UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

MAR 0 1 2013

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act (NEPA), an environmental review has been performed on the following action.

TITLE: Northeast Fisheries Science Center Research Survey Supplemental Environmental Assessment

LOCATION: Atlantic Ocean

SUMMARY: This supplemental environmental assessment (SEA) updates a previously approved environmental assessment drafted to analyze impacts resulting from the issuance of scientific research permits for the National Marine Fisheries Service Northeast Fisheries Science Center. The SEA supports new scientific research permits for 2013 and is necessary to ensure that critical vessel sampling programs continue without interruption. All beneficial and adverse impacts of the action were evaluated in the SEA, resulting in a finding of no significant impact.

RESPONSIBLE OFFICIAL:
John K. Bullard
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The environmental review process led us to conclude that this action will not have a significant effect on the human environment. Therefore, an environmental impact statement will not be prepared. A copy of the finding of no significant impact (FONSI) including the supporting SEA and original environmental assessment (EA) are enclosed for your information.

Although NOAA is not soliciting comments on this completed SEA/FONSI, we will consider any comments submitted that would assist us in preparing future NEPA documents. Please submit any written comments to the responsible official named above.

Sincerely,

Patricia A. Montanio
NOAA NEPA Coordinator

Enclosure

Northeast Fisheries Science Center's Research Surveys
Supplemental Environmental Assessment
Supplements the Environmental Assessment for the Northeast Fisheries Science Center's Research Surveys dated March 28, 2008

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March 1, 2013

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1.0 INTRODUCTION

This supplemental environmental assessment (SEA) updates the previously approved (March 31, 2008) environmental assessment (EA) drafted to analyze impacts resulting from the issuance of Scientific Research Permits (SRP) for the National Marine Fisheries Service (NMFS) Northeast Fisheries Science Center (NEFSC) research surveys. The 2008 EA concluded that research surveys would not significantly impact the quality of the human environment. All beneficial and adverse impacts of the action were evaluated in the EA, resulting in a finding of no significant impact.

Although a programmatic EA is under development to cover NEFSC's future research survey work, the new assessment likely will not be finalized until 2014 and impacts from research in the 2008 EA were not analyzed beyond 2012. Due to similarities between the research assessed in the 2008 EA and current operations, this SEA was prepared to cover 2013 research activities and issuance of the 2013 SRP. This SEA only updates portions of the 2008 EA that were found to be outdated, all other sections and analysis remain applicable and have not been modified. The following sections have been updated:

- Proposed Action
- Affected Environment (Updates to species descriptions for Atlantic wolfish, cusk, loggerhead sea turtle, and Atlantic sturgeon)
- Environmental Consequences of the Proposed Action
- Cumulative Impacts Assessment for Protected Resources
- List of Preparers
- Applicable Laws (Endangered Species Act and the National Environmental Policy Act)

This SEA is not a stand-alone document and is only intended to be utilized in conjunction with the attached 2008 EA. Sections addressed in this supplement should be considered within the context of the EA, including the purpose and need for this action. The purpose of the research surveys continues to be to provide data on abundance, distribution, feeding ecology, and size and age composition of stocks of economically and ecologically important species, as well as oceanographic and plankton data, in order to monitor the health and status of marine resources and their habitats. This is needed to ensure the continued operation of the various NEFSC research surveys through the issuance of an SRP

2.0 SUPPLEMENTAL PROPOSED ACTION

The following section revises the proposed action presented in section 3.1 of the original EA. While the gear types (bottom trawl survey, dredge survey, etc.) being used for the 2013 surveys are the same as those previously evaluated, as further discussed below, survey effort has been reduced. It is also important to note that the no action alternative outlined in the original 2008 EA remains unchanged. That is, the no action alternative would mean that the SRP for the NEFSC's research surveys would not be issued and these surveys would not be conducted. Data provided by the surveys would not be collected. Instead, scientists and managers 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.

2.1 Alternative 1 (Proposed Action) – Conduct NEFSC Research Surveys through the Issuance of a Scientific Research Permit

In 2013 the NEFSC proposes to conduct eight types of surveys utilizing the RVs *Gloria Michelle*, and *Hugh R. Sharp*, and FSVs *Henry B. Bigelow, Gordon Gunter, Ferdinand R. Hassler and Pisces* (for detailed descriptions of each vessel, go to http://www.nefsc.noaa.gov/femad/ecosurvey/mainpage/ under the research vessels link*)* and a yet-to-be determined surfclam dredge commercial vessel.

The FSV *Henry B. Bigelow* replaced the FRV *Albatross IV* in the spring of 2009 and has solely conducted the spring and fall bottom trawl surveys ever since. The RV *Hugh R. Sharp* was brought online in 2008 to replace the FRV *Albatross IV* for the sea scallop survey. Commercial clam dredge vessels have been contracted to replace the FRV *Delaware II*.

During 2013, these 8 surveys are projected to cumulatively take 236 days-at-sea (DAS) to complete their missions and to sample a total of 1,336 sites along the continental shelf, ranging from North Carolina to the Gulf of Maine (GOM).

For the purpose of analysis, the research activities are grouped into three categories based upon the type of gear used:

1. bottom trawl surveys (spring and fall standard BTS, northern shrimp and LMRCSC);
2. dredge surveys (sea scallop and surfclam/ocean quahog); and
3. miscellaneous (deep-sea coral, black sea bass and habitat mapping).

Surveys which conduct the same activity at different times of the year or the same activity done at different locations are listed together. An SRP would be required to be issued annually for the operation of the NEFSC surveys; however this SEA will analyze the impacts of the operation of these surveys for 2013 only.

The following surveys are scheduled to be conducted during the remainder of FY 2013 (starting March 4, 2013):

Trawl Surveys

<u>Multispecies standard bottom trawl survey</u>
This survey tracks mature fish species and juvenile abundance over their range of distribution. The NEFSC uses a trawl in this survey which is conducted in spring and fall in the Northeastern Continental Shelf LME. Tow speeds are typically 3.8 knots with maximum duration of 20 min. The surveys average 785 tows per year and require about 120 days of ship time *(H. B. Bigelow*). The 2013 survey is scheduled to occur from March 4-May 11 and September 4-November 15.

<u>Northern shrimp survey</u>
This survey determines the distribution and abundance of northern shrimp and collects related data. The NEFSC also uses the 4-seam modified commercial shrimp bottom trawl in the northern shrimp survey which is conducted yearly in July in the Gulf of Maine. Tow speeds are typically 2 knots with duration of 15 minutes. The survey averages 82 tows per year and requires 22 ship days (*G. Michelle*). The 2013 survey is scheduled to occur from July 21-August 17.

<u>Living Marine Resources Center Survey (LMRCSC)</u>
The LMRCSC determines distribution, abundance and recruitment patterns for multiple species. The NEFSC uses a 4-seam, 3-bridle bottom trawl and a 2 m beam trawl. The survey is conducted yearly in January in the Mid-Atlantic Bight. Tow speeds are typically 3.8 knots with duration of 30 min. The surveys average 25 tows per year and require about 11 days of ship time *(G. Gunter*). The 2013 survey is scheduled to occur from June 22-July 3.

Dredge Gear

Scallop dredge survey

This survey determines distribution and abundance of sea scallops. This survey has been conducted annually since 1982 and samples waters off Cape Hatteras, North Carolina to the Scotian Shelf, Canada. Approximately 259 stations are sampled each year (36 DAS). For standard dredge hauls, the survey uses a NEFSC 8-foot New Bedford type scallop dredge equipped with a 2-inch ring chain bag and lined with 1.5 inch mesh webbing liner to retain small scallops. The dredge is towed at 3.8 knots for 15-minutes. In addition, the NEFSC has collaborated with a group from the Woods Hole Oceanographic Institute to develop and test a stereo-optic towed camera array to count and measure sea scallops and associated fauna utilizing automated digital imagery. The camera system was towed during the 2012 standard survey for half of the sea days. The non-invasive vehicle is towed by a two foot fiber optic cable that keeps the vehicle about 1.5 meters off the sea floor (*H.R. Sharp*). The 2013 survey is scheduled to occur from June 13-July 20.

Surfclam and ocean quahog dredge survey

This cruise determines distribution and abundance of surf clams and quahogs and has been conducted triennially since 1976. Starting in 2012, the survey is conducted annually and it covers one-third of the waters off Cape Hatteras, North Carolina to the Scotian Shelf, Canada during 15 DAS. A contracted commercial clam vessel deploys a standard commercially sized clam dredge (13 foot blade width). The dredge is towed at 1.5 knots for 5 minutes. The 2013 survey is scheduled to occur in August.

Miscellaneous Gear

Black sea bass habitat visual survey

This one-time only cruise for 2013 will conduct a photographic assessment of black sea bass habitat. During the five day trip, the survey will take place during the summer in shallow waters off of the Delmarva coast. A stereo-optic towed vehicle will be primarily used (*H.R. Sharp*). The 2013 survey is scheduled to occur from July 22-26.

Habitat Mapping survey

This cruise has been utilizing AUV-mounted multibeam sonar and cameras and collecting water samples for methane analysis to map habitats, faunal distributions, and biochemical processes in Hudson Canyon aboard *Bigelow* during summer. In 2013 it has been diverted to perform multibeam mapping in shallow waters off the Delmarva coast (*F.R. Hassler*). The 2013 survey is scheduled to occur from August 5-15.

Deep-water coral survey

This cruise focuses on the determination of species diversity, community composition, distributions and extent of deep sea coral and sponge habitats. It is primarily conducted on the continental shelf from the GOM to Virginia each summer. 16 DAS are used. Various types of equipment are used (e.g. beam trawl, ROV, towed camera) during the survey (*H.B. Bigelow*). The 2013 survey is scheduled to occur from June 10-24.

2008-2012 Surveys Compared to 2013 Surveys

The major differences between the work scheduled to be conducted in 2013 compared to what was completed on the various Center platforms under the 2008-2012 EA are as follows:

- In 2008, the *Albatross IV* & *H.B. Bigelow* conducted side by side bottom trawl surveys. 1,711 tows were completed in 2008. Since then, the *Bigelow* accomplishes an average of 785 stations per year which greatly decreases the environmental impact of towing a net over the bottom.

- Additionally, the *Bigelow* tows for only 20 minutes (rather than 30 as the *Albatross IV*) which decreases the minimum area swept and affected bottom area.

- The Bigelow does not work in less than 18 meters of water which decreases the likelihood of encountering Atlantic sturgeon (6 Atlantic sturgeon in 2008 and a total of 11 in the last four years).

- Since the *Bigelow* replaced the *Albatross IV*, towing speed has been reduced from 3.5 to 3.0 knots. These aforementioned changes have probably cumulatively resulted in the decreased interception of turtles during a bottom trawl survey (eight turtles in 2008 and a total of five in the last four years).

- The scallop survey has incorporated new technology (Habcam) which has reduced the average number of tows from 480 (2008-2010) to 259 (2011-2012) tows/year. This also greatly decreases the environmental impact of towing a dredge over the bottom. There continues to be no Atlantic sturgeon/turtle takes during this survey.

- The triennial surfclam/ocean quahog survey is now a yearly survey but covers only one third of the survey area each year. It has also moved from the FRV *Delaware II* platform to a commercial dredge vessel. There continues to be no Atlantic sturgeon/turtle takes during this survey.

- This is the second year that the deep-sea coral cruise has been conducted and this is the only year that the black sea bass survey will be done.

- The benthic habitat survey, conducted periodically since 1996 on Georges Bank during summer or fall, will not be conducted in 2013. The Habitat Mapping Survey, conducted during summer in 2007, 2008, 2009, and 2011 around Hudson Canyon and combined with the Deep Water Corals cruise in 2012, was diverted for mapping near shore waters off the Delmarva coast for 2013.

- The 2008-2012 EA originally determined that once the calibration cruises between the FRV *Albatross IV* and FSV *H.B. Bigelow* were completed in 2008, that there would be a projected use of 350 DAS and 1,994 tows completed on a yearly basis between 2009-2012. In 2013, it is projected that 225 DAS will be used and 1,336 tows will be completed which is a substantial decrease over what was originally analyzed in the 2008 EA.

3.0 SUPPLEMENTAL AFFECTED ENVIRONMENT

The attached EA includes detailed descriptions of the valued ecosystem components (VECs) which comprise the affected environment. Discussion of physical environment/habitat/Essential Fish Habitat (EFH) is included in Section 4.1 of the attached EA and describes the primary geographic areas affected by the alternatives (GOM, Georges Bank, and Mid-Atlantic Bight). Section 4.2 describes habitat and EFH. Fisheries resources are addressed in Section 4.3 of the attached EA. Protected resources are addressed in Section 4.4 of the attached EA. This section discusses protected resources present in the area, protected species likely to be affected, species not likely to be affected, and action to minimize interactions with protected resources. The social and economic environment is addressed in Section 4.5. No substantial changes to the description of the affected environment, as described in the attached EA, have occurred with the exception of the following changes which are presented below.

3.1 Atlantic Wolffish

The New England Fishery Management Council added Atlantic wolffish to Northeast Multispecies Fishery Management Plan through Amendment 16. Therefore, impacts to wolffish are assessed in this SEA under the fisheries resource VEC. NEFSC spring and fall bottom trawl survey indices show abundance and biomass of Atlantic wolffish generally has declined over the last two to three decades. However, Atlantic wolffish are encountered infrequently on NEFSC bottom trawl surveys and there is uncertainty as to whether the NEFSC surveys adequately sample this species (NDPSWG, 2009). Atlantic wolffish continues to be considered a data poor species. An assessment update in 2012 determined that the stock is overfished, but overfishing is not occurring.

3.2 Candidate Species

Cusk (*Brosme brosme*), alewife (*Alosa pseudo harengus*),and blueback herring (*Alosa aestivalis*) are considered by NMFS to be candidate species. Candidate species are those petitioned species that NMFS is actively considering for listing as endangered or threatened under the ESA. Candidate species also include those species for which NMFS has initiated an ESA status review through an announcement in the *Federal Register*.

Candidate species receive no substantive or procedural protection under the ESA; however, NMFS recommends that project proponents consider implementing conservation actions to limit the potential for adverse effects on candidate species from any proposed project. NMFS has initiated review of recent stock assessments, bycatch information, and other information for these candidate and proposed species. The results of those efforts are needed to accurately characterize recent interactions between fisheries and the candidate/proposed species in the context of stock sizes. Any conservation measures deemed appropriate for these species will follow the information reviews. Please note that once a species is proposed for listing the conference provisions of the ESA apply (see 50 CFR 402.10).

3.3 Loggerhead Sea Turtles

On September 22, 2011, NMFS and USFWS issued a final rule (76 FR 58868), determining that the loggerhead sea turtle is composed of nine DPSs (as defined in Conant et al., 2009) that constitute species that may be listed as threatened or endangered under the ESA. Five DPSs were listed as endangered (North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Northeast Atlantic Ocean, and Mediterranean Sea), and four DPSs were listed as threatened (Northwest Atlantic Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean).
The 2013 NEFSC research surveys would only occur in the Northwest Atlantic Ocean. As such, this EA will only focus on the Northwest Atlantic Ocean DPS of loggerhead sea turtles, listed as threatened.

3.4 Atlantic Sturgeon

On February 6, 2012, NMFS issued two final rules (77 FR 5880-5912; 77 FR 5914-5982) listing five Distinct Population Segments (DPS) of Atlantic sturgeon as threatened or endangered. Four DPSs (New York Bight, Chesapeake Bay, Carolina and South Atlantic) are listed as endangered and one DPS (Gulf of Maine) is listed as threatened. The effective date of the listing is April 6, 2012.

NMFS issued a Biological Opinion (BO) for the 2013 and 2014 NEFSC research surveys on November 30, 2012. Based on the BO the research surveys are likely to result in the mortality of no more than 35 Atlantic sturgeon in 2013 and 2014. NMFS expects that the Atlantic sturgeon killed will be of adult or subadult life stages. No mortality of juveniles is anticipated. Additionally, the BO states that all other effects to Atlantic sturgeon, including effects to habitat and prey due to survey/study activities, will be insignificant and discountable. Using mixed stock analysis explained above, NMFS determined that Atlantic sturgeon in the action area were likely to originate from the five DPSs at the following frequencies: NYB 46%; SA 29%; CB 16%; GOM 8%; and Carolina 0.5%.

Atlantic sturgeon is an anadromous species that spawns in relatively low salinity, river environments, but spends most of its life in the marine and estuarine environments from Labrador, Canada to the Saint Johns River, Florida (Holland and Yelverton 1973, Dovel and Berggen 1983, Waldman et al. 1996, Kynard and Horgan 2002, Dadswell 2006, ASSRT 2007). Tracking and tagging studies have shown that subadult and adult Atlantic sturgeon that originate from different rivers mix within the marine environment, utilizing ocean and estuarine waters for life functions such as foraging and overwintering (Stein et al. 2004a, Dadswell 2006, ASSRT 2007, Laney et al. 2007, Dunton et al. 2010). Fishery-dependent data as well as fishery-independent data demonstrate that Atlantic sturgeon use relatively shallow inshore areas of the continental shelf; primarily waters less than 50 m (Stein et al. 2004b, ASMFC 2007, Dunton et al. 2010). The data also suggest regional differences in Atlantic sturgeon depth distribution with sturgeon observed in waters primarily less than 20 meters in the Mid-Atlantic Bight and in deeper waters in the Gulf of Maine (Stein et al. 2004b, ASMFC 2007, Dunton et al. 2010). Information on population sizes for each Atlantic sturgeon DPS is very limited. Based on the best available information, NMFS has concluded that bycatch, vessel strikes, water quality and water availability, dams, lack of regulatory mechanisms for protecting the fish, and dredging are the most significant threats to Atlantic sturgeon.

Comprehensive information on current abundance of Atlantic sturgeon is lacking for all of the spawning rivers (ASSRT 2007). Based on data through 1998, an estimate of 863 spawning adults per year was developed for the Hudson River (Kahnle et al. 2007), and an estimate of 343 spawning adults per year is available for the Altamaha River, GA, based on data collected in 2004-2005 (Schueller and Peterson 2006). Data collected from the Hudson River and Altamaha River studies cannot be used to estimate the total number of adults in either subpopulation, since mature Atlantic sturgeon may not spawn every year, and it is unclear to what extent mature fish in a non-spawning condition occur on the spawning grounds. Nevertheless, since the Hudson and Altamaha Rivers are presumed to have the healthiest Atlantic sturgeon subpopulations within the United States, other U.S. subpopulations are predicted to have fewer spawning adults than either the Hudson or the Altamaha (ASSRT 2007). It is also important to note that the estimates above represent only a fraction of the total population size as spawning adults comprise only a portion of the total population (e.g., this estimate does not include subadults and early life stages).

Atlantic sturgeon are known to be captured in sink gillnet, drift gillnet, and otter trawl gear (Stein et al. 2004a, ASMFC TC 2007). Of these gear types, sink gillnet gear poses the greatest known risk of mortality for bycaught sturgeon (ASMFC TC 2007). Sturgeon deaths were rarely reported in the otter trawl observer dataset (ASMFC TC 2007). However, the level of mortality after release from the gear is unknown (Stein et al. 2004a).

There have been a total of 136 Atlantic sturgeon caught during the 40,378 tows of the standard bottom trawl survey conducted between 1963-2012 with no fatalities. A one-time catch of 51 additional fish was taken on a herring cruise in 1982 using a bottom trawl that is no longer part of the NEFSC's operations. When sturgeon are captured, there are usually only one or two fish in the tow. These fish are the first to be removed from the catch, carefully handled, measured, weighed, tagged and quickly returned to the sea.

4.0 SUPPLEMENTAL ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

Section 4.1 evaluates the impact of each alternative on the VECs identified in Section 4 (physical environment, habitat/EFH, fishery resources, protected resources, and social and economic environment). Cumulative impacts of the proposed action in combination with other past, present, and reasonably foreseeable actions are discussed in Section 4.2.

4.1 Impacts of Alternative 1 (Proposed Action) – Conduct NEFSC Research Surveys through the Issuance of a Scientific Research Permit

4.1.1 Impacts on the Physical Environment

The impacts of NEFSC Research Survey efforts on the physical environment are anticipated to be negligible, as stated in Section 5.2.3 (Summary of Impacts) from the 2008 EA. The nature and distribution of the sampling will be similar to that described in the 2008 EA for the years 2009-2012, but reduced in intensity by about 33%. It is estimated that limitations in Days-at-Sea (DAS) in 2013 will limit sampling to 1,336 total tows as opposed to 1,994 in previous years. Compared to the no action alternative and the baseline impacts incurred as a result of commercial fishing, the proposed action is expected to have only minor, negligible impacts on the physical environment.

4.1.2 Impacts on Habitat/EFH

Habitat/EFH will also suffer negligible effects from NEFSC Research Survey efforts. The half-life habitat disturbance analysis utilized in Section 5 of the 2008 EA continues to be valid, and continues to predict the miniscule impact of survey efforts. This becomes even more true as sampling effort is reduced by 33% in 2013. Compared to the no action alternative and the baseline impacts incurred as a result of commercial fishing, the proposed action is expected to have only minor, negligible impacts on habitat/EFH.

4.1.3 Impacts on Fishery Resources

The new survey vessel (*Henry Bigelow*) and gear are able to capture one to ten times the amount of fish that the previous vessel (*Albatross IV*) did. Even with this increased catchability, the overall impact on fishery resources is likely to be minimal when compared with commercial and recreational fisheries. Several of the species for which the survey had the greatest impact in the 2008-2012 EA (blueback herring, spiny and smooth dogfish) have similar catchabilities between the two survey vessels. Even though the catchability of skates and monkfish is much higher with the *Bigelow*, the catch of skates and monkfish are less than 1 percent of the commercial landings (see Appendix 1 for a revised version of the original EA's Table 15). Compared to the no action alternative, research effort would result in a very slight increase in mortality on fish populations which would be negligible compared to commercial fishing effort.

4.1.4 Impacts on Protected Species

The larger size of the FSV *Bigelow* prevents the vessel from conducting research at some of the traditional inshore stations, where Atlantic sturgeon are most likely to occur. This factor, when combined with the proposed 2013 decrease in trawl survey effort, the shorter tow duration (i.e., 20 vs. 30 minutes), reduced tow speed (i.e., down from 3.5 to 3.0 knots), and overall yearly decrease in the number of stations (1,994 vs. 1,336), is expected to reduce the risk of incidental bycatch to marine mammals, sea turtles, and Atlantic sturgeon when compared to previous survey work analyzed under the 2008 EA. Further, when compared to the no action alternative, the minor level of interaction with protected species is not likely to result in jeopardy to any ESA-listed species or result in a substantial number of takes.

4.1.5 Impacts on the Social and Economic Environment

The NEFSC fishery-independent surveys would continue to provide indirect, downstream positive impacts to individuals and the fishing communities that rely upon commercial fisheries and the marine environment, as described in Section 5.5.2 of the 2008 EA. When compared to the no action alternative, conducting fishery-independent work would have a positive impact by providing greater confidence to management advice and allowing fleets to exploit available resources to a greater extent in the context of stock rebuilding programs than would be feasible under the no action alternative.

4.2 Cumulative Effects Analysis

Past, present, and future NEFSC survey activities likely have had a negligible impact on physical habitat, essential fish habitat, fish, social and economic environments and protected resources (see Table 16 from the original EA). The contributions of the NEFSC surveys to cumulative overall effects, taking into consideration the past, present, and reasonably foreseeable future actions that affect the resources within the survey area, have also been negligible. Proposed actions are of similar magnitude to what the agency has conducted over the past 40-45 years. The current and future functional effect of the past, present, and proposed action is approximately equivalent to adding 1.2 vessels to the groundfish fleet, 0.2 vessels to the commercial sea scallop fleet, 0.5 vessels to the commercial northern shrimp trawling fleet in the GOM, and 0.1 vessels to the commercial surfclam fleet on an annual basis. Proposed actions are likely to have a low negative impact on sea turtle populations (Table 16 from the original EA), as well as Atlantic sturgeon, where individuals are infrequently captured and rarely killed due to the survey effort and short duration of survey tows. Future surveys are likely to strive to shift to less reliance on resource capture techniques (trawls, dredges) and more dependence on sensing techniques (acoustic, optical). These trends will likely result in a reduction in the overall impact on living marine resources and their habitat.

The impacts from the proposed action when taken into consideration with past, present, and reasonably foreseeable future actions would not result in significant cumulative impacts and would do little to change the findings of the original 2008 EA.

5.0 LIST OF PREPARERS AND PERSONS/AGENCIES CONSULTED

This SEA was prepared by the Northeast Regional Office staff in the National Environmental Policy Act Group (Brian Hooper and Jennifer Anderson) as well as Northeast Fisheries Science Center Woods Hole staff (Linda Despres, Gordon Waring, Heather Haas, Katherine Sosebee, Matthew McPherson, John Kocik, James Hawkes, Nancy McHugh, William Kramer and Vince Guida (Sandy Hook, NJ)).

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6.0 COMPLIANCE WITH APPLICABLE LAWS AND EXECUTIVE ORDERS

6.1 Endangered Species Act (ESA)

Section 7 of the ESA requires Federal agencies conducting, authorizing, or funding activities that affect threatened or endangered species to ensure that those effects do not jeopardize the continued existence of listed species. For further information on the potential impact of the surveys, see Section 5.0 of this document. NMFS has determined that the surveys conducted by the NEFSC are not likely to result in jeopardy to any ESA-listed species under NMFS jurisdiction, or alter or modify any critical habitat, based on the analysis in this document and in the BO issued under the ESA section 7 consultation dated November 30, 2012 (http://www.nero.noaa.gov/Protected/section7/bo/actbo.html and titled NEFSC Research Vessel Surveys and Cooperative Gear Research Projects).

6.2 National Environmental Policy Act

Finding of No Significant Impact (FONSI)

This supplement updates the FONSI consistent with the conclusions derived in the 2008 attached EA and this document.

National Oceanic and Atmospheric Administration (NOAA) Administrative Order 216-6 (NAO 216-6) (May 20, 1999) contains criteria for determining the significance of the impacts of a Proposed Action. In addition, the Council on Environmental Quality (CEQ) regulations at 40 C.F.R. 1508.27 states that the significance of an action should be analyzed both in terms of "context" and "intensity." Each criterion listed below is relevant in making a finding of no significant impact and has been considered individually, as well as in combination with the others. The significance of this action is analyzed based on the NAO 216-6 criteria and CEQ's context and intensity criteria. These include:

1. *Can the proposed action reasonably be expected to jeopardize the sustainability of any target species that may be affected by the action?*

Response: The Proposed Action for the SEA would not jeopardize the sustainability of any of the target species because removal and mortality of target organisms by the 2013 research surveys are small, and are insignificant relative to removals by managed commercial and recreational fisheries. The biological impacts of the Proposed Action on the fishery resources are analyzed in Sections 4.1.3 and 4.2.

