of the No Research Alternative to cumulative effects on pinnipeds would be minor adverse.

5.6 CUMULATIVE EFFECTS ON BIRDS

Activities external to NEFSC fisheries research that could potentially affect birds in the NEFSC research area may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Mortality from by-catch in fisheries and hunting
- Collisions with ships
- Alteration or reduction of prey resources
- Loss or injury due to ingestion of or entanglement in marine debris
- Behavioral disturbance
- Loss or injury due to contamination of habitat or prey
- Loss or injury from collision with wind turbines

5.6.1 External Factors in the NEFSC Research Area

Cumulative effects on seabirds include actions that directly affect the seabirds, including underwater explosions, offshore wind power developments, offshore artificial lighting, entanglement in debris, ingestion of marine debris, fishery interactions, vessel collisions, and hunting. Seabird mortalities have been documented within the commercial fishing industry in the Northeast, with a number of species considered to be threatened with population level effects due to fisheries-related mortality (Zollett 2009). Although a number of mitigation measures have been developed to reduce bycatch of seabirds in gillnets, none have yet been implemented on the east coast of the United States to reduce bycatch of seabirds (Zollett 2009).

Cumulative effects also include indirect effects that alter or destroy seabird habitat (feeding, breeding or nesting grounds) such as contamination from oil and gas facilities, coastal development and transportation, dock construction, marine pollution, and dredging (Table 5.1-1). Climate change is also likely having effects on seabirds through changes in their prey abundance and distribution, although climate change may have adverse effects on some species while others may actually benefit.

As described in Section 3.5.1, the roseate tern and the Bermuda petrel are the only ESA-listed species in the project area. The roseate tern has suffered from major cumulative effects due to factors external to fisheries research, such as historical feather hunters, nesting habitat loss due to coastal development and heavy predation and competition from large gulls. The Bermuda petrel has been severely affected by the cumulative effects of human encroachment and introduced predators on their nesting habitat.

The factors that have affected seabirds in the project area in the past are likely to do so in the future. The population trends for most species are not well known and most populations tend to fluctuate normally due to natural factors.

5.6.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on seabirds are discussed in sections 4.2.5, 4.3.5, and 4.4.5. There have been no birds reported as being caught incidentally in past NEFSC fisheries research surveys or cooperative research projects. Given the continued use of fishing gears known to catch birds in commercial fisheries, there is a risk of future bird mortality in NEFSC fisheries and ecosystem research activities but, given the past record under Status Quo conditions, such captures would likely be rare and very small in magnitude. NEFSC fisheries and ecosystem research removes a negligible amount of small fish and invertebrates that may be used as prey of seabirds. Some NEFSC fisheries and

ecosystem research cruises also serve as vessels of opportunity for scientific surveys of seabirds in the Atlantic and thus have a beneficial contribution to knowledge about seabird abundance, distribution, and ecology that is shared with other resource agencies.

When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting seabirds in the Northeast Region, the contribution of NEFSC-affiliated fisheries research to the cumulative effects on seabirds is considered minor adverse for all species.

5.6.3 Contribution of the No Research Alternative

The lack of NEFSC fisheries and ecosystem research under this alternative would eliminate any direct effects on seabirds in the Atlantic. It is important to note that some of the NEFSC projects that would be eliminated under this alternative include bird observers as part of the cruise operations or opportunistically when space is available and collect a great deal of information on the abundance, distribution, and feeding behaviors of birds in the area. The loss of this information could indirectly affect resource management decisions concerning the conservation of seabirds. There are too many unknown variables to estimate the level of impact this lack of information would have on any particular bird species, but the contribution of this alternative to cumulative impacts on seabirds would likely be minor adverse.

5.7 CUMULATIVE EFFECTS ON SEA TURTLES

Activities external to NEFSC fisheries research that could potentially affect sea turtles within the NEFSC research area may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Mortality and injury from by-catch in fisheries
- Collisions with ships
- Alteration or reduction of prey resources through fisheries and climate change
- Loss or injury due to ingestion of or entanglement in marine debris
- Behavioral disturbance from marine vessels and coastal development
- Contamination and loss of nesting habitat through development and sea level rise

5.7.1 External Factors in the NEFSC Research Area

Sea turtles are susceptible to many natural and human effects on land and in marine environments, most of which are likely to continue to occur in the future (Table 5.1-1). Section 3.2.4 of this Final PEA provides some baseline information about five different species of ESA-listed sea turtles that occur in the NEFSC research area: Leatherback, Kemp's ridley, Green, Loggerhead, and Hawksbill sea turtles. All of these species have been subject to major population-level cumulative effects and have been subject to massive conservation efforts in many parts of the world.

Adverse external effects on land involve habitat degradation, injury, and mortality through numerous mechanisms: beach erosion, beach armoring and nourishment, artificial lighting, increases in human presence, beach cleaning, recreational beach equipment, beach driving, coastal construction, fishing piers, disturbance of dunes and beach vegetation, and poaching. Increases in human presence near nesting beaches have led to the introduction of exotic fire ants, hogs, dogs, raccoons, armadillos and opossums, which all raid and feed on turtle eggs (NMFS and USFWS 2007 a, b, c, and d).

Adverse external effects in the marine environment include: oil and gas exploration, coastal development and transportation, dock construction, marine pollution, hopper dredging, underwater explosions, offshore artificial lighting, entanglement in debris, ingestion of marine debris, fishery interactions, boat collisions, poaching, and power plant entrainment. Hurricanes and wave action can affect survival at sea and be destructive to nests on land and therefore reduce hatchling success. Cold stunning and biotoxin exposure are also sources of natural mortality (NMFS and USFWS 2007 a, b, c, and d).

Sea turtle takes have been well documented within the commercial fishing industry in the Northeast, especially loggerhead and leatherback turtles (Zollett 2009). This conservation issue has been the subject of numerous conservation engineering studies and subsequent adoption of turtle excluder devices and regulations designed to reduce the level of captures and mortality in trawl and dredge fisheries. Adoption of circle hooks instead of "J" hooks in the pelagic longline fisheries has also reduced mortalities of turtles. However, because of the ESA-listed status of all sea turtle species, capture and entanglement in several types of fishing gear continues to be a major conservation concern (NMFS and USFWS 1992a, b and 2008).

Sea turtle mortality has also been documented in dredging operations throughout the eastern United States. At least 50 loggerheads have been documented to have been killed in dredging projects since 1994 (NMFS and USFWS 2007a).

5.7.2 Contribution of the Research Alternatives

The primary mechanism of adverse effects on sea turtles from NEFSC fisheries research involves direct interactions with research gear. Fisheries research activities conducted and funded by the NEFSC have had direct gear interactions with Kemp's ridley, loggerhead, green, and leatherback sea turtles. There have been no documented interactions with hawksbill sea turtles. In the past ten years, 2004 to 2013, 75 sea turtles have been captured in NEFSC-affiliated research gear but all except one have been released alive and in apparently good condition (Table 4.2-14). Many NEFSC cruises include biologists trained in proper handling and safe release procedures for sea turtles and additional training in these issues for other crew members is included under the Preferred Alternative. The analysis of direct effects used historical capture rates for the different turtles in research gear and mortality rates in analogous fisheries to estimate future captures and mortalities based on projected levels of research effort with different gear types. For all species considered, the estimated levels of captures and risk of mortality were considered minor in magnitude. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed sea turtles in the Atlantic, the contribution of NEFSC-affiliated fisheries research activities to cumulative effects on ESA-listed sea turtles would be considered minor adverse under all three research alternatives.

In addition to the minor adverse impacts of fisheries research, a number of NEFSC funded cooperative research projects have been oriented toward reducing turtle bycatch in commercial fisheries and therefore have made a beneficial contribution to conservation efforts for these species. Conservation engineering projects oriented toward reducing sea turtle bycatch are expected to continue under all of the research alternatives. Some NEFSC fisheries and ecosystem research cruises also serve as vessels of opportunity for scientific surveys of sea turtles in the Atlantic and thus have a beneficial contribution to knowledge about sea turtle abundance, distribution, and ecology that has beneficial contribution to sea turtle conservation and management efforts.

5.7.3 Contribution of the No Research Alternative

The No Research Alternative would eliminate any direct impacts to sea turtles that could potentially occur under the research alternatives. However, the elimination of NEFSC fisheries research would also substantially reduce the collection of oceanographic and fisheries data important for monitoring the ecological status of the environment important to sea turtles. NEFSC-affiliated fisheries research, including conservation engineering projects in partnership with the fishing industry, have supported the adoption of fishing regulations on several gear types to reduce bycatch of sea turtles. NEFSC fisheries and ecosystem research has also supported management and conservation of sea turtle habitats and the ecosystems that sustain them. Under the No Research Alternative, the loss of information currently provided by NEFSC fisheries and ecosystem research activities would have a moderate contribution to adverse cumulative impacts to sea turtles in the Atlantic through indirect effects on management decisions important to the conservation and recovery of these species.

5.8 CUMULATIVE EFFECTS ON INVERTEBRATES

Activities external to NEFSC fisheries research that could potentially affect invertebrate species in the NEFSC fisheries research areas include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, other scientific research, military operations, climate change, and ocean acidification. These activities and potential effects are summarized in Table 5.1-1 and include:

- Injury or mortality due to directed catch or bycatch in commercial and recreational fisheries
- Benthic habitat disturbances
- Changes in distribution and food availability due to climate change or habitat degradation

5.8.1 External Factors in the NEFSC Research Area

Marine invertebrates continue to be susceptible to natural and anthropogenic effects including exploitation through commercial and recreational fishing, habitat degradation, pollution, and climate change. Because marine invertebrates do not regulate their body temperature, changes in water temperature may affect the distribution of certain species as well as affect growth rates, reproductive ability and survival (Harley et al. 2006, Fogarty et al. 2007). In addition, warmer water temperatures affect pH, dissolved oxygen and conductivity of sea water, all of which may have adverse effects on invertebrate species.

Habitat degradation can occur as a result of commercial and recreational fisheries that involve gear coming in contact with the sea floor (See Section 3.5). Other sources of habitat disruption identified in the RFFAs (Table 5.1-1) include ocean dredging, waste disposal, and off-shore development projects. In addition, pollution can negatively affect water quality and chemistry. While intentional discharges of pollutants (including fuel and oil) are relatively rare, accidental discharges may be rather common in some areas and have the potential to cause habitat degradation or direct mortality of invertebrates. Effects include decreased foraging ability and reproductive success and increased mortality (Milligan et al. 2009). Most accidental discharges are likely to be small and localized but some accidental discharges with large vessels or industrial activities may affect large geographic areas and impact benthic habitats for years.

Overexploitation of undersized or immature individuals can have serious implications for the sustainability of stocks, and the overall body size of individuals in a fished population may also change with intense fishing pressure on a single size (Donaldson et al. 2010). The sea scallop fishery in the Northeast is regulated in part through a series of rotating area closures to help prevent overfishing and habitat degradation. With the exception of the SNE stock of American lobster, which is overfished and depleted, the most recent stock assessment reports indicate that current commercial and recreational fisheries are sustainable for marine invertebrate stocks along the U.S. Atlantic coast (ASMFC 2013).

Some commercially valuable species of invertebrates (e.g. scallops and lobsters) have had population declines in the past due to overharvest. However, the commercially harvested species are all currently at sustainable population levels, at least in most areas of their range. Commercial fishing is likely to be the dominant factor in cumulative effects on these species in the future, although climate change may also have substantial effects on some species.

5.8.2 Contribution of the Research Alternatives

The NEFSC and affiliated cooperative research partners have several large research programs to help assess important invertebrate stocks and monitor the health of their habitats. As is the case with fish, the amount of invertebrate species caught during research sampling represents a very small proportion (much less than one percent) of the commercial catch of these species (Table 4.2-19). The footprint of these NEFSC-affiliated dredge and bottom trawl surveys also impacts a very small proportion of the benthic habitat (Table 4.2-2) and would have short-term effects on benthic organisms.

When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting invertebrate species in the Northeast, the contribution of NEFSC-affiliated fisheries research activities to adverse cumulative effects on invertebrates would be minor under all three research alternatives.

The NEFSC-affiliated research program also makes a beneficial contribution to cumulative effects on invertebrates through their role in providing scientific information to the commercial fisheries management process which strives to maintain sustainable populations. The beneficial value of fisheries research to a range of future management challenges from fishing to climate change is quite substantial and helps to address a range of adverse cumulative effects.

5.8.3 Contribution of the No Research Alternative

Under the No Research Alternative, the NEFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research in the Atlantic so would not directly contribute to cumulative effects on invertebrate species in this region. In the absence of research surveys and cooperative research projects to improve the fisheries, important scientific information would not be collected about the status of invertebrate stocks or the efficacy of different gear modifications. As is the case with commercially valuable fish stocks, this type of information is used for fisheries and conservation management, including the long-term monitoring of stock assessments, trends in abundance, recruitment rates, and the amount of invertebrates being harvested relative to overfishing metrics. This lack of data would make it much more difficult for fisheries managers to effectively monitor the status of stocks, develop fishery regulations, rebuild depleted stocks, and monitor effects of ecosystem changes. The lack of information and increasing uncertainty about the status of invertebrate stocks and their habitats would have serious implications for fisheries management. The indirect effects of the No Research Alternative could, therefore, impact invertebrate stocks through a lack of information essential for prudent decision making and conservation of invertebrates and their habitats. The indirect contribution of the No Research Alternative to cumulative effects on commercially valuable invertebrate species is difficult to ascertain but would likely have moderate adverse impacts on the long-term monitoring ability of NMFS or other agencies and the management capabilities for numerous economically and ecologically important species.

5.9 CUMULATIVE EFFECTS ON THE SOCIAL AND ECONOMIC ENVIRONMENT

Activities external to NEFSC fisheries research that could potentially affect the social and economic environment of fishing communities along the U.S. Atlantic coast include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and include:

- Provision of jobs and economic opportunity
- Changes in commercial fishing opportunities
- Economic costs of changes in resource availability due to climate change and ocean acidification

5.9.1 External Factors in the NEFSC Research Area

The intent of this section is to describe the contribution of NEFSC fisheries research activities to the social and economic environment of fishing communities along the U.S. Atlantic coast, which is closely related to general socioeconomic conditions in the Nation. The economies of communities in this area are exceedingly large and characterized by great diversity among economic sectors. Potential future socioeconomic cumulative effects from developments in non-fishing industries, such as liquid natural gas terminals, oil extraction, shipping commerce, or climate change cannot be feasibly estimated with available data, but would be expected to dominate the overall economy in the future. The focus of this section would therefore be limited to cumulative effects on fisheries-related sectors.

The cumulative effects on social and economic issues for fishing communities and related industries closely parallel the effects on commercially exploited fish and invertebrates. These include both natural factors such as climate change (including changes in ocean characteristics), and activities associated with offshore development, contamination, and commercial and sport fishing. Since these communities are dependent on the abundance and location of commercially exploitable fish and invertebrates, factors that influence fish and invertebrate stocks also influence the economic well-being of the fishing communities. Therefore, the historical effects of overfishing and the resultant declines in fish stocks, followed by the imposition of sometimes severe limits on fishing opportunities under FMPs, has had major adverse social and economic effects on fishing communities in the Northeast.

RFFAs that could contribute to cumulative effects on fisheries-related sectors include changes to regulations regarding the protection of ESA-listed or other protected species, such as marine mammal take reduction plans, critical habitat restrictions on fishing or marine vessels, new conservation measures for sea turtles, and new fishery management measures that may come into effect (Table 5.1-1). Species take reduction plans could include measures that would lead to increased costs for fishermen through required gear modifications. These plans could also call for time and/or area closures that would have short-term effects to fishing fleets having to alter their fishing locations. The potential effects of climate change on fisheries stocks and distribution is another RFFA of concern. Other effects on fish and invertebrates discussed in Sections 5.4 and 5.8 could have effects on the economies of fishing communities if not carefully monitored and controlled.

Existing fisheries regulations within the Northeast Region have already contributed to cumulative effects to the social and economic environment through numerous regulatory regimes affecting levels of effort for both commercial and recreational fishing. Most fishermen understand the need to protect different marine species and their important habitats. However, depending on locations of closed areas or the level of specificity in regulations, fishermen could feel varying levels of social and economic effects on their daily operations from these regulations.