2. *Can the proposed action reasonably be expected to jeopardize the sustainability of any non-target species?*

Response: The proposed action for the SEA is not expected to jeopardize the sustainability of any non-allocated target species. Removal and mortality of target organisms by the 2013 research surveys are small, and are insignificant relative to removals by managed commercial and recreational fisheries. The biological impacts of the Proposed Action on the fishery resources are analyzed in Sections 4.1.3 and 4.2.

3. *Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs?*

Response: Conducting survey activities such as the proposed action does cause damage to ocean habitats and EFH through the operation of dredges and trawls, but such activity is negligible and temporary relative to total available habitat. Furthermore, because of likely recovery times and other commercial fishing activity that is currently occurring in the NEFSC survey area (Section 5.0 of original 2008 EA); the impact of the various 2013 research cruises would be negligible.

4. *Can the proposed action be reasonably expected to have a substantial adverse impact on public health or safety?*

Response: Information collected on the 2013 surfclam/ocean quahog and sea scallop dredge surveys related to Paralytic Shellfish Poison (PSP) contamination of shellfish is likely to indirectly contribute positively to public health and safety by informing scientists and managers of the presence of PSP, such that appropriate management measures, if necessary, may be taken.

5. *Can the proposed action reasonably be expected to adversely affect endangered or threatened species, marine mammals, or critical habitat of these species?*

Response: The proposed surveys occasionally take threatened or endangered species, non-listed marine mammals and other non-target species (Section 4.0). However, survey effort has decreased for 2013 which is expect to reduce takes and the surveys conducted by the NEFSC are not likely to result in jeopardy to any ESA-listed species under NMFS jurisdiction, though takes of Atlantic sturgeon, loggerhead, leatherback, Kemp's ridley, and green sea turtles are expected to occur. NMFS issued a Biological Opinion (BO) for the 2013 and 2014 NEFSC research surveys on November 30, 2012. The BO states that the proposed action may adversely affect but are not likely to jeopardize the continued existence of the NWA DPS of loggerhead sea turtles; Kemp's ridley, green, or leatherback sea turtles; or the GOM, NYB, CB, Carolina, or SA DPSs of Atlantic sturgeon

Often, scientific staff are able to collect valuable data from these specimens and return them to their environments alive. Occasionally, organisms are inadvertently killed and in these cases, we ensure that the organisms are transferred to the most appropriate scientific institution to maximize the opportunity for scientific data collection. Interactions of this type are relatively infrequent and insignificant relative to other anthropogenic activities such as commercial and recreational fishing, commercial dredging operations, and other activities in the survey area.

6. *Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?*

Response: The proposed 2013 survey activities would have negligible direct and indirect impacts on habitat, fish stocks and protected species (Section 4.1.1 and 4.1.2), and as such, do not contribute to impacts to the function of the natural resource communities and relationships within the affected area. Instead, the overall purpose of the surveys is to produce important information required to both understand and monitor biodiversity and ecosystem function within the affected area.

7. *Are significant social or economic impacts interrelated with natural or physical environmental effects?*

Response: The proposed action cannot be reasonably expected to have significant negative social or economic impacts, and as such would not result in significant negative social or economic impacts that are interrelated with natural or physical environmental effects (Section 4.5). However, the NEFSC research surveys can reasonably be expected to result in indirect positive social or economic impacts. Much of what we know about the status of fisheries and invertebrate resources and their habitats has resulted from the collection of biological and habitat data during scientific resource surveys. These surveys have the potential to result in positive social and economic benefits to society because they support the management of living marine resources and their habitats that is based upon the best scientific information available.

8. *Are the effects on the quality of the human environment likely to be highly controversial?*

Response: The proposed action is not expected to result in impacts on the human environment that are highly controversial. The impacts of the NEFSC survey activities are well documented and have been on-going for more than 40 years. As such, the interaction of the survey with elements of the human environment, including protected species, fish, and the physical environment and habitat are known and described in Section 4.1.

9. *Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, parkland, prime farmlands, wetlands, wild and scenic rivers or ecologically critical areas?*

Response: It is possible that historic or cultural resources such as shipwrecks could be present in the area where the surveys are prosecuted. However, vessels try to avoid fishing too close to wrecks due to the possible loss or entanglement of fishing gear. Therefore, it is not likely that the proposed action would result in substantial impacts to unique areas.

10. *Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?*

Response: The proposed action cannot be reasonably expected to result in substantial impacts on human environments or involve unique or unknown risks. Many of these surveys have been conducted for more than four decades and the effects on human habitat are both known and negligible. We are not aware of any unique or unknown risks.

11. *Is the proposed action, related to other actions with individually insignificant, but cumulatively significant impacts?*

Response: The proposed action cannot be reasonably expected to contribute to cumulatively significant impacts. The proposed action is similar to commercial fishing activities permitted in the NEFSC survey area and does contribute to the cumulative impacts of these activities. The functional effect of the proposed action is approximately equivalent to adding 1.2 vessels to the groundfish fleet, 0.2 vessels to the commercial sea scallop fleet, 0.5 vessels to the commercial northern shrimp trawling fleet in the GOM, and 0.1 vessels to the commercial surfclam fleet on an annual basis (Section 5.3 of the 2008 EA).

12. *Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historical resources?*

Response: Although there are shipwrecks present in areas where the proposed action surveys would occur, including some registered on the National Register of Historic Places, vessels try to avoid fishing too close to wrecks due to the possible loss or entanglement of fishing gear. Therefore, it is not likely that the proposed action would adversely affect the historic resources.

13. *Can the proposed action reasonably be expected to result in the introduction or spread of a non-indigenous species?*

Response: The NEFSC survey activities proposed cannot reasonably be expected to result in the introduction or spread of non-indigeneous species. Organisms are sampled from the environment and no new organisms are introduced through these activities. Some vessel operations will occur in deep water environments off the continental shelf, but live organisms are not transported to other areas.

14. *Is the proposed action likely to establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration?*

Response: NMFS has conducted scientific research cruises for over 40 years. The proposed action would continue this work and is not likely to establish a precedent for future actions with significant effects. The survey activities conducted by the NEFSC would likely have negligible or minor impacts on the human environment, as demonstrated by the impact assessment of this action and the 2008 EA. As such, the issuance of a SRP to support the NEFSC would not set a precedent for consideration of an action with significant impacts. Furthermore, the research conducted by the NEFSC surveys provides a unique platform specifically designed to meet a number of unique objectives; NMFS would consider future actions that may be similar in the same way.

15. *Can the proposed action reasonably be expected to threaten a violation of federal, state, or local law or requirements imposed for the protection of the environment?*

Response: To our knowledge, the proposed actions cannot be reasonably expected to threaten a violation of Federal, State or local law or requirements imposed for the protection of the environment.

16. *Can the proposed action reasonably be expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?*

Response: The proposed actions are expected to have a negligible cumulative effect that could result in a substantial effect on target and non-target species (Section 4.3). The proposed actions produce important information required to both understand and evaluate cumulative mortality and population status of both target and non-target species. The direct impact of survey activity is negligible on target and non-target species (Section 5.1). As such, the surveys conducted by the NEFSC do not contribute to or result in the cumulative adverse impact of other past, present and reasonably foreseeable future activities occurring within the survey area.

DETERMINATION

In view of the information presented in this SEA and the original EA prepared for the 2008-2012 surveys, it is hereby determined that the approval of the 2013 SRP will not significantly impact the quality of the human environment as described above and in the supporting SEA. In addition, 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.

for John K. Bullard
Regional Administrator Northeast Region, NMFS

1 MAR 2013
Date

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APPENDIX 1- Revised Table 15 from original EA- Stock Status and comparative Bottom Trawl survey catch and commercial landings values, 2007-2011

Species		Stock Status		Council	Fishery Management Plan	Average Annual NEFSC BTS	Catch Weights Commercial Landings (kg)	Survey to Commercial Ratio
	Stock	**Overfishing**	**Overfished**					
Atlantic Cod	Gulf of Maine	yes	yes	NEFMC	NE Multispecies	3771	8102599	0.0465
	Georges Bank	yes	yes					
Haddock	Gulf of Maine	yes	no	NEFMC	NE Multispecies	9301	6146879	0.1513
	Georges Bank	no	no					
Yellowtail Flounder	Cape Cod/Gulf of Maine	yes	yes	NEFMC	NE Multispecies	1918	1603609	0.1196
	Georges Bank	yes	yes					
	S. New England/Mid-Atlantic	no	no					
Witch Flounder		yes	yes	NEFMC	NE Multispecies	308	914457	0.0337
American Plaice		no	no	NEFMC	NE Multispecies	822	1234242	0.0666
Winter Flounder	Gulf of Maine	no	unknown	NEFMC	NE Multispecies	1848	2144721	0.0862
	Georges Bank	no	no					
	S. New England/Mid-Atlantic	no	yes					
White Hake		yes	yes	NEFMC	NE Multispecies	1619	1791061	0.0904
Pollock		no	no	NEFMC	NE Multispecies	910	7486649	0.0122
Redfish		no	no	NEFMC	NE Multispecies	8004	1391228	0.5753
Ocean Pout		no	yes	NEFMC	NE Multispecies	435	2762	15.749
Windowpane Flounder	Gulf of Maine/Georges Bank	yes	yes	NEFMC	NE Multispecies	358	95539	0.3747
	S. New England/Mid-Atlantic	no	no					
Halibut		no	yes	NEFMC	NE Multispecies	79	29119	0.2713
Wolffish		no	yes	NEFMC	NE Multispecies	28	29412	0.0952
Atlantic Sea Scallop		no	no	NEFMC	Sea Scallop	1720	211363673	0.0081
Monkfish	Gulf of Maine/N. Georges Bank	no	no	NEFMC & MAFMC	Monkfish	1477	9480743	0.0156
	S. Georges Bank/Mid-Atlantic	no	no					
Atlantic Herring		no	no	NEFMC & ASMFC	Herring	5850	78550673	0.0074
Silver Hake	Gulf of Maine/N. Georges Bank	no	no	NEFMC	NE Multispecies - Small Mesh	7288	7221729	0.1009
	S. Georges Bank/Mid-Atlantic	no	no					
Red Hake	Gulf of Maine/N. Georges Bank	no	no	NEFMC	NE Multispecies - Small Mesh	2637	579897	0.4547
	S. Georges Bank/Mid-Atlantic	no	no					
Offshore Hake		unknown	unknown	NEFMC	NE Multispecies - Small Mesh	65	13157	0.494
Spiny		no	no	NEFMC	Dogfish	70031	5394206	1.298

Dogfish				& MAFMC				
Red Crab		no	unknown	NEFMC	Red Crab	40	1324465	
Winter Skate		no	no	NEFMC	Skate			
Little Skate		no	no	NEFMC	Skate			
Thorny Skate		no	yes	NEFMC	Skate			
Rosette Skate		no	no	NEFMC	Skate	23439	22166776	0.1057
Barndoor Skate		no	no	NEFMC	Skate			
Smooth Skate		no	no	NEFMC	Skate			
Clearnose Skate		no	no	NEFMC	Skate			
Atlantic Salmon		no	yes	NEFMC	Atlantic Salmon			
Atlantic Mackerel		no	no	MAFMC	Atl. Mackerel/Squid/Butterfish	1788	15735197	0.0114
Long-finned Squid		unknown	no	MAFMC	Atl. Mackerel/Squid/Butterfish	3302	9668642	0.0342
Short-finned Squid		no	unknown	MAFMC	Atl. Mackerel/Squid/Butterfish	674	15271151	0.0041
Butterfish		no	unknown	MAFMC	Atl. Mackerel/Squid/Butterfish	4734	549316	0.8618
Bluefish		no	no	MAFMC & ASMFC	Bluefish	461	2779421	0.0166
Surfclam		no	no	MAFMC	Surfclam & Ocean Quahog	0.019	123798232	0
Ocean Quahog		no	no	MAFMC	Surfclam & Ocean Quahog	0.0536	125925637	0
Summer Flounder		no	no	MAFMC & ASMFC	Summer Flounder/Scup/Black Sea Bass	1150	5353876	0.0215
Scup		no	no	MAFMC & ASMFC	Summer Flounder/Scup/Black Sea Bass	2419	4279058	0.0565
Black Sea Bass		no	no	MAFMC & ASMFC	Summer Flounder/Scup/Black Sea Bass	275	782552	0.0351
Golden Tilefish		no	no	MAFMC	Tilefish	0.0978	945545	0
American Eel		unknown	yes	ASMFC	Interstate FMP for American Eel	0.6036	364434	0.0002
American Lobster	Gulf of Maine	no	no	ASMFC	Interstate FMP for American Lobster	2184	45845484	0.0476
	Georges Bank	no	no					
	Southern New England	no	yes					
Atlantic Croaker		no	unknown	ASMFC	Interstate FMP for Atlantic Croaker	4152	7345320	0.0565
Atlantic Medhaden		yes	no	ASMFC	Interstate FMP for Medhaden	160	207826459	0
Atlantic Sturgeon		unknown	yes	ASMFC	Interstate FMP for Atlantic Sturgeon	47		
Horseshoe Crab		unknown	unknown	ASMFC	Interstate FMP for Horseshoe Crab	204	839746	0.0243
Northern Shrimp		yes	yes	ASMFC	Northern Shrimp	215	4239355	0.0051
Red Drum		no	unknown	ASMFC	Red Drum	6	43147	0.0139
American Shad		unknown	yes	ASMFC	Interstate Shad & River Herring	50	67876	0.0737
Alewife		unknown	yes	ASMFC	Interstate Shad & River Herring	680	558889	0.1217
Blueback Herring		unknown	yes	ASMFC	Interstate Shad & River Herring	208	5306	3.9201

Spanish Mackerel		no	no	ASMFC	Spanish Mackerel	11	301951	0.0036
Spot		unknown	unknown	ASMFC	Spot	1050	1592117	0.0659
Spotted Trout		unknown	unknown	ASMFC	Spotted Seatrout	0.0138	32773	0
Striped Bass		no	no	ASMFC	Interstate FMP for Striped Bass	1072	3475285	0.0308
Tautog		yes	yes	ASMFC	Interstate FMP for Tautog	9	121869	0.0074
Weakfish		no	yes	ASMFC	Interstate FMP for Weakfish	570	147575	0.3862
Cusk				NEFMC	NE Multispecies	37	51813	0.0714
Smooth Dogfish		unknown	unknown		Interstate FMP for Atlantic Coastal Sharks	2672	1102326	0.2424
Roughtail Stingray					Significant Bycatch	654		
Fourspot Flounder					Significant Bycatch	1336	7254	18.427
Sea Raven					Significant Bycatch	576	1968	29.268
Spotted Hake					Significant Bycatch	1140		
Bay Anchovy					Significant Bycatch	294	148	198.64
Striped Anchovy					Significant Bycatch	237		
Round Herring					Significant Bycatch	780		
Northern Sandlance					Significant Bycatch	66	3218	2.051
Northern Sea Robin					Significant Bycatch	812	216	375.93
Icelandic Scallop					Significant Bycatch	0.0232		
Cancer Crab					Significant Bycatch	92	5748302	0.0016

Environmental Assessment

for the

Northeast Fisheries Science Center's Research Surveys

Bottom Trawl Survey

Surfclam/Ocean Quahog Survey

Sea Scallop Survey

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March 28, 2008

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Glossary of Acronyms and Terms

AA	Access Area
ADCP	Acoustic Doppler Current Profiler
ALWTRP	Atlantic Large Whale Take Reduction Plan
ASMFC	Atlantic States Marine Fisheries Commission
ATL	Atlantic
BO	Biological Opinion
BTS	Bottom Trawl Survey
C	Centigrade
CA	Closed Area
CCB	Cape Cod Bay
CH	Cape Hatteras
CM	Centimeters
CPUE	catch-per-unit effort
CTD	Conductivity, Temperature, Depth
DAS	Days-at-Sea
DSEIS	Draft Supplemental Environmental Impact Statement
DPS	Distinct Population Segment
E	East
EA	Environmental Assessment
ECOMON	Ecosystem Monitoring
EFH	Essential Fish Habitat
EEZ	Exclusive Economic Zone
EO	Executive Order
EPP	Educational Partnership Program
ESA	Endangered Species Act of 1973
FMC	Fishery Management Councils
FMP	Fishery Management Plan
FRV	Fishery Research Vessel
FSV	Fishery Survey Vessel
FV	Fishing Vessel
GB	Georges Bank
GPS	Global Positioning System
GOM	Gulf of Maine
GOMOOS	Gulf of Maine Ocean Observing System
GSC	Great South Channel
HAPC	Habitat Areas of Particular Concern
HAC	Habitat Area Closures
HCA	Habitat Closed Areas
HPA	Habitat Protection Area
HPTRP	Harbor Porpoise Take Reduction Plan
HR	Hour
ITS	Incidental Take Statement
IYGPT	International Young Gadoid Pelagic Trawl
KG	Kilograms
KHZ	kilohertz

KM	Kilometers
LMRCSC	Living Marine Resources Cooperative Science Center
M	Meters
MAB	Mid-Atlantic Bight
MAFMC	Mid-Atlantic Fishery Management Council
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation & Management Act
MID-ATL	Mid-Atlantic
MM	Millimeters
MMPA	Marine Mammal Protection Act
MARMAP	Marine Resources Monitoring Assessment & Prediction Program
MRFSS	Marine Recreational Fisheries Statistics Survey
MT	Metric Ton
N	North
NAFO	Northwest Atlantic Fisheries Organization
NCS	Northeast Continental Shelf
NE	New England
NEAMAP	Northeast Area Monitoring and Assessment Program
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NERO	Northeast Regional Office
NLA	Nantucket Lightship Area
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
PDT	Plan Development Team
PSP	Paralytic Shellfish Poison
S	South
SARC	Stock Assessment Review Committee
SAW	Stock Assessment Workshop
SNE	Southern New England
SRP	Scientific Research Permit
STA	Station
STSSN	Sea Turtle Stranding and Salvage Network
TEWG	Turtle Expert Working Group
TAC	Total Allowable Catch
US	United States
USFWS	US Fish and Wildlife Service
VEC	Valued Ecosystem Component
VTR	Vessel trip report
W	West
WGOM	Western Gulf of Maine

1.0 Introduction

Since 1963, the National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center (NEFSC), has been conducting research cruises to supply fishery managers with important information on marine ecosystems and the status of fish stocks. The various NEFSC surveys are designed to improve the quality of fish, shellfish, invertebrate and benthic resource data that are ultimately used for assessment, habitat designation and management/regulatory purposes (Reid et al. 1999). This environmental assessment (EA) describes the environmental impact of issuing a scientific research permit (SRP) that authorizes the NEFSC to conduct its research surveys in 2008 and evaluates the proposed 5-year (2008-2012) continuation of current and future fishery resource and ecosystem-based research cruises conducted by the NEFSC.

As stipulated under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) of 1996, the fish off the coasts of the United States (US), the highly migratory species of the high seas, the species which dwell on or in the continental shelf within the United States' exclusive economic zone (EEZ; 3-200 miles), and the anadromous species which spawn in US rivers or estuaries, constitute valuable and renewable natural resources. These fishery resources contribute to the food supply, economy, and health of the Nation and provide recreational opportunities.

Two of the main purposes of the Magnuson-Stevens Act 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 which will achieve and maintain, on a continuing basis, the optimum yield from each fishery. The 10 national standards of the Magnuson-Stevens Act require that fishery management plans 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 habitats, and to realize the full potential of the nation's fishery resources. Furthermore, the Magnuson-Stevens Act 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 various resource and research surveys conducted by the NEFSC are designed to meet the requirements of the Magnuson-Stevens Act by providing the best scientific information available to fishery conservation and management scientists and managers, and that will support a management program that is able to respond to changing ecosystem conditions, and to manage risk by developing science-based decision tools.

The US 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 comprise a broader ecosystem monitoring program that meets this emerging critical need. The potential effects of survey activities must be weighed against the risk of in-adequately characterizing the state of the ecosystem and potential human impacts on the system.

The main focus of this EA will concentrate on the NEFSC's bottom trawl survey since it has the longest time series (initiated in the fall of 1963) and covers the broadest geographic area (from just south of Cape Hatteras to the western Scotian Shelf). It operates in depth zones between 10-365 meters (m) (although the deepwater biodiversity survey operates in depths between 1000-2000 m). This seasonal trawl survey is the most highly scientifically respected, continuously operated, multispecies survey in the world.

The entire area surveyed by all of the various NEFSC research surveys encompasses approximately 100,000 square nautical miles. Subsequent to the stratified random design of the bottom trawl survey, other types of bottom or mid-water trawl, dredge, and miscellaneous surveys began their time series (Table 1). This EA will describe the purpose and specifics of each type of survey in Sections 2.2 and 3.1.

Table 1. Total number of stations sampled on surveys from 1963 - 2007

	Bottom Trawl Surveys:							Dredge Surveys:		Pelagic Surveys:		Miscllaneous:	
year	**Winter BTS[1]**	**Spring BTS**	**Summer BTS**	**Fall BTS**	**Shrimp**	**Benthic**	**LMRCSC[2]**	**Sea Scallop**	**Surfclam**	**Atl. Herring**	**Deepwater**	**EcoMon[3]**	**GoMOOS[4]**
1963			181	194									
1964	194		176	185									
1965	177		186	193									
1966	192			194				198					
1967				276									
1968		265		279									
1969		268	267	282									
1970		342		312									
1971		419		334									
1972	56	366		646									
1973		495		451									
1974		416		379									
1975		303		406				243					
1976		384		340									
1977		354	291	419				333				1846	
1978	88	398	337	556				374	509			2077	
1979		477	303	600				306	138			1134	
1980		468	325	420				369	411			1030	
1981	86	395	164	421				344				1023	
1982		443		449				439	299			897	
1983		428		476	22			615	396			968	
1984		407		433	39			699	448			1133	
1985		391		368	55			573				1269	
1986		368		364	54			505	334			1307	
1987		349		335	57			651				1479	
1988		321		326	44			619				704	
1989		299		342	49			435	361			467	
1990		322		345	48			468				861	
1991		333	84	354	56			437				805	
1992	138	326	120	353	57			424	496			917	
1993	125	329	149	339	53			448				926	
1994	164	345	71	341	49			482	538		44	486	
1995	155	335	82	360	53			561				681	
1996	140	350		365	58			453				576	
1997	130	345		369	55			496	472			531	
1998	138	374		374	61			570		68		550	
1999	148	329		346	61	46		404	606	38	54	608	
2000	130	333		337	55	45		510		52	25	579	
2001	175	325		339	57	45		553		56		608	
2002	159	331		342	54	75		535	556	49	20	734	
2003	107	332		336	62			504		25	22	481	
2004	140	332		319	54	46		596		29	16	607	
2005	108	334		332	68	52	35	538	433	52	27	440	4
2006	132	344		367	54	34	19	536		55	18	660	5
2007	139	363		349	79	34	29	591				612	3
Total # sta	**3021**	**14438**	**2736**	**16247**	**1354**	**377**	**83**	**15809**	**5997**	**424**	**226**	**26996**	**12**

[1]BTS = Bottom Trawl Survey
[2]LMRCSC = Living Marine Resources Cooperative Science Center
[3]EcoMon = Ecosystems Monitoring
[4]GoMOOS = Gulf of Maine Ocean Observing System

2.0 Purpose and Need for the NEFSC Research Surveys

The continued operation of the various NEFSC research surveys through the issuance of an SRP is needed to collect high quality, standardized, fisheries-independent data. The purpose of the NEFSC stratified random bottom trawl, sea scallop, surfclam/ocean quahog and northern shrimp surveys is to provide data on abundance, distribution, feeding ecology, and size and age composition of stocks of economically and ecologically important species, as well as oceanographic and plankton data, for the purposes of monitoring the health and status of marine resources and their habitats. The data are vital for assessment and a wide variety of research programs and are used to provide the scientific foundation for management programs with an ecosystem-based framework.

To evaluate the status of exploited fishery resources, NMFS must collect and analyze many different kinds of information. Basic landings statistics (including the numbers and weight of each species landed) and demographic data (such as length and age samples) are needed to characterize what is brought ashore. At-sea sampling aboard commercial fishing vessels is used to establish the numbers and length/age composition of animals culled overboard. Telephone recall and roving samplers are used to estimate recreational catches. Effort data collected with catches are combined into indices of stock abundance based on catch-per-unit-effort (CPUE) ratios. Data from these 4 types of surveys are generally referred to as fishery-dependent information: these data are derived directly from the commercial and recreational fisheries.

Fishery-dependent data are vital to our ability to monitor stocks, and for some species is often the only reliable source of data. However, use of fishery-dependent data alone may severely limit NMFS' ability to evaluate and make predictions about the status of some stocks. For example, in fisheries heavily dependent on the yearly incoming age group (the new recruits), fishery-dependent data alone cannot be used to forecast catches because very small fish are generally not taken with standard fishing gear. Likewise, CPUE may not be a reliable measure of abundance for schooling species, or when the increase in fishing technology cannot be factored into the relationship between catch and fishing effort. Consequently, fishery scientists throughout the world conduct research vessel sampling programs to gather fishery-independent information (Clark 1981).

2.1 General Objectives of the Fishery Independent Surveys

Fishery-independent surveys, (i.e., bottom trawl, sea scallop, surfclam/ocean quahog and northern shrimp) which monitor the northeast fishery resources are conducted for six important reasons as described below:

2.1.1 To monitor recruitment

Research surveys are generally conducted with sampling gear equipped with smaller mesh than is allowed in most fisheries. Small-mesh gear is used in order to estimate the abundance of very small animals that will eventually become large enough to be caught in standard fishing gear. To predict future landings and stock sizes, we must estimate the survival of fish already large enough to be retained by harvesting gear as well as the incoming recruitment to the fishery each year. 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.

For some species, however, growth rates are much faster, and thus the time interval between when fish are detected by the surveying gear and when they are landed by the fisheries is much shorter. In the case of the Atlantic sea scallop, annual dredge surveys are conducted.

2.1.2 To monitor abundance and survival of harvestable sizes

Research vessel samples generally span the full size and age range of a population on the 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. 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. 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. Thus, dredge surveys conducted in the 1960s and 1970s were the only source of information on the abundance of the ocean quahog resource of the Mid-Atlantic (Mid-Atl), Southern New England (SNE) and Georges Bank (GB) areas. Minimum population estimates were made by expanding the average catch-per-square-nautical-mile from the surveys by the number of square nautical miles 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.