5.9.2 Contribution of the Research Alternatives

The fundamental purpose of fisheries management is to monitor and counteract the contribution of commercial and sport fishing to the adverse cumulative effects on fish stocks from past, present, and reasonably foreseeable actions. NEFSC fisheries research is one of the most effective mechanisms to monitor the status of exploited stocks and changes in the marine environment, providing substantial beneficial contributions to cumulative effects through scientific input to fishery management and other environmental decision-making processes. Continuation of this research would provide consistent data to allow evaluation of fish stock trends and the effects of actions not related to fishing.

The management of commercial and recreational fisheries in the Northeast would continue to be supported by the proposed fisheries research conducted and funded by the NEFSC under the three research alternatives. This would help promote sustainable fish and invertebrate populations and have substantial benefits for local economies dependent on stable fishing opportunities. Cooperative research programs would also continue to improve the trust and collaboration between the fishing industry and fisheries managers in protecting marine resources. Long-term sustainable catches would be promoted, increasing stability in the fishing communities and reducing boom and bust cycles related to over-exploitation of target species.

Research results contribute to understanding effects not related to commercial or recreational fishing that could threaten species recoveries and sustainable yield levels. Using NEFSC long-term data sets and short-term research projects, resource managers could identify emerging issues in sufficient time to take corrective action before population level effects would be noticed by fishers in the form of reduced abundance and lower catches. This includes potential effects of climate change and ocean acidification.

Finally, NEFSC fisheries research creates jobs and purchases services in fishing communities. Depending on the community, this is a minor to moderate beneficial contribution to cumulative effects.

The importance of federally managed fisheries in the social and economic environment of Northeast communities varies substantially from place to place. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting the socioeconomic environment in the Northeast, the contribution of the research alternatives to cumulative effects on the socioeconomic environment would be moderate and beneficial in that continued research would support science-based, sustainable fisheries management and provide information important to the assessment of potential effects on fisheries resources from climate change and resource development projects.

5.9.3 Contribution of the No Research Alternative

Under the No Research Alternative, the NEFSC would not contribute to the information base needed for sustainable fisheries management or tracking ecosystem changes. Fisheries research activities conducted by state and private organizations are not likely to be sufficient to identify trends in target fish stocks and set sustainable fishery harvest limits without the contribution from the NEFSC. Some major commercial species would likely receive attention from state and private research efforts, so potential adverse effects would not likely be uniform across the fishing communities. Some fishers that target these major species may continue to benefit from sustainable fisheries management, but others may be affected by lack of information on their target species. Lack of consistent data input into the fisheries management process would have major adverse effects on the quality of the management analyses, and subsequently to the value of the management process. Elimination of at-sea operations would reduce science-based input into fisheries management decisions, which would increase the potential for adverse cumulative effects on commercial fisheries.

The No Research Alternative would contribute a moderate adverse effect to the cumulative effects on the socioeconomic environment because at-sea research efforts of the NEFSC that could detect and anticipate

cumulative effects on fisheries resources, which are important for fisheries management decisions that strongly influence the socioeconomic conditions of fishing communities, would not be conducted.

6.1 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

In 1976, Congress passed the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 USC 1801, *et seq*.). This law authorized the U.S. to manage its fishery resources in an area extending from a State's territorial sea (extending in general and in Alaska to 3 nautical miles from shore) to 200 nautical miles off its coast (termed the [Exclusive Economic Zone [EEZ]).

Two of the main purposes of the MSA are to promote domestic commercial and recreational fishing under sound conservation and management principles, and to provide for the preparation and implementation, in accordance with national standards, of fishery management plans (FMPs) which would achieve and maintain, on a continuing basis, the optimum yield from each fishery. The 10 National standards of the MSA require that FMPs contain certain conservation and management measures, including measures necessary to prevent overfishing, to rebuild overfished stocks, to insure conservation, to facilitate long-term protection of Essential Fish Habitat (EFH), and to realize the full potential of the Nation's fishery resources. Furthermore, the MSA also declares that the National Fishery Conservation and Management Program utilizes, and is based upon, the best scientific information available; involves, and is responsive to the needs of interested and affected States and citizens; considers efficiency; and draws upon federal, state, and academic capabilities in carrying out research, administration, management, and enforcement.

Certain stocks of fish have declined to the point where their survival is impacted, and other stocks of fish have been so substantially reduced in number that they could become similarly affected as a consequence of (a) increased fishing pressure, (b) the inadequacy of fishery resource conservation and management practices and controls, or (c) direct and indirect habitat losses which have resulted in a diminished capacity to support existing fishing levels.

The resource and research surveys conducted by the NEFSC are designed to meet the requirements of the MSA by providing the best scientific information available to fishery conservation and management scientists and managers, and that would support a management program that is able to respond to changing ecosystem conditions, and to manage risk by developing science-based decision tools.

The U.S. Commission on Ocean Policy has identified the need for more holistic assessments of the status of marine ecosystems. The President's Ocean Action Plan has endorsed the concept of marine Ecosystem-Based Management. Sustained ecosystem monitoring programs are essential for tracking the health of marine ecosystems as part of this overall approach. The individual NEFSC surveys are components of a broader ecosystem monitoring program that meets this emerging critical need. The potential effects of survey activities must be weighed against the risk of inadequately characterizing the state of the ecosystem and potential human impacts on the system.

The EFH provisions of the MSA require NMFS to provide recommendations to federal and state agencies for conserving and enhancing EFH, for any actions that may adversely impact EFH. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". Federal agencies must consult with NMFS and assess the effects of their actions on EFH. There is no separate permit or authorization process; EFH consultation is typically addressed during the NEPA process and incorporated into other permits.

On May 20, 2015, NEFSC requested concurrence from the NMFS Greater Regional Fisheries Office (GARFO) on its determination that minimal adverse effects would result to EFH as a result of proposed fisheries research conducted by NEFSC in the Atlantic. On August 14, 2015 GARFO provided its comments and suggestions for information to be included. Those comments and requests for additional information were addressed in this Final PEA. On November 16, 2015 the NEFSC received an agreement

memo from GARFO concurring that, "…proposed research actions by NEFSC will have effects that are minimal and temporary in nature on areas identified as EFH for federally managed species."

Substantial parts of the proposed action meet the definition of scientific research activity conducted by a scientific research vessel and are therefore exempt from the requirements of the MSA. Other parts of the proposed action consist of cooperative research programs that take place on commercial fishing vessels. Some of these projects do not alter the nature of the commercial fishing activity, as specified by FMP regulations, but merely involve scientific data collection from the catch. Other projects involve modifications to the methods or locations of the commercial fishing efforts which require Experimental Fishing Permits under the MSA. Section 404 of the MSA requires the Secretary of Commerce to initiate and maintain, in cooperation with the Fishery Management Councils, a comprehensive program of fishery research to carry out and further the purposes, policy, and provisions of the MSA. The proposed action is part of a comprehensive program to address this requirement.

The Sustainable Fisheries Act of 1996 (Public Law 104-297) is also an amendment to the MSA. Sections 104 and 105 clarify issues surrounding highly migratory fish, and the international agreements that govern fisheries. Among the topics covered by these sections are fishing in international waters of the Atlantic and Pacific oceans; fishing in the Bering Sea, shared with Russia; and congressional rules setting time limits on approval of international fishing treaties. Sections 116 to 406 of the Sustainable Fisheries Act describe the management measures and research necessary to implement the act. These sections specify the agencies responsible for research and the nature of the research to be conducted in each of several specific fishing areas, including the Atlantic Ocean.

The 1996 amendments to the MSA also require assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities:

> *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 in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.*

6.2 MARINE MAMMAL PROTECTION ACT

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. 1361 *et seq*.), as amended, prohibits the "take" [13] of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. The primary management objective of the MMPA is to maintain the health and stability of the marine ecosystem, with a goal of obtaining an optimum sustainable population of marine mammals within the carrying capacity of the habitat. The MMPA is intended to work in concert with the provisions of the Endangered Species Act (ESA). The secretary is required to give full consideration to all factors regarding regulations applicable to the take of marine mammals, including the conservation, development, and utilization of fishery resources, and the economic and technological feasibility of implementing the regulations.

Section 101(a)(5)(A-D) of the MMPA provides a mechanism for allowing, upon request, the "incidental," but not intentional, taking, of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing or directed research on marine mammals) within a

[13] The MMPA defines take as: "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal." Harassment means any act of pursuit, torment, or annoyance which, 1) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or 2) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B Harassment).

specified geographic region. The NMFS Office of Protected Resources (OPR) processes applications for incidental takes of small numbers of marine mammals. Authorization for incidental takes may be granted if NMFS finds a negligible impact on the species or stock(s), and if the methods, mitigation, monitoring and reporting for takes are permissible.

The purpose of issuing incidental take authorizations is to provide an exemption to the take prohibition in the MMPA, and to ensure that the action complies with the MMPA and NMFSs implementing regulations. ITAs may be issued as either: 1) regulations and associated Letters of Authorization (LOAs) under Section 101(a)(5)(A) of the MMPA; or 2) Incidental Harassment Authorizations (IHAs) under Section 101(a)(5)(D) of the MMPA. An IHA can only be issued when there is no potential for serious injury and/or mortality or where any such potential can be negated through required mitigation measures. Pursuant to Section 101(a)(5)(A) of the MMPA, NMFS, upon application from the NEFSC, has promulgated regulations to govern the unintentional taking of marine mammals, by harassment, incidental to the proposed fisheries research activities by the NEFSC in the Atlantic Ocean. The issuance of MMPA incidental take regulations and associated LOAs to the NEFSC is a federal action, thereby requiring NMFS to analyze the effects of the action on the human environment pursuant to the NEPA and NMFSs NEPA procedures.

After an application is submitted, the NMFS OPR may authorize incidental takes of marine mammals through either a one-year IHA or LOAs, which is a rulemaking process that can cover activities for up to five years. The NEFSC applied for an rulemaking for the small number of incidental takes of marine mammals that could occur during their future fisheries and ecosystem research surveys. NMFS OPR issued a proposed rule authorizing those takes under the MMPA on July 9, 2015 (80 FR 39542), with addendums to the proposed rule published on 6 August, 2015 (80 FR 46939) and 17 August, 2015 (80 FR 49196). This Final PEA provides informational support for that LOA application and provides NEPA compliance for the authorization.

6.3 ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) of 1973 as amended (16 USC 1531, *et seq*.), provides for the conservation of endangered and threatened species of fish, wildlife, and plants. The program is administered jointly by NMFS and the U.S. Fish and Wildlife Service (USFWS), with some exceptions - NMFS oversees most marine mammal species, marine and anadromous fish species, and marine plant species and the USFWS oversees several marine mammals (polar bear, walrus, sea otter, and manatee), seabird species, and terrestrial and freshwater wildlife and plant species. NMFS and USFWS share jurisdiction for sea turtles whereby NMFS has jurisdiction in the marine environement and USFWS in the terrestrial environment.

The listing of a species as threatened or endangered is based on the biological health of that species. Threatened species are those likely to become endangered in the foreseeable future (16 USC § 1532[20]). Endangered species are those in danger of becoming extinct throughout all or a significant portion of their range (16 USC § 1532[20]). Species can be listed as endangered without first being listed as threatened.

In addition to listing species under the ESA, the appropriate expert agency (NMFS or USFWS) must designate critical habitat of the newly listed species within a year of its listing to the "maximum extent prudent and determinable" (16 USC § 1533[b][1][A]). The ESA defines critical habitat as those specific areas that are essential to the conservation of a listed species and that may be in need of special consideration. Federal agencies are prohibited from undertaking actions that destroy or adversely modify designated critical habitat. Some species, primarily the cetaceans (whales), which were listed in 1969 under the Endangered Species Conservation Act and carried forward as endangered under the ESA, have not received critical habitat designations.

Federal agencies have an affirmative mandate to conserve listed species. One assurance of this is that federal actions, activities, or authorizations must be in compliance with the provisions of the ESA.

Section 7 of the ESA provides a mechanism for consultation by the federal action agency with the appropriate expert agency. Informal consultations are conducted for federal actions that have no adverse effects on the listed species and typically result in letters of concurrence from the expert agency. In cases where the proposed action may affect listed species or critical habitat, the action agency prepares a biological assessment to determine if the proposed action would adversely affect listed species or modify critical habitat. The biological assessment contains an analysis based on biological studies of the likely effects of the action on the species or habitat. The expert agency either concurs with the assessment or provides its own analysis to continue the consultation.

If the action agency or expert agency concludes that a proposed action may have adverse effects on a listed species, including take[14] of any listed species, they must enter formal consultations under section 7 of the ESA. The expert agency must then write a Biological Opinion (BiOp) that determines whether the proposed action places the listed species in jeopardy of extinction or adversely modifies its critical habitat. If the BiOp concludes the proposed (or ongoing) action will cause jeopardy to the species or adversely modify its critical habitat, it must also include reasonable and prudent alternatives that would modify the action so it no longer posed jeopardy to the listed species. These reasonable and prudent alternatives must be incorporated into the federal action if it is to proceed. Regardless of whether the BiOp reaches a jeopardy or no jeopardy conclusion, it often contains a series of mandatory and/or recommended management measures the action agency must implement to further reduce the negative impacts to the listed species and critical habitat (50 CFR 402.24[j]). If a proposed action would likely involve the taking of any listed species, the expert agency may append an incidental take statement to the BiOp to authorize the amount of take that is expected to occur from normal promulgation of the action. The NEFSC used the Draft PEA to initiate section 7 consultation on the proposed action with the NMFS Greater Atlantic Regional Fisheries Office (GARFO), Protected Resources Division (formal consultation described below).

The section 7 consultation with NMFS and resulting BiOp, issued on June 23, 2016, covers two related actions taken by NMFS in relation to NEFSC research activities considered together as one proposed action. (1) On May 8, 2015, the GARFO received a formal ESA consultation initiation request from the NEFSC regarding the research activities described in the Draft PEA that may result in incidental take of ESA-listed species. On July 9, 2015, the GARFO notified the NEFSC that the request had been reviewed and accepted as complete, and that consultation had been initiated. (2) On July 15, 2015, the GARFO received an ESA consultation initiation request from the OPR regarding the proposed issuance of the MMPA LOA, as published in the Federal Register on July 9, 2015. On August 27, 2015, the OPR notified the GARFO that the anticipated take levels for sperm whales to be exempted in the LOA due to active acoustic sources were being revised to reflect considerations of functional hearing in relation to the specific active sources. At that point, formal consultation was put on hold. On September 28, 2015, the OPR provided the GARFO with the revised take estimates for sperm whales. Following receipt and review of the new acoustic take estimates, consultation recommenced.

In January 2016, staff from the NEFSC brought up several concerns related to the working draft BiOp and proposed LOA and suggested a workshop be held to get all stakeholders within the agency on the same page. The focus of the suggested workshop was to discuss mitigation and monitoring, data collection, and reporting requirements post-permit and BiOp issuance and the need for coordination, training, and communications as the NEFSC switched into implementation mode for upcoming field seasons. As a result, formal consultation was again put on hold. On February 29, 2016, a mini-workshop on

[14] The term “take” under the ESA means “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct” (16 U.S.C. § 1538[a][1][B]).

environmental compliance and implementation involving staff from the NEFSC, OPR, and GARFO was held at the NEFSC. The agenda of the workshop included discussion on the programmatic BiOp, the species to be addressed and for which take should be exempted, and the Reasonable and Prudent Measures (RPMs) and Terms and Conditions (T&Cs) to be included. Shortly after the mini-workshop, on March 18, 2016, the NEFSC sent comments to the GARFO on the proposed RPMs/T&Cs based upon feedback from staff in the Ecosystems Surveys, Protected Species, Fisheries Sampling, and Cooperative Research programs. Along with those comments, the NEFSC also submitted a request to the GARFO to include Atlantic salmon take exemptions and coverage in the BiOp although not previously addressed in the Draft PEA or acknowledged by the GARFO as a species likely to be adversely affected by the proposed action. Following receipt of those comments and requests, consultation recommenced.