2.1.3 To monitor the geographic distribution of species

Some species lead sedentary lives while others are highly migratory. Research vessel surveys conducted over multiple seasons per year are a major source of data on the movement patterns and geographic extent of stocks. Distribution maps can be drawn from reports of fishermen, but these may give a biased picture of the stock, emphasizing only where high density fishable concentrations exist. Distribution data are important not only for fishery management, but also for evaluating the population level effects of pollution and environmental change.

2.1.4 To 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 northeastern US continental shelf waters (Appendix 1a-g). Many of these species are relatively rare, and have little or no commercial or recreational value. However, when we evaluate the effect of intensive harvesting on selected species, we can observe the response of the entire animal community. The dramatic changes in the system reflect the depletion of several important commercial fishery species, such as haddock, yellowtail flounder, pollock, and American plaice, 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 multispecies surveying approach thus provides an important research opportunity in the emerging field of ecosystem-based management.

2.1.5 To monitor biological rates of the 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 4 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.

2.1.6 To 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, pollution levels, etc.) and to allow other researchers to piggyback on surveys to collect a host of data not directly related to the 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.

2.2 Specific Objectives of each Survey Type

The specific purposes and objectives of each of the NEFSC's 11 types of research surveys are described below.

2.2.1 Spring and Autumn Bottom Trawl Surveys

The purposes of the seasonal bottom trawl surveys are to: collect data on species composition, biomass, relative abundance, and distribution of living marine resources; record size, age, sex, and reproductive condition for target species; collect environmental data coincident with living marine resource monitoring activities; provide biological specimens to cooperating agencies and other investigators upon request, subject to time and space limitations; and to manage and disseminate data collected by the survey.

The NEFSC bottom trawl surveys are universally recognized as the most scientifically valuable and longest time series of fisheries-related data in the world. In addition to tracking mature animals, these surveys provide indices of juvenile abundance, which can indicate strong year classes before fish are vulnerable to commercial or recreational fisheries. Bottom trawl surveys assess the status of a stock over its entire distribution range, not just in small areas of commercial or recreational concern. These seasonal surveys also provide data to help monitor the processes of growth, maturity, predation, and mortality of a stock as well as trophic dynamics of fish communities. Results from these fishery independent cruises are vital for assessment biologists and fishery managers who work in close collaboration with the New England and Mid-Atlantic Fishery Management Councils (MAFMC) to develop management measures for the rebuilding and maintenance of overfished stocks.

2.2.2 Spring and Autumn Bottom Trawl Calibration Trials

The purposes of the seasonal bottom trawl calibration trials are to calibrate current bottom trawl surveys conducted with a # 36 Yankee trawl aboard the National Oceanographic and Atmospheric Administration (NOAA) Fishery Research Vessel (FRV) *Albatross IV* with future surveys conducted using a 4-seam, 3-bridle bottom trawl that will be used aboard the Fishery Survey Vessel (FSV) *Henry B. Bigelow*.

Efforts have been made to maintain a standard trawl time series for over 4 decades. However, changes to the vessels, trawls, and trawl doors have been inevitable. These trials are necessary to ensure comparability of survey indices over time and to perform statistical evaluations of sampling adequacy. These are experiments designed to yield a correction factor for changes in survey equipment and vessels. These surveys, which involve an enhanced sampling effort, will only be conducted during 2008.

Due to the ship's draft and safety requirements, the FSV *Henry B. Bigelow*, will not be able to conduct survey operations in waters shallower than ten fathoms. Approximately 30-35 previously sampled inshore stations will not be completed between Long Island, New York and Cape Fear, North Carolina. This area will now, and in the future, be covered by the Northeast Area Monitoring and Assessment Program (NEAMAP) which primarily operates in waters between 3-18 fm.

2.2.3 Benthic Habitat Survey

The objectives of the benthic habitat survey are to: characterize the benthic habitat and fish productivity on the outer continental shelf adjacent to the Hudson Canyon and GB; identify overwintering habitats of juvenile seasonal migrant species; collect acoustic bottom data to create maps of habitat areas of interest; look for tropical/subtropical species as indicators of climate change; document relationships to other ecosystem components and substrates; continue monitoring recovery and productivity of untrawled gravel habitats in Habitat Areas of Particular Concern (HAPC) on northeastern GB (as compared to nearby trawled habitats); and to ground truth existing multi-beam imagery to create habitat maps.

This cruise works to assess the degree and extent of disturbance by commercial trawling. It also investigates the changes that occur as a benthic ecosystem recovers from chronic fishing impacts.

2.2.4 Northern Shrimp Survey

The objectives of the Atlantic States Marine Fisheries Commission (ASMFC) northern shrimp survey are to: determine the distribution and relative abundance of northern shrimp in the western Gulf of Maine (WGOM); collect biological specimens and data relating to the age and size composition of the northern shrimp stock; collect biological data for other Gulf of Maine (GOM) species in support of NEFSC research objectives; and to conduct shrimp trawl mensuration work to characterize net geometry.

This survey provides a unique glimpse of the inshore GOM during a period not otherwise surveyed. It enables managers to have real time stock assessment information when the upcoming season's regulations are set each fall.

2.2.5 Living Marine Resources Cooperative Science Center (LMRCSC) Survey

The purpose of this survey is to provide scientific personnel of NOAA's LMRCSC the opportunity to study marine fish diversity and composition along latitudinal gradients of the northwestern Atlantic Ocean with the objective of examining species diversity and biomass at stations along the Atlantic coast. It also provides experience to graduate and undergraduate students who are engaged in academic programs in the marine sciences.

Through NOAA's Educational Partnership Program (EPP), this survey provides experience for the students and insight into the planning and onboard management of multi-sampling and multi-project cruises, in anticipation of more inclusive kinds of cruise programs that will be demanded in support of ecosystem-based fisheries management.

2.2.6 Sea Scallop Survey

The objectives of the sea scallop survey are to: determine the distribution and relative abundance of the sea scallop and Iceland scallop; collect biological samples and data relative to assessment needs; monitor hydrographic and meteorological conditions; and collect biological samples requested by scientists at various research institutions and laboratories.

This survey monitors the distribution, abundance, and recruitment patterns of the sea scallop resource in US offshore waters from Cape Hatteras to GB. Data collected on this survey were used to create the essential fish habitat source document on sea scallops (Hart and Chute 2004).

2.2.7 Surfclam/Ocean Quahog Survey

The objectives of the surfclam/ocean quahog survey are to: determine the distribution and relative abundance, and collect biological data for surfclams and ocean quahogs in continental shelf waters, from the Delmarva Peninsula to GB.

This shellfish survey is needed to monitor and evaluate the distribution, abundance, and size composition of Atlantic surfclam and ocean quahog populations off the northeast coast between Cape Hatteras and GB. The survey was initially designed to monitor the surfclam population; however, as the ocean quahog industry grew, the survey was expanded to monitor that species as well. This survey is the main source of data to indicate fishery independent trends in surfclam and ocean quahog biomass and also provides indices of abundance and recruitment for both species.

2.2.8 Atlantic Herring Survey

These annual surveys are conducted each autumn on the historical spawning grounds of the Atlantic herring. The main goal of this cruise is to provide timely and accurate fisheries-independent estimates of herring spawning stock biomass using state-of-the-art technologies. Operational objectives are to: calibrate the EK500 Scientific Sounder; and participate in multi-institutional and multi-vessel advanced sampling and acoustic technology experiments on GB; conduct performance tests and evaluate the new Advanced Fisheries Tow Vehicle; conduct systematic surveys of selected Atlantic herring spawning stocks; and collect biological data to verify species measurements using midwater trawls and underwater video, which ultimately improves the accuracy and precision of population estimates for management and conservation of living marine resources.

2.2.9 Deepwater Biodiversity Survey

The primary objective of the deepwater biodiversity survey is to collect fish, cephalopod, and crustacean specimens from depths ranging from 1000 - 2000 m.

These collections are used for tissue samples, photographs of freshly collected specimens, documentation of systematic characters, and voucher specimens placed at the National Museum of Natural History and the Museum of Comparative Zoology. These specimens and observations contribute to several Census of Marine Life projects. Additionally, the cruise provides educational experience in deep-sea biology to college students.

2.2.10 Ecosystem Monitoring Survey

The primary objective of the ecosystem monitoring (EcoMon) survey is to assess changing biological and physical properties which influence the sustainable productivity of living marine resources in the northeast US continental shelf ecosystem. Key parameters measured for this survey include ichthyoplankton and zooplankton composition, abundance and distribution, plus water column temperature and salinity. Near-surface along-track chlorophyll-a fluorescence, water temperature and salinity are measured while underway with the vessel's flow-through sampling system. Occasionally, the shipboard Acoustic Doppler Current Profiler (ADCP) is run during these cruises to provide comparative data with moored current profilers stationed throughout the ecosystem.

The ichthyo- and zooplankton samples are processed, the specimens saved, and the data entered into a database. The water column and along-track hydrographic data also are processed and entered into a database. These data, individually and in combination, contribute to numerous research and management activities. The ADCP data is more limited with the instrument running on some, but not all, surveys. The ADCP data have been used for research projects, but is currently not part of the operational activities of the EcoMon survey.

2.2.11 Gulf of Maine Ocean Observing System (GoMOOS) Mooring Cruise

The primary objective of the GoMOOS mooring cruise is to service oceanographic moorings that are operated by the University of Maine.

The mooring service operations include retrieving and deploying oceanographic moorings in the GOM. The shipboard ADCP is run occasionally during these cruises. These data are processed onshore and used in strictly an evaluative role and not operationally.

The provision of shiptime to GoMOOS is one contribution of the NEFSC to the regional ocean observing effort. The University of Maine maintains numerous oceanographic moorings in the GOM as part of a regional ocean observing effort and is responsible for the mooring activities.

3.0 Alternatives

3.1 Alternative 1 (Proposed Action) – Conduct NEFSC Research Surveys through the Issuance of a Scientific Research Permit

During the next 5 years, the NEFSC proposes to conduct 11 types of surveys utilizing the FRVs *Albatross IV,* and *Delaware II*, RVs *Gloria Michelle*, and *Hugh R. Sharp*, and FSV *Henry B. Bigelow* (for detailed descriptions of each vessel, go to http://www.nefsc.noaa.gov/esb/ under the ships link*)*.

The FSV *Henry B. Bigelow* was brought online to replace the FRV *Albatross IV*; however, both the FRV *Albatross IV* and FSV *Henry B. Bigelow* will be operating together to conduct the spring and autumn bottom trawl survey and calibration trails during 2008. The RV *Hugh R. Sharp* will be brought online in 2008 to replace the FRV *Albatross IV* for the sea scallop survey.

During 2008, these 11 surveys are projected to cumulatively take 520 days-at-sea (DAS) to complete and to sample a total of 3200 sites along the continental shelf, ranging from North Carolina to the GOM. In more typical years, from 2009-2012, after the completion of the bottom trawl calibration trials and when the triennial surfclam/ocean quahog survey is not taking place, survey activities are projected to take 350 DAS and sample a total of 1994 sites per year.

For the purpose of analysis, the research activities are grouped into 4 categories based upon the type of gear used (Table 2):

- bottom trawl surveys (spring and fall standard BTS, calibration, benthic, northern shrimp and LMRCSC),
- dredge surveys (sea scallop and surfclam/ocean quahog),
- pelagic surveys (Atlantic herring, deepwater biodiversity), and
- miscellaneous (EcoMon, GoMOOS)

Surveys which conduct the same activity at different times of the year or the same activity done at different locations are listed together. A SRP would be required to be issued annually for the operation of the NEFSC surveys; however this EA will analyze the impacts of the operation of these surveys for the next 5 years (2008-2012).

3.1.1 Bottom Trawl Surveys:

3.1.1.1 Spring and Autumn Bottom Trawl Surveys

Standard bottom trawl surveys have been conducted annually since 1963 (Table 1) and sample waters from North Carolina to the Scotian Shelf, including the GOM (Figure 1), using the FRVs *Albatross IV*, *Delaware II* and RV *Atlantic Twin* (Azarovitz 1981). In the past, approximately 712 stations were sampled each year during the months of March through April and September through October (~96 DAS). The survey uses a standardized # 36 Yankee bottom trawl equipped with rubber discs (spaced 15 inches apart), chain sweep, and 450 kilogram (kg) poly-valent doors. The cod end and upper belly are lined with 1/2-inch mesh to retain young-of-the-year fish (for more detailed information on this net, go to: http://www.nefsc.noaa.gov/esb/ and search under the FAQ/gear used link). The gear is towed at 3.8 knots for 30 minutes (Table 2**).**

Starting in 2008, the trawl survey aboard the FRV *Albatross IV* will expand the number of sampling stations to approximately 456 stations per season, as the winter trawl survey was discontinued in 2007 and a portion of that effort (~100 stations) has been redirected into the spring and fall bottom trawl surveys. As a result, the spring survey will begin in February and end in May and the fall survey will begin in September and end in November (~134 DAS).

3.1.1.2 Spring and Autumn Bottom Trawl Calibration Trials

The NEFSC will be calibrating current surveys conducted with the # 36 Yankee bottom trawl on the FRV *Albatross IV* with future surveys using a 4-seam, 3-bridle bottom trawl (for more information on this net, go to: http://www.nefsc.noaa.gov/esb/ and search under the FAQ/gear used link) on the FSV *Henry B. Bigelow* during the months of February – May and September – November, 2008.

The calibration trials will consist of a total of 456 stations (~67 DAS) each season that will be sampled along the Atlantic Coast (NC to the GOM) (Figure 1) by the FSV *Henry B. Bigelow*. These stations will be similar to those sampled by the FRV *Albatross IV* during the spring and autumn bottom trawl surveys. The 3-bridle bottom trawl will be towed at 3.0 knots for 20 minutes (this will become the new 'standard' towing speed and tow duration which is a decrease from the FRV *Albatross IV's* current towing speed of 3.8 knots for 30 minutes). These calibration studies will only be conducted during 2008 and will constitute a yearly total of approximately 134 DAS (Table 2).

3.1.1.3 Benthic Habitat Survey

Benthic habitat surveys have been conducted periodically since 1996 (Table 1) using FRVs *Albatross IV*, and *Delaware II*, and in the future, the FSV *Henry B. Bigelow*. Approximately 40 stations are sampled each year on GB (Figure 2) during the months of October – November (~11 DAS). On the Mid-Atl survey, approximately 54 bottom trawl stations are sampled each year in and around the Hudson Canyon during the month of August (~11 DAS).

The surveys use the # 36 Yankee bottom trawl (previously described in Section 3.1.1.1) and is towed at 3.8 knots for 30 minutes. In order to obtain samples of benthic species, at each station, a 1 m Naturalist dredge (for more information on this dredge, go to: http://seagrant.gso.uri.edu/research/georges_bank/Sampling%20Design.htm) is towed along the seafloor for 30 to 60 seconds at 2-3 knots, sampling 30-90 square m (Table 2). Additionally, at each station, benthic samples (0.1 square m) are taken of the top 20 centimeters of the sea floor using a Van Veen grab (for more information on this grab, go to: http://woodshole.er.usgs.gov/operations/sfmapping/seaboss.htm).

Table 2. General summary description of surveys

Survey Type	Vessel used*	Survey frequency	Gear used	Tow Speed (knots)	Tow Duration (minutes)	General Area of Operation[1]	Yearly Ave # of Tows	Yearly DAS
Bottom Trawl								
Standard BTS	*AL IV / DE II*	spring & fall	#36 Yankee w/ roller gear	3.8	30	CH to W. Scotian Shelf	712	134
Calibration	*H.B. Bigelow*	spring & fall	4-seam, 3 bridle net	3	20	CH to W. Scotian Shelf	712	134
Benthic	*AL IV / DE II*	yearly	#36 Yankee w/ roller gear	3.8	30	Hudson Canyon/ GB	54	22
			0.1 m Van Veen sediment grab	0	0	Hudson Canyon/ GB	29	
			1m Naturalist dredge	2-3	1	Hudson Canyon/ GB	5	
Northern Shrimp	*G. Michelle*	yearly	4-seam modified commercial shrimp trawl	2	15	Gulf of Maine	54	21
LMRCSC	*AL IV / DE II*	yearly	#36 Yankee	3.8	30	Mid-Atlantic Bight	25	11
			2m beam trawl,single wire	2	15	Mid-Atlantic Bight	6	
			0.1 m Van Veen sediment grab	0	0	Mid-Atlantic Bight	6	
Dredge								
Sea Scallop	*AL IV & Sharp*	yearly	2.44 meter New Bedford type drege	3.8	15	North Carolina to GB	494	36
Surfclam / Ocean Quahog	*DE II*	every 3 years	hydraulic-jet dredge, 60-inch blade	1.5	5	S. Virginia to GB	428	36
Pelagic								
Atlantic Herring	*DE II*	fall	Gourock High Speed Midwater Rope Trawl	4	5-30	GOM & N. GB	47	34
Deepwater Biodiversity	*AL IV / DE II*	yearly	International Young Gadoid Pelagic Trawl	1.5-2.5	60	W. North Atlantic	18	16
			#36 Yankee w/ roller gear	1.5-2.5	60	W. North Atlantic	10	
Miscellaneous								
EcoMon	*AL IV / DE II / H.B. Bigelow*	quarterly	300 or 150 kHz ADCP on vesssel	all	continuous	CH to W. Scotian Shelf	800 km /yr	64
			61 cm bongo net	1.5-2	5-15	CH to W. Scotian Shelf	600	
			CTD profiler					
GoMOOS	*DE II*	spring	300 kHz ADCP on vesssel	all	continuous	Gulf of Maine	50 km /yr	12
			300 and 75 kHz ADCP on moorings	0	continuous	Gulf of Maine		
						Total	3200	520

**AL IV* - FRV *Albatross IV*
H.B.Bigelow - FSV *Henry B. Bigelow*
DE II - FRV *Delaware II*
G Michelle - RV *Gloria Michelle*
Sharp - RV *Hugh R. Sharp*

[1]CH - Cape Hatteras
GB - Georges Bank

3.1.1.4 Northern Shrimp Survey

The ASMFC northern shrimp survey has been conducted annually since 1984 (Table 1) and samples waters in the WGOM (Figure 3) using the RV *Gloria Michelle*. Approximately 54 stations are sampled each year during the months of July and August (~21 DAS). The survey uses a NEFSC shrimp bottom trawl (for more information on this net, go to: http://www.nefsc.noaa.gov/esb and search under the FAQ/gear used link) and is towed at 2 knots for a 15-minute tow (Table 2).

3.1.1.5 Living Marine Resources Cooperative Science Center Survey

NOAA's LMRCSC survey has been conducted on the Mid-Atlantic Bight (MAB) continental shelf (Figure 4) each January (~11 DAS) since 2005 (Table 1) on either the FRVs *Albatross IV* or *Delaware II*. Approximately 25 stations are sampled on each survey. At each station, two random trawls are conducted using either a # 36 Yankee bottom trawl (previously described in Section 3.1.1.1) towed for 30 minutes at 3.8 knots, or a beam trawl (for more information on this net, go to: http://www.oceansatlas.org/world_fisheries_and_aquaculture/html/tech/capture/h/gearsmeth/geartype/gt305.htm), towed for 15 minutes at 2 knots (Table 2). Additionally, at each station, benthic samples are taken of the top 20 centimeters (0.1 square m) of the sea floor using a Van Veen grab (previously described in Section 3.1.1.3).

3.1.2 Dredge Surveys:

3.1.2.1 Sea Scallop Survey

The sea scallop survey has been conducted annually since 1982 (Table 1) and samples waters off Cape Hatteras, to the Scotian Shelf, using the FRV *Albatross IV*. An average of 494 stations have been sampled each year during the months of July and August (~36 DAS) in the Mid-Atl/GB area (Figure 5). The survey uses a NEFSC 8-foot sea scallop dredge equipped with a 2-inch ring chain bag and lined with 1-1/2 inch mesh webbing to retain small sea scallops (for more information on this dredge, go to: http://www.nefsc.noaa.gov/esb and search under the FAQ/gear used link). The dredge is towed at 3.8 knots for 15-minute tow intervals (Table 2).

In 2008, the RV *Hugh R. Sharp* will conduct the sea scallop survey. The total number of stations sampled (i.e., 500), tow speeds, and tow times are expected to remain the same.

3.1.2.2 Surfclam/Ocean Quahog Survey

This survey has recently been conducted once every 3 years (Table 1) in continental shelf waters, from Delmarva Peninsula to GB (Figure 5) aboard the FRV *Delaware II*. Approximately 428 stations are sampled each survey year during the months of May-June (~36 DAS). Five-minute tows are made at the speed of 1.5 knots with a hydraulic jet dredge equipped with a 5-foot wide blade and submersible pump positioned on the dredge (for more information on this dredge, go to: http://www.nefsc.noaa.gov/esb and search under the FAQ/gear used link) (Table 2).

3.1.3 Pelagic Surveys:

3.1.3.1 Atlantic Herring Survey

This survey has been conducted annually since 1997 (Table 1) and samples waters on GB and in the WGOM (Figure 6) using FRV *Delaware II*. Approximately 47 stations are sampled each year during the month of September (~34 DAS). The survey uses a Gourock high speed midwater rope trawl with 53.1-m headropes and footropes (for more information on this net, go to: http://www.nefsc.noaa.gov/femad/ecosurvey/acoustics/index.html) towed at 4.0 knots for 5 to 30 minutes (Table 2).

3.1.3.2 Deepwater Biodiversity Survey

The deepwater biodiversity survey has been conducted periodically since 1994 (Table 1) using FRV *Delaware II*. This survey samples waters of the western north Atlantic in the area between and including Bear Seamount and Physalia Seamount **(**Figure 7) in depths up to 2000 m. Approximately 28 stations are sampled each spring (~16 DAS). Each year, on average, 18 midwater trawls are made at selected stations over and around Bear and Physalia Seamounts and the area between them using an International Young Gadoid Pelagic Trawl (IYGPT) (for more information on this net, go to: http://www.nefsc.noaa.gov/esb/ and search under the FAQ/gear used link). On average, 10 bottom trawls are deployed using a NEFSC standardized, roller rigged, # 36 Yankee otter trawl (previously described in Section 3.1.1.1). Both trawl types are towed at 1.5-2.5 knots for 60 minutes (Table 2).

3.1.4 Miscellaneous:

3.1.4.1 Ecosystem Monitoring Survey

The EcoMon survey has been conducted in one form or another since 1977 (Table 1), with the beginning of the Marine Resources Monitoring Assessment and Prediction Program (MARMAP). Waters from Cape Hatteras, to the western Scotian Shelf are surveyed. In the survey's current format (from ~1994), 6 surveys are conducted per year: 4 with dedicated shiptime (~16 DAS each) and 2 piggybacked on the annual spring and autumn bottom trawl surveys. Approximately 30 stations are sampled in 4 regions (MAB, SNE, GB, and GOM) during each survey (Figure 1). Station locations are based on a random-stratified design similar to the bottom trawl survey design. Sampling occurs with a 61cm bongo net with 333 μm nets and a SeaBird conductivity, temperature, depth (CTD) sensor (for more information, go to: http://www.nefsc.noaa.gov/epd/ocean/MainPage/Projects.html). Typically these gears are deployed together and a double oblique tow is made at 1.5-2 knots (Table 2). Approximately 200 m^3 of water is sampled.

During these cruises, the shipboard ADCP is occasionally run. The ADCP aboard the FRVs *Delaware II* and *Albatross IV* is a 300 kHz broadband and the ADCP aboard the FSV *Henry B. Bigelow* is a 150 kHz Ocean Surveyor (for more information on the ADCP, go to: http://www.rdinstruments.com/surveyor.html). The trial efforts of the NEFSC with the ADCP started in the mid-1990s, and continues today (for more information, go to: http://www.nefsc.noaa.gov/epd/ocean/MainPage/adcp/Adcp.html). Quantifying the use of the ADCP during EcoMon surveys is difficult because these instruments are not part of the operational data collection. A typical survey covers about 4000 kilometers (km) of cruise track and the ADCPs are on for, at most, 5% of the time. Thus, the annual estimate of shiptrack with the ADCP in operation is approximately 800 km/yr. The FSV *Henry B. Bigelow* is planning to develop ADCP operational products, so the use of this equipment is expected to increase.

3.1.4.2 Gulf of Maine Ocean Observing System Mooring Cruise

During the University of Maine's GoMOOS mooring cruises, which started in 2005 (Table 1), various sites in the GOM (Figure 8) are visited and moorings serviced or replaced. There are currently 12 moorings deployed throughout the GOM, with emphasis on the western coast.

More information regarding these moorings can be obtained at: http://gyre.umeoce.maine.edu/GoMoos/gommrg.phtml. More information regarding specific buoys can be found at: http://gyre.umeoce.maine.edu/data/gomoos/buoy/html/B01.html. These moorings are equipped with numerous oceanographic sensors and have either a 300 kHz or 600 kHz ADCP, which operate continuously.

The shipboard ADCP is occasionally run during these cruises. The ADCP aboard the FRV *Delaware II* is a 300 kHz broadband (for more information on the ADCP, go to: http://www.rdinstruments.com/surveyor.html. Quantifying the use of the ADCP during GoMOOS mooring cruises is difficult because the data is for evaluative purposes only. GoMOOS cruises cover, at most, 500 km of shiptrack and the ADCP is in operation, at most, 10% of the time. Thus, the annual estimate of shiptrack with the ADCP in operation is approximately 50 km/yr. Fewer GoMOOS moorings may be deployed in the future, so the amount of ADCP shiptrack on these cruises may decrease.

3.1.5 Future Studies

During the summer of 2008, the NEFSC sea scallop survey may take a more integrated survey approach by using a combination of sampling methods. Direct sampling (dredge), optical sensing (video), and acoustic (multibeam sonar) technologies continue to be developed and evaluated. Combined sampling methods could make the survey more precise and yield significant benefits by reducing biomass removal, minimizing habitat interactions and reducing bycatch.

The NEFSC has been working cooperatively with industry partners to redesign the sea scallop survey dredge to increase its capture efficiency and consistency. The Center has also recently completed a 4 year study on the effects of chain mats on survey dredge efficiency. As a result of these processes, the Center intends to adopt and utilize survey dredges outfitted with chain mats beginning in 2008. The chain mats are intended to exclude large rocks from entering the dredge, but were also intentionally designed to comply with turtle chain excluder regulations implemented for the commercial fishery.

The current “chain mat” rule (71 FR 66466, November 18, 2006) requires the use of turtle chain mats on dredge gear. However, the language in the rule states that the requirement only applies to vessels “. . . with a sea scallop dredge and required to have a Federal Atlantic sea scallop fishery permit . . . .” The Magnuson-Stevens Act does not regulate research that does not meet the definition of “fishing” (50 CFR 600.10) as is the case with this research project. Since the vessels to be used in the NEFSC survey cruises are not required under the Magnuson-Stevens Act to have a Federal Atlantic sea scallop fishery permit in order to conduct their studies (including towing dredge gear), the vessels are not required to use a chain mat on the dredge gear when they are towing the gear for research purposes. The effects of the proposed action on ESA-listed species under NMFS jurisdiction were considered and the incidental take authorization provided by the August 20, 2007 Biological Opinion (BO) applies to these vessels while they are participating in the noted NEFSC survey cruise activities.

Gear testing of various nets, doors, dredges, or sensor monitoring equipment is needed from time to time for bottom trawl and shellfish surveys. No gear testing is scheduled in 2008 but it may become necessary in the future.

Once the 2008 spring and autumn bottom trawl surveys are completed, the FSV *Henry B. Bigelow* will replace the FRV *Albatross IV* and there will no longer be the need for spring and autumn bottom trawl calibration studies.

3.2 No Action Alternative

This alternative is required by the National Environmental Policy Act (NEPA). The no action alternative would mean that the SRP for the NEFSC's research surveys would not be issued, and therefore these surveys would not be conducted. Data provided by the surveys would not be collected to support the scientific and management purposes as outlined in Section 2.0. Instead, scientists and managers 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.

3.3 Alternatives Considered but Rejected from Further Analysis

NMFS considered other methods to collect ecosystem and fisheries data, such as alternative survey methodologies or utilizing fishery-dependant data. However, alternatives to the methodology utilized by the various NEFSC research surveys were rejected from further analysis because alternative approaches would not meet our need to maintain an objective unbiased sampling approach provided by the independent surveys. The purpose and need of this action includes specific elements that would not be met if the operation, design or execution of the NEFSC research surveys were modified from current and past practices. The operation of the NEFSC surveys, following the current design, is needed to collect high quality, fisheries-independent data that is standardized and provides continuity of data. Essential fundamental data comprising of abundance, distribution, sexual maturity, feeding ecology, size, and age compositions of stocks of economically and ecologically important species, including oceanographic and plankton data, are collected through a methodology that has been perfected over the last 45 years. To introduce different methodologies would not meet the purpose and need of the action and would undermine the value and importance of the various NEFSC research surveys.

4.0 Affected Environment

The NEFSC Ecosystems Surveys Branch supports approximately 30 survey legs (usually 12 days each) of 11 different cruise types each year within an area that extends from just south of Cape Hatteras, to the western Scotian Shelf in depth zones between 10 and 365 m and occasionally out to 2000 m during the deepwater biodiversity cruises. The entire area surveyed by the NEFSC encompasses approximately 100,000 square nautical miles.

The following affected environment and environmental consequences of the alternatives focus on valued ecosystem components (VECs) and are identified as important to this action:

1. Physical Environment
2. Habitat and EFH

3. Fishery Resources
4. Protected Resources
5. Social and Economic Environment

NMFS staff determined that the 5 VECs are appropriate for the purpose of evaluating direct, indirect and cumulative effects of the proposed action based on the environmental components that have the potential to be affected by the NEFSC's research surveys, and statutory requirements to complete assessments of these factors under the Magnuson-Stevens Act, Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), and several Executive Orders (EO). The VECs are intentionally broad (for example, there is one devoted to protected resources, rather than just specific species of sea turtles) to allow for flexibility in assessing all potential resources and environmental factors that are likely to be impacted by the action.

4.1 Physical Environment

The geographic area and physical environment affected by the NEFSC's research surveys occur off the Atlantic coast of the US, primarily from Cape Hatteras, to the US-Canada border. This area of the northwest Atlantic Ocean is also known as the Northeast US Continental Shelf Large Marine Ecosystem (Sherman et al. 1996) and includes the subsystems known as the GOM, GB, and the MAB (Figure 1). For more information about the physical characteristics of the environment described below, refer to Sherman et al. (1996); and Stevenson et al. (2004).

4.1.1 Gulf of Maine

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. 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 throughout the GOM, and are 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 Gulf, many small gyres and minor currents do occur. Freshwater runoff from the many rivers along the coast of the GOM influences coastal circulation as well. These water movements feed into and affect the circulation patterns on GB and in SNE, both of which are discussed below.

4.1.2 Georges Bank

GB is a shallow, elongate extension of the northeastern US continental shelf, and it is characterized by a steep slope on its northern edge and a broad, flat, and gently sloping southern flank. The GOM lies to the north of GB, the Northeast Channel (between GB and Browns Bank) is to the east; the continental slope lies to the south, and the Great South Channel (GSC) separates GB and SNE to the west. Although the top of GB is predominantly 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.

The most dominant oceanographic features of GB include a weak but persistent clockwise gyre that circulates over the whole bank, strong tidal flows (predominantly northwest and southeast), and strong but intermittent storm-induced currents. 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.

4.1.3 Mid-Atlantic Bight

The MAB includes the continental shelf and slope waters from GB to Cape Hatteras. Occasionally discussed separately, most texts consider SNE a subregion within the MAB. The basic morphology and sediments of the MAB were shaped during the retreat of the last ice sheet. The continental shelf south of New England is broad and flat, dominated by fine grained sediments (sand and silt). Patches of gravel can be found in places, such as on the western flank of the GSC.

The shelf slopes gently away from the shore out to 100-200 km offshore, where it transforms into the continental slope at the shelf break (at water depths of 100-200 m). 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.

The southwestern flow of cold shelf water feeding out of the GOM and off GB dominates the circulatory patterns in this area. The countervailing Gulf Stream provides a source of warmer water along the coast as warm-core rings and meanders 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.

4.2 Habitat and Essential Fish Habitat (EFH)

Under the Magnuson-Stevens Act, EFH is defined as "those waters and substrate necessary for fish spawning, breeding, feeding or growth to maturity." Some definitions associated with EFH include:

- "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate;
- "substrate" includes sediments, hard bottom, structures underlying the waters, and associated biological communities;
- "necessary" means the habitat required to support a sustainable fishery and managed species' contribution to a healthy ecosystem;
- "spawning, breeding, feeding or growth to maturity" covers a species' full life cycle.

In practice, the EFH for a managed species is designated for each life stage: eggs and larvae (normally pelagic), and juveniles and adults (pelagic and/or demersal). The MAFMC uses

Technical Teams working on the fishery management plans (FMPs) to describe the EFH for a species' life stages based upon information in the scientific literature and NMFS/NEFSC EFH Source documents. The New England Fishery Management Council (NEFMC) established a Habitat Plan Development Team (PDT) to aid the Habitat/Marine Protected Areas/Ecosystems Committee in describing the EFH for the NEFMC's managed species. For the 1998 EFH designated amendment, descriptions of the relative abundance within 10 minute squares from the NMFS/NEFSC bottom trawl surveys were used to delineate potential EFH for juveniles/adults, while the MARMAP surveys were employed to delineate the EFH for eggs and larvae. These EFH descriptions were supplemented by information from the NMFS/NEFSC EFH Source Documents and input on historically important fishing areas from commercial fishers (NEFMC EFH Amendment 1998).

EFH applies to federally managed species in both state and Federal jurisdictional waters throughout the range of the species. These federally managed species include those under the jurisdiction of MAFMC, and the NEFMC. The commercial/recreational species managed by the states and ASMFC that are not included in Federal FMPs are not covered by the EFH provisions, even though the Habitat Area Closures (HACs) may provide some benefit to these species. There are many forage fish species and those species that contribute to the biodiversity of the oceanic ecosystem that are not managed by the states, by the ASMFC, or under the Federal FMPs, may also receive some benefit from the HACs. The designation of EFH by itself does not confer any protection of the bottom areas from nonfishing or fishing impacts.

The area affected by the preferred alternative has been identified as EFH for species managed under the NE Multispecies; Atlantic Sea Scallop; Atlantic Monkfish; Summer Flounder, Scup and Black Sea Bass; Squid, Atlantic Mackerel and Butterfish; Atlantic Surfclam and Ocean Quahog; Atlantic Bluefish; Deep Sea Red Crab; Northeast Skate Complex; Spiny Dogfish; Golden Tilefish; and Atlantic Herring Fishery Management Plans (Table 3).

In general, EFH for these 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 (MAFMC 2007; NMFS 2006). Specific text descriptions and accompanying maps detailing EFH by species and life stage are included in the Omnibus EFH Amendment (NEFMC 2007).

One of the consequences of designating EFH separately for the 4 life stages for each managed species is that taken over all species/life stages, EFH occurs almost everywhere on the Northeast Continental Shelf (NCS). This is advantageous for NMFS and state regulators in commenting on non-fishing impacts on EFH (environmental protection focus), but is not useful in developing management rules to reduce fishing impacts (direct, on physical/biological structure on the bottom, or indirect, by altering prey field and predator/prey interactions) on EFH. The NE Multispecies FMP designated habitat protection areas on GB, Nantucket Lightship Area (NLA), WGOM, Cashes Ledge and Jeffreys Ledge to protect multispecies habitat from mobile fishing gear impacts. The FMP closures/habitat protection measures are separate from the HAPC designated under the EFH provisions of the Magnuson-Stevens Act. HAPCs are not management areas; there are no regulations affecting fishing operations within these areas unless an HAPC happens to be included within a Habitat Closed Area (e.g., the Juvenile Cod HAPC in Closed Area II).

Table 3. List of species under various management plans and state and council jurisdictions (current and future).

Species	Council	Fishery Management Plan
American eel	ASMFC	Interstate FMP
American lobster	ASMFC	Interstate FMP
Atlantic croaker	ASMFC	Interstate FMP
Atlantic menhaden	ASMFC	Interstate FMP
Atlantic sturgeon	ASMFC	Interstate FMP
Horseshoe crab	ASMFC	Interstate FMP
Northern shrimp	ASMFC	Interstate FMP
Red drum	ASMFC	Interstate FMP
Spanish mackerel	ASMFC	Interstate FMP
Spot	ASMFC	Interstate FMP
Spotted trout	ASMFC	Interstate FMP
Striped bass	ASMFC	Interstate FMP
Tautog	ASMFC	Interstate FMP
Weakfish	ASMFC	Interstate FMP
Alewife	ASMFC	Interstate Shad & River Herring FMP
American shad	ASMFC	Interstate Shad & River Herring FMP
Blueback herring	ASMFC	Interstate Shad & River Herring FMP
Atlantic mackerel	MAFMC	Atl. Mackerel/Squid/Butterfish FMP
Butterfish	MAFMC	Atl. Mackerel/Squid/Butterfish FMP
Long-fin squid	MAFMC	Atl. Mackerel/Squid/Butterfish FMP
Short-fin squid	MAFMC	Atl. Mackerel/Squid/Butterfish FMP
Atlantic surfclam	MAFMC	Atl. Surfclam & Ocean Quahog FMP
Ocean quahog	MAFMC	Atl. Surfclam & Ocean Quahog FMP
Golden tilefish	MAFMC	Tilefish FMP
Bluefish	MAFMC & ASMFC	Bluefish FMP
Black sea bass	MAFMC & ASMFC	Summer Flounder/Scup/Black Sea Bass FMP
Scup	MAFMC & ASMFC	Summer Flounder/Scup/Black Sea Bass FMP
Summer flounder	MAFMC & ASMFC	Summer Flounder/Scup/Black Sea Bass FMP
Atlantic salmon	NEFMC	Atlantic Salmon FMP
American plaice	NEFMC	NE Multispecies FMP
Atlantic cod	NEFMC	NE Multispecies FMP
Haddock	NEFMC	NE Multispecies FMP
Halibut	NEFMC	NE Multispecies FMP
Ocean pout	NEFMC	NE Multispecies FMP
Pollock	NEFMC	NE Multispecies FMP
Redfish	NEFMC	NE Multispecies FMP
White hake	NEFMC	NE Multispecies FMP
Windowpane flounder	NEFMC	NE Multispecies FMP
Witch flounder	NEFMC	NE Multispecies FMP
Yellowtail flounder	NEFMC	NE Multispecies FMP
Winter flounder	NEFMC & ASMFC	NE Multispecies FMP
Offshore hake	NEFMC	NE Multispecies - Small Mesh FMP
Red hake	NEFMC	NE Multispecies - Small Mesh FMP
Silver hake	NEFMC	NE Multispecies - Small Mesh FMP
Red crab	NEFMC	Red Crab FMP
Atlantic sea scallop	NEFMC	Sea Scallop FMP
Barndoor skate	NEFMC	Skate FMP
Clearnose skate	NEFMC	Skate FMP
Little skate	NEFMC	Skate FMP
Rosette skate	NEFMC	Skate FMP
Smooth skate	NEFMC	Skate FMP
Thorny skate	NEFMC	Skate FMP
Winter skate	NEFMC	Skate FMP
Atlantic herring	NEFMC & ASMFC	Herring FMP
Spiny dogfish	NEFMC & MAFMC	Spiny Dogfish FMP
Monkfish	NEFMC & MAFMC	Monkfish FMP
Cusk		Possible Future Management Action
Hagfish		Possible Future Management Action
Wolffish		Possible Future Management Action
Bay anchovy		Significant Bycatch
Cancer crab		Significant Bycatch
Fourspot flounder		Significant Bycatch
Icelandic scalop		Significant Bycatch
Northern sandlance		Significant Bycatch
Northern sea robin		Significant Bycatch
Roughtail stingray		Significant Bycatch
Round herring		Significant Bycatch
Sea raven		Significant Bycatch
Smooth dogfish		Significant Bycatch
Spotted hake		Significant Bycatch
Striped anchovy		Significant Bycatch

Amendment 13 to the Multispecies FMP created Habitat Closed Areas (HCAs) on GB, in and adjacent to the Nantucket Lightship Closed Area, in the WGOM, and on Cashes Ledge and Jeffreys Bank (Figures 9-10). The multispecies Closed Areas (CAs) are designed to reduce fishing mortality on overfished multispecies stocks on GB and in the GOM to promote recovery. These CAs are temporary in nature. The HCAs were created to protect habitat from the effects of mobile fishing gear. The CAs and HCAs exhibit a high degree of geographic overlap.

It can be seen from Figures 9-10 that the Cashes Ledge CA, Jeffreys Bank CA, WGOM CA, GB CAs I and II, and Nantucket Lightship CA contain regions that are HCAs (from mobile gear impacts on the bottom) established through the Northeast Multispecies FMP process. These CAs are designed to allow multispecies populations to recover, with fixed fishing gear allowed in the water column and periodic sea scallop dredge operation outside of the mobile gear habitat protection areas. Even though these areas are covered by EFH for some species/life stages of NEFMC managed species, they are separate from HAPCs designated through the 1998 Habitat Designation Process (NEFMC 1998). The restricted use of mobile gear in these HCAs do provide some benefits to EFH, while the closure to multispecies fishing means that the NEFSC resource surveys are one of the few bottom trawl gear types deployed in these areas. The NE Multispecies FMP provides details on the location of these HCAs and the appropriate regulations within these protection areas and the justification. The development of the Omnibus Habitat Amendment has proposed additional HAPC regions (GOM, GB, and SNE) in Phase 1 (NEFMC, 2007) with an ecological risk assessment of fishing gear impacts on EFH and management measures being completed during Phase 2 (2009 target date).

For the purposes of this EFH analysis, station and biological data from all cruise types (bottom trawl, Atlantic herring, ern shrimp, surfclam/ocean quahog and sea scallop) that maintain their data in the Woods Hole,Massachusetts, data base have been summarized from 2003-2007 (Table 4).

Table 4. Total number of survey stations by gear type, 2003-2007.

gear type	year	Total number of stations
Bottom Trawl	2003	775
	2004	791
	2005	774
	2006	843
	2007	851
Total		**4034**
Atlantic Herring	2003	25
	2004	29
	2005	52
	2006	55
	2007	32
Total		**193**
Northern Shrimp	2003	62
	2004	54
	2005	68
	2006	54
	2007	79
Total		**317**
Surfclam/Ocean Quahog	2005	433
Total		**433**
Sea Scallop	2003	504
	2004	596
	2005	538
	2006	536
	2007	591
Total		**2765**
Grand Total		**7742**

Tables 5-9 list the total number of stations of each cruise type that fall within various HAPCs, Closed Areas, Sea Scallop Access Areas or Habitat Closure Areas, as designated under different FMPs. Figures 12-15 visually indicate the same information within the major identified management areas.

Table 5. Number of survey stations within Year-round Closed Areas on Georges Bank and in the Gulf of Maine, 2003-2007.

Cruise Type	Season	Number of sta not in CA	Cashes Ledge CA	CA I	CA II	NLA CA	WGOM CA	Grand Total
Bottom Trawl	FALL	1572	5	22	48	30	26	1703
	SPRING	1593	4	21	43	24	20	1705
	WINTER	598		1		27		626
Total		**3763**	**9**	**44**	**91**	**81**	**46**	**4034**
Atlantic Herring	FALL	159		10	2		18	189
	SPRING	4						4
Total		**163**		**10**	**2**		**18**	**193**
Northern Shrimp	SUMMER	276	9	1			31	317
Total		**276**	**9**	**1**			**31**	**317**
Surfclam / Ocean Quahog	SPRING	420				13		433
Total		**420**				**13**		**433**
Sea Scallop	SUMMER	2144		188	285	148		2765
Total		**2144**		**188**	**285**	**148**		**2765**
Grand Total		**6766**	**18**	**243**	**378**	**242**	**95**	**7742**

Table 6. Number of survey stations within Habatat Closed Areas in the Gulf of Maine, 2003-2007.

Cruise Type	Season	Number of sta not in CA	Cashes Ledge Habitat CA	CA II Habitat CA	CA I N Habitat CA	CA I S Habitat CA	Jeffreys Bank Habitat CA	NLA Habitat CA	W GOM Habitat CA	Grand Total
Bottom Trawl	FALL	1651	2	5	6	4	2	12	21	1703
	SPRING	1658		6	7	2	3	12	17	1705
	WINTER	612				1		13		626
Total		**3921**	**2**	**11**	**13**	**7**	**5**	**37**	**38**	**4034**
Atlantic Herring	FALL	167		2	8				12	189
	SPRING	4								4
Total		**171**		**2**	**8**				**12**	**193**
Northern Shrimp	SUMMER	285	1		1		7		23	317
Total		**285**	**1**		**1**		**7**		**23**	**317**
Surfclam / Ocean Quahog	SPRING	425						8		433
Total		**425**						**8**		**433**
Sea scallop	SUMMER	2548		75	75	13		54		2765
Total		**2548**		**75**	**75**	**13**		**54**		**2765**
Grand Total		**7350**	**3**	**88**	**97**	**20**	**12**	**99**	**73**	**7742**

Table 7. Number of survey stations within Scallop Access Areas, 2003-2007.

Cruise Type	**Season**	**Number of sta not in CA**	**CA I Scallop AA**	**Grand Total**
Surfclam / Ocean Quahog	SPRING	433		433
Total		433		433
Sea Scallop	SUMMER	2712	53	2765
Total		**2712**	**53**	**2765**
Grand Total		3145	53	3198

Cruise Type	**Season**	**Number of sta not in CA**	**CA II Scallop AA**	**Grand Total**
Surfclam / Ocean Quahog	SPRING	433		433
Total		433		433
Sea Scallop	SUMMER	2581	184	2765
Total		**2581**	**184**	**2765**
Grand Total		3014	184	3198

Cruise Type	**Season**	**Number of sta not in CA**	**Hudson Canyon AA**	**Grand Total**
Surfclam / Ocean Quahog	SPRING	425	8	433
Total		425	8	433
Sea Scallop	SUMMER	2498	267	2765
Total		**2498**	**267**	**2765**
Grand Total		2923	275	3198

Cruise Type	**Season**	**Number of sta not in CA**	**Elephant Trunk Scallop AA**	**Grand Total**
Surfclam / Ocean Quahog	SPRING	415	18	433
Total		415	18	433
Sea Scallop	SUMMER	2430	335	2765
Total		**2430**	**335**	**2765**
Grand Total		2845	353	3198

Cruise Type	**Season**	**Number of sta not in CA**	**Delmarva AA**	**Grand Total**
Surfclam / Ocean Quahog	SPRING	415	18	433
Total		415	18	433
Sea Scallop	SUMMER	2595	170	2765
Total		**2595**	**170**	**2765**
Grand Total		3010	188	3198

Table 8. Number of survey stations within Tilefish HAPC, 2003-2007.

Cruise Type	Season	Number of stations not in Tilefish HAPC	Tilefish HAPC	Grand Total
Bottom trawl	FALL	1618	85	1703
	SPRING	1611	94	1705
	WINTER	517	109	626
Total		**3746**	**288**	**4034**
Atlantic Herring	FALL	189		189
	SPRING	2	2	4
Total		**191**	**2**	**193**
Northern Shrimp	SUMMER	317		317
Total		**317**		**317**
Surfclam / Ocean Quahog	SPRING	432	1	433
Total		**432**	**1**	**433**
Sea Scallop	SUMMER	2689	76	2765
Total		**2689**	**76**	**2765**
Grand Total		**7375**	**367**	**7742**

Table 9. Number of survey stations within Sandbar Shark HAPC, 2003-2007.

Cruise Type	Season	Number of stations not in Tilefish HAPC	Sandbar Shark HAPC	Grand Total
Bottom trawl	FALL	1675	28	1703
	SPRING	1674	31	1705
	WINTER	626		626
Total		**3975**	**59**	**4034**
Atlantic Herring	FALL	189		189
	SPRING	4		4
Total		**193**		**193**
Northern Shrimp	SUMMER	317		317
Total		**317**		**317**
Surfclam / Ocean Quahog	SPRING	433		433
Total		**433**		**433**
Sea Scallop	SUMMER	2765		2765
Total		**2765**		**2765**
Grand Total		**7683**	**59**	**7742**

4.2.1 Habitat Areas of Particular Concern

HAPCs are components of EFH that satisfy one or more of the following criteria:

- importance of ecological function provided by the habitat;
- extent to which habitat is sensitive to human-induced environmental degradation;
- whether, and to what extent, development activities are, or will be, stressing the habitat type; and
- rarity of habitat type.

There is an HAPC for:

- Juvenile Cod on the northeast peak of GB (Figure 13**)** which lies within Closed Area II,
- Tilefish at the shelf/slope boundary in the MAB-SNE (Figures 11 and 13),
- Sandbar Shark (Figures 11 and 15) at the mouth of Delaware/Chesapeake Bays and adjacent coastal waters,
- Atlantic salmon located in various New England rivers.

In the most recent reauthorization of the Magnuson-Stevens Act, the Fishery Management Councils were allowed to develop protection measures for deep sea corals based upon those listed in the State of Deep Sea Coral Ecosystems of the US report (Lumsden et al. 2007). These areas lie outside of the region sampled by the NEFSC researach surveys.

In the past 5 years, the bottom trawl has been the primary sampling tool within the Tilefish HAPC (288 stations of the 367 total stations occupied in this area) (Table 8; Figure 13**)**. Bottom trawl are the only gear type that has sampled the Sandbar Shark HAPC (59 stations total) (Table 9; Figure 15). The sampling in habitat protection zones within Closed Areas I and II on GB is dominated by sea scallop and surfclam dredge tows (75 stations of 97 total stations and 75 stations of 88 total stations, respectively) (Table 6; Figures 12 and 14). The mobile gear habitat protection zones within the Nantucket Light Ship (99 stations), Jeffreys Bank (12 stations), and Cashes Ledge (3 stations) (Table 6; Figure 12) sites have low levels of resource survey sampling. The mobile sampling gears with the greatest impacts on EFH are bottom trawl, surfclam hydraulic dredge, and sea scallop dredge. These impacts are analyzed in Section 5.2.

4.2.1.1 Juvenile Cod HAPC

The Juvenile Cod HAPC on GB (Figure 13) is comprised of gravel, cobble, and boulder-pile habitat which is known to promote the survival of juvenile cod. This region meets the HAPC criteria of: importance of ecological function; sensitivity to human-induced environmental degradation (mobile fishing gear) and rarity of habitat type. This HAPC lies within CA II on GB (Figure 13) and thus is subject to restrictions on commercial fishing gear. The NEFMC's Omnibus Habitat Amendment (under development with a 2009 completion date) is considering expanding the current HAPC to the west (extending outside CA II).

4.2.1.2 Tilefish HAPC

The Tilefish HAPC occupies statistical areas 537 (SNE) and 616 (MAB) (Figure 16) and ranges in depths from 76 to 366 m. This area is where 90% of the commercial landings are obtained. The HAPC meets the criteria of: sensitivity to human-induced environmental degradation; importance of ecological function (allows secondary burrowing of other species); and rarity of habitat (hard clay outcrops which produce pueblo village habitats which may be impacted by bottom tending mobile fishing gear- otter trawls - used to harvest groundfish).

The tilefish FMP is considering Gear Restriction Area alternatives to protect the EFH that is sensitive to bottom tending mobile fishing gear.

4.2.1.3 Sandbar Shark HAPC

The Sandbar Shark HAPC was designed to protect the estuarine/coastal pupping areas for this species under the NMFS Highly Migratory Species FMP (important ecological function) (Figure 15).

4.2.1.4 Atlantic Salmon HAPC

The HAPCs for Atlantic salmon are located in New England rivers, in areas not covered by the NEFSC resource surveys. These Atlantic salmon rivers do not coincide with those protected under the ESA, but the latter are a subset of the former.

4.3 Fishery Resources

There are thousands of species of finfish, elasmobranchs and invertebrates that occur within the area surveyed by the various NEFSC cruises. During the 45 year history of the bottom trawl survey, 641 species have been collected and identified. Appendix 1a-g list all species captured during the history of this survey. The data has been sorted by total weight and by total number of individuals caught. Appendix 1h-n list the total weight and number of all species captured throughout the history of the respectively identified cruise types (benthic, northern shrimp, sea scallop, surfclam/ocean quahog and Atlantic herring).

For the purposes of this EA, a brief life history of the 56 species that are either federally or state managed (Table 3) will be presented. Three species (cusk, hagfish and wolffish) have also been included due to possible future management actions. Species synopses are additionally provided for 12 other species due to significant bottom trawl survey bycatch (in either total weight or number (Appendix 1a-g).

The following species descriptions are presented under state and council jurisdiction and FMP order (Table 3). More detailed information about these species can be obtained at: http://www.nefsc.noaa.gov/sos/.