The BiOp considered the following possible impacts of the proposed action on ESA-listed species and designated critical habitats from NEFSC research activities: (1) incidental capture, hooking, or entanglement in gear used for biological or oceanographic sampling; (2) vessel collisions; (3) exposure to noise from use of oceanographic equipment and vessels that may produce sound levels that can produce injury, disrupt behavior, or produce harassment; (4) potential reductions in prey through removals from survey sampling; and (5) effects to habitat through deployment of fishing gear or oceanographic equipment. The BiOp concluded that the proposed action is not likely to jeopardize the continued existence of the following species expected to be incidentally or directly captured, hooked, or entangled in research survey gear: Northwest Atlantic distinct population segment (DPS) of loggerhead sea turtle; leatherback sea turtle; Kemp's ridley sea turtle; North Atlantic DPS of green sea turtle; shortnose sturgeon; the Gulf of Maine DPS of Atlantic salmon; or any of the five listed DPSs of Atlantic sturgeon. The BiOp also concluded that the proposed action is not likely to jeopardize the continued existence of sperm whales, which are expected to be exposed to Level B harassment (as defined under the MMPA) by two of the active acoustic sources proposed for use by the NEFSC.

The BiOp concluded that the proposed action is not likely to adversely affect the following species through any of the potential impacts considered: North Atlantic right whales, humpback whales, fin whales, sei whales, blue whales, or hawksbill sea turtles. The BiOp also concluded that the proposed action is not likely to adversely affect any designated critical habitats for ESA-listed species, including those for North Atlantic right whales, the Northwest Atlantic DPS of loggerhead sea turtles, or the Gulf of Maine DPS of Atlantic salmon. On June 9, 2016, shortly following the publication of two proposed rules to designate critical habitat for the five listed DPSs of Atlantic sturgeon, the NEFSC wrote a memo to the GARFO determining that the proposed action was not likely to result in the destruction or adverse modification of Atlantic sturgeon critical habitat and that a conference was not necessary.

6.4 ATLANTIC TUNAS CONVENTION ACT

This Act addresses and codifies the obligations of the International Convention for the Conservation of Atlantic Tunas that was signed in Rio de Janeiro on May 14, 1966. The Act allows for an advisory committee to be established to provide advice and recommendations on the conservation and management of any highly migratory species covered by the Convention and allows the Secretary of Commerce to adopt and enforce regulations to carry out the purposes and objectives of the Convention and Act.

Regulations may establish closed seasons, impose size and catch limits, limit incidental take, require fishing records, clearance certificates, and permits, require fishery observes, and other requirements to obtain scientific data. This Act also recommends the prohibition of the use of large-scale driftnet fishing in Convention waters and the adoption of measures for the conservation and management of Atlantic swordfish. Fisheries research conducted by the NEFSC contributes to the scientific information used to implement the Act and research activities are consistent with the Act's conservation recommendations.

6.5 MIGRATORY BIRD TREATY ACT

The Migratory Bird Treaty Act (MBTA) protects approximately 836 species of migratory bird species from any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof, unless permitted by regulations (i.e. for hunting and subsistence activities). Additional protection is allotted under the Bald and Golden Eagle Protection Act for the identified species. Compliance with the MBTA does not require a permit or authorization; however, the USFWS often requests that other agencies incorporate MBTA mitigation measures as stipulations in their permits. In addition, a recently signed Memorandum of Understanding (MOU) between NMFS and USFWS focuses on the means and intent to avoid and minimize, to the extent practicable, adverse impacts on migratory birds through enhanced interagency collaboration. In compliance with the MOU, the NEFSC has identified and evaluated the impacts of the proposed actions on migratory birds, which are considered minor. NMFS provided a copy of the Draft PEA to the USFWS and received no comments from them concerning compliance with the MBTA.

6.6 FISH AND WILDLIFE COORDINATION ACT

The Fish and Wildlife Coordination Act (FWCA) requires USFWS and NMFS to consult with other State and federal agencies in a broad range of situations to help conserve fish and wildlife populations and habitats in cases where federal actions affect natural water bodies(16 USC § 661 1934). Specific provisions involve conservation or expansion of migratory bird habitats related to water body impoundments or other modifications. FWCA requires consultation among agencies and the incorporation of recommended conservation measures if feasible, but does not involve a separate permit or authorization process. NMFS provided a copy of the Draft PEA to the state fish and wildlife agencies in every state affected by the NEFSC fisheries research activities considered in this document and received no comments concerning compliance with the FWCA.

6.7 NATIONAL MARINE SANCTUARIES ACT

The Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) (16 U.S.C. 1431) prohibits all ocean dumping, except that allowed by permits, in any ocean waters under U.S. jurisdiction, by any U.S. vessel, or by any vessel sailing from a U.S. port. MPRSA authorizes the Secretary of Commerce (through NOAA) to coordinate a research and monitoring program with the EPA and the U.S. Coast Guard (USCG). The MPRSA established nine regional marine research boards for the purpose of developing comprehensive marine research plans, considering water quality and ecosystem conditions and research and monitoring priorities and objectives in each region. It also launched a national coastal water quality monitoring program that directs the EPA and NOAA together to implement a long-term program to collect and analyze scientific data on the environmental quality of coastal ecosystems, including ambient water quality, health and quality of living resources, sources of environmental degradation, and data on trends. Results of these actions are used to provide the information required to devise and execute effective programs under the Clean Water Act and Coastal Zone Management Act (CZMA).

The National Marine Sanctuaries Act (also known as Title III of the MPRSA) authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries. The primary objective is to protect marine resources, such as coral reefs, sunken historical vessels or unique habitats.

Section 304(d) requires interagency consultation between the NOAA Office of National Marine Sanctuaries and federal agencies taking actions that are "likely to destroy, cause the loss of, or injure a sanctuary resource." In compliance with the MPRSA, the NEFSC has identified and evaluated the impacts of the proposed actions on National Marine Sanctuaries, which are considered minor.

On August 4, 2015, NEFSC initiated the sanctuary consultation process pursuant to section 304(d) of the National Marine Sanctuaries Act by contacting the four (4) sanctuary offices affected by our activity: NOAA Office of Marine Sanctuaries (ONMS), Gray's Reef National Marine Sanctuary, GA; Monitor National Marine Sanctuary, VA; and Stellwagen National Marine Sanctuary, MA. On September 23, 2015, ONMS responded with comments and recommendations resulting from its review of the NEFSC DPEA before agreeing to concurrence. ONMS recommended: (1) A permit will be required for those activities that are prohibited in Stellwagen Bank National Marine Sanctuary. These include described survey activities that will result in disturbance of the seafloor within the sanctuary; (2) Consultation will be required for those activities that are not prohibited, but may result in injury to sanctuary resources. These include described survey activities that will result in acoustic harassment of marine mammals and biomass removal of fish and marine invertebrates; (3) Implement the protocols for avoiding historical resources presented in the DPEA (page 4-11). The goal of permitting would be to ensure the implementation of this practice within the terms of issued permits; (4) At this time, we cannot concur with the statement in the DPEA that "The Status Quo therefore already includes the potential prohibition or restriction of NEFSC research activities in MPAs" (page 4-96). The ONMS concluded that permitting can commence with application and that consultation would begin when ONMS makes a finding of sufficient information in the form of a sanctuary resource statement to meet the needs of the consultation. On November 16, 2015, the NEFSC responded to the ONMS requests for additional information and submitted the requested application and documents: (1) NMS Permit application from the Northeast Fisheries Science Center, (2) Collection Data Form (as directed by the permit application), and (3) Historical bottom trawl data (2008-2014) for Stellwagen Bank NMS. On April 1, 2016, ONMS issued a permit to NEFSC (SBNMS-2015-003) to conduct fisheries research activities within Stellwagen Bank National Marine Sanctuary. The permit described the terms and conditions for the NEFSC to conduct that research.

6.8 NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the National Historic Preservation Act NHPA requires review of any project funded, licensed, permitted, or assisted by the federal government for impact on significant historic properties. The agencies must allow the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation, a federal agency, to comment on a project. On August 4, 2015, NEFSC initiated consultation with the nine (9) affected states' Historic Preservation Offices under Section 106 of the National Historic Preservation Act (ME, MD, NH, MA RI, CT, NY, VA, and NC). NEFSC received seven responses to its letter following a thirty-day review period. Two states, MA and VA, requested the NEFSC to contact their offices in advance of research within their jurisdiction. The NEFSC has revised standard cruise instructions for those research activities that occur in state waters to direct the Principal Investigator on what types of information to provide and who to contact before they conduct their research in those areas. The cruise instructions also describe what to do and who to contact if any historically significant items are incidentally affected during research.

6.9 EXECUTIVE ORDER 12989, ENVIRONMENTAL JUSTICE

Executive Order (EO) 12898 directs federal agencies to take the appropriate and necessary steps to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law. No such effects are identified in this Final PEA.

6.10 EXECUTIVE ORDER 13158, MARINE PROTECTED AREAS

The purpose of this order is to strengthen and expand the Nation's system of marine protected areas (MPAs) to enhance the conservation of our Nation's natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for future generations. The

order encourages federal agencies to use science-based criteria and protocols to identify and prioritize natural and cultural resources in the marine environment that should be protected to secure valuable ecological services and to monitor and evaluate the effectiveness of MPAs. Each federal agency whose actions affect the natural or cultural resources that are protected by an MPA shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA.

6.11 COASTAL ZONE MANAGEMENT ACT

The principal objective of the Coastal Zone Management Act (CZMA) is to encourage and assist states in developing coastal management programs, to coordinate State activities, and to safeguard regional and national interest in the coastal zone. Section 307(c) of the CZMA requires federal activity affecting the land or water uses or natural resources of a state's coastal zone to be consistent with that state's approved coastal management program, to the maximum extent practicable. NMFS will provide a copy of this Final PEA and a consistency determination to the state coastal management agency in every state with a federally-approved coastal management program whose coastal uses or resources are affected by these fisheries research activities. Each state has sixty days in which to agree or disagree with the determination regarding consistency with that state's approved coastal management program. If a state fails to respond within sixty days, the state's agreement may be presumed.

This page intentionally left blank.

Abend, A. and T. D. Smith. 1999. Review of the distribution of the long-finned pilot whale, *Globicephala melas*, in the North Atlantic and Mediterranean. NOAA Tech. Memo. NMFS-NE-117.

Aguillar, A. 2009. Fin whale *Balaenoptera physalus*. 433-437 pp., in W.F. Perrin, B. Würsig, and H.G.M. Thewissen (eds.), Encyclopedia of Marine Mammals, Academic Press, San Diego, CA. 1316 pp.

Allen, S. J., J. A. Tyne, H. T. Kobryn, L. Bejder, K. H. Pollock, N. R. Loneragan 2014. Patterns of dolphin bycatch in a North-Western Australian trawl fishery. PLoS ONE 9(4): e93178.doi:10.1371/journal.pone.0093178

Alsop, III, F. J. 2001. Smithsonian Handbooks: Birds of North America eastern region. DK Publishing, Inc. New York, NY.

Aquarone, M. C. 2008. Southeast U.S. Continental Shelf – LME #6. Available at: www.lme.noaa.gov/Portal

Asch, R.G. and J.S. Collie. 2008. Changes in a benthic megafaunal community due to disturbance from bottom fishing and the establishment of a fishery closure. Fish. Bull. 106:438-456.

Atlantic States Marine Fisheries Commission (ASMFC). 2009. Stock Assessment Report No. 09-01 (Supplement) of the Atlantic States Marine Fisheries Commission American Lobster Stock Assessment Report for Peer Review. Available from: http://www.asmfc.org

Atlantic Trawl Gear Take Reduction Team (ATGTRT). 2008. Draft Atlantic trawl gear take reduction strategy--Final. 51pp. Available at: http://www.nero.noaa.gov/prot_res/atgtrp/meeting/ATGTRT%20Draft%20Take%20Reduction%20Strategy%20FINAL.pdf

Au, W. W. L. and M. C. Hastings. 2008. Au, W.W.L. and M.C. Hastings. 2008. Principles of Marine Bioacoustics. New York: Springer.

Auster, P. J. and R. W. Langton. 1999. The effects of fishing on fish habitat. In L. Benaka (ed.). Fish Habitat: Essential Fish Habitat and Rehabilitation. Am. Fish. Soc. Symp. 22:150-187.

Baird, R. W. 2001. Status of harbor seals, *Phoca vitulina*, in Canada. Can. Field-Nat. 115: 663-675.

Baraff, L. S. and T. R. Loughlin. 2000. Trends and potential interactions between pinnipeds and fisheries of New England and the U.S. west coast. Mar. Fish. Rev. 64(2): 1-39.

Barco, S. G., W. A. McLellan, J. M. Allen, R. A. Asmutis-Silvia, R. Mallon-Day, E. M. Meagher, D. A. Pabst, J. Robbins, R. E. Seton, W. M. Swingle, M. T. Weinrich and P. J. Clapham. 2002. Population identity of humpback whales, *Megaptera novaeangliae*, in the waters of the U.S. mid-Atlantic states. J. Cetacean Res. Manage. 4(2): 135-141.

Barlas, M. E. 1999. The distribution and abundance of harbor seals, *Phoca vitulina concolor*, and gray seals, *Halichoerus grypus*, in southern New England, winter 1998 - summer 1999. MA Thesis, Boston University, Graduate School of Arts and Sciences, Boston, MA.

Barlow, J. and R. Gisiner. 2006. Mitigating, monitoring and assessing the effects of anthropogenic sound on beaked whales. J. Cetacean Res. Manage. 7 (3): 239-250.

Barnette, M. 2001. A review of fishing gear utilized within the Southeast Region and their potential impacts on essential fish habitat. NOAA Technical Memorandum NMFS-SEFSC-449. Pp. 62.

Best, P. B., A. Brandão, and D.S. Butterworth. 2001. Demographic parameters of southern right whales off South Africa. J. of Cetacean Res. and Manage. (Special Issue) 2: 161-169

Boulva, J. and I. A. McLaren. 1979. Biology of the harbor seal, *Phoca vitulina*, in eastern Canada. Bull. Fish. Res. Bd. Can. 200: 1-24.

Bureau of Ocean Energy Management (BOEM). 2014. Atlantic OCS Proposed Geological and Geophysical activities Mid-Atlantic and South Atlantic Planning Areas Final Programmatic Environmental Impact Statement. Vol 1. OCS EIS/EA BOEM 2014-001. Bureau of Ocean Energy Mangament, Gulf of Mexico OCS Region. 788 pp.

Buscaino, G., A. Bellante, G. Buffa, F. Filiciotto, V. Maccarrone, G. Tranchida, and S. Mazzola. 2011. Depredation of striped dolphin on squid fishery and behavioural responses to interactive pinger. J. Acoust. Soc. Am. 129: 2399 http://dx.doi.org/10.1121/1.3587805

Calambokidis, J. and T. Chandler. 2000. Marine mammal observations and mitigation associated with USGS seismic surveys in the Southern California Bight in 2000. Final report. Cascadia Research, Olympia, WA. 13 pp.

Carretta, J. V. and J. Barlow. 2011. Long-term effectiveness, failure rates, and "dinner bell" properties of acoustic pingers in a gillnet fishery. Marine Technology Society Journal 45(5): 7-19.

Caswell, H., S. Brault and M. Fujiwara. 1999. Declining survival probability threatens the North Atlantic right whale. Proc. Natl. Acad. Science 96: 3308-3313.

Cetacean and Turtle Assessment Program (CETAP). 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC.

Clapham, P. J., L. S. Baraff, C. A. Carlson, M. A. Christian, D. K. Mattila, C. A. Mayo, M. A. Murphy and S. Pittman. 1993. Seasonal occurrence and annual return of humpback whales, *Megaptera novaeangliae*, in the southern Gulf of Maine. Can. J. Zool. 71: 440-443.

Clapham, P. J., S. B. Young and R. L. Brownell, Jr. 1999. Baleen whales: conservation issues and the status of the most endangered populations. Mamm. Rev. 29: 35-60.

Clapham, P. J. (ed.). 2002. Report of the working group on survival estimation for North Atlantic right whales. Northeast Fish. Sci. Cent.

Clapham, P. J., J. Barlow, T. Cole, D. Mattila, R. Pace, D. Palka, J. Robbins, and R. Seton. 2003. Stock definition, abundance and demographic parameters of humpback whales from the Gulf of Maine. J. Cetacean Res. Manage. 5: 13-22.

Clapham, P. J. 2009. Humpback whale Megaptera novaeangliae. 582-585 pp., in W.F. Perrin, B. Würsig, and H.G.M. Thewissen (eds.), Encyclopedia of Marine Mammals, Academic Press, San Diego, CA. 1316 pp.

Clark, C. W., W. T. Ellison, B. L. Southall, L. Hatch, S. M. Van Parijs, A. Frankel, and M. Ponirakis. 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implications: Marine Ecology Progress Series, v. 395, 301-322 pp.

Colburn, L., P. Clay, J. Olson, P. daSilva, S. Smith, A. Westwood, and J. Ekstrom. 2010. Community Profiles for Northeast U.S. Marine Fisheries, Northeast Fisheries Science Center Social Sciences Branch. Available at: http://www.nefsc.noaa.gov/read/socialsci/communityProfiles.html. Accessed December 5, 2012.

Cole, T. V. N., P. Hamilton, A. G. Henry, P. Duley, R. M. Pace III, B. N. White, and T. Frasier. 2013. Evidence of a North Atlantic right whale *Eubalaena glacialis* mating ground. Endangered Species Research 21: 55-64.

Cole, T. V. N. and A. G. Henry. 2013. Serious injury determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast and Atlantic Canadian Provinces, 2007-2011. US Dept Commer, NEFSC Ref Doc. 13-24; 14 p. Available at: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543- 1026, or online at http://nefsc.noaa.gov/publications/

Collie, J. S., G. A. Escanero, and P. C. Valentine. 2000. Photographic evaluation of the impacts of bottom fishing on benthic epifauna. ICES Journal of Marine Science, 57: 987–1001.

Collie, J.S., J.M. Hermsen, P.C. Valentine, and F.P. Almeida. 2005. Effects of fishing on gravel habitats: assessment and recovery of benthic megafauna on Georges Bank. Amer. Fish. Soc. Symp. 41:325-343.

Collie, J.S., J.M. Hermsen, and P.C. Valentine. 2009. Recolonization of gravel habitats on Georges Bank (northwest Atlantic). Deep-Sea Res. II, Vol. 56(19-20):1847-1855.

Commercial Fisheries Research Foundation (CFRF) 2011. Funding announcement for 2011 awards. Available at: http://www.cfrfoundation.org/research-programs/snecri

Conant, T. A., P. H. Dutton, T. Eguchi, S. P. Epperly, C. C. Fahy, M. H. Godfrey, S. L. MacPherson, E. E. Possardt, B. A. Schroeder, J. A. Seminoff, M. L. Snover, C. M. Upite and B. E. Witherington. 2009. Loggerhead sea turtle, *Caretta caretta* 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Bio. Rev. Team to the NMFS. 222 pp.

Cook, S. L, and T. G. Forrest. 2005. Sounds produced by nesting leatherback sea turtles (Dermochelys coriacea). Herpetological Review, 36(4): 387–390.

Coral Reef Information System (CORIS). 2010. Deep Water Coral. NOAA. Available at: http://coris.noaa.gov/about/deep/

Curry, B. E. and J. Smith. 1997. Phylogeographic structure of the bottlenose dolphin, *Tursiops truncatus*: stock identification and implications for management. Molecular Genetics of Marine Mammals. Spec. Publ. 3. A. E. Dizon, S. J. Chivers and W. F. Perrin, Society for Marine Mammalogy**:** 327-247.

Cury, P. M., I. L. Boyd, S. Bonhommeau, T. Anker-Nilssen, R. J. M. Crawford, R. W. Furness, J. A. Mills, E. J. Murphy, H. Österblom, M. Paleczny, J. F. Piatt, J-P Roux, L. Shannon, and W. J. Sydeman. 2011. Global seabird response to forage fish depletion – one-third for the birds. *Science* vol. 334 (6063): 1703-1706.

Cuyler, L. C., R. Wiulsrød, and N. A. Øritsland. 1992. Thermal IR Radiation from Free Living Whales, Marine Mammal Science, 8(2): 120–134.

Davies, J. L. 1957. The geography of the gray seal. J. Mamm. 38: 297-310.

DeHart, P. A. P. 2002. The distribution and abundance of harbor seals, *Phoca vitulina concolor*, in the Woods Hole region. Graduate School of Arts and Sciences. Boston, MA, Boston University.

Department of Energy (DOE). 2008. Potential environmental effects of marine and hydrokinetic energy technologies. Draft report to congress, prepared in response to Energy Independence and Security Act of 2007, Section 633)b). Available at: http://www.ornl.gov/sci/eere/EISAReport/report.html

Department of the Interior (DOI), U.S. Minerals Management Service (MMS). 2009. Cape Wind Energy Project, Final EIS. MMS EIS-EA, OCS Publication No. 2008-040. Available at: http://www.boem.gov/uploadedFiles/BOEM/Renewable_Energy_Program/Studies/Cape%20Wind%20Energy%20Project%20FEIS.pdf

Department of the Navy (DON). 2005. Marine resources assessment for the Northeast Operating Area: Atlantic City, Narragansett Bay, and Boston. Naval Facilities Engineering Command, Atlantic; Norfolk, VA. Contract No. N62470-02-D-9997. Task Order No. 0018.

DON. 2008a. Final Atlantic fleet active sonar training Environmental Impact Statement/Overseas Environmental Impact Statement. Naval Facilities Engineering Command, Atlantic, Norfolk, VA. Available at: http://www.nmfs.noaa.gov/pr/pdfs/permits/afast_eis.pdf

DON. 2008b. Request for Letter of Authorization for the incidental harassment of marine mammals resulting from Navy training activities conducted within the northwest training range complex. September 2008. 323 pp.

DON. 2013. Atlantic Fleet Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement. Department of the Navy, NAVFAC Atlantic, Norfolk, VA. Available at: http://aftteis.com/

Doeringer, P. B., P. I. Moss and D. G. Terkla. 1986. Captialism and Kinship: Do Institutions Matter in the Labor Market? Industrial and Labor Relations Review 40(1):48-60.

Donaldson, A., C. Gabriel, B. J. Harvey, and J. Carolsfeld. 2010. Impacts of fishing gears and other than bottom trawls, dredges, gillnets, and longlines on aquatic biodiversity and vulnerable marine ecosystems. Dep. of Fish. and Ocean Canada Res. Doc. 2010:011. 90 pp.

Dotson, R. C., D. A. Griffith, D. L. King, and R. L. Emmett. 2010. Evaluation of a marine mammal excluder device (MMED) for a Nordic 264 midwater rope trawl. U.S. Department of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-455. 19 pp. http://docs.lib.noaa.gov/noaa_documents/NMFS/SWFSC/TM_NMFS_SWFSC/NOAA-TM-NMFS-SWFSC-455.pdf

Dow Piniak, W. E., S. A. Eckert, C. A. Harms, and E. M. Stringer. 2012. Underwater hearing sensitivity of the leatherback sea turtle (*Dermochelys coriacea*): Assessing the potential effect of anthropogenic noise. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM 2012-01156. 35pp.

Duffield, D. A., S. H. Ridgway, and L. H. Cornell. 1983. Hematology distinguishes coastal and offshore forms of dolphins, Tursiops. Can. J. Zool. 61:930-933.

Duffield, D. A. 1986. Investigation of genetic variability in stocks of the bottlenose dolphin, *Tursiops truncatus*. Final report to the NMFS/SEFSC. Contract No. NA83-GA-00036.

Eckert, S.A., and J. Lien. 1999. Recommendations for eliminating incidental capture and mortality of leatherback sea turtles, *Dermochelys coriacea*, by commercial fisheries in Trinidad and Tobago. A report to the Wider Caribbean Sea Turtle Conservation Network (WIDECAST). Hubbs-Sea World Research Institute Technical Report No. 2000-310.

Edds-Walton, P. L. 1997. Acoustic communication signals of mysticete whales. Bioacoustics 8:47–60.

Ehrhart, L. M. 1979. A survey of marine turtle nesting at Kennedy Space Center, Cape Canaveral Air Force Station, North Brevard County, Florida. Unpublished report to the Florida Department of Natural Resources, Division of Marine Fisheries, St. Petersburg, FL.

Eno, N. C., D. S. Macdonald, J. A. M. Kinnear, S. C. Amos, C. J. Chapman, R. A. Clark, F. Bunker, and C. Munro. 2001. Effects of crustacean traps on benthic fauna. Journal of Marine Science. 58: 11-20.

Epperly, S. P., J. Braun, and A. J. Chester. 1995. Aerial surveys for sea turtles in North Carolina waters. Fish. Bull. 93:254-261.

Epperly, S., L. Avens, L. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J.Poffenberger, C. Sasso, E. Scott-Denton, and C. Yeung. 2002. Analysis of sea turtle bycatch in the commercial shrimp fisheries of southeast U.S. waters and the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-490: 1-88.

Ernst, C., and R. Barbour. 1972. Turtles of the United States. University Press of Kentucky. Lexington, KY.

Federal Register. 1994. Designated Critical Habitat; Northern Right Whale. Final Rule (59 FR 28805) [1994 June 3].

Fogarty, M., L. Incze, R. Wahle, D. Mountain, A. Robinson, A. Pershing, K. Hayhoe, A. Richards, J. Manning. 2007. Potential climate change impacts on marine resources of the Northeastern United States. Report of the Northeast Climate Impacts Assessment Division, Union of Concerned Scientists. Available at: http://www.ucsusa.org

Freiwald, A., J. H. Fossa, A. Grehan, T. Koslow, and M. Roberts. 2004. Cold-water coral reefs, out of sight – no longer out of mind. UNEP World Conservation Monitoring Centre. 86 pp. Dotson, R. C., D. A. Griffith, D. L. King, and R. L. Emmett. 2010. Evaluation of a marine mammal excluder device (MMED) for a Nordic 264 midwater rope trawl. U.S. Department of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-455. 19 pp. http://docs.lib.noaa.gov/noaa_documents/NMFS/SWFSC/TM_NMFS_SWFSC/NOAA-TM-NMFS-SWFSC-455.pdf

Fujioka, E., C. Y. Kot, B. P. Wallace, B. D. Best, J. Moxley, J. Cleary, B. Donnelly, and P. N. Halpin. 2014. Data integration for conservation: leveraging multiple data types to advance ecological assessments and habitat modeling for megavertebrates using OBIS-SEAMAP. Ecological Informatics, 20: 13-26.

Gannon, D. P., J. E. Craddock, and A. J. Read. 1998. Autumn food habits of harbor porpoises, *Phocoena phocoena*, in the Gulf of Maine. Fish. Bull. 96:428-437.

Garrison, L. P. and L. Stokes. 2012. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic Pelagic Longline Fleet during 2011. NOAA Technical Memorandum NOAA NMFS-SEFSC-632. 61pp.

Gaskin, D. E. 1977. Harbour porpoise, *Phocoena phocoena* (L.), in the western approaches to the Bay of Fundy 1969-75. Rep. Int. Whal. Commn. 27: 487-492.

Gaskin, D. E. 1984. The harbor porpoise, *Phocoena phocoena* (L.): Regional populations, status, and information on direct and indirect catches. Rep. int Whal. Commn 34:569-586.

Gaskin, D. E. and A.P. Watson. 1985. The harbor porpoise, *Phocoena phocoena*, in Fish Harbor, New Brunswick, Canada: occupancy, distribution, and movements. Fish. Bull. 83(3): 427-42.

Gearhart, J. L. 2010. Evaluation of a turtle excluder device (TED) designed for use in the U.S. mid-Atlantic Atlantic croaker fishery. NOAA Technical Memorandum NMFS-SEFSC-606, 30 pp.

Gilbert, J. R. and N. Guldager. 1998. Status of harbor and gray seal populations in northern New England. Final Report under NMFS/NER Cooperative Agreement 14-16-009-1557, to NMFS. Woods Hole, MA, Northeast Fisheries Science Center.

Gilkinson, K., E.L. King, M.Z. Li, D. Roddick, E. Kenchington, and G. Han. 2015. Processes of physical change over a 10-year period following experimental hydraulic clam dredging on Banquereau, Scotian shelf. Cont. Shelf Res. 92:72-86.

Gillman, E., N. Brothers, G. McPherson, and P. Dalzel. 2006. A review of cetacean interactions with longline gear. Journal of Cetacean Research and Management, 8 (2): 215-223.

Graber, J., J. Thomson, B. Polagye, and A. Jessup. 2011. Land-based infrared imagery for marine mammal detection. Proceedings of SPIE Vol. 8156. In W. Gao, T. J. Jackson, J. Wang, N.-B. Chang (eds.). Remote Sensing and Modeling of Ecosystems for Sustainability VIII. 81560B.

Greater Atlantic Regional Fisheries Office (GARFO). 2015. Summary of essential fish habitat (EFH) and general habitat parameters for federally managed species. Available online at http://www.greateratlantic.fisheries.noaa.gov/hcd/efhtables.pdf.

Hain, J. H. W., Edel R. K., Hays H. E., Katona S. K. and Roanowicz J. D. 1981. General distribution of cetaceans in the continental shelf waters of the northeastern United States. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf, BLM AA551-CT8-48.

Hain, J. H. W., M. A. Hyman, R. D. Kenney and H. E. Winn 1985. The role of cetaceans in the shelf-edge region of the northeastern United States. Mar. Fish. Rev. 47(1): 13-17

Hain, J. H. W., M. J. Ratnaswamy, R. D. Kenney, and H. E. Winn 1992. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. Rep. Int. Whal. Commn. 42: 653-669.

Hamazaki T. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, North Carolina, U.S.A. to Nova Scotia, Canada). Mar. Mamm. Sci. 18:920–939.

Hamer, D. J., S. J. Childerhouse, and N. J. Gales. 2010. Mitigating operational interactions between odontocetes and the longline fishing industry: a preliminary global review of the problem and of potential solutions. IWS SC Paper # SC/62/BC6.

Harley, C. D. G., A. R. Hughes, K. M. Hultgren, B. G. Miner, C. J. B. Sorte, C. S. Thornber, L. F. Rodriguez, L. Tomanek, S. L. Williams. 2006. The impacts of climate change in coastal marine ecosystems. Ecology Letters 9:228-241.

Hatch, L., C. Clark, R. Merrick, S. V. Parijs, D. Ponirakis, K. Schwehr, M. Thompson and D. Wiley. 2008. Characterizing the relative contributions of large vessels to total ocean noise fields: A case study using the Gerry E. Studds Stellwagen Bank National Marine Sanctuary. Environmental Management 42: 735-752.

Hatch, L. T., C. W. Clark, S. M. VanParijs, A. S. Frankek, and D. W. Ponirakis. 2012. Quantifying loss of acoustic communication space for right whales in and around a U.S. National Marine Sanctuary. Conservation Biology 26: 983-994.

Heifetz, J., R.P. Stone, and S.K. Shotwell, 2009. Damage and disturbance to coral and sponge habitat of the Aleutian archipelago. Mar. Ecol. Progr. Ser. 397:295-303.

Henry, A. G., T. V. N. Cole, M. Garron, L. Hall, W. Ledwell and A. Reid. 2012. Mortality and serious injury determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast and Atlantic Canadian Provinces, 2006–2010, NEFSC Reference Document 12-11. 24 pp.

Henwood, T. A., and W. Stuntz. 1987. Analysis of sea turtle captures and mortalities during commercial shrimp trawling. Fishery Bulletin 85(4):813-817.

Hersh, S. L. and Duffield D. A. 1990. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. San Diego, CA., Academic Press. 129-139 pp.

Hiddink, J. G., S. Jennings, M. J. Kaiser, A. M. Queiros, D. E.Duplisea, and G. J. Piet. 2006. Cumulative impacts of seabed trawl disturbance on benthic biomass, production, and species richness in different habitats. Canadian Journal of Fisheries and Aquatic Sciences 63: 721-736.