4.3.1 Interstate Fishery Management Plan

4.3.1.1 American eels, *Anguilla rostrata*, are distributed in the Atlantic Ocean from Greenland to Brazil. Along the Atlantic coast of the US, eels between Maine and Florida are considered part of a single management unit. American eels are members of the family Anguillidae and are closely related to the European eel, *Anguilla anguilla*. Both species spawn in the Sargasso Sea, a warm water area in the middle of the North Atlantic between the Azores and West Indies. American eel larvae spend 9 to 12 months as leptocephali during which time they are transported by the Gulf Stream into coastal US waters. At approximately 60 millimeters (mm) in length, the larvae develop into the first juvenile phase, called glass eels, and migrate into coastal estuaries. As the glass eels grow and become pigmented, they develop into elvers. Elvers may migrate upstream to freshwater or remain in marine estuaries but subsequently develop into sexually immature adults, known as yellow eels. Yellow eels remain in this stage of maturity for as few as 3 or as many as 20-plus years.

Maturity appears to be a function of size rather than age, therefore faster growing individuals mature earlier. Maximum size is approximately 130 centimeters (cm) for females but only 60 cm for males. Although American eels were classified as the only catadromous species in North America, the species is now considered to exhibit facultative catadromy as individuals move into freshwater systems only under favorable conditions. The freshwater distribution of eels is influenced by sex as males tend to remain in estuaries while females migrate upriver. Upon reaching maturity, eels migrate out of the freshwater or estuary systems and return to the Sargasso Sea to spawn. Prior to their long ocean return migration to the spawning grounds, eels undergo significant physical changes, such as enlargement of the eyes and pectoral fins, changes in visual pigmentation and changes in body coloration (to what is known as the silver phase). Additionally, eels cease feeding and the gut begins to degenerate. Although spawning has never been observed, eels are believed to die after spawning.

4.3.1.2 The **American lobster,** *Homarus americanus*, is distributed in the northwest Atlantic from Labrador to Cape Hatteras, from coastal waters out to depths of 700 m. Lobsters are locally abundant in coastal regions within the GOM as well as in SNE. Coastal lobsters are concentrated in rocky areas where shelter is readily available, although occasional high densities occur in mud substrates suitable for burrowing. Offshore populations are most abundant along the continental shelf edge in the vicinity of submarine canyons. Lobsters exhibit a complex life cycle in which mating occurs following molting of the female. Eggs (7,000 to 80,000) are extruded and carried under the female's abdomen during a 9 to 11 month incubation period. The eggs hatch during late spring or early summer and the pelagic larvae undergo 4 molts before attaining adult characteristics and settling to the bottom. Lobsters molt approximately 20 times (in 5 to 8 years) before reaching minimum legal size.

Tagging experiments in coastal waters suggest that small lobsters undertake rather limited movement, although larger individuals may travel extensively. In contrast, offshore lobsters show well-defined shoalward migrations during the spring, regularly 80 km, and often as much as 300 km. Lateral movements along the shelf edge occur as well. For assessment purposes, based on differences in biological attributes and exploitation patterns, 3 stock areas are recognized: GOM, GB and SNE.

4.3.1.3 The **Atlantic croaker,** *Micropogonias undulates*, is a demersal, shallow water member of the drum family, *Sciaenidae*. They range from the Gulf of Mexico north to Massachusetts (Murdy et al. 1997). They are one of the most abundant inshore bottom dwelling fish along the US Atlantic coast, and large recreational and commercial fisheries exist for this species. From North Carolina to the northern extent of their range, Atlantic croaker are found from the littoral zone in open beaches and embayments out to approximately 50 m depth, with the center of abundance based on NEFSC spring and fall trawl surveys around 20 m. Atlantic croaker have been recorded to reach as much as 66 cm standard length (Murdy et al. 1997), but are usually much smaller, averaging around 24 cm in the northern part of their range based on NEFSC trawl survey data. Croaker reach maturity at an approximate average size of 18 cm, with all fish over 25 cm being sexually mature. In the northern part of their range croaker spawn in the fall, and congregations of mature fish may be found in open water at this time of year, away from their normal shoreline habitat. Croaker have been aged to a maximum of 12 years. Croaker migrate south during the colder months and based on trawl survey data are usually absent from the northern extent of their Mid-Atl range in winter and early spring.

4.3.1.4 The **Atlantic menhaden,** *Brevoortia tyrannus*, is a coastal pelagic schooling fish of the herring family, *Clupeidae*. Atlantic menhaden range from Nova Scotia to Florida (Munroe 2002a). Adult menhaden average 20-30 cm in length, reaching a maximum known length of 47 cm (Munroe 2002a). Menhaden are distinct among saltwater fishes along the US east coast in that it is capable of filter feeding phytoplankton and thus represent a direct piscine link to primary production. Menhaden are usually found in extremely tight schools that may range in size from a few hundred individuals to vast shoals covering acres. They exhibit seasonal north-south migrations, generally moving north and inshore in summer and south and deeper in the winter (Munroe 2002a).

Mature menhaden spawn over a broad geographic and temporal range (Lewis et al. 1987), probably every month of the year but varying with locale (Nicholson 1972; Lewis et al. 1987). Spawning occurs both offshore on the continental shelf and near major sounds and bays (Munroe 2002a). The eggs are buoyant and both eggs and larvae depend on Ekman transport and tidal current to reach coastal estuaries where the young develop (Nicholson 1972; Nelson et al. 1977; Munroe 2002a). Atlantic menhaden are not long-lived, reaching about 8 years of age with a maximum record of 12 (Henry 1971; Reintjes 1969). Reproductive maturity begins at about 2 years and by age 3 all are fully mature (Lewis et al. 1987). Menhaden are an extremely important fish both recreationally and commercially. Commercially, they are not eaten directly by humans but processed into fishmeal and oil (Munroe 2002a). Additionally, they are captured for bait for other fisheries (Munroe 2002a). Recreationally, they are used for bait for many different gamefishes. They are also a vital component to the ecosystem by being a major food source to multiple species, as menhaden are heavily preyed upon by many different fishes, sea birds, and marine mammals (Munroe 2002a). Due to their tight schooling patterns and high position in the water column, menhaden are not well represented in the NEFSC BTS..

4.3.1.5 The **Atlantic sturgeon,** *Acipenser oxyrhynchus*, and the **shortnose sturgeon**, *Acipenser brevirostrum*, are demersal, anadromous species distributed along the Atlantic coast of North America. Both species occur between Florida and New Brunswick, but the distribution of the Atlantic sturgeon extends further north to Labrador. Both species 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. In water where the species co-occur, shortnose sturgeons (an endangered species), tend to begin their migration earlier than the Atlantic sturgeon. Spawning generally occurs in the lower sections of rivers, below the fall line. Eggs are deposited on hard surfaces on the bottom where they adhere for 4 to 6 days until hatching. Juvenile sturgeons remain in freshwater for their first summer before migrating to estuaries in winter. Juveniles remain in the freshwater-estuary system for 3 to 5 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.

Tagging studies indicate that Atlantic sturgeons migrate extensively in the marine environment; fish tagged in the Hudson and Delaware Rivers have been recaptured as far north as coastal Maine and south to North Carolina. Sturgeons from southern systems have more restricted marine migrations, remaining closer to their natal rivers.

Sturgeons are considered to be among the most primitive bony fishes, with origins dating back 120 million years. Sturgeons are characterized by 5 rows of bony plates or scutes along the back rather than scales and have prominent barbels under their snout used as sensory organs. Juveniles and adults of both species are benthic (or bottom) feeders, consuming a variety of crustaceans, bivalves, worms, plants, and occasionally small fish. Shortnose are smaller than Atlantic sturgeons and may attain maximum sizes of approximately 100 cm and 23 kg, whereas Atlantic sturgeons reach maximum sizes of 430 cm and 363 kg. Both species are long lived, potentially reaching ages in excess of 60 years for females and about 30 for males. Maturity occurs in female shortnose sturgeons between the ages of 7 and 15, with maturity at younger ages at the southern end of the distributional range. Atlantic sturgeons exhibit a similar latitudinal pattern in female age at maturity, with southern fish maturing between ages 7 and 19, compared to sturgeon in the St. Lawrence River, Canada, reaching maturity in 27 to 29 years. Both species are highly fecund, with total egg production increasing proportional to body size, with individual fish spawning once every 3 to 5 years.

There have been a total of 161 Atlantic sturgeon caught during the 36,442 tows of the bottom trawl survey with no fatalities. When sturgeons are captured, there are usually only 1-2 fish in the tow although in 1982, 51 Atlantic sturgeon were caught off the New Jersey highlands. These fish are the first to be removed from the catch, carefully handled, measured, weighed, tagged and quickly returned to the sea.

Atlantic sturgeon are considered an ESA Candidate Species as NMFS has initiated a status review for this species to determine if listing as threatened or endangered under the ESA is warranted. A status review report was completed by a status review team in February 2007. NMFS is currently reviewing the report and other available information to determine if listing under the ESA is warranted. A listing determination, and, if listing is warranted, accompanying proposed rule(s) are expected to be published by NMFS in 2008. If it is determined that listing is warranted, a final rule listing the species will be published within one year from the date of publication of the proposed rule.

4.3.1.6 The **horseshoe crab**, *Limulus polyphemus*, is an arthropod of the class *Merostomata* (ITIS 2008). Horseshoe crabs are found on the US east coast from the GOM to the Gulf of Mexico. They are vulnerable to a bottom trawl, and may be caught throughout the entire survey region, although they are most commonly encountered south of the New York Bight. Horseshoe crabs are encountered on the survey most often in depths above 30 m; however, they have been occasionally encountered as deep as 300 m. A commercial fishery exists for horseshoe crabs.

4.3.1.7 Northern or pink **shrimp,** *Pandalus borealis*, occur in boreal waters of the North Atlantic, North Pacific, and Arctic Oceans. In the GOM, northern shrimp are considered to constitute a unit stock. They inhabit soft mud bottom at depths of approximately 10 to 300 m, most commonly in the cold waters of the southwest GOM. The GOM is the southern limit of the northern shrimp distribution in the North Atlantic, and temperature affects growth and development rates and reproductive success in the stock.

Northern shrimp are hermaphroditic, maturing first as males at roughly 2½ years of age and then transforming to females at about 3½ years of age. In the GOM, spawning begins in offshore waters in late July. In late autumn and winter egg bearing females move inshore, where the eggs hatch. Juveniles remain in coastal waters for a year or more before migrating to deeper offshore waters, where they mature as males. The exact extent and location of these migrations is variable. Males undergo a series of transitional stages before maturing as females. Some females may survive to repeat the spawning process in succeeding years. Natural mortality seems to be most pronounced immediately following hatching. Most northern shrimp do not live past age 5.

4.3.1.8 The **red drum**, is a large, inshore demersal fish of the family *Sciaenidae*, or drums (ITIS 2008). They range in the US from New York to the Gulf of Mexico. They are encountered in the survey region primarily off North Carolina, in depths less than 30 m. Red drum that are encountered on the bottom trawl survey are typically greater than 80 cm in length and have been recorded as large as 114 cm. The red drum is only infrequently encountered on NEFSC trawl surveys, most likely due to its close proximity to shore during the survey seasons. The red drum is heavily targeted by recreational fishing.

4.3.1.9 The **Spanish mackerel**, *Scomberomorus maculatus*, is a small to medium sized, coastal pelagic member of the *Scombridae*, or tuna family (ITIS 2008). They range in the US from the Gulf of Mexico to as far north as Massachusetts. During bottom trawl surveys, they are captured most commonly below New Jersey in depths of 30 m or less. Spanish mackerel may reach up to 77 cm (Collette 2002), but are most commonly encountered on the survey in lengths between 19 and 40 cm. There are both recreational and commercial fisheries for this species.

4.3.1.10 The **spot**, *Leiostomus xanthurus*, is a small, shallow-water demersal species of the family *Sciaenidae*, or drums (ITIS 2008). They range in the US from the Gulf of Mexico to as far north as Massachusetts, but on the survey are commonly encountered south of New York. Spot are found in depths of usually less than 40 m in the survey region with peak abundance around 18 m. Spot are capable of reaching about 34 cm (Klein-MacPhee 2002d). On the survey spot are usually encountered between 11 and 20 cm length. Spot are very numerous and make up a significant component of the Mid-Atl inshore catch in the fall. They are often captured in the same habitats as the Atlantic croaker. Spot make north-south migrations, and in the spring survey period they are found primarily off North Carolina. Spot are both recreationally and commercially fished.

4.3.1.11 The **spotted sea trout**, *Cynoscion nebulosus*, is a medium to large sized coastal pelagic fish of the family *Sciaenidae*, or drums (ITIS 2008). In the US, spotted sea trout are found from the Gulf of Mexico to Cape Cod (Murdy et al. 1997), but are rare north of Delaware Bay. They are found in very shallow water and can tolerate low salinities (Murdy et al. 1997). They are rarely captured on NEFSC surveys, due to the extreme shallow habitat, and when captured are usually found in depths less than 23 m. Spotted sea trout are capable of reaching sizes of up to 90 cm (Murdy et al. 1997), but on the survey are usually less than 40 cm. They are commercially fished, and are one of the most important recreational fishes, ranking second in catch by weight for US anglers as recently as 1997 (Murdy et al. 1997).

4.3.1.12 The **striped bass,** *Morone saxatilis***,** is an anadromous species distributed along the Atlantic coast from northern Florida to the St. Lawrence estuary. They have been successfully introduced in numerous inland lakes and reservoirs and to the Pacific coast, where they now occur from Mexico to British Columbia. The Atlantic coast stocks, which originate in the Chesapeake Bay, Delaware River and Hudson River, undergo seasonal coastal migrations ranging from North Carolina to Nova Scotia, whereas stocks to the north or south remain within their natal rivers or estuaries. Recreational fishing on the coastal migratory stocks occurs year round, with peak activity occurring during the spring and fall migrations. Commercial fisheries are conducted seasonally, primarily with hook and line and gillnets.

Striped bass may attain lengths of up to 150 cm and weights of 25 to 35 kg (Collette and Klein-MacPhee 2002). Maximum age is in excess of 25 years and sexual maturity is attained between ages 2 to 4 for males and 5 to 8 for females (ASMFC 1990). Spawning occurs in the migratory stocks during April to June as fish migrate into fresh or brackish water. Water temperatures during spawning may range from 10° to 23° Centigrade (C); peak spawning activity is observed between 15° and 20° C (Hardy 1978). After spawning, most large females leave the estuaries and participate in coastal migrations. Males also leave the spawning grounds but may remain within the estuaries throughout the year. Striped bass are omnivorous, feeding on a variety of invertebrates and fish species (Walter et al. 2003), particularly clupeids such as menhaden and river herring.

4.3.1.13 The **tautog**, *Tautoga onitis*, is one of two northern members of the *Labridae*, or wrasse family, in the US Atlantic (ITIS 2008). They range in the US from northern South Carolina to the GOM, but are most abundant from Cape Cod to Chesapeake Bay (Munroe 2002c). They are not often captured on NEFSC surveys due to the fact that their preferred habitat is heavy structure. The presence of this species in the catch is usually associated with significant trawl damage due to bottom obstructions. Tautog are capable of reaching lengths up to 90 cm (Munroe 2002c), but on the surveys are usually encountered between 20-50 cm. Tautogs are both recreationally and commercially fished.

4.3.1.14 The **weakfish**, *Cynoscion regalis*, is a medium to large sized coastal pelagic fish of the family *Sciaenidae*, or drums (ITIS 2008). In the US weakfish are found from Florida north to Massachusetts, but are most abundant from Virginia to New York (Klein-MacPhee 2002d). Weakfish are most often encountered on the survey in depths less than 42 m, but have been recorded numerous times in deeper water up to 140 m. Weakfish are capable of reaching lengths greater than 100 cm, but on the survey are usually captured between 5 and 30 cm. Weakfish greater than 40 cm are rarely encountered on NEFSC surveys, and it is unclear whether this phenomenon is depth related or due to larger individuals exhibiting trawl avoidance. Weakfish can be numerous and are often a significant component of the Mid-Atl inshore survey catch. There are both recreational and commercial fisheries for this species.

4.3.2 Interstate Shad & River Herring FMP

4.3.2.1 "River herring" is a term applied collectively to **alewife,** *Alosa pseudoharengus***,** and **blueback herring,** *Alosa aestivalis*. The range of the alewife extends from Labrador to South Carolina, while the range of the blueback herring is from Nova Scotia to Florida. In coastal rivers where the distributions of the two species overlap, the fisheries are typically mixed. Both species are anadromous, migrating upriver to spawn during spring. Alewives can live as long as 10 years and may reach a maximum length of 36 cm. Blueback herring may live for about 7 or 8 years and can reach a maximum size of about 32 cm.

Alewives spawn in spring when water temperatures are between 16° C and 19° C; blueback herring spawn later in spring, when water temperatures are about 5° C warmer. Fecundity and age at maturity for both species are similar. Between 60,000 and 300,000 eggs are produced per female; most individuals are sexually mature at age 4.

4.3.2.2 American shad, *Alosa sapidissima*, is an anadromous species distributed along the Atlantic coast from southern Labrador to northern Florida. An introduced stock occurs along the Pacific coast. American shad undergo extensive seasonal migrations, moving into rivers for spawning beginning in January in southern rivers, and continuing until July in the northernmost portion of their range. After spawning, shad migrate north along the coast to Canada where they feed during the summer. A southward migration occurs later along the continental shelf where the fish overwinter prior to spring spawning migrations to their natal rivers.

Life history patterns of shad vary depending on the latitudinal location of their natal rivers. Most shad remain in the ocean for 4 years before returning for their first spawn, although the mean age at first spawning is age 5 for the more northern fish. Fecundity also changes with latitude, ranging from 300,000 to 400,000 eggs per mature female in southern rivers decreasing to 125,000 for fish in northern rivers. After spawning, American shad north of Cape Hatteras move offshore to feed and overwinter and may return to their natal rivers to spawn in several subsequent years; however, southern members of the species usually die after spawning.

4.3.3 Atlantic Mackerel, Squid and Butterfish FMP

4.3.3.1 Atlantic mackerel, *Scomber scombrus*, is a fast swimming, pelagic, schooling species distributed in the northwest Atlantic between Labrador and North Carolina. There are two major spawning components in the population: a southern group that spawns primarily in the MAB during April and May, and a northern group that spawns in the Gulf of St. Lawrence in June and July. Both groups winter between Sable Island (off Nova Scotia) and Cape Hatteras in waters generally warmer than 7° C, with extensive northerly (spring) and southerly (autumn) migrations to and from spawning and summering grounds. The two groups are managed as a unit stock. Maximum observed size in recent years is about 42 cm in length and 1.0 kg in weight. Sexual maturity begins at age 2 and is usually complete by age 3. Maximum age is about 20 years.

4.3.3.2 The **butterfish,** *Peprilus triacanthus*, is a small, bony food fish weighing up to 0.5 kg, with a thin oval body. Butterfish are short-lived and grow rapidly. Few live to more than 3 years of age, and most are sexually mature at age 1. Butterfish range from Florida to Newfoundland, but are primarily found from Cape Hatteras to the GOM where the population is considered to be a unit stock.

Butterfish migrate in response to seasonal changes in water temperature. During summer, butterfish move northward and inshore to feed and spawn. Spawning occurs during June to August, and peaks progressively later at higher latitudes. During winter, butterfish move south-ward and offshore to avoid cool waters. Butterfish are primarily pelagic, and form loose schools that feed upon small fish, squid, and crustaceans. Butterfish have a high natural mortality rate and are preyed upon by many species including silver hake, bluefish, swordfish, and long-finned squid. During summer, juvenile butterfish associate with jellyfish to avoid predators.

4.3.3.3 Longfin squid, *Loligo pealeii*, are distributed primarily in continental shelf waters located between Newfoundland and the Gulf of Venezuela (Cohen 1976; Roper et al. 1984). In the northwest Atlantic Ocean, longfin squid are most abundant in the waters between GB and Cape Hatteras, where the species is commercially exploited. The stock area extends from the GOM to Cape Hatteras. Distribution varies seasonally. North of Cape Hatteras, squid migrate offshore during late autumn to overwinter in warmer waters along the shelf edge and slope, and then return inshore during the spring where they remain until late autumn (Jacobson 2005). Bottom trawl survey catches of *L. pealeii* are affected by water temperature, time-of-day, and depth (Serchuk and Rathjen 1974) and the effects vary by body size (Brodziak and Hendrickson 1999; Cadrin and Hatfield 1999). Longfin squid live for about nine months, grow rapidly, and spawn year-round (Brodziak and Macy 1996), with peaks during late spring and autumn. Individuals hatched in summer grow more rapidly than those hatched in winter and males grow faster and attain larger sizes than females (Brodziak and Macy 1996).

4.3.3.4 The northern **shortfin squid,** *Illex illecebrosus*, is a highly migratory, transboundary species that is distributed in the northwest Atlantic Ocean from the Florida Straits to Newfoundland (Dawe and Hendrickson 1998). The northern component of the stock, extending from Newfoundland to the southern Scotian Shelf, is assessed annually and managed by the Northwest Atlantic Fisheries Organization (NAFO) based on a total allowable catch (TAC). The southern and US stock component, extending from the GOM to Florida, has been managed since 1977 by the MAFMC, based on an annual TAC, under the provisions of the Atlantic Mackerel, Squid, and Butterfish FMP.

Illex illecebrosus live for less than one year, experience high natural mortality rates, and exhibit a protracted spawning season whereby overlapping "microcohorts" enter the population throughout the year over a wide geographic area and exhibit variable growth rates. Age estimation, accomplished by counting daily growth increments in the statoliths, has been validated for *I. illecebrosus* (Dawe and Beck 1985; Hurley et al. 1985). Back-calculated hatch dates from statolith-based aging studies indicate that spawning occurs throughout most of the year (Dawe and Beck 1997; Hendrickson 2004). The only confirmed spawning area is located in the MAB, where the winter cohort spawns during late May (Hendrickson 2004). Spawning may also occur offshore in the Gulf Stream/slope water frontal zone, where *Illex* sp. paralarvae have been collected (O'Dor and Balch 1985; Rowell et al. 1985), and south of Cape Hatteras, during winter, where *Illex* sp. hatchlings have been collected (Dawe and Beck 1985). The life span of the winter cohort in US waters ranges from 115 to 215 days (Hendrickson 2004). The species is semelparous and fishing mortality and spawning mortality occur simultaneously on the US shelf (Hendrickson and Hart 2006). The species inhabits offshore shelf and slope waters primarily during spring through autumn (Hendrickson and Holmes 2004). Species distribution and abundance are strongly influenced by oceanographic factors (Dawe and Warren 1993). Annual survey indices of relative abundance and biomass and average body size suggest that the stock has experienced low and high productivity periods (Hendrickson and Showell 2006; NEFSC 2006). The information provided herein reflects the results of the most recent peer-reviewed assessment of the US component of the *I. illecebrosus* stock.

4.3.4 Atlantic Surfclam/Ocean Quahog FMP

4.3.4.1 Atlantic surfclams, *Spisula solidissima*, are distributed along the western north Atlantic Ocean from the southern Gulf of St. Lawrence to Cape Hatteras. Commercial concentrations are found primarily off New Jersey, the Delmarva Peninsula, and on GB. In the Mid-Atl region, surfclams are found from the intertidal zone to a depth of about 60 m but densities are low at depths greater than 40 m. Surfclams occur in both state (≤ 3 miles from shore) and Federal waters (i.e. the EEZ, between 3 and 200 miles from shore).

Maximum size is about 22.5 cm shell length, but surfclams larger than 20 cm are rare. Maximum age exceeds 30 years, and surfclams 15-20 years of age are common in many areas.

Surfclams are capable of reproduction in their first year of life, although full maturity may not be reached until the second year. Eggs and sperm are shed directly into the water column. Recruitment to the bottom occurs after a planktonic larval period of about 3 weeks.

4.3.4.2 The **ocean quahog,** *Arctica islandica*, is a bivalve mollusk distributed in temperate and boreal waters on both sides of the north Atlantic Ocean. In the northeast Atlantic, quahogs occur from Newfoundland to Cape Hatteras. In US waters, they are managed as a single stock.

Ocean quahogs are found at depths from 8 to 400 m. Further north, they occur closer to shore. The US stock resource is almost entirely within the EEZ, outside of state waters, and at depths between 20 and 80 m. The notable exception is fishable concentrations in state waters off the coast of Maine. Ocean quahogs are rarely found where bottom water temperatures exceed 16° C. They burrow in a variety of substrates and are often associated with fine sand.

Ocean quahogs are among the longest lived, slowest growing marine organisms in the world. Off SNE, in the MAB and on GB, they can live to at least 200 years. In the EEZ, they are relatively large and old, with most individuals, 70-110 mm shell length. Growth is slower after about age 20, which is also about the age at which many individuals become vulnerable to fishing. Growth is faster on GB and off Maine, although ocean quahogs in Maine waters are seldom larger than 70 mm.

Size and age at sexual maturity are variable and poorly known. Based on studies in Icelandic waters, 10%, 50% and 90% of female ocean quahogs were sexually mature at 40, 64 and 88 mm shell length, or approximately 2, 19 and 61 years of age. Spawning occurs over a protracted interval from summer through autumn. Free-floating larvae may drift far from their spawning location because they develop slowly and are planktonic for more than 30 days before settling. Major recruitment events appear to be separated by periods of decades.

4.3.5 Tilefish FMP

4.3.5.1 Golden tilefish, *Lopholatilus chamaeleonticeps*, are distributed in the northeast Atlantic along the outer continental shelf from Nova Scotia to South America, and are relatively abundant in the SNE/Mid-Atl region at depths of 80 to 440 m. Golden tilefish have a narrow temperature preference of 9° to 14° C and generally occur in and around submarine canyons where they occupy burrows in the sedimentary substrates. Golden tilefish are relatively slow growing and long-lived with a maximum observed age and length for females of 46 years and 110 cm, and 39 years and 112 cm for males. At lengths exceeding 70 cm, the predorsal adipose flap, characteristic of the species, is larger in males and can be used to distinguish the sexes. Golden tilefish of both sexes are mature at ages of 5 to 7 years (Grimes et al. 1988).

4.3.6 Bluefish FMP

4.3.6.1 The **bluefish,** *Pomatomus saltatrix*, is a migratory, pelagic species found throughout the world in most temperate coastal regions, except the eastern Pacific. Bluefish may reach ages of 12 years and sizes in excess of 100 cm and 14 kg (Collette and Klein-MacPhee 2002). Along the US Atlantic coast, bluefish are found from Maine to Florida and mix extensively during seasonal coastal migrations. During winter, large bluefish tend to remain in the MAB, moving south to North Carolina by March. Small fish move farther south in winter with some fish wintering off the coast of Florida. As water temperatures increase, the spring migration north begins and spawning occurs in the South Atlantic Bight at this time. By summer, bluefish move north into the MAB, although some medium size fish may remain off Florida (Shepherd et al. 2006). A second spawning occurs in the offshore waters of the MAB during summer.