Hildebrand, J. A., G. L. D'Spain, M. A. Roch, and M. B. Porter. 2009. Glider-based passive acoustic monitoring techniques in the Southern California Region. Office of Naval Research Award Number: N000140811124.

Hirth, H. F. 1997. Synopsis of the biological data of the green turtle, *Chelonia mydas* (Linnaeus 1758). USFWS Biological Report 97(1).

Holland, S. M. and R. B. Ditton. 1992. Fishing Trip Satisfaction: A Typology of Anglers. *North American Journal of Fisheries Management* 12(1):28-33.

Horwood, J. 2009. Sei whale Balaenoptera borealis. 1001-1003 pp., in W.F. Perrin, B. Würsig, and H.G.M. Thewissen (eds.), Encyclopedia of Marine Mammals, Academic Press, San Diego, CA. 1316 pp.

Huang, Hsiang-Wen. 2011. Bycatch of high sea longline fisheries and measures taken by Taiwan: Action and challenges. Marine Policy 35: 712-720.

Hunter, W. C., W. Golder, S. Melvin, and J. Wheeler. 2006. Southeast United States Regional Waterbird Conservation Plan. Available at:: http://www.pwrc.usgs.gov/nacwcp/pdfs/regional/seusplanfinal906.pdf

International Maritime Organization (IMO). 2010. International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL), cited 2010 October 6. Available at: http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx

International Whaling Commission (IWC). 2002. Report of the Scientific Committee. International Whaling Commission. Annex H: Report of the Sub-committee on the Comprehensive Assessment of North Atlantic humpback whales. J. Cetacean Res. Manage. (4): 230-260.

Jacobs, S. R. and J. M. Terhune. 2000. Harbor seal, *Phoca vitulina*, numbers along the New Brunswick coast of the Bay of Fundy in autumn in relation to aquaculture. Northeast Nat. 7(3): 289-296.

Jefferson, T. and B. Curry. 1996. Acoustic methods of reducing or eliminating marine mammal-fishery interactions: do they work? Ocean Coast Manage. 31(1):41-70.

Jennings, S., J. K. Pinnegar, N. V. Polunin, and K. J. Warr. 2001. Impacts of trawling disturbance on the trophic structure of benthic invertebrate communities. Marine Ecology Progress Series 213: 127-142.

Jensen, A. S. and G. K. Silber. 2003. Large Whale Ship Strike Database. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-OPR-25, 37 pp.

Johnson, A., G. Salvador, J. Kennedy, J. Robbins, S. Kraus, S. Landry, and P. Clapham. 2005. Fishing gear involved in entanglements of right and humpback whales. Marine Mammal Science 21(4): 635-645.

Kastak D. R., B. J. Southall, R. D. Schusterman, and C. R. Kastak. 2005. Underwater temporary threshold shifts in pinnipeds: effects of noise level and duration. Journal of the Acoustical Society of America 118:3154-3163.

Kastelein, R. A., R. Gransier, L. Hoek, and M. Rambags. 2013. Hearing frequency thresholds of a harbor porpoise (*Phocoena phocoena*) temporarily affected by a continuous 1.5 kHz tone. J. Acoust. Soc. Am. 134(3): 2286-2292.

Kastelein, R. A., P. Wensveen, L. Hoek, and J. M. Terhune. 2009. Underwater hearing sensitivity of harbor seals (*Phoca vitulina*) for narroe noise bands between 0.2 and 80 kHz. J. Acoust. Soc. Am. 126 (1): 476-483.

Kasting, N. W., S. A. Adderley, T. Safford, and K. G. Hewlett. 1989. Thermoregulation in beluga (*Delphinapterus leucas*) and killer (*Orcinus orca*) whales. Physiological Zoology, 62(3): 687-701.

Katona, S. K. and Beard J. A. 1990. Population size, migrations, and feeding aggregations of the humpback whale, *Megaptera novaeangliae*, in the western North Atlantic Ocean. Rep. Int. Whal. Commn. 12 (Special Issue): 295-306.

Katona, S. K., V. Rough, and D. T. Richardson. 1993. A Field Guide to Whales, Porpoises, and Seals from Cape Cod to Newfoundland. Washington, DC, Smithsonian Institution Press.

Keinath, J. A., J. A. Musick, and R. A. Byles. 1987. Aspects of the biology of Virginia's sea turtles: 1979-1986. Virginia J. Sci. 38(4): 329-336.

Kenney, M. K. 1994. Harbor seal population trends and habitat use in Maine. Orono, ME, University of Maine. M.S. Thesis.

Kenney, R. D. 1990. Bottlenose dolphins off the northeastern United States. In S. Leatherwood, and R.R. Reeves (eds.). The Bottlenose Dolphin. San Diego, CA, Academic Press, 369-386.

Kenney, R. D., H. E. Winn and M. C. Macaulay 1995. Cetaceans in the Great South Channel, 1979-1989: right whale, *Eubalaena glacialis*. Cont. Shelf Res. 15: 385-414

Kenney, R. D., P. M. Payne, D. W. Heinemann, and H. E. Winn. 1996. Shifts in Northeast Shelf cetacean distributions relative to trends in Gulf of Maine/Georges Bank finfish abundance. In K. Sherman, N. A. Jaworski, and T. J. Smayda (eds.), The Northeast Shelf Ecosystem: Assessment, Sustainability, and Management, Blackwell Science, Inc., Cambridge, MA. 169–196 pp.

Kenney, R. D., G. P. Scott, T. J. Thompson, and H. E. Winn. 1997. Estimate of prey consumption and trophic impacts of cetaceans in the USA Northeast U.S. Continental shelf ecosystem. J. Northw. Atl. Fish. Sci. 22: 155-171.

Kenney, R. D. 2001. Anomalous 1992 spring and summer right whale, *Eubalaena glacialis*, distributions in the Gulf of Maine. *J. Cet. Res. Manage.* (Special issue) 2: 209-223.

Kenney, R. D., C.A. Mayo, and H. E. Winn. 2001. Migration and foraging strategies at varying spatial scales in western North Atlantic right whales: a review of hypotheses. *J. Cetacean Res. Manage.* (Special issue) 2: 251-260.

Kenney, R. D. 2009. Right whales Eubalaena glacialis, E. japonica, and E. australis. 962-972 pp., in W.F. Perrin, B. Würsig, and H.G.M. Thewissen (eds.), Encyclopedia of Marine Mammals, Academic Press, San Diego, CA. 1316 pp.

Kenney, R. P. and H. E. Winn. 1986. Marine mammal data transfer and documentation. NMFS. 40EANF501629, NMFS, 83 pp.

Ketten, D. R. 1998. Marine mammal auditory systems: a summary of audiometric and anatomical data and its implications for underwater acoustic impacts. NOAA-TM-NMFS-SWFSC-256. 74 pp.

Ketten, D. R. and S. M. Bartol. 2006. Functional measures of sea turtle hearing. Final report for Office of Naval Research, ONR award Nooo14-02-1-0510. 4 pp.

Knowlton, A. R., S. D. Kraus and R. D. Kenney 1994. Reproduction in North Atlantic right whales, *Eubalaena glacialis*. Can. J. Zool. 72: 1297-1305.

Knowlton, A. R. and S. D. Kraus. 2001. Mortality and serious injury of northern right whales, *Eubalaena glacialis*, in the western North Atlantic Ocean. J. Cetacean Res. Manage. (Special Issue) 2:193-208.

Kobayashi, D. R. and J. J. Polovina. 2005. Evaluation of time-area closures to reduce incidental sea turtle take in the Hawaii-based longline fishery: Generalized Additive Model (GAM) development and retrospective examination. U.S. Department of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-4. 46 pp. Available at: http://www.pifsc.noaa.gov/tech/NOAA_Tech_Memo_PIFSC_4.pdf

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. Woods Hole, MA. NMFS.

Kraus, S. D., M. W. Brown, H. Caswell, C. W. Clark, M. Fujiwara, P. K. Hamilton, R. D. Kenney, A. R. Knowlton, S. Landry, C. A. Mayo, W. A. McLellan, M. J. Moore, D. P. Nowacek, D.A.Pabst, A. J. Read and R. M. Rolland. 2005. North Atlantic right whales in crisis. Science 309(5734): 561-562.

Kraus, S. D. and R. M. Rolland (eds.). 2007. The Urban Whale: North Atlantic Right Whales at the Crossroads. Cambridge, MA, Harvard University Press.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science. 17: 35-75.

Leatherwood, S., D. K. Caldwell, and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. NOAA Tech. Rep. NMFS Circ. 396.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. San Francisco: Sierra Club Books.

Lesage, V. and M. O. Hammill. 2001. The status of the grey seal, *Halichoerus grypus*, in the Northwest Atlantic. Can. Field-Nat. 115(4): 653-662.

Lovell, S. J., S. Steinback, and J. Hilger. 2013. The Economic Contribution of Marine Angler Expenditures in the United States, 2011. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-F/SPO-134, 188 p. Available at: http://spo.nmfs.noaa.gov/tm/TM134.pdf

Lumsden S.E., T.F. Hourigan, A.W. Bruckner, and G. Dorr (eds.). 2007. The State of Deep Coral Ecosystems of the United States. NOAA Technical Memorandum CRCP-3. Silver Spring MD. http://www.coris.noaa.gov/activities/deepcoral_rpt/

Lurton, X. and S. DeRuiter. 2011. Sound radiation of sea-floor mapping echosounders in the water column, in relation to the risks posed to marine mammals. International Hydrographic Review (November 2011): 7-17.

Lutcavage, M. and J. A. Musick. 1985. Aspects of the biology of sea turtles in Virginia. Copeia 1985:449-456.

Lyle, J. M. and S. T. Willcox. 2008. Dolphin and seal interactions with mid-water trawling in the Small Pelagic Fishery, including an assessment of bycatch mitigation strategies. Australian Fisheries Management Authority, Final Report Project R05/0996. 49pp. http://www.imas.utas.edu.au/__data/assets/pdf_file/0005/149648/R05_0996_Final-Rep.pdf

Macdonald, D. S., M. Little, N. C. Eno, and K. Hisckock. 1996. Disturbance of benthic species by fishing activities: a sensitivity index. Aquatic Conservation: Marine and Freshwater Ecosystems. 6: 257-268.

Mackay, A. and S. Northridge. 2006. Dolphin bycatch in the UK bass pair trawl fishery. Presentation to the ATGTRT meeting, Providence, RI, September 20, 2006.

Mansfield, A. W. 1966. The grey seal in eastern Canadian waters. Can. Audubon Mag. 28: 161-166.

Mansfield, A. W. 1967. Distribution of the harbor seal, Phoca vitulina Linnaeus, in Canadian Arctic waters. J. Mamm. 48(2): 249-257.

Mayo, R, F. Serchuk, and E. Holmes (eds.). 2006. Status of Fishery Resources off the Northeastern United States. NOAA/NMFS/NEFSC, Resource Evaluation and Assessment Division, Population Dynamics Branch. http://www.nefsc.noaa.gov/sos/

Mead, J. G. and C. W. Potter. 1995. Recognizing two populations for the bottlenose dolphin, Tursiops truncates, off the Atlantic coast of North America: morphologic and ecologic considerations. Int. Bio. Res. Institute Reports 5: 31-43.

Melvin, E. F., J. K. Parrish, K. S. Dietrich, and O. S. Hamel. 2001. Solutions to seabird bycatch in Alaska's longline demersal fisheries. Final report to NMFS on research performed by the University of Washington Sea Grant Program in collaboration with the Fishing Vessel Owners Association, the North Pacific Longline Association, NMFS, and USFWS.

Milligan, S. R., W. V. Holt, and R. Lloyd. 2009. Impacts of climate change and environmental factor on reproduction and development in wildlife. Philosophical Transactions of the Royal Society B 364: 3313-3319.

Mitchell, E. D. 1975. Trophic relationships and competition for food in northwest Atlantic whales. Proc. Can. Soc. Zool. Ann. Mtg.:123-133.

Mitchell, E. and D. G. Chapman. 1977. Preliminary assessment of stocks of northwest Atlantic sei whales, *Balaenoptera borealis*. Rep. Int. Whal. Commn 1 (Special Issue): 117-120.

Mitchell, E. D. 1991. Winter records of the minke whale, *Balaenoptera acutorostrata*, Lacepede 1804; in the southern North Atlantic. Rep Int Whal. Commn 41: 455-457.

Mooney, T. A., P. E. Nachtigall, and W. W. L. Au. 2004. Target strengths of a nylon monofilament and an acoustically enhanced gillnet: Predictions of biosonar detection ranges. Aquatic Mammals. 30(2): 220-226. http://www.whoi.edu/page.do?pid=52857

Morgan, L. E., and R. Chuenpagdee. 2003. Shifting gears addressing the collateral impacts of fishing methods in U.S. waters. PEW Science Series on conservation and the environment. 52 pp.

Morreale, S. J., and E. A. Standora. 1998. Early life stage ecology of sea turtles in northeastern U.S. waters. NOAA Tech. Memo. NMFS-SEFSC-413.

Mullin, K. D. and G. L. Fulling. 2003. Abundance and distribution of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull. 101: 603-613.

Murray, K. T. 2009. Characteristics and magnitude of sea turtle bycatch in U.S. mid-Atlantic gillnet gear. Endangered Species Research 8: 211-224. Available online at: http://www.int-res.com/articles/esr2009/8/n008p211.pdf

Murray, K. T. 2011. Sea turtle bycatch in the U.S. sea scallop (Placopecten magellanicus) dredge fishery, 2001-2008. Fish Res. 107:137-146.

Musick, J. A. and C. J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. In Lutz, P.L., and J.A. Musick (eds.). The Biology of Sea Turtles. CRC Press, NY. 137-164 pp.

New England Aquarium (NEA). 2010. Climate change and the oceans. Available at: http://www.neaq.org/conservation_and_research/climate_change/climate_change_and_the_oceans.php

New England Fishery Management Council (NEFMC). 1987. Fishery management plan for Atlantic salmon: incorporating an environmental assessment and regulatory impact review/initial regulatory flexibility analysis. New England Fishery Management Council. Saugus, MA. 64 pp.

NEFMC. 1998. Amendment #1 to the Atlantic Salmon Fishery Management Plan for Essential fish habitat. In consultation with NMFS. Available at: http://archive.nefmc.org/habitat/planamen/original_omnibus/EFH_amendment2.htm

NEFMC. 2003. Final amendment 13 to the Northeast multispecies fishery management plan including a final supplemental environmental impact statement and an initial regulatory flexibility analysis. Available online at http://s3.amazonaws.com/nefmc.org/Final-Amendment-13-SEISVol.-I-II.pdf

NEFMC. 2007. *Essential Fish Habitat Omnibus Amendment #2 Draft Supplemental Environmental Impact Statement.* In consultation with NMFS and the Mid-Atlantic Fishery Management Council. Gloucester, MA. Available at: https://www.nefmc.org/habitat/habitat.html

NEFMC. 2011a. Final environmental assessment for Framework 23 to the scallop fishery management plan. 234 pp. Available online at: http://www.nefmc.org/scallops/

NEFMC. 2011b. Omnibus Essential Fish Habitat (EFH) Amendment 2 Draft Environmental Impact Statement, Appendix D: The Swept Area Seabed Impact (SASI) approach: a tool for analyzing the effects of fishing on Essential Fish Habitat. New England Fishery Management Council, Newburyport, MA. 257 pp. Available online at: http://s3.amazonaws.com/nefmc.org/Appendix_D_Swept_Area_Seabed_Impact_approach_1.pdf

NEFMC 2014. Omnibus Essential Fish Habitat (EFH) Amendment 2 Draft Environmental Impact Statement, Vol. 3: Spatial management alternatives and environmental impacts of spatial management alternatives . New England Fishery Management Council, Newburyport, MA. 724 pp. Available online at: http://s3.amazonaws.com/nefmc.org/14haboa2eisvol3spatialmanagementaltsimpacts.pdf

Northeast Fisheries Science Center (NEFSC). 2008. Environmental Assessment for the NEFSC Research Surveys. NEFSC. Woods Hole, MA. March 28, 2008.