The result of these two spawning events is the appearance of two distinct size groups of juvenile bluefish during autumn; a spring spawned cohort consisting of fish about 15-25 cm in length and a summer spawned cohort consisting of fish about 4-14 cm in length (Able and Fahay 1998). Fish from the two spawning cohorts mix extensively during the year and constitute a single genetic stock (Graves et al. 1992). Bluefish are voracious predators, feeding primarily on squid and fish, particularly menhaden and smaller fish such as silversides (Buckel et al. 1999; Fahay et al. 1999).

4.3.7 Summer Flounder, Scup, Black Sea Bass FMP

4.3.7.1 Black sea bass, *Centropristis striata*, are distributed in the northwest Atlantic from Maine to Florida, with Cape Hatteras, serving as a geographic boundary between northern and southern stocks (Musick and Mercer 1977; Shepherd 1991). Sea bass are members of the family *Serranidae*, which includes groupers commonly found in tropical and sub-tropical waters. Structures such as reefs, wrecks or oyster beds are preferred habitats. Black sea bass may attain sizes up to 60 cm and 3.6 kg with maximum age of 10-12 years. Sexual maturity is attained between ages 2 and 4 for females. Black sea bass are protogynous hermaphrodites, meaning that they change sex from female to male. Born as females, most fish will change sex to males between ages 2 and 5 (Musick and Mercer 1977). The factors that lead to the sex change have not been proven although it has been speculated that the relative scarcity of males in a spawning group may be the stimulus for a female to switch sex. Spawning in the northern stock generally occurs from April to June after fish have migrated into coastal habitats (Collette and Klein-MacPhee 2002).

Males develop a pronounced blue hump on their heads during spawning season and aggressively defend territory although actual spawning behavior is not well documented. Larvae and juveniles develop and grow in inshore habitats and juveniles attain lengths of 10-14 cm by fall. Sea bass remain in coastal habitats until water temperatures decrease in fall into early winter, and then migrate to deeper offshore water along the edge of the continental shelf. In the spring, most fish return to the same area that was vacated the previous fall. Juvenile sea bass experience little if any growth throughout the winter. Adult black sea bass are omnivorous, feeding on a variety of benthic invertebrates, squid and fish (Steimle et al. 1999).

4.3.7.2 Scup or porgy**,** *Stenotomus chrysops***,** is a demersal, schooling species distributed in the MAB from Cape Cod, Massachusetts to Cape Hatteras. Previous tagging studies have indicated the possibility of two stocks, one in SNE waters and the other extending south from New Jersey. However, the lack of definitive tag return data from these studies, coupled with distributional information from NEFSC trawl surveys, support the concept of a single unit stock from New England to Cape Hatteras. A new industry-cooperative tagging study for scup, designed to evaluate fish movement and estimate mortality rates, was initiated in 2005.

Scup undertake extensive migrations between coastal waters in summer and offshore waters in winter, migrating north and inshore to spawn in spring. Sexual maturity is essentially complete by age 3 at a total length of 21 cm (O'Brien et al. 1993). Scup attain a maximum fork length of about 40 cm, and ages of up to at least 14 years.

4.3.7.3 The **summer flounder** or fluke**,** *Paralichthys dentatus*, is a demersal flatfish distributed from the southern GOM to South Carolina. Important commercial and recreational fisheries exist from Cape Cod, Massachusetts to Cape Hatteras. The resource is managed as a unit stock from North Carolina to Maine. Summer flounder are concentrated in bays and estuaries from late spring through early autumn, when an offshore migration to the outer continental shelf is undertaken. Spawning occurs during autumn and early winter, and the larvae are transported toward coastal areas by prevailing water currents. Development of post larvae and juveniles occurs primarily within bays and estuarine areas, notably Pamlico Sound and Chesapeake Bay (Packer et al. 1999). Most fish are sexually mature by age 2 (O'Brien et al. 1993). Female summer flounder may live up to 20 years, but males rarely live for more than 10 years (Bolz et al. 2000). Growth rates differ appreciably between the sexes with females attaining weights up to 11.8 kg.

4.3.8 Atlantic Salmon FMP

4.3.8.1 The **Atlantic salmon,** *Salmo salar*, is a highly prized game and food fish native to New England rivers. The historic North American range of Atlantic salmon extended from the rivers of Ungava Bay, Canada, to rivers of Long Island Sound. As a consequence of industrial and agricultural development, most populations native to New England were extirpated. Remnant native populations of Atlantic salmon in the US now persist only in Maine. Restoration and rehabilitation efforts, in the form of stocking and fish passage construction, are underway in the Connecticut, Pawcatuck, Merrimack, Saco, Kennebec, Penobscot, and eastern Maine rivers of New England.

Atlantic salmon life history is extremely complex owing to its use of both freshwater and marine habitats and long ocean migrations. Atlantic salmon spawn in freshwater during fall. Eggs remain in gravel substrates and hatch during winter, and fry emerge from the gravel in spring. Juvenile salmon, commonly called parr, remain in freshwater 1 to 3 years in New England rivers, depending on growth. When parr grow to sufficient size (>13cm) they develop into smolts and migrate to the ocean in spring. Tagging data for New England stocks indicate that US salmon migrate as far north as Greenland.

After the first winter at sea for US salmon (the fish are now referred to as 1 sea-winter or 1SW salmon), a small portion (~ 10%) of the cohort, typically males, become sexually mature and return to natal rivers to spawn. Those remaining at sea feed in the coastal waters of West Greenland and Canada (off the Newfoundland and Labrador coasts). Historically, it has been in these foraging areas that commercial northeast Atlantic gillnet fisheries for salmon occurred. After their second winter at sea, most US salmon return home to spawn. Three sea-winter and repeat-spawning salmon life history patterns also occur in New England populations but have become rare (< 5%) with declining stock size.

Significant declines in abundance of Atlantic salmon populations in the US prompted an endangered listing of the species under the ESA (65 Federal Register 69459, November 17, 2000). The ESA of 1973 was amended in 1978 to define a species as "...any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." A Distinct Population Segment (DPS) is a subgroup of a vertebrate species that is treated as a species for purposes of listing under the ESA. It is required that the subgroup be separable from the remainder of and significant to the species to which it belongs (61 Federal Register 4722).

The strong homing capability of Atlantic salmon fosters the formation and maintenance of local breeding groups resulting in intraspecific sub-structuring. Stocks from a given area exhibit heritable adaptations to local riverine ecosystems. The importance of maintaining these local adaptations has been demonstrated in Atlantic salmon. Assessing DPS structure requires broad scale consideration of geologic and climatic features that shape population structure through natural selection. For Atlantic salmon, factors such as climate, soil type, and hydrology are particularly important because these factors influence ecosystem structure and function including transfer of energy in aquatic food chains. Numerous ecological classification systems were examined, which integrate the many factors necessary to perform such a DPS analysis (Colligan et al. 1999; Fay et al. 2006). Biologists have delineated US Atlantic salmon populations into 3 discrete DPSs for the purpose of management: 1) Long Island Sound DPS; 2) Central New England DPS; and the 3) GOM DPS. Both the Long Island Sound and Central New England DPS were extirpated in the 1800s. Atlantic salmon stocks from the Penobscot River in Maine were used in the restoration programs in the Connecticut (Long Island Sound DPS) and in the Merrimack and Saco Rivers (Central New England DPS).

4.3.9 NE Multispecies FMP

4.3.9.1 The **American plaice** or dab**,** *Hippoglossoides platessoides*, is a large mouthed, "right-handed" flounder, distributed along the northwest Atlantic continental shelf from southern Labrador to Rhode Island in relatively deep waters (Collette and Klein-MacPhee 2002). Off the US coast, American plaice are managed as a single stock in the GOM/GB region. The greatest commercial concentrations exist between 90 and 182 m. Maturation begins between ages 2 and 3, but most individuals do not reach sexual maturity until age 4 (O'Brien et al. 1993). Spawning occurs in spring, generally during March through May. Growth is rather slow; 3 year old fish are normally between 22 and 28 cm in length, and weigh between 90 and 190 grams. After age 4, females grow faster than males (Sullivan 1982). American plaice from GB have faster growth at age than fish from the GOM (Esteves and Burnett 1993).

4.3.9.2 The **Atlantic cod,** *Gadus morhua*, is a demersal gadoid species found on both sides of the north Atlantic. In the northwest Atlantic, cod occur from Greenland to North Carolina. In

US waters, cod are assessed and managed as two stocks: GOM, and GB and Southward. Both stocks support important commercial and recreational fisheries. Commercial fisheries are conducted year round, primarily with otter trawls and gill nets. Recreational fishing also occurs year round; peak activity occurs during the late summer in the lower GOM and during late autumn to early spring from Massachusetts southward.

Cod may attain lengths of up to 130 cm and weights of 25 to 35 kg. Maximum age is in excess of 20 years, although young fish (ages 2 to 5) generally constitute the bulk of the catch. Sexual maturity is attained between ages 2 to 4 (O'Brien et al. 1993; O'Brien 1998); spawning occurs during winter and early spring.

Cod are omnivorous, feeding on a variety of invertebrates and fish species (Lough 2004; O'Brien et al. 2005). Growth rates differ between the stocks although each is exploited by the same gear types with similar selection characteristics. Cod growth in the GOM has historically been slower than on GB (Pentilla and Gifford 1976; O'Brien 1998), but appears to have increased in recent years. Differences in growth rate by sex have also become less pronounced in both stocks.

4.3.9.3 The **Atlantic haddock,** *Melanogrammus aeglefinus*, is a commercially-exploited groundfish found in the northwest and northeast Atlantic Ocean. This demersal gadoid species is distributed from Cape May, New Jersey, to the Strait of Belle Isle, Newfoundland, in the northwest Atlantic (Collette and Klein-MacPhee 2002), where a total of six distinct haddock stocks have been identified (Begg 1998). Two of these haddock stocks are found in US waters: GB and GOM (Brodziak 2005). The GB haddock stock is found in the shallow productive waters of GB while the GOM stock inhabits waters of the southwestern GOM. Both stocks support important commercial fisheries (Clark et al. 1982; Brown and Munroe 2000; Brodziak et al. 2002; Brodziak et al. 2006). Commercial fishing for haddock occurs year round in US waters. Otter trawl fishing gear produces the majority of haddock landings, while the remainder of the catch is taken with longlines or gill nets. Recreational catches are relatively minor and amount to roughly 1-2% of commercial catches in recent years. Most of the recreational haddock catch is taken with hook and line gear in the GOM region during spring to late-autumn.

Adult haddock range in length from 30 cm up to a maximum size of about 1 m. The largest haddock captured in US waters weighed 13.6 kg (Collette and Klein-MacPhee 2002). The oldest recorded haddock in the US waters was a 17 year old fish captured during a 1980 NEFSC research survey. Most of the US commercial haddock catch comprises of age 3 to 7 year old fish weighing between 1 and 3 kg. Haddock reach sexual maturity between ages 1 and 4. In recent years, the median age of maturity for females has been 1.8 years. Haddock spawning occurs from January to June, and peaks during February to early-April on GB, the primary spawning area (Brodziak 2005). Haddock are primarily an offshore groundfish and are commonly found at depths of 40 to 150 m. Adult haddock can be found at temperatures of 0° to 13° C but generally prefer temperatures of 2° to 9° C. Juvenile haddock tend to occupy shallower water on bank and shoal areas, while large adults are more commonly found in deeper water. Adult haddock undertake seasonal movements in the WGOM, the GSC and on the northeast peak of GB, spending much of winter in deeper waters and moving to shoaler waters in spring to spawn.

Adult haddock are benthic feeders. They have a diverse diet that includes gastropod and bivalve mollusks, polychaete worms, amphipods, crabs, shrimps, sea stars, sea urchins, sand dollars, brittle stars, and occasional fish eggs (Brodziak 2005). Adult haddock will sometimes consume small fishes, especially herring. Pelagic larvae and small juvenile haddock feed on phytoplankton, copepods, and invertebrate eggs in the upper part of the water column. Juvenile haddock eat small crustaceans, primarily copepods and euphausiids, as well as polychaetes and small fishes. Juveniles make a transition from pelagic to demersal habitat at ages from 3 to 5 months. Juvenile haddock are eaten by elasmobranchs (spiny dogfish and skates) and many groundfish species (cod, pollock, cusk, white hake, red hake, silver hake, goosefish, halibut, and sea raven). Gray seals also prey on haddock.

Growth rates of haddock have fluctuated over the past 50 years. During the 1960s, an age-4 haddock averaged 48-50 cm. During the 1980s and 1990s when stock sizes were lower, size at age increased and an age-3 fish averaged about 48-50 cm in length. In recent years growth rates have slowed, with haddock reaching 48 to 50 cm at age 4. On GB, haddock growth appears to be density-dependent, with reductions in mean lengths at age across age classes as stock size has increased in recent years (Brodziak et al. 2006). Commercial fishery mean weights at age of GB haddock during 2001-2004 were below their long-term average for all age classes, with decreases ranging from 7% to 44%.

Haddock maturation rates have also changed through time. During the early 1960s, all females of age 4 and older were sexually mature and 75% of age-3 females were mature. Size at maturity of GB haddock has declined in recent years (O'Brien et al. 1993; Trippel et al. 1997). For example, median length of maturity for females was about 40 cm during 1977-1983, but declined to about 34-36 cm in the early 1990s. Since 1998, virtually all age-3 females and 50% of age-2 females are mature (Brodziak et al. 2006). Although earlier maturation will increase spawning stock biomass, the actual reproductive success of first-spawning haddock has not been documented.

Haddock are highly fecund broadcast spawners that spawn over rock, gravel, sand, or mud bottom. An average-sized female (55 cm) produces approximately 850,000 eggs. Larger females are capable of producing up to 3 million eggs annually. Haddock spawning is concentrated on the northeast peak of GB. The western edge of GB also supports a smaller spawning concen-tration (Walford 1938). The two spawning components are persistent and exhibit phenoltypic differences in otolith morphometrics (Begg et al. 2000). Spawning concentrations also occurred historically along the Maine coast. Females release eggs near the ocean bottom in batches where they are fertilized by a courting male. After fertilization, haddock eggs become buoyant and rise to the surface water layer where they drift with ocean currents. Juvenile haddock are pelagic for 3-5 months after hatching and settle to the bottom at a size of roughly 10 cm.

4.3.9.4 The **Atlantic halibut,** *Hippoglossus hippoglossus***,** is the largest species of flatfish found in the northwest Atlantic Ocean. This long-lived, late-maturing flatfish is distributed from Labrador to SNE (Bigelow and Schroeder 1953). In the GOM/GB region, halibut supported important commercial fisheries from the early-1800s to the 1880s (Hennemuth and Rockwell 1987). The population was heavily overfished in the 19th and early 20th centuries and has not recovered. There is currently no directed fishery for Atlantic halibut within Federal waters of the US EEZ, although some small-scale harvests occur within state waters off of Maine. Virtually all landings from the GOM/GB stock region occur as bycatch in US or Canadian groundfish fisheries.

Adult Atlantic halibut range in length from 80 cm to 220 cm in the GOM/GB region. The largest halibut reported captured in US waters was 280 kg dressed weight (headed and gutted) and was captured 88 km off Cape Ann (Collette and Klein-MacPhee 2002). Females typically grow faster and achieve greater sizes than males. Maximum age is reported to be 50 years. Most of the US bycatch of Atlantic halibut consists of age-5 to age-10 fish weighing between 20 to 40 kg. Atlantic halibut reach sexual maturity between 5 to 15 years and the median female age of maturity in the GOM/GB region is about 7 years (Sigourney et al. 2006). There have been no reports of Atlantic halibut spawning in the GOM/GB region in recent years. In general, Atlantic halibut spawn once per year in synchronous groups during late winter through early spring (Neilson et al. 1993). Females can produce up to 7 million eggs per year depending on size (Haug and Gulliksen 1988). Spawning is believed to occur in waters of the upper continental slope at depths of 200 m or greater (Scott and Scott 1988).

4.3.9.5 The **ocean pout,** *Zoarces americanus*, is a demersal eel-like species found in the northwest Atlantic from Labrador to Delaware. In US waters, ocean pout are assessed as a unit stock from GOM/Cape Cod Bay (CCB) south to Delaware.

Stock identification studies suggest the existence of two stocks: one occupying the Bay of Fundy/northern GOM region east of Cape Elizabeth, and a second stock ranging from GOM/CCB south to Delaware (Olsen and Merriman 1946). The southern stock is characterized by faster growth rates, and to date has supported the commercial fishery.

Ocean pout may attain lengths up to 98 cm and weights of 5.3 kg. Ocean pout prefer depths of 15 to 80 m and temperatures of 6° to 7° C. Tagging studies and NEFSC bottom trawl survey data indicate that ocean pout do not undertake extensive migrations, but rather move seasonally to different substrates (Bigelow and Schroeder 1953). During this period, ocean pout are not available to commercial fishing operations. T ypically, catches increase when adults return to their feeding grounds in late autumn and winter. The diet consists primarily of invertebrates, with fish being only a minor component (Steimle et al. 1999). Median length at maturity for females was 26.2 cm and 31.3 cm for the GOM area and SNE area, respectively, with a possible three-year egg development period (O'Brien et al. 1993). Mercer et al. (1993) and Yao and Crim (1995) indicate that ocean pout eggs are internally fertilized.

4.3.9.6 Pollock, *Pollachius virens*, occur on both sides of the North Atlantic; in the northwest Atlantic, the species is most abundant on the western Scotian Shelf and in the GOM. One major spawning area exists in the WGOM and on GB, and several areas have been identified on the Scotian Shelf (Mayo et al. 1989; Cargnellis et al. 1999a). Tagging studies suggest considerable movement of pollock between the Scotian Shelf and GB and, to a lesser extent, between the Scotian Shelf and the GOM (Neilson et al. 2006). Electrophoretic analyses of pollock tissue samples from the Scotian Shelf and WGOM showed no significant differences between areas, although differences in some morphometric and meristic characteristics (McGlade et al. 1986) were significant (Mayo et al. 1989). Unlike earlier assessments conducted by USA scientists (Mayo and Figuerido 1993), the most recent assessment of this stock (Mayo et al. 2005) was restricted to the area primarily under US management authority (NAFO Subareas 5 and 6).

Spawning occurs from November through February with a peak in December (Collette and Klein- MacPhee 2002). Sexual maturation is essentially complete by age 6 (Mayo et al. 1989), although more than 50% of fish are mature before age 3 (O'Brien et al. 1993). Juvenile pollock are common in inshore areas, but move offshore as they grow older. Pollock attain lengths up to 110 cm and weights of 16 kg.

4.3.9.7 Three species of *Sebastes* are common in the northwest Atlantic**.** The **Acadian redfish,** S. *fasciatus Storer***,** and the deepwater redfish, *S. mentella Travin*, are virtually indistinguishable from each other based on external characteristics. Both species are considered as beaked redfish based on the presence of a prominent tubercle on the anterior mandible (Klein-MacPhee and Collette 2002). The third species, the golden redfish*, S. norvegicus Ascanius*, (formerly *S. marinus*, Robins et al. 1991) can be distinguished from the beaked redfishes based on external characteristics, notably a greatly diminished tubercle.

Visual separation of Acadian redfish and deepwater redfish can be accomplished reliably by counting the number of soft rays in the anal fin (Ni 1982) and internal examination of the passage of the extrinsic gas bladder musculature between the second, third and fourth ventral ribs (Ni 1981; see Hallacher 1974). The two species can also be distinguished genetically by the genotype at the malate dehydrogenase locus (MDH-A*) (Payne and Ni 1982; McGlade et al. 1983). In general, deepwater redfish are predominant in the northernmost reaches of the northwest Atlantic, extending from the Gulf of St. Lawrence and the Grand Banks of Newfoundland across the north Atlantic to European waters (Atkinson 1987). Acadian redfish and deepwater redfish co-occur in the Gulf of St. Lawrence and the Laurentian Channel, where introgressive hybridization occurs between the two species, and on the Grand Banks and the Flemish Cap. Morphometric studies have shown that, within the Gulf of St. Lawrence, deepwater redfish have a more fusiform body shape than Acadian redfish. Deepwater redfish are less prominent in the more southerly regions of the Scotian Shelf and appear to be virtually absent from the GOM where Acadian redfish appear to be the sole representative of the genus *Sebastes*. Acadian redfish inhabiting the waters of the GOM and deeper portions of GB and the GSC are managed as a unit stock in US waters.

Acadian redfish are long-lived, exhibiting ovoviviparous reproduction, and are characterized by low fecundity and low natural mortality rate. The testes of the males ripen in the autumn, and mating occurs in late autumn and early winter (Kelly and Wolf 1959; Pikanowski et al. 1999). Fertilization of the ripe eggs is delayed until spring and larval extrusion generally occurs from late spring through July and August, as incubation requires between 45 and 60 days (Kelly et al. 1972; Kelly and Wolf 1959). Generally, between 15,000 and 20,000 extruded larvae are produced per female during each spawning cycle (Kelly et al. 1972).

4.3.9.8 The **white hake,** *Urophycis tenuis*, occurs from Newfoundland to SNE and is common on muddy bottom throughout the GOM (Bigelow and Schroeder 1953; Klein-MacPhee 2002). Depth distribution of white hake varies by age and season; juveniles typically occupy shallower areas than adults, but individuals of all ages tend to move inshore or shoalward in summer, dispersing to deeper areas in winter (Musick 1974; Markel et al. 1982). Most trawl catches are taken at depths of 110 m or greater, although hake are taken as shallow as 27 m by gillnetting. Small white hake are difficult to distinguish from red hake, *Urophycis chuss*, resulting in a small degree of bias in reported nominal catches (Mayo and Terceiro 2005).

Larval distributions indicate the presence of two spawning groups in the GOM, GB and Scotian Shelf region, one which spawns in deep water on the continental slope in late winter and early spring, and a second which spawns on the Scotian Shelf in the summer (Fahay and Able 1989; Lang et al. 1994). Populations in US waters appear to be supported by both spawning events, but individuals are not distinguishable in commercial landings. White hake attain a maximum length of at least 135 cm and weights of up to 21 kg, with females being larger (Klein-MacPhee 2002a). Ages up to 15 years have been documented (NEFSC 1999). Juveniles feed primarily upon shrimp and other crustaceans, but adults feed almost exclusively on fish, including juveniles of their own species (Bowman, 1981; Bowman et al. 1987; Bowman et al. 2000).

4.3.9.9 Windowpane or sand flounder**,** *Scophthalmus aquosus*, is a thin bodied, left eyed flatfish species distributed in the northwest Atlantic from the Gulf of St. Lawrence to Florida (Bigelow and Schroeder 1953). Windowpanes prefer sandy bottom habitats and are most abundant from GB to the southern tip of Virginia. Windowpanes occur in bays and estuaries at depths from the shoreline to 60 m. On GB, the species is most abundant on the shoals (depths < 60 m) during late spring through autumn but overwintering occurs in deeper waters out to 366 m (Chang et al. 1999).

In US waters, windowpane flounder are assessed and managed as two stocks, GOM/GB and SNE/Mid-Atl, based on differences in growth rates (Thorpe 1991), size at maturity, and relative abundance trends.

The median length at maturity is 22.5 cm for females from the northern stock and 21.2 cm for females from the southern stock (O'Brien et al. 1993). The maximum length of windowpane flounder collected in NEFSC bottom trawl surveys during 1963-2004 is 51 cm for the GOM/GB stock and 48 cm for the SNE/Mid-Atl stock. Fish from SNE attain a maximum age of about 8 years and females reach maturity between 3 and 4 years of age (Moore 1947). With the exception of GB, a split spawning season, with peaks in spring and autumn, occurs in most coastal areas between Virginia and Long Island (Chang et al. 1999). Spawning occurs in the southern MAB during April or May and on GB during July and August and then reoccurs in a north to south direction with a second peak in October or November depending on latitude (Morse and Able 1995). During the first year of life, spring-spawned fish have significantly faster growth rates than autumn-spawned fish, which may result in differential natural mortality rates between the two cohorts (Neuman et al. 2001).

4.3.9.10 The **witch flounder,** *Glyptocephalus cynoglossus*, is a demersal flatfish distributed on both sides of the north Atlantic. In the northwest Atlantic, the species ranges from Labrador southward to Virginia, and is closely associated with mud or sand-mud bottom. In US waters, witch flounder are common throughout the GOM and in deeper areas on and adjacent to GB and along the shelf edge as far south as Cape Hatteras. Witch flounder are assessed as a unit stock.

Witch flounder appear to be sedentary, preferring moderately deep areas; few fish are taken shallower than 27 m and most are caught between 110 and 275 m. The diet of witch flounder consists mostly of polychaete worms. Witch flounder attain lengths up to 78 cm and weights of approximately 2 kg (Bigelow and Schroeder 1953), but are slow-growing, late-maturing, and can live as old as 30 years. Female witch flounder reach maturity between ages 5 and 6; spawning occurs in late spring and summer. The larval period is relatively long, between 6 and 12 months (Cargnellis et al. 1999b).

4.3.9.11 The **yellowtail flounder,** *Limanda ferruginea*, is a demersal flatfish distributed from Labrador to Chesapeake Bay generally at depths between 40 and 70 m. Off the US coast, 3 stocks are considered for management purposes (Cadrin 2003): Cape Cod/GOM, GB, and SNE/Mid-Atl Yellowtail flounder have been described as relatively sedentary, although evidence exists for off bottom movements (Walsh and Morgan 2004; Cadrin and Westwood 2004), limited seasonal movements (Royce et al. 1959; Lux 1963; Stone and Nelson 2003), and transboundary movements (Stone and Nelson 2003; Cadrin 2005).

Spawning occurs during spring and summer, peaking in May (Cadrin 2003). Eggs are deposited on or near the bottom and after fertilization float to the surface. Larvae drift for approximately two months, then change form and settle to the bottom.

Off the northeast US, yellowtail flounder grow to 55 cm total length and attain weights of 1.0 kg. Growth is sexually dimorphic, with females growing at a faster rate than males (Lux and Nichy 1969; Cadrin 2003). Yellowtail flounder appear to have variable maturity schedules, with age 2 females 40% mature during periods of high stock biomass to 90% mature during periods of low stock biomass (NEFSC 2005a).

4.3.9.12 The **winter flounder,** blackback, or lemon sole**,** *Psuedopleuronectes americanus*, is a demersal flatfish distributed in the northwest Atlantic from Labrador to Georgia. Important US commercial and recreational fisheries exist from the GOM to the MAB. In USA waters, the resource is assessed and managed as 3 stocks: GOM, SNE-MAB, and GB. Winter flounder generally occur in inshore bays and estuaries during the winter, and move to deeper water in the summer. Spawning occurs during the winter and spring months (Pereira et al. 1999). Growth and maturity vary by stock; GB fish have the fastest growth and reach the largest size, and they reach maturity at the earliest age and smallest size. GOM fish grow the slowest and reach the smallest size, and they reach maturity at the oldest age and largest size (O'Brien et al. 1993). Winter flounder may grow up to 58 cm in total length and attain 15-20 years of age (Pentilla et al. 1989, Pereira et al. 1999).