NEFSC. 2002. Workshop on the Effects of Fishing Gear on Marine Habitats off the Northeastern United States, October 23-25, 2001, Boston, Massachusetts. Northeast Fish. Sci. Cent. Ref. Doc. 02-01; 86 p. Available online at: http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0201/

NEFSC. 2009. Standardized Bycatch Reporting Methodology Annual Discard Report 2009. Internal document. 1560 pp. Available at: NMFS, Woods Hole, MA. 02543-1026, or online from: http://www.nefsc.noaa.gov/femad/fishsamp/fsb/

NEFSC. 2011a. NMFS website on the ecology of the Northeast U.S. Continental Shelf Large Marine Ecosystem, cited 2011 April 19. Available at: http://www.nefsc.noaa.gov/ecosys/ecology/

NEFSC. 2011b. Preliminary summer 2010 regional abundance estimate of loggerhead turtles (*Caretta caretta*) in northwestern Atlantic Ocean continental shelf waters. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 11-03; 33 pp. Available at: NMFS, 166 Water Street, Woods Hole, MA 02543-1026, or online at: http://www.nefsc.noaa.gov/nefsc/publications/

NEFSC. 2012. 53rd Northeast Regional Stock Assessment Workshop (53rd SAW) Assessment Summary Report. US Dept Commer, NEFSC Ref Doc. 12-03; 33 pp. Available at: NMFS, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

NEFSC. 2013. Personal Communication between NEFSC Operations Management and Information Staff with Rich Kleinleder, URS, on 30 October, 2013.

Northeast Regional Office (NERO). 2004. Vessels to which operational measures apply. Accessed 6 October 2010. Available at: http://www.nero.noaa.gov/shipstrike/news/vesselsize_July_2004.pdf

NERO. 2013. Modifications to the Harbor Porpoise Take Reduction Plan Environmental Assessment. US Dept Commer., NOAA, NMFS, Northeast Regional Office. 37pp.

Nishida, T. and G. McPherson. 2011. Assessment of specialized acoustic pingers to mitigate toothed whales depredation on Japanese tuna longline catches in the Central Pacific. J. Acoust. Soc. Am. 129: 2399 http://dx.doi.org/10.1121/1.3587804

National Marine Fisheries Service (NMFS). 1991. Recovery plan for the humpback whale, *Megaptera novaeangliae*. Prepared by the Humpback Whale Recovery Team for the NMFS, Silver Spring, MD. 105 pp.

NMFS. 1998. Recovery Plan for the Shortnose Sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the NMFS, Silver Spring, Maryland. 104 pp.

NMFS. 2000. Status review of smalltooth sawfish (*Pristis pectinata*). December 2000. Available at: http://www.flmnh.ufl.edu/fish/sharks/sawfish/srt/statusreview.pdf

NMFS. 2004. Alaska Groundfish Fisheries Final Programmatic Supplemental Environmental Impact Statement. NMFS, Alaska Region, Juneau, AK. Available at: http://www.fakr.noaa.gov/analyses/default.htm.

NMFS. 2005. Recovery Plan for the North Atlantic Right Whale, *Eubalaena glacialis*. NMFS, Silver Spring, MD.

NMFS. 2006. Environmental Assessment, Regulatory Impact Review, and final Regulatory Flexibility Act analysis for a final rule to implement the Bottlenose Dolphin Take reduction Plan and revise the large mesh size restriction under the Mid-Atlantic Large Mesh Gillnet Rule. U.S. Dep Commer., NOAA, NMFS, Southeast Regional Office, Protected Resources Division. 240 pp.

NMFS. 2006b. Review of the status of the right whales in the North Atlantic and North Pacific Oceans. Prepared by NOAA NMFS. 62 pp.

NMFS. 2006c. Final Consolidated Atlantic Highly Migratory Species Fishery Management Plan. National Oceanic and Atmospheric Administration, NMFS, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. Public Document. pp. 1600.

NMFS. 2007a. Endangered Species Act Section 7 Consultation on the Northeast Fisheries Science Center Research Vessel Activities. Consultation No. F/NER/2007/01541. NMFS Northeast Region Protected Resource Division. 102 pp.

NMFS. 2007b. Guidance for Social Impact Assessment. U.S. Dept. Commerce, NOAA Instruction 01-111-02. 39 pp. Available at:: https://reefshark.nmfs.noaa.gov/f/pds/publicsite/documents/procedures/01-111-02.pdf

NMFS. 2008a. Final Environmental Impact Statement to implement vessel operational measures to reduce ship strikes to North Atlantic right whales. Office of Protected Resources, NMFS, Silver Spring, MD. 850 pp.

NMFS. 2008b. Compliance guide for right whale ship strike reduction rule (50 CFR 224.105). Available at: http://www.nero.noaa.gov/shipstrike/doc/compliance_guide.pdf. Accessed 6 October 2010.

NMFS. 2008c. Endangered Species Act Section 7 Consultation on the Northeast Fisheries Science Center Research Vessel Activities [Consultation No. F/NER/2007/01541]. NMFS Northeast Regional Office, Protected Resources Division. 103 pp.

NMFS. 2009a. Environmental assessment, regulatory impact review, and final regulatory flexibility analysis for the Final Pelagic Longline Take Reduction Plan. Southeast Regional Office, Protected Resources Division, NMFS, NOAA, US Dep Commer. St. Petersburg, FL. 55pp. http://www.nmfs.noaa.gov/pr/pdfs/interactions/pltrt_ea_rir_frfa.pdf

NMFS. 2009b. Reducing marine mammal interactions in Atlantic trawl fisheries. Brochure available at: http://www.nero.noaa.gov/prot_res/atgtrp/G-NMFS-GSSA.pdf

NMFS. 2009c. Endangered Species Act Section 7 Consultation on the proposed award of Research Set-Aside for the spring and fall 2009 surveys of the NEAMAP near shore trawl program. Biological Opinion issued 16 April 2009. Consultation No. F/NER/2008/08795. NMFS Northeast Region Protected Resource Division. 64 pp.

NMFS. 2009d. Recovery Plan for Smalltooth Sawfish (Pristis pectinata). Prepared by the Smalltooth Sawfish Recovery Team for the NMFS, Silver Spring, Maryland.

NMFS. 2009e. Fishing Communities of the United States 2006. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-F/SPO-98, 84 pp. Available at:: http://www.st.nmfs.noaa.gov/st5/publication/communities/CommunitiesReport_ALL.pdf

NMFS. 2010a. Status of Fishery Resources off the Northeastern US Species List, cited 2010 January 13. Available at: http://www.nefsc.noaa.gov/sos/species

NMFS. 2010b. Guide to the Atlantic Large Whale Take Reduction Plan: An evolving plan to reduce the risk to North Atlantic large whales (right, humpback, and fin) posed by commercial trap/pot and gillnet fishing gear in the U.S. Atlantic Ocean. Available at: http://www.nero.noaa.gov/whaletrp/plan/ALWTRPGuide.pdf

NMFS. 2010c. Harbor porpoise take reduction plan: New England. Available at: http://www.nero.noaa.gov/prot_res/porptrp/doc/HPTRPNewEnglandGuide.pdf

NMFS. 2010d. Harbor porpoise take reduction plan: Mid-Atlantic. Available at: http://www.nero.noaa.gov/prot_res/porptrp/doc/HPTRPMidAtlanticGuide_Feb%202010.pdf

NMFS. 2010e. Recovery plan for the fin whale, *Balaenoptera physalus*. NMFS, Silver Spring, MD. 121 pp.

NMFS. 2010f. Recovery plan for the sperm whale (*Physeter macrocephalus*). NMFS, Silver Spring, MD. 165 pp.

NMFS. 2011a. Final Recovery Plan for the Sei Whale (*Balaenoptera borealis*). NMFS, Office of Protected Resources, Silver Spring, MD. 107 pp.

NMFS. 2011b. Atlantic Trawl Gear Take Reduction Strategy (ATGTRS) research needs and priorities, October 2011 Working Matrix. NMFS, Northeast Regional Office, Protected Resources Division. http://www.nero.noaa.gov/prot_res/research/doc/ATGTRT_research_needs_Oct_2011.pdf

NMFS. 2012a. NOAA Fisheries – Office of Protected Resources webpage. Accessed May 22, 2012 at http://www.nmfs.noaa.gov/pr/species/fish/

NMFS. 2012b. Endangered Species Act Section 7 Consultation on the NEFSC Research Vessel Surveys as well as Two Cooperative Gear Research Studies to be overseen by the NEFSC Protected Species Branch (PSB) [PCTS ID: NER-2012-9241]. NMFS Northeast Regional Office, Protected Resources Division. 180 pp.

NMFS. 2012c. Fisheries Economics of the United States, 2011. U.S. Dept. Commerce, NOAA. Tech. Memo. NMFS-F/SPO-118, 175 pp. Available at: https://www.st.nmfs.noaa.gov/st5/publication/index

NMFS. 2012d. Status of stocks. 2012 Annual Report to Congress on the Status of U.S. Fisheries. US Dept Commerce, NOAA, NMFS. Available at: http://www.nmfs.noaa.gov/sfa/statusoffisheries/2012/2012_SOS_RTC.pdf

NMFS. 2013a. Draft Environmental Impact Statement for amending the Atlantic Large Whale Take Reduction Plan: Vertical line rule. NMFS, NOAA, Dept. Commerce, Washington D.C.

NMFS 2013b. Fisheries of the United States 2012. National Marine Fisheries Service, Office of Science and Technology. Silver Spring, MD. September 2013.

NMFS. 2013c. Endangered Species Act Section 7 Consultation on Two Research Projects to be Administered by the Northeast Fisheries Science Center in 2013: (1) the Northeast Area Monitoring and Assessment Program (NEAMAP) Near Shore Trawl Surveys, and (2) a Study Assessing Sea Turtle/Sturgeon Exclusion and Target Catch Retention in a Mid-Atlantic Gillnet Fishery [PCTS ID: NER-2013-9677]. NMFS Northeast Regional Office, Protected Resources Division. 178 pp.

NMFS. 2013d. 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]. May 20, 2013 DRAFT—NOT FINAL.

NMFS. 2014a. Fisheries Economics of the United States, 2012. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-F/SPO-137, 175p. Available at: https://www.st.nmfs.noaa.gov/Assets/economics/documents/feus/2012/FEUS2012.pdf.

NMFS. 2014b. Commercial Fishery Statistics, Annual Commercial Landings by Group 2012. NOAA Fisheries, Office of Science and Technology. Retrieved May 1, 2014 at http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings-with-group-subtotals/index

NMFS. 2014c. Commercial Fisheries Statistics, Total Commercial Fishery Landings at Major U.S. Ports Summarized by Year and Ranked by Dollar Value. National Marine Fisheries Service, Office of Science and Technology. Available online at: http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/other-specialized-programs/total-commercial-fishery-landings-at-major-u-s-ports-summarized-by-year-and-ranked-by-dollar-value/index

NMFS and Southeast Fisheries Science Center (SEFSC). 2009. An assessment of loggerhead sea turtles to estimate impacts of mortality reductions on population dynamics. NMFS SEFSC Contribution PRD-08/09-14: 45 pp.

NMFS and U.S. Fish and Wildlife Service (USFWS). 1991a. Recovery plan for U.S. population of Atlantic green turtle. NMFS, Washington, DC.

NMFS and USFWS. 1991b. Recovery plan for U.S. population of loggerhead turtle. NMFS, Washington DC. Available at: http://ecos.fws.gov/docs/recovery_plans/1991/911226a.pdf

NMFS and USFWS. 1992a. Recovery plan for leatherback turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. NMFS, Washington, DC. Available at: http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_leatherback_atlantic.pdf

NMFS and USFWS. 1992b. Recovery plan for the Kemp's ridley sea turtle, *Lepidochelys kempii*. U.S. Fish and Wildlife Service and NMFS, St. Petersburg, FL.

NMFS and USFWS. 1995. Status reviews for sea turtles listed under the Endangered Species Act of 1973. NMFS, Silver Spring, MD.

NMFS and USFWS. 2005. Recovery plan for the Gulf of Maine Distinct Population Segment of Atlantic salmon (*Salmo salar*). NMFS, Silver Spring, MD.

NMFS and USFWS. 2007a. Leatherback sea turtle, *Dermochelys coriacea*, 5 year review: summary and evaluation. NMFS. Silver Spring, MD: 79 pp.

NMFS and USFWS. 2007b. Kemp's ridley sea turtle, *Lepidochelys kempii*, 5 year review: summary and evaluation. NMFS, Silver Spring, MD: 50 pp.

NMFS and USFWS. 2007c. Green sea turtle, *Chelonia mydas*, 5 year review: summary and evaluation. NMFS, Silver Spring, MD: 102 pp.

NMFS and USFWS. 2007d. Loggerhead sea turtle, *Caretta caretta*, 5 year review: summary and evaluation. NMFS, Silver Spring, MD: 65 pp.

NMFS and USFWS. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle, *Caretta caretta*, 2nd Rev. NMFS, Silver Spring, MD.

NMFS and USFWS. 2013a. Leatherback sea turtle, *Dermochelys coriacea*, 5 year review: summary and evaluation. NMFS. Silver Spring, MD and USFWS, Jacksonville, FL: 89 pp.

NMFS and USFWS. 2013b. Hawksbill sea turtle, *Eretmochelys imbricata*, 5 year review: summary and evaluation. NMFS, Silver Spring, MD and USFWS, Jacksonville, FL: 87 pp.

NMFS, USFWS and SEMARNAT. 2011. Bi-national recovery plan for the Kemp's ridley sea turtle, *Lepidochelys kempii*. Second revision. NMFS, Silver Spring, MD. 156 pp + appendices.

National Marine Sanctuary Program (NMSP). 2008. Stellwagen Bank National Marine Sanctuary Draft Management Plan / Draft Environmental Assessment. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program, Silver Spring, MD.

National Oceanic and Atmospheric Administration (NOAA). 2004. North East multispecies regulated mesh areas and restrictions on gear and methods of fishing. Wildlife and Fisheries, Electronic Code of Federal Registers, 50 CFR 648.81. Available at: http://www.nefmc.org/nemulti/index.html

NOAA. 2006. NOAA NOS NMSP Silver Fox & Manta UAS Evaluation Project. February 13-19, 2006. Upulo Point Airport, Hawi, Hawaii. 8 pp. http://uas.noaa.gov/projects/demos/silverfox/SilverFoxFinalReport.doc

NOAA. 2010a. Marine Protected Areas of the United States. Available at: http://marineprotectedareas.noaa.gov/

NOAA. 2010b. Safety and Environmental Compliance Office; Summary of applicable statutes, regulations, and guidelines, cited 2010 October 6. Available at: http://www.seco.noaa.gov/documents/shipSummary.html

NOAA. 2010c. U.S. Marine Protected Areas Online Mapping Tool. Available at: http://www.mpa.gov/dataanalysis/mpainventory/mpaviewer/mpaviewer.swf

NOAA. 2010d. National Ocean Service. Contaminants in the Environment. Available at: http://oceanservice.noaa.gov/observations/contam/

NOAA. 2010e. Marine Debris. Office of Response and Restoration. Available at: http://marinedebris.noaa.gov/info/impacts.html

NOAA. 2012a. NOAA Fisheries, Northeast Fisheries Center Website. Retrieved November 28, 2012 at http://www.nefsc.noaa.gov/

NOAA. 2012b. Annual Commercial Landings Statistics 2007-2012. Retrieved October 30, 2012 at http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html

NOAA. 2012c.Total Commercial Fishery Landings At Major U.S. Ports Summarized By Year And Ranked By Dollar Value. Available at: http://www.st.nmfs.noaa.gov/st1/commercial/landings/lport_yeard.html

NOAA. 2013. Draft guidance for assessing the effects of anthropogenic sound on marine mammals: Acoustic threshold levels for the onset of permanent and temporary threshold shifts. Available at: http://www.nmfs.noaa.gov/pr/acoustics/draft_acoustic_guidance_2013.pdf

NOAA, Coral Reef Conservation Program (NOOA CRCP). 2010. NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems: Research, Management, and International Cooperation. Silver Spring, MD: NOAA Coral Reef Conservation Program. NOAA Technical Memorandum CRCP 11. 67 pp.

National Research Council (NRC). 1990. Decline of the sea turtles: causes and prevention. National Academy Press, Washington, D.C. 259 pp.

NRC. 2002. Effects of trawling and dredging on seafloor habitat. National Research Council, Committee on Ecosystem Effects of Fishing, National Academy Press, Washington, D.C., 125 pp.

NRC. 2005. Marine mammal populations and ocean noise: Determining when noise causes biologically significant effects. National Academy Press, Washington, DC. 142 pp.

Northridge, S. 2003. Further development of a dolphin exclusion device. Final Report to UK Department for Environment Food and Rural Affairs (DEFRA), Project MF0735.

Nowacek, D. P., L. H. Thorne, D. W. Johnston, and P. L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Review 37: 81-115.

O'Connell, A. F., B. Gardner, A. T. Gilbert, and K. Laurent. 2009. Compendium of avian occurrence information for the continental shelf waters along the Atlantic Coast of the United States, Final Report (Database Section - Seabirds). Prepared by the USGS Patuxent Wildlife Research Center, Beltsville, MD. U.S. Department of the Interior, Geological Survey, and Bureau of Ocean Energy Management Headquarters, OCS Study BOEM 2012-076.

Olmstead, T. J., M. A. Roch, P. Hursky, M. B. Porter, H. Klinck, D. K. Mellinger, T. Helble, S. S. Wiggins, G. L. D'Spain, and J. A. Hildebrand. 2010. Autonomous underwater glider based embedded real-time marine mammal detection and classification. The Journal of the Acoustical Society of America 127(3): 1971-1971.

Orphanides, C. D. 2011. Estimates of Cetacean and Pinniped Bycatch in the 2009 New England Sink Gillnet and Mid-Atlantic Gillnet Fisheries. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 11-08; 28 pp. Available at: NMFS, 166 Water Street, Woods Hole, MA 02543-1026, or online from: http://www.nefsc.noaa.gov/nefsc/publications/

Packer, D. and A. Drohan. 2013. Identification sheets for the common deep-sea corals off the Northeast and Mid-Atlantic U.S. Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory Highlands, NJ 07732. Version 1.0. Available online: http://www.nefsc.noaa.gov/femad/fishsamp/fsb/training/NortheasternU.SDeepsea_Coral_Guide.pdf

Palka, D. L. 1995a. Abundance estimate of Gulf of Maine harbor porpoise. Int. Whal. Commn 16(Spec. Issue): 27-50.

Palka, D. L. 1995b. Influences on spatial patterns of Gulf of Maine harbor porpoises. Whales, Seals, Fish and Man. ,A.S. Blix, L. Walloe and O. Ulltang Elsevier Science. 69-75 pp.

Palka, D. L., A. J. Read, A. J. Westgate, and D. W. Johnston. 1996. Summary of current knowledge of harbour porpoises in U.S. and Canadian Atlantic waters. Rep. Int Whal. Commn 46:559-565.

Palka, D. L. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. Northeast Fish. Sci. Cent. Ref. Doc. 00-07.

Palsbøll, P. J., P. J. Clapham, D. K. Mattila, F. Larsen, R. Sears, H. R. Siegismund, J. Sigurjónsson, O. Vásquez, and P. Arctander. 1995. Distribution of mtDNA haplotypes in North Atlantic humpback whales: the influence of behavior on population structure. Mar. Eco. Prog. Series 116:1-10.

Palsbøll, P. J., J. Allen, M. Berube, P. Clapham, T. Feddersen, P. Hammond, R. Hudson, H. Jørgensen, S. Katona, A. H. Larsen, F. Larsen, J. Lien, D. Mattila, J. Sigurjonsson, R. Sears, T. Smith, R. Sponer, P. Stevick, and N. Oien. 1997. Genetic tagging of humpback whales. Nature 388: 767-769.

Paquet, D., C. Haycock, and H. Whitehead. 1997. Numbers and seasonal occurrence of humpback whales, *Megaptera novaeangliae*, off Brier Island, Nova Scotia. Can. Field-Nat. 111: 548-552.

Payne, P. M., L. A. Selzer, and A. R. Knowlton. 1984. Distribution and density of cetaceans, marine turtles, and seabirds in the shelf waters of the northeastern United States, June 1980-December 1983, based on shipboard observations. NOAA/NMFS Contract No. NA-81-FA-C-00023.

Payne, P. M., J. R. Nicholas, L. O'Brien, and K. D. Powers. 1986. The distribution of the humpback whale, *Megaptera novaeangliae*, on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel, *Ammodytes americanus*. Fish. Bull. 84: 271-277.

Payne, M. and D. W. Heinemann. 1990. A distributional assessment of cetaceans in the shelf and shelf edge waters of the northeastern United States based on aerial and shipboard surveys, 1978-1988. Report to NMFS. NEFSC, Woods Hole, MA 02543.

Payne, P. M., D. N. Wiley, S. B. Young, S. Pittman, P. J. Clapham, and J. W. Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fish. Bull. 88: 687-696.

Payne, P. M. and D. W. Heinemann. 1993. The distribution of pilot whales (*Globicephala* sp.) in shelf/shelf edge and slope waters of the northeastern United States, 1978-1988. Rep. Int Whal. Commn 14(Special Issue): 51-68.

Pelagic Longline Take Reduction Plan (PLTRP). 2012. Pelagic Longline Take Reduction Team Key Outcomes Memorandum. St. Petersburg, FL. August 21-23, 2012.

Perrin, W. F., D. K. Caldwell, and M. C. Caldwell. 1994. Atlantic spotted dolphin. In Ridgeway, S. H. and R. Harrison (eds.).Handbook of Marine Mammals: The First Book of Dolphins. Academic Press, San Diego, CA. 5:173-190.

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. Marine Fisheries Review 61(1): 1-74.

Pollnac, R. B. and J. J. Poggies. 2008. Happiness, Well-being and Psychocultural Adaptation to the Stresses Associated with Marine Fishing. *Human Ecology Review* 15(2):194-200.

Popper, A. N. and R. R. Fay. 2011. Rethinking sound detection by fishes. Hearing Research 273: 25-36.

Poulakis, G. R. and J. C. Seitz. 2004. Recent occurrence of the smalltooth sawfish, *Pristis pectinata* (Elasmobranchiomorphi: Pristidae), in Florida Bay and the Florida Keys, with comments on sawfish ecology. Florida Scientist 67(27): 27-35.

Read, A. J. 1999. Harbour porpoise, *Phocoena phocoena* (Linnaeus, 1758). In S.H. Ridgway and R. Harrison (eds.). Handbook of Marine Mammals. The second book of dolphins and porpoises. San Diego, CA. Academic Press. 323-355 pp.

Recchia, C. A. and A. J. Read. 1989. Stomach contents of harbour porpoises, Phoco*ena phocoena*, from the Bay of Fundy. Can. J. Zool. 67:21402146.

Reeves, R. R., P. J. Clapham, R. L. Brownell, Jr., and G. K. Silber. 1998. Recovery Plan for the blue whale, *Balaenoptera musculus*. Office of Protected Resources, NMFS, Silver Spring, MD. 42 pp.

Reeves, R. R., C. Smeenk, C. C. Kinze, R. L. Brownell, Jr., and J. Lien. 1999. White-beaked dolphin, *Lagenorhynchus albirostris* (Gray 1846). In Ridgeway, S. H. and R. Harrison (eds.). Handbook of Marine Mammals. Academic Press, San Diego, CA. 6:1-30.

Renner, M., J. K. Parrish, J. F. Piatt, K. J. Kuletz, A. E. Edwards, and G. L. Hunt. 2013. Modeled distribution and abundance of a pelagic seabird reveal trends in relation to fisheries. Marine Ecology Progress Series, 484: 259-277.

Richardson, D. T. 1976. Assessment of harbor and gray seal populations in Maine 1974-1975 Final report, contract No. MM4AC009. Mar. Mammal Commn. Washington, DC.

Richardson, W. J., C. R. J. Green, C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. San Diego, CA, Academic Press.

Rolland, R. M., S. E. Parks, K. E. Hunt, M. Castellote, P. J. Corkeron, D. P. Nowacek, S. K. Wasser, and S. D. Kraus. 2012. Evidence that ship noise increases stress in right whales. Proc. R. Soc. B. doi:10.1098/rspb.2011.2429.

Rosel, P. E., L. Hansen and A. A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: Common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Mol. Ecol.18: 5030–5045.

Rosenfeld, M., M. George, and J. M. Terhune. 1988. Evidence of autumnal harbour seal, *Phoca vitulina*, movement from Canada to the United States. Can. Field-Nat. 102(3): 527-529.

Ross, J. P. 1996. Caution urged in the interpretation of trends at nesting beaches. Marine Turtle Newsletter 74:9-10.

Rowe, S. J. 2007. A review of methodologies for mitigating incidental catch of protected marine mammals. DOC Research & Development Series 83. Science & Technical Publishing, Dept of Conservation, Wellington, NZ. Available at: http://www.conservation.co.nz/documents/science-and-technical/drds283.pdf

Ruser, A., M. Dähne, J. Sundermeyer, K. Lucke, D. S. Houser, J. J. Finneran, J. Driver, I. Pawliczka, T. Rosenberger, U. Siebert. 2014. In-air evoked potential audiometry of grey seals (*Halichoerus grypus*) from the North and Baltic Seas. PLoS ONE 9(3): e90824. doi:10.1371/journal.pone.0090824

Ryder, C. E., T. A. Conant, and B. A. Schroeder. 2006 Report of the workshop on marine turtle longline post-interaction mortality. U.S. Dept. Commerce, NOAA Technical Memorandum NMFS-F/OPR-29, 36 p.

Sasso, C. R. and S. P. Epperly. 2006. Seasonal sea turtle mortality risk from forced submergence in bottom trawls. Fisheries Research 81:86-88.

Schneider, D. C. and P. M. Payne. 1983. Factors affecting haul-out of harbor seals at a site in southeastern Massachusetts. J. Mamm. 64(3): 518-520.

Scott, T. M. and S. S. Sadove. 1997. Sperm whale, *Physeter macrocephalus*, sightings in the shallow shelf waters off Long Island, New York. Mar. Mammal Sci. 13: 317-321.

Sears, R., F. Wenzel, and J. M. Williamson. 1987. The blue whale: a catalog of individuals from the western North Atlantic (Gulf of St. Lawrence). Mingan Island Cetacean Study, St. Lambert, Quebec, Canada, 27 pp.

Sears, R., and W.F. Perrin. 2009. Blue whale Balaenoptera musculus. 120-124 pp. in W.F. Perrin, B. Würsig, and H.G.M. Thewissen (eds.), Encyclopedia of Marine Mammals, Academic Press, San Diego, CA. 1316 pp.

Selzer, L. A. and P. M. Payne. 1988. The distribution of white-sided, *Lagenorhynchus acutus* and common dolphins, *Delphinus delphis* vs. environmental features of the continental shelf of the northeastern United States. . Mar. Mammal. Sci. 4(2): 141-153.

Sergeant, D. E. and H. D. Fisher. 1957. The smaller Cetacea of eastern Canadian waters. J. Fish. Res. Bd. Canada, 14:83-115.

Sherman, K., N. A. Jaworski, and T.J. Smayda (eds.). 1996. The Northeast Shelf Ecosystem – Assessment, Sustainability, and Management. Blackwell Science, Cambridge, MA.

Sherman, K., and G. Hempel (eds.). 2009. The UNEP Large Marine Ecosystem report: A perspective on changing conditions in LME's of the Regional Seas. UNEP Regional Seas Report and Studies No. 182. United Nations Environment Programme. Nairobi, Kenya. Available at:: http://www.lme.noaa.gov/index.php?option=com_content&view=article&id=178&Itemid=62

Sherman K., P. Celone, and S. Adams. 2004. NOAA Fisheries Service's Large Marine Ecosystems Program: Status Report. NOAA Tech Memo NMFS NE 183; 21 pp.

Shertzer, K. W., E. H. Williams, and J. C. Taylor. 2009. Spatial structure and temporal patterns in a large marine ecosystem: Exploited reef fishes of the southeast United States. Fisheries Research 100(2): 126-133.

Silber, G.K., S. Bettridge, and D. Cottingham. 2009. Report of a workshop to identify and assess technologies to reduce ship strikes of large whales, 8-10 July, 2008, Providence, RI. U.S. Dep. Comm., NOAA Tech. Memo. NMFS-OPR-42. 55 pp. Available at: http://www.nmfs.noaa.gov/pr

Silva, M. A., R. Prieto, I. Cascao, M. I. Seabra, M. Machete, M. F. Baumgartner, and R. S. Santos. 2014. Spatial and temporal distribution of cetaceans in the mid-Atlantic waters around the Azores. Marine Biology Research, 10: 123-137.

Shoop, R. C. and R. D. Kenney. 1992. Seasonal distributions and abundances of loggerhead and leatherback sea turtles in waters of the Northeastern United States. Herpetological Monographs 1991 No. 6:43-67.

Simpfendorfer, C. A. and T. R. Wiley. 2004. Determination of the distribution of Florida's remnant sawfish population, and identification of areas critical to their conservation. Mote Marine Laboratory Technical Report, July 2, 2004. 37 pp.

Smith, C. and P. M. Clay. 2010. Measuring subjective and objective well-being: analyses from five marine commercial fisheries. *Human Organization* 69(2):158-168

Sosebee, K. and P. Rago. 2006. Spiny dogfish. Status of Fishery Resources off the Northeastern US. NEFSC Resource Evaluation and Assessment Division. Available at: http://www.nefsc.noaa.gov/sos/spsyn/og/dogfish/

Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Greene, Jr., D. R. Ketten, J. H. Miller, P.E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aqu. Mam. 33(4): 411-509.

South Atlantic Fisheries Management Council (SAFMC). 2012. Bermuda petrel species account. Accessed May 21, 2012 at:

http://www.safmc.net/Portals/0/ProtRes/New_PR/Spaccounts_sptable/pdf%20versions/Bermuda%20petrel.pdf

Southwest Fisheries Science Center (SWFSC). 2013. Draft Programmatic Environmental Assessment for fisheries research conducted and funded by the Southwest Fisheries Science Center. NMFS, La Jolla, CA. 300 pp. Available at: https://swfsc.noaa.gov/uploadedFiles/Divisions/PRD/Administration/Draft_SWFSC_Fisheries_Research_EA_public_release_draft_v2_18Apr2013_bookmarks.pdf

Southwood, A., K. Fritsches, R. Brill, and Y. Swimmer. 2008. Sound, chemical, and light detection in sea turtles and pelagic fishes: sensory-based approaches to bycatch reduction in longline fisheries. Endangered Species Research 5: 225-238.

Spendelow, J. A. 1995. Roseate tern fact sheet. U.S.G.S. Biological Survey. Available at: http://www.mbr-pwrc.usgs.gov/mbr/tern2.htm

Spotila, J. R., A. E. Dunham, A. J. Leslie, A. C. Steyermark, P. T. Plotkin, and F. V. Paladino. 1996. Worldwide population decline of *Dermochelys coriacea*: are leatherback turtles going extinct? Chelonian Conservation and Biology 2(2):290-222.

Steinback, S., K. Wallmo, and P. M. Clay. 2009. Saltwater sport fishing for food or income in the Northeastern U.S.: Statistical estimates and policy implications. *Marine Policy* 33(1):49–57.

Stephenson, P. C. and S. Wells. 2008. Evaluation of the effectiveness of reducing dolphin catches with pingers and exclusion grids in the Pilbara trawl fishery. Final report to Fisheries Research and Development Corporation on Project No. 2004/068. Fisheries Research Report No. 173, Department of Fisheries, Western Australia, 44p.

Stevenson, D., L. Chiarella, D. Stephan, R. Reid, K. Wilhem, J. McCarthy, and M. Pentony. 2004. Characterization of the fishing practices and marine benthic ecosystems of the Northeast U.S. Shelf, and an evaluation of the potential effects of fishing on essential fish habitat. NOAA Tech. Memo. NMFS-NE-181.

Stevick, P. T., J. Allen, P. J. Clapham, N. Friday, S. K. Katona, F. Larsen, J. Lien, D. K. Mattila, P. J. Palsbøll, J. Sigurjónsson, T. D. Smith, N. Øien, and P. S. Hammond. 2003. North Atlantic humpback whale abundance and rate of increase four decades after protection from whaling. Mar. Eco. Prog. Series 258: 263-273.Stevick, P., pers. comm., unpublished data, Provincetown Center for Coastal Studies and College of the Atlantic.