4.3.10 NE Multispecies - Small Mesh FMP

4.3.10.1 The **offshore hake**, *Merluccius albidus*, is a hake of the family *Merluciidae* or *merlucciid* hakes (ITIS 2008). They are nearly identical in appearance to the silver hake, *Merluccius bilinearis*, a heavily commercially fished species. The offshore hake is thus sometimes commercially targeted as well. Offshore hake are found in a narrow band of deeper water along the continental slope throughout the entire survey region. They are found most often in depths greater than 220 m but less than 400 m. In the Mid-Atl region just south of the New York Bight, offshore hake are also found in shallower water on the continental shelf in depths of up to 100 m or less. Offshore hake captured on the survey average around 25 cm but have been recorded as large as 68 cm.

4.3.10.2 Red hake, *Urophycis chuss*, is a demersal gadoid species distributed from the Gulf of St. Lawrence to North Carolina, and is most abundant from the WGOM through SNE waters.

Red hake are separated into northern and southern stocks for management purposes. The northern stock is defined as the GOM to northern GB region, while the southern stock is defined as the Southern GB to MAB region. Both red hake stocks were last assessed in the fall of 1990.

Red hake migrate seasonally, preferring temperatures between 5° and 12° C (Grosslein and Azarovitz 1982). During the spring and summer months, red hake move into shallower waters to spawn, and during the winter months move offshore to deep waters in the GOM and the edge of the continental shelf along SNE and GB. Spawning occurs from May through November, with primary spawning grounds on the southwest part of GB and in the SNE area off Montauk Point, Long Island (Colton and Temple 1961).

Red hake do not grow as large as white hake, and normally reach a maximum size of 50 cm and 2 kg (Musick 1967). However, females are generally larger than males of the same age, and reach a maximum length of 63 cm and a weight of 3.6 kg (Collette and Klein-MacPhee 2002). Although they generally do not live longer than 8 years, red hake have been recorded up to 14 years old. In the northern stock, the age at 50% maturity is 1.4 years for males and 1.8 years for females, and the size at 50% maturity is 22 cm for males and 27 cm for females (O'Brien et al. 1993). In the southern red hake stock, the age at 50% maturity is 1.8 years for males and 1.7 years for females, and the size at 50% maturity is 24 cm for males and 25 cm for females (O'Brien et al. 1993).

Red hake prefer soft sand or muddy bottom, and feed primarily on crustaceans such as euphausiids, decapods, and rock crabs, as well as fish such as haddock, silver hake, sea robins, sand lance, mackerel, and small red hake (Bowman et al. 2000). Primary predators of red hake include spiny dogfish, cod, goosefish, and silver hake (Rountree 1999). As juveniles, red hake seek shelter from predators in sea scallop beds, and are commonly found in the mantle cavities of (or underneath) sea scallops. In the fall, red hake likely leave the safety of the sea scallop beds due to their increasing size and to seek warmer temperatures in offshore waters (Steiner et al. 1982).

4.3.10.3 Silver hake, also known as whiting, *Merluccius bilinearis*, range primarily from Newfoundland to South Carolina. Silver hake are fast swimmers with sharp teeth, and are important fish predators that also feed heavily on crustaceans and squid (Lock and Packer 2004). Although they do not swim in definitive schools, silver hake tend to aggregate in large numbers (Collette and Klein-MacPhee 2002). In US waters, two stocks have been identified, based on differences of head and fin lengths (Almeida 1987), otolith morphometrics (Bolles and Begg 2000), otolith growth differences, and seasonal distribution patterns (Lock and Packer 2004). The northern silver hake stock inhabits GOM/northern GB waters, and the southern silver hake stock inhabits Southern GB/MAB waters.

As nocturnal, semi-pelagic predators, silver hake move up in the water column to feed at night, primarily between dusk and midnight, and return to rest on the bottom during the day, preferring sandy, muddy, or pebbly substrate (Collette and Klein-MacPhee 2002).

There is some difference in diet between the two stocks. Northern silver hake primarily feed on euphausiids, Atlantic herring, silver hake, and other fish, while southern silver hake primarily feed on crangonid shrimp, squids, cephalopods, and sand lance. Diet varies depending on size, sex, season, migration, spawning, and age (Lock and Packer 2004). Small silver hake prey on euphausiids, while larger, especially older females prey primarily on fish. Silver hake tend to prey more heavily on fish during the spring and autumn, whereas during the summer months, their diets often include a mixture of fish, crustaceans, and mollusks (Lock and Packer 2004).

Silver hake migrate in response to seasonal changes in water temperatures, moving toward shallow, warmer waters in the spring. They spawn in these shallow waters during late spring and early summer and then return to deeper waters in the autumn (Brodziak et al. 2001). The older, larger silver hake especially prefer deeper waters. During the summer, portions of both stocks can be found on GB, whereas during the winter, fish in the northern stock move to deep basins in the GOM, while fish in the southern stock move to outer continental shelf and slope waters. Silver hake are widely distributed, and have been observed at temperature ranges of 2° to 17° C and depth ranges of 11-500 m. However, they are most commonly found between 7° to 10º C (Lock and Parker 2004).

Female silver hake are serial spawners, producing and releasing up to 3 batches of eggs in a single spawning season (Collette and Klein-MacPhee 2002). Major spawning areas include the coastal region of the GOM from Cape Cod to Grand Manan Island, southern and southeastern GB, and the SNE area south of Martha's Vineyard. Peak spawning occurs earlier in the south (May to June) than in the north (July to August). Over one-half of age-2 fish (20 to 30 cm) and virtually all age-3 fish (25 to 35 cm) are sexually mature. Silver hake grow to a maximum length of over 70 cm, and ages up to 14 years have been observed in US waters, although few fish older than age-6 have been observed in recent years (Brodziak et al. 2001).

4.3.11 Red Crab FMP

4.3.11.1 Deep sea **red crabs,** *Chaceon quinquedens*, are distributed on and along the edge of the continental shelf of the northwest Atlantic Ocean and in the GOM and the Gulf of Mexico. They inhabit mud, sand, and hard bottom at depths from 200 to 1800+ m, at water temperatures between 5° to 8° C (Wigley et al. 1975). In the GOM, red crabs are found in waters as shallow as 75 m. Male red crabs are believed to require 5-6 years to attain commercial size, and more than 15 years to reach a maximum size of about 180 mm carapace width (Haefner 1978). Female red crabs grow only to a maximum size of about 120 mm. During mating, the larger male crab forms a protective “cage” around the female, carrying her until she molts and becomes ready to copulate. Female deep sea red crabs brood their eggs under their abdominal flap for up to 9 months. After the larvae hatch, they remain in the plankton for 23-125 days. Larval settlement is believed to occur near the base of the continental slope, and the young crabs move up the slope as they mature. Male and juvenile crabs are commonly found in deeper water than females.

4.3.12 Sea Scallop FMP

4.3.12.1 Sea scallops, *Placopecten magellanicus*, are distributed in the northwest Atlantic Ocean from Newfoundland to North Carolina, mainly on sand and gravel sediments where bottom temperatures remain below 20° C. North of Cape Cod, concentrations generally occur in shallow water < 40 m deep. South of Cape Cod and on GB, sea scallops typically occur at depths between 25 and 200 m, with commercial concentrations generally between 35 and 100 m.

Sea scallops are filter feeders, feeding primarily on phytoplankton, but also on microzooplankton and detritus (Hart and Chute 2004). Sea scallops grow rapidly during the first several years of life. Between ages 3 and 5, they commonly increase 50 to 80% in shell height and quadruple their meat weight. During this time span, the number of meats per pound is reduced from greater than 100 to about 23. The largest observed size is about 23 cm shell height, but sea scallops rarely grow larger than 17 cm shell height. Sea scallops have been known to live more than 20 years. They usually become sexually mature at age 2, but individuals younger than age 4 probably contribute little to total egg production. Sexes are separate and fertilization is external. Spawning usually occurs in late summer and early autumn; spring spawning may also occur, especially in the MAB. Sea scallops are highly fecund; a single large female can release hundreds of millions of eggs annually. Larvae remain in the water column for 4 to 7 weeks before settling to the bottom. Sea scallops attain commercial size at about 4 to 5 years old, though historically, 3 year- olds were often exploited.

4.3.13 Skate FMP

Skates, Family *Rajidae*, are distributed throughout the northwest Atlantic from near the tide line to depths exceeding 700 m (Bigelow and Schroeder 1953; McEachran 2002). Members of this family lay eggs that are enclosed in a hard, leathery case commonly called a mermaid's purse. Incubation time is at least 6 to 12 months, with the young having the adult form at the time of hatching. Skates are not known to undertake large scale migrations, but move seasonally in response to changes in water temperature, generally offshore in summer and early autumn and vice versa during winter and spring. There are 7 species of skates occurring along the north Atlantic coast of the US (McEachran and Musick 1975):

4.3.13.1 Barndoor skate, *Dipturus laevis***,** is a large-bodied species reaching sizes of 150 cm (Bigelow and Schroeder 1953), and ages of more than 10 (Gedamke et al. 2005). Males reach sexual maturity at age 6, at a size of 108 cm, while females attain maturity at age 6.5 and 116 cm. The center of distribution for barndoor skates is GB and SNE, with some animals occasionally found in the GOM and on the Scotian Shelf.

4.3.13.2 Clearnose skate, *Raja eglanteria***,** are smaller, reaching sizes of 90 cm, and live to be around 8 years old (Gelsleichter 1998). Size at first maturity is 56 cm for males and 66-73 cm for females (Sosebee 2005b). Clearnose skates are a southern species, occurring primarily in the inshore Mid-Atl and inshore SNE.

4.3.13.3 Little skate, *Leucoraja erinacea*, is the second smallest skate species reaching sizes around 54 cm (McEachran 2002), and maximum ages between 8 and 12 (Waring 1984; Frisk 2004; Frisk and Miller 2006). Size at first maturity is reached at 39 cm for males and 40-42 cm for females (Sosebee 2005b). Little skate are found in all areas, but primarily GB and SNE.

4.3.13.4 Rosette skate, *Leucoraja. garmani*, is the smallest of the seven species and reaches a maximum size of 45-50 cm (McEachran 2002). Sexual maturity occurs at 33 cm for males and 33-35 cm for females (Sosebee 2005b). Rosette skates are a southern species, occurring primarily in deep waters in the Mid-Atl, SNE, and occasionally off GB.

4.3.13.5 Smooth skate, *Malacoraja senta*, reach a slightly larger size of around 58 cm (McEachran 2002), and size at first maturity occurs at 50 cm for males and 33-48 cm for females (Sosebee 2005b). Smooth and thorny skates are most commonly found in the GOM.

4.3.13.6 Thorny skate, *Amblyraja radiata*, is a large-bodied species with a maximum size of 102 cm (McEachran 2002), and can live to be age 16 and older (Sulikowski et al. 2005a). Sexual maturity appears to occur over a broad size range (Sosebee 2005b), with most mature animals over 80 cm (Sulikowski et al. 2005b).

4.3.13.7 Winter skate, *Leucoraja ocellata***,** are large-bodied and can potentially reach sizes of 150 cm (McEachran 2002), and 20 years of age (Sulikowski et al. 2003; Frisk 2004). Sexual maturity is reached at a large size of around 74 cm at about age 12 (Sulikowski et al. 2004; Frisk 2004; Frisk and Miller 2006). The center of distribution for winter skate is GB and SNE, with some animals occasionally found in the GOM, on the Scotian Shelf, and in the Mid-Atl.

4.3.14 Herring FMP

4.3.14.1 The **Atlantic herring,** *Clupea harengus*, is widely distributed in continental shelf waters of the northeast Atlantic, from Labrador to Cape Hatteras. Important commercial fisheries for juvenile herring (ages 1 to 3) exist along the coasts of Maine and New Brunswick. Development of large-scale fisheries for adult herring is comparatively recent, primarily occurring in the WGOM, on GB, and on the Scotian Shelf. GOM herring migrate from summer feeding grounds along the Maine coast and on GB to SNE and Mid-Atl areas during winter, with larger individuals tending to migrate farther distances. Tagging experiments provide evidence of intermixing of GOM, GB, and Scotian Shelf herring during different phases of the annual migration.

Spawning in the GOM occurs during late August-October, beginning in northern locations and progressing southward. Atlantic herring are not fully mature until age 4. Age at maturity varies annually and appears to change in response to density dependent effects. Herring eggs are demersal and are typically deposited on gravel substrates. Primary spawning locations off the northeastern US are located on the Maine coast, Jeffreys Ledge, Nantucket Shoals, and GB. Incubation is temperature dependent, but usually occurs for 7 to 10 days. Larvae metamorphose by late spring into juvenile brit herring that may form large aggregations in coastal waters during summer. By age 2, juvenile herring are fully vulnerable to fixed and mobile gear coastal fisheries.

In the past, the herring resource along the East Coast of the US was divided into the GOM and GB stocks. There is currently no genetic evidence to suggest that these two components are separate stocks. However, morphometric analyses suggest that discernable phenotypic differences exist among herring from the GOM, GB, and the Scotian shelf. However, fishery-independent measures of abundance for herring include fish originating from all spawning areas. As a consequence, herring from the GOM and GB components are combined for assessment purposes into a single coastal stock complex. This approach has many advantages over the separate stock approach, but also poses a number of technical and management challenges, particularly for the management of the smaller inshore component.

4.3.15 Spiny Dogfish FMP

4.3.15.1 Spiny dogfish, *Squalus acanthias*, are distributed in the western north Atlantic from Labrador to Florida and are considered to be a unit stock in this region (Burgess 2002). During spring and autumn, spiny dogfish occur in coastal waters between North Carolina and SNE. In summer, dogfish migrate northward to the GOM/GB region and into Canadian waters, and return southward in autumn and winter (Jensen 1965). They tend to school by size and, when mature, by sex. Dogfish feed on many species of fish and crustaceans, but generally target the most abundant species (Link et al. 2002). In the northwest Atlantic, maximum reported ages for males and females are 35 and 40 years, respectively (Nammack 1982). The species bears live young; the gestation period is about 18 to 22 months, and an average of 6 pups are produced (range of 2 to 15 pups). Size at maturity for females is around 80 cm, but can vary from 78 cm to 85 cm depending on the abundance of females (Sosebee 2005a).

4.3.16 Monkfish FMP

4.3.16.1 Goosefish, *Lophius americanus*, also called monkfish, are distributed in the northwest Atlantic from the Grand Banks and northern Gulf of St. Lawrence south to Cape Hatteras. Goosefish may be found from inshore areas to depths of at least 900 m. Seasonal onshore/ offshore migrations occur and appear to be related to spawning and possibly food availability (Collette and Klein-MacPhee 2002).

Goosefish rest partially buried on soft bottom substrates and attract prey using a modified first dorsal fin ray that resembles a fishing pole and lure. Goosefish are piscivorous and commonly eat prey as large as themselves. Growth is rapid at about 10 cm per year, and is similar for both sexes up to age 6 and lengths of around 60 cm. Few males are found older than age 7, but females can live to 12-14 years or older (NEFSC 2002, 2005). Goosefish as large as 138 cm have been captured in NEFSC bottom trawl surveys.

Female goosefish begin to mature at age 4, and 50% of females are mature by age 5 (~ 43 cm). Males mature at slightly younger ages and smaller sizes (50% maturity at age 4 (~36 cm) (NEFSC 2002)). Spawning takes place from spring through early autumn, progressing from south to north, with most spawning occurring during the spring and early summer. Females lay a buoyant mucoid egg raft or veil which can be as large as 12 m long and 1.5 m wide and only a few mm thick. The eggs are arranged in a single layer in the veil, and the larvae hatch after 1-3 weeks, depending on water temperature. The larvae and juveniles spend several months in a pelagic phase before settling to a benthic existence at a size of about 8 cm (Collette and Klein-MacPhee 2002).

Genetic studies have revealed a genetically homogeneous population of goosefish off the US east coast (Chikarmane et al. 2000) and survey information indicates little or no difference in growth and maturation rates between goosefish from southern and northern management regions (NEFSC 2002, 2005). However, because of differences in how the fisheries in these two regions are prosecuted, goosefish are managed separately as two “stocks”: the "northern stock" (GOM and northern GB) and the "southern stock" (southern GB/Mid-Atl).

4.3.17 Species for Possible Future Management Action Consideration

4.3.17.1 The **cusk,** *Brosme brosme*, is a deepwater species that is distributed on both sides of the Atlantic Ocean on hard bottom areas. Although the stock structure is unknown, the greatest concentrations of cusk off the US coast occur in the central part of the GOM and extend onto the western Scotian Shelf (Sosebee and Cadrin 2006; Harris, L.E. et al. 2002). Spawning occurs in spring and early summer; eggs rise to the surface where hatching and larval development occur. Juveniles move to the bottom at about 5 cm in length, where they become sedentary and rather solitary in habit. Individuals commonly attain lengths from 46-76 cm and weights from 2.3- 4.5 kg. The major prey items of cusk in the GOM are crustaceans, primarily toad crabs and pandalid shrimps (Collette and Klein-MacPhee 2002). Although little information is available for GOM fish, cusk from the Scotian Shelf area are relatively slow growing and late maturing. Scotian Shelf cusk reach a maximum age greater than 14 years and attain sexual maturity by age 5 for males and age 7 for females (Oldham 1972).

4.3.17.2 The **Atlantic hagfish,** or "slime eel," *Myxine glutinosa*, is found in deep, cold waters to depths of at least 1100 m. In the western north Atlantic, hagfish are distributed from Davis Straits, Greenland, to the continental slope waters off of Florida. In the GOM, the distribution of hagfish is primarily affected by salinity, temperature, and substrate type (Collette and Klein-MacPhee 2002).

Hagfish are considered to be the most primitive vertebrate species either living or extinct (Collette and Klein-MacPhee 2002; Powell et al. 2005). Hagfish evolved over at least 300 million years and have the same basic morphological traits of fossilized specimens (Bardack 1991).

Hagfish lack bones, paired fins, and a true jaw. The hagfish skeleton is composed of cartilage, the dorsal fin is actually a skin fold, and the jaw is a rasping plate with horn-like teeth. Atlantic hagfish belong to the family *Myxinidae*, which has 1 pair of gill openings attached to 6-7 internal gill pouches per opening. The species has paired barbels on the tip of its snout and 4 barbels surrounding the mouth. Hagfish are almost blind because their eyes are rudimentary, but their sense of smell is keen. The skin of the Atlantic hagfish is smooth and scale-less with a series of slime glands along both sides of the ventral midline (Collette and Klein-MacPhee 2002). These glands produce fibrous mucus that protects hagfish from predators and possibly parasites.

Atlantic hagfish inhabit soft clay or muddy sediments and spend much of their time in temporary burrows in the sea floor (Collette and Klein-MacPhee 2002). They prey primarily on shrimp, worms and small crabs (Gustafson 1935, Shelton 1978, Collette and Klein-MacPhee 2002). They are also scavengers that feed upon dead and dying fish, mammals, and shellfish. Hagfish are often considered a nuisance by commercial fishermen because they can feed on targeted species (Martini et al. 1997; Collette and Klein-MacPhee 2002).

Age at maturity and life expectancy are unknown in the GOM, as are spawning locations. Length at 50% maturity for Grand Banks hagfish is estimated at 378 mm (Grant 2006). Spawning may occur at any time of year, as females have been observed in various stages of oogenesis during all seasons (Collette and Klein-MacPhee 2002; Martini et al. 1997). Hagfish can possess both mature male and female sexual organs but it is unknown if both are functional at the same time (Powell et al. 2005). Females produce clutches containing an average of 20-30 yolky eggs (Collette and Klein-MacPhee 2002). Time required to develop a clutch of eggs is unknown but has been estimated at 1-2 years. Development from egg to hatchling may be several months based on egg yolk volume (NEFSC 2003). Studies in the GOM suggest that the adult population is composed of 10% sexually immature individuals, 59% females, roughly 6% males and approximately 25 % of unknown gender (Martini et al. 1997).

4.3.17.3 Atlantic wolffish, *Anarhichas lupus***,** are distributed on both sides of the north Atlantic Ocean. In the northwest Atlantic the species occurs from Davis Straits off of Greenland to Cape Cod, and sometimes in SNE and New Jersey waters (Collette and Klein-MacPhee 2002). In the GOM/GB region, abundance is highest in the southwestern portion at depths of 80 to 120 m, but wolffish are also found in waters from 40 to 240 m (Nelson and Ross 1992).

Atlantic wolffish are sedentary and mostly solitary in habit, except during mating. They seem to prefer complex benthic habitats with large stones and rocks, which provide shelter (Pavlov and Novikov 1993). They do not display territorial behavior (Pavlov and Novikov 1993). The diet of GOM/GB wolffish consists primarily of bivalves, gastropods, decapods, and echinoderms.

Little is known about the biology, migration patterns or seasonal movements of Atlantic wolffish in the GOM/GB region. The peak spawning period is believed to occur from September to October (Collette and Klein-MacPhee 2002). Laboratory studies indicate that wolffish may be found in a ripe condition throughout most of the year, and spawning may be correlated with photoperiod (Johannessen et al. 1993, Pavlov and Moksness 1994). There is weak indication of a deep to shallow migration between the fall and spring seasons (Nelson and Ross 1992).

In the GOM/GB region individuals may attain lengths of 150 cm and weights of 18 kg (Collette and Klein-MacPhee 2002). In the western Atlantic most individuals mature by age 5-6 when they reach approximately 47 cm total length (Nelson and Ross 1992, Templemann 1986). However, size at first maturity varies regionally; northern fish mature at smaller sizes than faster growing southern fish. Atlantic wolffish have lower fecundity compared to their relatives, the spotted wolffish (*Anarhichas minor*) and the northern wolffish (*Anarhichas denticulus*). Fecundity is related to fish size and body mass. A 60 cm female produces approximately 5,000 eggs, while an 80-90 cm female will lay 12,000 eggs (Falk-Petersen and Hansen 1991).

4.3.18 Species with Significant Bycatch on Bottom Trawl Surveys

4.3.18.1 The **bay anchovy,** *Anchoa mitchilli*, is a small, inshore pelagic, shallow water species of the anchovy family, *Engraulidae*. They range from Maine to the Gulf of Mexico but are most abundant south of New England. They are found from the littoral zone to depths as great as 70 m, but in the NEFSC survey region reach peak abundance around 18 m depth and beyond 36 m their numbers fall significantly. Bay anchovy usually reach a maximum size of around 7.5 cm, but have been recorded at 11 cm (Hildebrand 1963). They are very short-lived and may reach up to 3 years, but few survive to this age (Newberger and Houde 1995). Bay anchovies are heavily preyed upon by other fishes and thus represent an important link in the ecosystem. South of New England they are found in large numbers, and in the south Atlantic and Gulf coasts are reported as having the largest numbers of any estuarine fish (Baird and Ulanowicz 1989). They have only limited commercial use (Hildebrand 1963), and recreationally are used only for bait. Due to their small size, they are retained in bottom trawl surveys only through the use of a small-mesh liner. Of the 3 species of anchovy encountered on NEFSC bottom trawl surveys, the bay anchovy is by far the most numerous.

4.3.18.2 There are two species of **cancer crab** captured in the NEFSC survey region, the **Atlantic rock crab**, *Cancer irroratus*, and the **Jonah crab,** *Cancer borealis*, (ITIS 2008). Both species are found throughout the NEFSC survey region, in depths ranging from the shore out to 500 m. They are nearly identical in size and appearance, and both species are commercially fished. Both species represent a significant component of the decapod crustacean catch throughout the majority of the survey region. They are capable of being released alive during survey operation.

4.3.18.3 The **fourspot flounder,** *Hippoglossina oblonga*, is a small to medium sized flatfish of the sand flounder family, *Paralichthyidae*. Fourspot flounder range in the US from the GOM to Tortugas, Florida (Collette and Klein-MacPhee 2002c). They live in a wide range of depths, from 5 m out to 500 m, but are most common around 70 m depth. NEFSC surveys have encountered fourspot flounder up to 49 cm in length but they are much more common in the 24-28 cm range. The fourspot is a soft-fleshed fish, and is not regarded well commercially or recreationally. No directed fishery exists for this species, despite being fairly numerous.

4.3.18.4 The **Icelandic scallop**, *Chlamys islandica*, is a bivalve of the family *Pectinidae* (ITIS 2008). They are captured on NEFSC surveys primarily in the GSC area of the GOM. Icelandic scallops are unusual in that, unlike other scallop species, they attach to bottom substrate with byssal threads, much like the mussel. They tend to be found in rocky substrate in the NEFSC survey region. There is a limited commercial fishery for this species.

4.3.18.5 The **Northern sand lance**, *Ammodytes dubius*, is a small, eel-like schooling fish of the family *Ammodytidae*, or sand lances (ITIS 2008). In the US, they are found from Cape Hatteras to the GOM (Nizinski 2002). Sand lance are unique in having hardened, narrow snouts which are used to burrow into sandy bottom substrate. It is thus difficult to capture in bottom trawls as this trait along with its narrow body makes the sand lance capable of burrowing through small mesh liners. Their dense schooling nature, however, allows for some degree of capture by virtue of sheer numbers, and they are often captured at sizes that would otherwise escape through the liner. Sand lance are encountered in depths of 12 to 240 m. They range in size on NEFSC surveys from 2 to 30 cm. A close relative, the American or inshore sand lance is also captured on NEFSC trawl surveys. These two species can not be practically identified in the field and are commonly lumped together.

4.3.18.6 The **Northern sea robin**, *Prionotus carolinus*, is a small, coastal, demersal fish of the family *Triglidae*, or searobins (ITIS 2008). In the US, northern sea robins are found from Florida to the GOM, but are most common from Cape Ann to South Carolina. Northern sea robins have been captured in depths as great as 460 m on NEFSC surveys, but are much more common between 14 and 127 m. They range in size on NEFSC surveys from 2 to 39 cm, averaging about 20 cm. They can be a significant portion of the catch in the Mid-Atl part of the survey region. There are no directed fisheries for this species.