Swingle, W. M., S. G. Barco, T. D. Pitchford, W. A. McLellan, and D. A. Pabst. 1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Mar. Mamm. Sci. 9: 309-315. Tove, M. 1995. Live sighting of *Mesoplodon CF. M. Mirus*, True’s Beaked Whale. Mar. Mamm. Sci. 11(1): 80-85.

Tasker, M. L. and R. W. Furness. 1996. Estimation of food consumption by seabirds in the North Sea. Seabird/Fish Interactions, with Particular Reference to Seabirds in the North Sea. G.L.Hunt Jr. and R.W.Furness (eds.). International Council for the Exploration of the Sea, pp.87.

Temte, J. L., M. A. Bigg, and O. Wiig. 1991. Clines revisited: the timing of pupping in the harbour seal, *Phoca vitulina*. J. Zool. Lond. 224: 617-632.

TEWG (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 Tech. Memo. NMFS-SEFSC-409.

TEWG. 2000. Assessment update for the Kemp’s ridley and loggerhead sea turtle populations in the western North Atlantic. NOAA Tech. Memo. NMFS-SEFSC-444.

TEWG. 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. NOAA Tech Memo NMFS-SEFSC-555:1116.

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. NOAA Tech. Rep. NMFS 140. 240 pp.

Tillin, H. M., J. G. Hiddink, S. Jennings, and M. J. Kaiser. 2006. Chronic bottom trawling alters the functional composition of benthic invertebrate communities on a sea-basin scale. Mar Ecol Prog Ser 318: 31-45.

Toth, J. F. and R. B. Brown. 1997. Racial and gender meanings of why people participate in recreational fishing. *Leisure Sciences* 19(2), 129 - 146.

Transboundary Resources Assessment Review Committee (TRAC). 2012. Eastern Georges Bank Cod. TRAC Status Report 2012/02. Available at: http://www.nefmc.org/nemulti/index.html

Upite, C., K. T. Murray, B. A. Stacy, S. E. Weeks, and C. R. Williams. 2013. Serious injury and mortality determinations for sea turtles in U.S. Northeast and Mid-Atlantic fishing gear, 2006-2010. NOAA Tech Memo NMFS NE 222. 18 pp. NMFS, 166 Water Street, Woods Hole, MA 02543-1026. Available online at http://www.nefsc.noaa.gov/nefsc/publications/.

U.S. Census. 2010. Population and economic statistics. Retrieved November 15, 2012 at http://www.census.gov/

U.S. Department of Labor, Bureau of Labor Statistics (USDOL). 2012. Retrieved November 15, 2012 at http://data.bls.gov/timeseries/LNU04035109?data_tool=XGtable

U.S. Fish and Wildlife Service (USFWS). 1997. Synopsis of the biological data on the green turtle, *Chelonia mydas* (Linnaeus 1758). Biological Report 97(1). U.S. Fish and Wildlife Service, Washington, DC.

USFWS. 2010. Least tern, *Sterna antillarum* species profile. Available at: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B07N

U.S. Geological Survey (USGS).2005. CONMAPSG: Continental margin mapping (CONMAP) sediments grainsize distribution for the United States East Coast continental margin. Open-File Report 2005-1001, U.S. Geological Survey, Coastal and Marine Geology Program, Woods Hole Science Center, Woods Hole, MA.

USGS. 2011. An evaluation of the science needs to inform decisions on Outer Continental Shelf energy development in the Chukchi and Beaufort Seas, Alaska: U.S. In , Holland-Bartels, L., and Pierce, B. (eds.). Geological Survey Circular 1370. 278 pp.

Vanderlaan, A.S.M. and C. Taggart. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Marine Mammal Science 23: 144-156.

Veltre, D. W. and M. J. Veltre. 1983. Resource utilization in Unalaska, Aleutian Islands, Alaska. Alaska Dept. of Fish & Game, Division of Subsistence (Bethel, Alaska).

Wang, J. H., L. C. Boles, B. Higgins, and K. J. Lohmann. 2007. Behavioral responses of sea turtles to lightsticks used in longline fisheries. Animal Conservation, 10(2): 176-182.

Wang, J., S. Fisler, and Y. Swimmer. 2009. Developing visual deterrents to reduce sea turtle bycatch: testing shark shapes and net illumination. In Gilman, E., (ed.). Proceedings of the Technical Workshop on Mitigating Sea Turtle Bycatch in Coastal Net Fisheries. IUCN: 49–50.

Wang, J., J. Barkan, S. Fisler, C. Godinez-Reyes, and Y. Swimmer. 2013. Developing ultraviolet illumination of gillnets as a method to reduce sea turtle bycatch. Biology Letters 9: http://dx.doi.org/10.1098/rsbl.2013.0383

Waring, G. T., C. P. Fairfield, C M. Ruhsam, and M. Sano. 1992. Cetaceans associated with Gulf Stream features off the northeastern USA Shelf. ICES [Int. Counc. Explor. Sea] C.M. N:12.

Waring, G. T., C. P. Fairfield, C M. Ruhsam, and M. Sano. 1993. Sperm whales associated with Gulf Stream features off the northeastern USA shelf. Fish. Oceanogr. 2(2): 101-105.

Waring, G. T. and J. T. Finn. 1995. Cetacean trophic interactions off the northeast USA inferred from spatial and temporal co-distribution patterns. ICES [Int. Counc. Explor. Sea] C.M. 1995/N: 7 44.

Waring, G. T., T. Hamazak, D. Sheehan, G. Wood, and S. Baker. 2001. Characterization of beaked whale, *Ziphiidae* and sperm whale, *Physeter macrocephalus*, summer habitat in shelf-edge and deeper waters off the northeast U.S. Mar. Mammal Sci. 17(4): 703-717.

Waring, G. T., E. Josephson, C. P. Fairfield, and K. Maze-Foley (eds.). 2007. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2006. NOAA Tech. Memo. NMFS-NE-201, 378 pp.

Waring, G. T., E. Josephson, C. P. Fairfield, and K. Maze-Foley. 2009a. U. S. Atlantic and Gulf of Mexico marine mammal stock assessments - 2008. NOAA Tech. Memo. NMFS-NE- 210, 429 pp.

Waring G. T., E. Josephson, K. Maze-Foley, and P. E. Rosel (eds.). 2010. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2010. NOAA Tech Memo NMFS-NE-219; 598 pp.

Waring G. T., E. Josephson, K. Maze-Foley, and P. E. Rosel (eds.). 2012. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2011. NOAA Tech Memo NMFS-NE-221; 319 pp.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds.). 2013a. U. S. Atlantic and Gulf of Mexico marine mammal stock assessments - 2012. NOAA Tech. Memo. NMFS-NE 223, 425 pp.

Waring et al. 2014. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2013. Available online from: http://www.nmfs.noaa.gov/pr/sars/region.htm

Wartzok, D., and D. R. Ketten. 1999. Marine mammal sensory systems. 117-175 pp. in J. E. Reynolds, III, and S.A. Rommel (eds.). Biology of Marine Mammals. Smithsonian Institution Press, Washington, D.C.

Wenzel, F., D. K. Mattila, and P. J. Clapham. 1988. *Balaenoptera musculus* in the Gulf of Maine. Mar. Mammal Sci. 4(2):172-175.

Whitehead, H. 2009. Sperm whale Physeter macrocephalus. 1093-1097 pp. in W.F. Perrin, B. Würsig, and H.G.M. Thewissen (eds.), Encyclopedia of Marine Mammals, Academic Press, San Diego, CA. 1316 pp.

Whitman, A. A. and P. M. Payne. 1990. Age of harbour seals, *Phoca vitulina concolor*, wintering in southern New England. Can. Field-Nat. 104(4):579-582.

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. U.S. Geol. Surv. Prof. Paper 529-N. 198 pp.

Wigley, S. and L. Col. 2006. Ocean Pout. Status of Fishery Resources off the Northeastern US. NEFSC Resource Evaluation and Assessment Division. Available at: http://www.nefsc.noaa.gov/sos/spsyn/og/pout/

Wiley, D. N., R. A. Asmutis, T. D. Pitchford, and D. P. Gannon. 1995. Stranding and mortality of humpback whales, *Megaptera novaeangliae*, in the mid-Atlantic and southeast United States, 1985-1992. Fish. Bull. 93:196-205.

Williams, R., S. L. Hedley, and P. S. Hammond. 2006. Modeling distribution and abundance of Antarctic baleen whales using ships of opportunity. Ecology and Society, 11 [online]: http://www.ecologyandsociety.org/vol11/iss1/art1/

Wilson, S. C. 1978. Social organization and behavior of harbor seals, Phoca concolor, in Maine. Washington, DC. Mar. Mamm. Comm. Final Report contract MM6ACO13, GPO-PB-280-188.

Winn, H. E., C. A. Price, and P. W. Sorensen. 1986. The distributional biology of the right whale, *Eubalaena glacialis*, in the western North Atlantic. Rep. Int. Whal. Comm. (Special issue) 10:129-138.

Witherington, B., R. Herren, and M. Bresette. 2006. *Caretta caretta* – Loggerhead sea turtle. Chelonian Res. Monographs 3:74-89.

Wood LaFond, S. 2009. Dynamics of Recolonization: a Study of the Gray Seal, *Halichoerus grypus*, in the Northeast U.S. Ph.D. Dissertation. University of Massachusetts, Boston. 83 pp.

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.

Yoder, J. A. 1991. Warm-temperate food chains of the southeast shelf ecosystem. In Sherman, K., L. M. Alexander, B. D. Gold, (eds.), Food Chains, Yields, Models and Management of Large Marine Ecosystems. American Association for the Advancement of Science Symposium. Westview Press, Inc., Boulder, U.S., 49–66 pp.

Zollett, E. A. 2005. A review of cetacean bycatch in trawl fisheries. Literature review prepared for the Northeast Fisheries Science Center. Available at: http://nero.noaa.gov/prot_res/atgtrp/ai/gr/16.pdf

Zollett, E. A. 2009. Bycatch of protected species and other species of concern in US east coast commercial fisheries. Endangered Species Research 9: 49-59. Doi: 10.3354/esr00221.Supplement 1 (Tables) are Available at: www.int-res.com/articles/suppl/n009p049_app.pdf

Zug, G. R., and J. F. Parham. 1996. Age and growth in leatherback turtles, *Dermochelys coriacea* (Testudines: *Dermochelyidae*): a skeletochronological analysis. Chelonian Conservation Biology 2(2):244-249.

This page intentionally left blank.

8.1 NORTHEAST FISHERIES SCIENCE CENTER PROJECT TEAM

LT Carl Rhodes, Deputy Chief Ecosystems Survey Branch, Northeast Marine Facility Operations Manager, Woods Hole, Massachusetts

Gordon Waring, Research Fishery Biologist, Protected Species Branch, Woods Hole, Massachusetts

John Hoey, NEFSC Cooperative Research Program, Director, Narragansett, Rhode Island

Earl Meredith, NEFSC Cooperative Research Coordinator, Gloucester, Massachusetts

Linda Despres, NEFSC Bottom Trawl Survey, Chief Scientist (retired), Woods Hole, Massachusetts

Russell Brown, Deputy Science and Research Director, NEFSC, Woods Hole, Massachusetts

8.2 NOAA FISHERIES PROJECT MANAGEMENT

Mridula Srinivasan, Project Manager, Marine Ecologist, Protected Species Science (F/ST4), National Marine Fisheries Services (NMFS) Office of Science and Technology

Stephen K. Brown, Chief, Assessment and Monitoring Division (F/ST4), NMFS Office of Science and Technology

8.3 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) CONSULTANTS, PROGRAMMATIC ENVIRONMENTAL ASSESSMENT PREPARATION

[Note: This work was primarily completed by consultants from URS Corporation in Anchorage, Alaska. In October 2014, URS was purchased by AECOM, Inc. and the final stages of the project were completed by some of the listed personnel as AECOM staff, although the service contract remained under the URS name.]

Jon Isaacs, Principal-in-Charge, URS Corporation, 700 G Street, Suite 500, Anchorage, Alaska 99501

Rich Kleinleder, Project Manager, Senior Biologist, URS Corporation, Homer, Alaska

Steve Rusak, Deputy Project Manager, Environmental Scientist, URS Corporation, Anchorage, Alaska

Lisa Baraff, Marine Mammal Biologist, URS Corporation, Fairbanks, Alaska

Maria Shepherd, Senior Biologist, URS Corporation, Anchorage, Alaska

Dana Seagars, Senior Marine Mammal Biologist, URS Corporation, Anchorage, Alaska

Bridget Easley, Senior Planner/Environmental Scientist, URS Corporation, Anchorage, Alaska

Kim Holmes, Environmental Scientist/GIS Specialist, URS Corporation, Anchorage, Alaska

Valerie Watkins, Environmental Scientist/Biologist, URS Corporation, Anchorage, Alaska

Jessica Evans, Environmental Scientist/GIS Specialist, URS Corporation, Anchorage, Alaska

Wes Cornelison, Fisheries Biologist, Environmental Section Leader, URS Corporation, Anchorage, Alaska

Erin Dunable, Wildlife Biologist, URS Corporation, Anchorage, Alaska

Stephen Rideout, Environmental Scientist/GIS Technician, URS Corporation, Anchorage, Alaska

Tim Kramer, Environmental Scientist, URS Corporation, Anchorage, Alaska

Linda Harriss, Senior Word Processor/Graphic Designer, URS Corporation, Anchorage, Alaska

Joanne Jones, GIS Specialist, URS Corporation, Anchorage, Alaska

Thomas Schultz, GIS Specialist, URS Corporation, Anchorage, Alaska

Courtney Smith, GIS Specialist, URS Corporation, Anchorage, Alaska

8.4 NMFS NEPA COMPLIANCE OVERSIGHT

Steve Leathery, NMFS National NEPA Coordinator, NMFS NEPA Headquarters, Silver Spring, Maryland

Patience Whitten, NMFS, NEPA Headquarters, Silver Spring, Maryland

Steven K. Davis, Contract Officer Technical Representative for URS, NMFS Alaska Region NEPA Coordinator, Alaska Regional Office, Anchorage, Alaska

Jason Forman, Attorney Advisor, NOAA Fisheries Office of General Counsel, Headquarters, Silver Spring, Maryland

Brian Ward, NMFS NEPA Headquarters, Silver Spring, Maryland

Timothy Cardiasmenos, NMFS Greater Atlantic Regional Fisheries Office NEPA Analyst, Gloucester, Massachusetts

8.5 MARINE MAMMAL PROTECTION ACT COMPLIANCE

Ben Laws, NMFS Office of Protected Resources, Permits and Conservation Division (F/PR1), Silver Spring, Maryland

Jeannine Cody, NMFS Office of Protected Resources, F/PR1, Silver Spring, Maryland

Kristy Long, NMFS Office of Protected Resources, Marine Mammal and Sea Turtle Conservation Division (F/PR2), Silver Spring, Maryland

Thomas R. Loughlin, Letters of Authorization Application Consultant, TRL Wildlife Consulting, Redmond, Washington

Jason Gedamke, Acoustics Program Manager, NMFS Office of Science and Technology, Silver Spring, Maryland

Brandon Southall, Bioacoustics Consultant, Southall Environmental Associates, Inc., Aptos, California

8.6 ENDANGERED SPECIES ACT COMPLIANCE

Daniel Marrone, NMFS Greater Atlantic Regional Fisheries Office, Protected Resources Division, Gloucester, Massachusetts

This page intentionally left blank.

APPENDICES

Each of the following appendices will be submitted under separate cover:

Appendix A: NEFSC Research Gear and Vessel Descriptions

Appendix B: Spatial and Temporal Distribution of NEFSC Research Activity

Appendix C: NEFSC Application for Incidental Take under the Marine Mammal Protection Act

Appendix D: NEFSC Handling Procedures for Incidentally Caught Protected Species

Appendix E: Addendum to the NEFSC LOA Application

This page intentionally left blank.