4.3.18.7 The **roughtail stingray**, *Dasyatis centroura*, is a large, demersal ray of the family *Dasyatidae* or whiptail stingrays (ITIS 2008). Roughtail stingrays in the US are found from the Gulf of Mexico to Cape Cod (McEachran 2002). On NEFSC surveys, roughtails are found in depths ranging from the shore to 215 m, most commonly over 100 m, and with peak abundance at around 30 m. Roughtail stingrays captured on NEFSC surveys range from 31 to 190 cm (disc width), with a fairly wide size distribution. There are no fisheries for this species other than as bycatch, and it can be dangerous to handle. Large individuals are capable of being released live on NEFSC surveys.

4.3.18.8 The **round herring**, *Etrumeus teres*, is a small, pelagic, schooling fish of the family *Clupeidae*, or herrings (ITIS 2008). In the US, round herring are found from the Gulf of Mexico to the GOM, but are more common south of Cape Cod (Munroe 2002a). Round herring are captured on NEFSC surveys in depths ranging from the shore to 300 m, with peak abundance between 12 and 71 m. Round herring captured on NEFSC surveys range from 4 cm to 28 cm, with an average close to 12 cm. They can be very numerous when encountered and are an important prey item for many fish species (Munroe 2002a). Round herring are sometimes used as bait for recreational fishing, but there are no major commercial fisheries for this species in US waters (Munroe 2002a).

4.3.18.9 The **sea raven**, *Hemitripterus americanus*, is a small to medium sized demersal fish of the family *Hemitripteridae* or searavens (ITIS 2008). In the US, sea ravens range from Chesapeake Bay to the GOM (Klein-MacPhee 2002b). They are most often encountered from New Jersey northward on NEFSC surveys, in depths ranging from the shore to 320 m, with a peak abundance between 20 and 110 m. Sea ravens can attain sizes of 65 cm, but average about 31 cm on NEFSC surveys. They are important fish predators based on survey data (Klein-MacPhee 2002b). There are no directed fisheries for this species.

4.3.18.10 The **smooth dogfish**, *Mustelus canis*, is a small, demersal, near-shore species of shark of the family *Mustelidae*, or smoothhounds (ITIS 2008). In the US, smooth dogfish are found from the Gulf of Mexico to the GOM, but are most common in the Mid-Atl from Cape Cod to Cape Hatteras (Branstetter 2002). Smooth dogfish on NEFSC surveys are encountered in a wide range of depths, as deep as 365 m but more commonly less than 60 m, with peak abundance at approximately 20 m. They are capable of reaching sizes of up to 150 cm (Branstetter 2002), but on the surveys average around 82 cm. Smooth dogfish undergo strong seasonal north-south migrations and are more likely to be found offshore during the colder months. NEFSC trawl survey data shows that smooth dogfish feed heavily on decapod crustaceans including at least 2 species of commercial importance (Branstetter 2002). Both recreational and commercial fisheries occur for this species.

4.3.18.11 The **spotted hake**, *Urophycis regia*, is a small, demersal fish of the family *Gadidae*, (ITIS 2008). In the US, spotted hake are found from the Gulf of Mexico (Klein-MacPhee 2002a) to the GOM. Spotted hake are most abundant on NEFSC trawl surveys from the southern flank of GB south to Cape Hatteras. They are encountered in a wide range of depths, ranging from the shore to 500 m, with peak abundance between 12 and 180 m. Spotted hake can reach a maximum size of 46 cm, but average 21 cm on NEFSC bottom trawl surveys. There are no directed fisheries for spotted hake.

4.3.18.12 The **striped anchovy,** *Anchoa hepsetus*, is a small, inshore pelagic, shallow water species of the anchovy family, *Engraulidae*. It ranges in US waters from the GOM to the Gulf of Mexico, but is common only south of New England. Striped anchovy encountered on NEFSC surveys reach peak abundance around 20 m depth, and unlike the bay anchovy, their abundance significantly tapers much deeper, at around 60 m. They have been recorded beyond 100 m, although this is rare. It is larger on average than the bay anchovy in the Mid-Atl region, but less numerous. Striped anchovy reach a maximum size of 15 cm (Munroe 2002b), but on bottom trawl surveys average approximately 9-10 cm. They are an important prey item for numerous predatory species, including bluefish and weakfish (Rountree 1999).

4.4 Protected Resources

The following protected species are found in the environment utilized by the NEFSC research surveys. A number of the species are listed under the ESA of 1973 as endangered or threatened, while others are identified as protected under the MMPA of 1972. Two right whale critical habitat designations (59 FR 28793, June 3, 1994) are located in the area in which the surveys are conducted. The information provided here summarizes the more detailed and extensive descriptions and life history information (provided in Sergeant 1962; Boulva and McLaren 1979; Lavigne and Kovacs 1988; Selzer and Payne 1988; Mead 1989; Kenney 1990; Rosel et al. 1999; Gaskin 1992; Katona et al. 1993; Read and Hohn 1995; Lesage and Hammill 2001; Perrin et al. 2002; Reeves et al. 2002; Clapham et al. 2003; Stenson et al. 2003; Stevick et al. 2003; Torres et al. 2003; Gilbert et al. 2005; Kraus and Rolland, 2007; and Waring et al. 2007).

Cetaceans	***Status***
Northern right whale (*Eubalaena glacialis*)	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered
Fin whale (*Balaenoptera physalus*)	Endangered
Blue whale (*B. musculus*)	Endangered
Sei whale (*B. borealis*)	Endangered
Sperm whale (*Physeter macrocephalus*)	Endangered
Minke whale (*B. acutorostrata*)	Protected
Cuvier’s beaked whale (*Ziphius cavirostris*)	Protected
Mesoplodon beaked whales (*Mesoplodon* spp.)	Protected
Pilot whale (*Globicephala* spp.)	Protected
Atlantic spotted dolphin (*Stenella frontalis*)	Protected
Striped dolphin (*S. coeruleoalba*)	Protected
Risso’s dolphin (*Grampus griseus*)	Protected
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Protected
White-beaked dolphin (*L. albirostris*)	Protected
Common dolphin (*Delphinus delphis*)	Protected
Bottlenose dolphin: coastal stocks (*Tursiops truncatus*)	Depleted
Bottlenose dolphin: offshore stock (*T. truncatus*)	Protected
Harbor porpoise (*Phocoena phocoena*)	Protected

Seals

Harbor seal (*Phoca vitulina*)	Protected
Gray seal (*Halichoerus grypus*)	Protected
Harp seal (*Pagophilus groenlandica*)	Protected
Hooded seal (*Crystophora cristata*)	Protected

Sea Turtles

Leatherback sea turtle (*Dermochelys coriacea*)	Endangered
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered
Green sea turtle (*Chelonia mydas*)	Threatened/Endangered*
Loggerhead sea turtle (*Caretta caretta*)	Threatened

Fish

Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered
Atlantic salmon (*Salmo salar*)	Endangered

Critical Habitat Designations

Right whale Cape Cod Bay
Great South Channel

*Green turtles in US waters are listed as threatened except for the Florida breeding population, which is listed as endangered.

It is expected that all of the species identified above have the potential to be affected by the operation of the surveys. However, given differences in abundance, distribution, and migratory patterns, it is likely that effects and the magnitude of those effects will vary amongst the species.

4.4.1 Species Not Likely to be Affected

4.4.1.1 Large whales

Large whales are not likely to be affected by NEFSC survey activity for several reasons: These cetaceans are too large to be caught in research trawl, dredge, zooplankton, or oceanographic sampling gear deployed by the NEFSC research platforms. Towing speed is low (<4.0 knots) and tow duration is 30 minutes or less for all research sampling. Vessel transit speed is normally below 10.0 knots, particularly under adverse weather conditions. Survey vessels do not tow gear in close proximity to cetaceans, particularly right whales. Further, sperm whales are not commonly seen on shelf waters and blue whales are rarely sighted in EEZ waters off the northeast US coast.

4.4.1.1.1 Individuals of the western Atlantic **Northern right whale** population range from wintering and calving grounds in the coastal waters of the southeastern US to summer feeding and nursery grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf (CeTAP 1982; Kraus and Rolland 2007; Waring et al. 2007). The six major habitats or congregations areas are: coastal waters of the southeastern US; the GSC; GOM/GB; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Scotian Shelf. New England waters are a primary feeding habitat for right whales, which feed primarily on copepods (largely of the genera *Calanus* and *Pseudocalanus*) in this area (Mayo and Marx 1990).

4.4.1.1.2 Humpback whales in the western north Atlantic feed during spring, summer and fall over a range which encompasses the eastern coast of the US (including the GOM), the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard 1990; Clapham et al. 2003; Waring et al. 2007). Based on genetic studies, the GOM feed stock is treated as a separate management stock (Palsbøll et al. 1995; IWC 2002). Feeding is the principal activity of humpback whales in New England waters, and their distribution in this region has been largely correlated to prey species and abundance, although behavior and bottom topography are factors in foraging strategy (Payne et al. 1986, 1990). Humpback whales are frequently piscivorus when in these waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes. In the northern GOM, euphausiids are also frequently taken (Paquet et al. 1997). Commercial depletion of herring and mackerel led to an increase in sand lance in the southwestern GOM in the mid-1970s, with a concurrent decrease in humpback whale abundance in the northern GOM. Humpback whales were densest over the sandy shoals in the southwestern GOM, favored by the sand lance during much of the late 1970s and early 1980's, humpback distribution appeared to have shifted to this area (Payne et al. 1986). An apparent reversal began in the mid 1980s, and herring and mackerel increased as sand lance again decreased (Fogarty et al. 1991). Humpback whale abundance in the northern GOM increased dramatically during 1992-1993, along with a major influx of herring. Humpback whales were few in nearshore Massachusetts waters in the 1992-1993 summer seasons. They were more abundant in the offshore waters of Cultivator Shoal and the Northeast Peak on GB, and on Jeffreys Ledge; these latter areas are more traditional locations of herring occurrence. In 1996 and 1997, sand lance, and therefore humpback whales were once again abundant in the Stellwagen Bank area. However, unlike previous cycles, when an increase in sand lance corresponded to a decrease in herring, herring remained relatively abundant in the northern GOM, and humpbacks correspondingly continued to occupy this portion of the habitat, where they also fed on euphausiids (unpublished data, Center for Coastal Studies and College of the Atlantic).

4.4.1.1.3 Fin whales are common in waters of the US EEZ, principally from Cape Hatteras northward. Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys (CeTAP 1982) between Cape Hatteras and Nova Scotia during 1978-82. While much remains unknown, the magnitude of the ecological role of the fin whale is impressive. In this region, fin whales are probably the dominant large cetacean species in all seasons, with the largest standing stock, the largest food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Kenney et al. 1997; Hain et al. 1992). There is little doubt that New England waters represent a major feeding ground for the fin whale.

4.4.1.1.4 Sei whales are most abundant in US waters in the spring months, with sightings concentrated in the GSC and along the northern edge of George's Bank (F. Wenzel pers. comm.). Sei whales are also found along the eastern margin of GB and into the Northeast Channel area, and along the southwestern edge of GB in the area of Hydrographer Canyon (CeTAP 1982). This region represents the southern portion of the species range (Mitchell and Chapman 1977; Waring et al. 2007). The sei whale is often found in the deeper waters characteristic of the continental shelf edge region (Hain et al. 1985), and NMFS aerial surveys found substantial numbers of sei whales in this region, south of Nantucket, in the spring of 2001. This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters. Although known to take piscine prey, sei whales (like right whales) are largely planktivorous, feeding primarily on euphausiids and copepods. In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the GSC (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (Payne et al. 1990).

4.4.1.1.5 Blue whales are occasionally seen in US waters; they are more commonly found in Canadian waters (Waring et al. 2000).

4.4.1.1.6 Sperm whales are principally distributed along the continental shelf edge, over the continental slope, and into mid-ocean regions (CeTAP 1982; Waring et al. 2001; Waring et al. 1993, 2007). However, in summer the distribution also includes the area east and north of GB and into the Northeast Channel region, as well as the continental shelf (inshore of the 100 m isobath) south of New England (Scott and Sadove 1997; Waring et al. 2001).

The only known interaction between a large whale and sea scallop gear occurred in 1983 when a humpback whale became entangled in the cables of sea scallop dredge gear off of Chatham, Massachusetts. The entanglement was reported and responded to by disentanglement personnel. Although this event shows that interactions between large cetaceans and sea scallop gear can occur, such interactions are expected to be extremely unlikely to occur given that these whale species are larger than a sea scallop dredge or trawl opening, and have the speed and maneuverability to get out of the way of oncoming sea scallop fishing gear. Similarly, there have been no documented interactions between any endangered marine mammal and the north Atlantic bottom trawl or pelagic trawl fisheries. The use of trawl gear is not affected by the Atlantic Large Whale Take Reduction Plan (ALWTRP) because this gear type is not known to result in serious injuries or mortality to large whales (e.g., right, humpback, or fin whales). Similarly, sperm whales and sei whales are too large to be impacted by the research fishing gear used aboard NEFSC survey vessels. Further, sperm whales occur mainly beyond the depth range (~400 m) encompassed in most NEFSC surveys.

Critical habitat for right whales has been designated for CCB, GSC, and coastal Florida and Georgia (outside of the action area for this BO). The habitat features identified in this designation include copepods (prey), and oceanographic conditions created by a combination of temperature and depth that are conducive for calving and nursing. There is no evidence to suggest that the NEFSC research activities will have any adverse effects on the habitat features in the specific areas designated as right whale critical habitat.

4.4.1.2 Medium size whales

4.4.1.2.1 Cuvier's and *Mesoplodon* spp. beaked whales (these include **True's beaked whale**, *M. mirus*; **Gervais' beaked whale**, *M. europaeus*; **Blainville's beaked whale**, *M. densirostris*; and **Sowerby's beaked whale**, *M. bidens*; Mead 1989) are difficult to identify to the species level at sea; therefore, much of the available characterization for beaked whales is to genus level only. Beaked whales occur principally along the shelf edge and deeper oceanic waters (CeTAP 1982; Waring et al. 2001; Waring et al. 2007), and therefore are mainly beyond the depth range (~400 m) encompassed in most NEFSC surveys. Further, there are no documented incidental mortalities for these species in fishing gear with similar characteristics to NEFSC research trawls/dredges.

4.4.1.3 Dolphins and porpoises

4.4.1.3.1 Risso's dolphins are distributed 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 begins at the MAB and extends further into oceanic waters (Payne et al. 1984). In general, the population occupies the Mid-Atl continental shelf edge year round, and is rarely seen in the GOM (Payne et al. 1984). During 1990, 1991 and 1993, spring/summer surveys conducted in continental shelf edge and deeper oceanic waters had sightings of Risso's dolphins associated with strong bathymetric features, Gulf Stream warm-core rings, and the Gulf Stream north wall (Waring et al. 1992).

4.4.1.3.2 Striped dolphins are distributed along the continental shelf edge from Cape Hatteras to the southern margin of GB, and also occur offshore over the continental slope and rise in the Mid-Atl region (CeTAP 1982; Mullin and Fulling 2003). Continental shelf edge sightings in this program were generally centered along the 1000 m depth contour in all seasons (CeTAP 1982). During 1990 and 1991 cetacean habitat-use surveys, striped dolphins were associated with the Gulf Stream north wall and warm-core ring features (Waring et al. 1992). Striped dolphins seen in a survey of the New England Sea Mounts (Palka 1997) were in waters that were between 20^{o} and 27^{o} C and deeper than 900 m.

4.4.1.3.3 Atlantic spotted dolphins are distributed in tropical and warm temperate waters of the western north Atlantic (Leatherwood et al. 1976). Their distribution ranges from SNE, south through the Gulf of Mexico and the Caribbean to Venezuela (Leatherwood et al. 1976; Perrin et al. 1994). Atlantic spotted dolphins 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). Sightings have also been made along the north wall of the Gulf Stream and warm-core ring features (Waring et al. 1992).

The distribution of Risso's, Atlantic spotted and striped dolphins are mainly beyond the depth range (~400 m) encompassed in most NEFSC surveys. Further, there are no documented incidental mortalities for these species in fishing gear with similar characteristics to NEFSC research trawls/dredges.

4.4.1.3.4 White-beaked dolphins are the more northerly of the two species of *Lagenorhynchus* in the northwest Atlantic (Leatherwood et al. 1976). White-beaked dolphins are found in waters from SNE north to western and southern Greenland and Davis Straits (Leatherwood et al. 1976; CeTAP 1982), and in the Barents Sea and south to at least Portugal (Reeves et al. 1999). In waters off the northeastern US coast, white-beaked dolphin sightings have been concentrated in the WGOM and around Cape Cod (CeTAP 1982). The limited distribution of this species in US waters has been attributed to opportunistic feeding (CeTAP 1982). Prior to the 1970s, **white-sided dolphins** (*L. acutus*) in US waters were found primarily offshore on the continental slope, while white-beaked dolphins were found on the continental shelf. During the 1970s, there was an apparent switch in habitat use between these two species. This shift may have been a result of the increase in sand lance in the continental shelf waters (Katona et al. 1993; Kenney et al.

1996). There are no documented incidental mortalities for these species in fishing gear with similar characteristics to NEFSC research trawls/dredges.

4.4.1.4 Seals

4.4.1.4.1 The **hooded seal** occurs throughout much of the north Atlantic and Arctic Oceans (King 1983) preferring deeper water and occurring farther offshore than harp seals (Sergeant 1976; Campbell 1987; Lavigne and Kovacs 1988; Stenson et al. 1996). The western north Atlantic stock whelps off the coast of eastern Canada and is divided into 3 whelping areas. The Front herd (largest) breeds off the coast of Newfoundland and Labrador, Gulf herd breeds in the Gulf of St. Lawrence, and the third area is in the Davis Strait. Hooded seals are highly migratory and may wander as far south as Puerto Rico (Mignucci-Giannoni and Odell 2001), with increased occurrences from Maine to Florida. These appearances usually occur between January and May in New England waters, and in summer and autumn off the southeast US coast and in the Caribbean (McAlpine et al. 1999; Harris et al. 2001; Mignucci-Giannoni and Odell 2001). Although it is not known which stock these seals come from, it is known that during spring, the northwest Atlantic stock of hooded seals are at their southernmost point of migration in the Gulf of St. Lawrence. There have been no documented bycatches of hooded seals in trawl fisheries off the northeast US coast (Waring et al. 2007). Therefore, at this time, it is unlikely that the NEFSC research fishing activities will affect hooded seals.

4.4.1.5 Sea Turtles

4.4.1.5.1 The **hawksbill turtle** is uncommon in the waters of the continental US. Hawksbills prefer coral reefs, such as those found in the Caribbean and Central America. 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 (STSSN) database). However, many of these strandings were observed after hurricanes or offshore storms. No takes of hawksbill sea turtles have been recorded in northeast or Mid-Atl 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. Although observer coverage in many of these fisheries has typically been low, given the best available information regarding the range of hawksbill sea turtles and based on the lack of documented takes of hawksbill sea turtles in fisheries that operate in and near the action area, it is reasonable to conclude that the proposed action is unlikely to affect hawksbill sea turtles.

4.4.1.6 Marine Fishes

4.4.1.6.1 **Shortnose sturgeons** are benthic fish that mainly occupy the deep channel sections of large rivers. 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. The species is anadromous in the southern portion of its range (i.e., south of Chesapeake Bay), while some northern populations are amphidromous (NMFS 1998). 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 that operate in the action area. Since the NEFSC research activities do not occur in or near the rivers where concentrations of shortnose sturgeon are most likely found, it is highly unlikely that the NEFSC research activities will affect shortnose sturgeon.

4.4.1.6.2 The wild populations of **Atlantic salmon** found in rivers and streams from the lower Kennebec River north to the US/Canada border are listed as endangered under the ESA. These populations include those in the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, and Sheepscot Rivers and Cove Brook (i.e., Downeast Maine subpopulations). Juvenile salmon in New England rivers typically migrate to sea in May after a 2 to 3 year period of development in freshwater streams. Juveniles leave the GOM and migrate to wintering grounds in the vicinity of Greenland and remain there for 1 to 2 winters before returning to US natal rivers in April and May. During the early fall, adults that have returned to their natal streams spawn in the upper reaches of the river, and overwinter until April in the lower river. Adults then return to their wintering grounds off Greenland beginning in April and May (Baum 1997). In 2001, a commercial fishing vessel engaged in fishing operations captured an adult salmon. Although this was subsequently determined to be an escaped aquaculture fish, it does show the potential for take of ESA-listed salmon in fishing gear. In addition, 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. Therefore, the NEFSC research activities deploying small mesh active gear (pelagic trawls within 10 m of the surface) may have the potential to incidentally take smolts. To date, however, only1 Atlantic salmon has been captured in US waters during the NEFSC annual fishery surveys. The Atlantic salmon was captured in the winter bottom trawl survey in 1977 by FRV *Delaware II* along the coastline of downeast Maine. Another Atlantic salmon was captured by a cooperating foreign FRV in February of 1978. NMFS believes that the proposed action is unlikely to affect ESA-listed Atlantic salmon since:

- the number of tows occurring in areas were ESA-listed Atlantic salmon are likely to occur is limited to less than 10 tows per year on average in the spring bottom trawl survey (NMFS-NEFSC 2001, 2002, 2003, 2004, 2005, 2006);
- tow duration is short (i.e., 30 minutes in 2007 and 2008, 20 minutes in 2009+[1]); and
- mid-water and bottom trawl gear does not operate within 10 m of the surface except for the short duration when it is being deployed and retrieved.

It is, therefore, unlikely that the action being considered in this EA will affect the GOM DPS of Atlantic salmon. Thus, this species will not be considered further in this EA.

4.4.2 Species Likely to be Affected

4.4.2.1 Small whales

4.4.2.1.1 Minke whales off the eastern coast of the US are considered to be part of the Canadian East Coast stock, which inhabits the area from the eastern half of the Davis Strait (45º W) to the Gulf of Mexico (Waring et al. 2007). Minke whales are common and widely

[1]Effort in 2009 and thereafter is expected to remain the same.

distributed off the northeast US coast, particularly in the GOM/GB regions (CeTAP 1982; Waring et al. 2007). They are designated at a non strategic stock in the Atlantic stock assessment report. Entanglement and mortalities have been reported in several fixed gear fisheries within the US EEZ (Waring et al. 2007). One freshly dead minke whale was caught in a bottom trawl in 2004 on the northeast tip of GB in US waters (Waring et al. 2007, 2008). Minke whales have also been observed feeding behind fishing trawls (Fertl and Leatherwood 1997).

4.4.2.1.2 There are two species of pilot whales in the western Atlantic: the **Atlantic** or **long-finned pilot whale**, *Globicephala melas*, and the **short-finned pilot whale**, *G. macrorhynchus* (CeTAP 1982; Waring et al. 2007). These species are difficult to differentiate at sea; therefore, some of the descriptive material below refers to *Globicephala* sp., and is identified as such. The species is considered to occur from Canada to Cape Hatteras. Short-finned pilot whales occupy tropical to warm temperate waters; therefore, seasonally their distribution may extend into shelf-edge waters north of Cape Hatteras. Long-finned pilot whales are distributed along the shelf edge off the northeast US in winter and early spring (CeTAP 1982; Payne and Heinemann 1993; Abend and Smith 1999). In late spring, pilot whales move onto GB and into the GOM and more northern waters, and remain in these areas through late autumn (CeTAP 1982; Payne and Heinemann 1993; Waring et al. 2007). Pilot whales have been incidentally taken in several fisheries off the northeast US coast, including bottom trawl, Atlantic herring mid-water trawl, and Atlantic herring and Atlantic mackerel pair trawling (Waring et al. 2007). Pilot whales were bycaught in foreign Atlantic mackerel fishing operations off the northeast US coast during the 1980s and early 1990s (Waring et al. 1990; Fairfield et al. 1993; Waring 1995). They have frequently been designated as strategic stocks in annual Atlantic stock assessment reports, due to mortality in fishing operations. Because of their propensity to forage around fishing trawlers (Fertl and Leatherwood 1997), there is some likelihood of interaction with NEFSC pelagic trawl activities.

4.4.2.2 Dolphins and porpoises

4.4.2.2.1 Common dolphin may be one of the most widely distributed species of cetaceans, as it is found world-wide in temperate, tropical, and subtropical seas. In the north Atlantic, common dolphins appear to be present over the continental shelf along the 200-2000 m isobaths or over prominent underwater topography from 50º N to 40º N latitude (Evans 1994). The species is less common south of Cape Hatteras, although schools have been reported as far south as eastern Florida (Gaskin 1992). Common dolphins are distributed along the continental slope (100 to 2000 m), and are associated with Gulf Stream features in waters off the northeastern US coast (CeTAP 1982; Selzer and Payne 1988; Waring et al. 1992). 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). Common dolphins move northward onto GB and the Scotian Shelf from mid-summer to autumn. Selzer and Payne (1988) reported very large aggregations (greater than 3000 animals) on GB in autumn. Common dolphins are occasionally found in the GOM, where temperature and salinity regimes are lower than on the continental slope of the GB-Mid-Atl region (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11º C (Sergeant et al. 1970; Gowans and Whitehead 1995).

Common dolphins have been incidentally taken in US and foreign bottom and pelagic trawl fisheries off the northeast US coast (Waring et al. 1990; Gerrior et al. 1994; Waring et al. 2007). They have occasionally been designated as strategic stocks in annual Atlantic stock assessment reports, due to mortality in fishing operations. Common dolphins have been incidentally taken on two occasions (2004 pelagic trawl and 2007 bottom trawl) in NEFSC research trawling (Protected Species Branch, pers. comm.). Because of their known interactions with commercial trawl fisheries (Fertl and Leatherwood 1997) and research pelagic trawls there is some likelihood of interactions with NEFSC trawl activities.

4.4.2.2.2 Atlantic white-sided dolphins are found in temperate and sub-polar waters of the north Atlantic, primarily in continental shelf waters to the 100 m depth contour. The species inhabits waters from central West Greenland to North Carolina (about 35˚ N) and perhaps as far east as 43˚ W (Evans 1987). Distribution of sightings, strandings and incidental takes suggest the possible existence of 3 stocks: GOM, Gulf of St. Lawrence and Labrador Sea stocks (Palka et al. 1997). Evidence for a separation between the well-documented unit in the southern GOM and a Gulf of St. Lawrence population comes from a hiatus of summer sightings along the Atlantic side of Nova Scotia. This has been reported in Gaskin (1992), is evident in Smithsonian stranding records, and was seen during abundance surveys conducted in the summers of 1995 and 1999 that covered waters from Virginia to the entrance of the Gulf of St. Lawrence. White-sided dolphins were seen frequently in GOM waters and in waters at the mouth of the Gulf of St. Lawrence, but only a few sightings were recorded between these two regions. The GOM stock of white-sided dolphins is most common in continental shelf waters from Hudson Canyon (approximately 39˚ N) north through GB, and in the GOM to the lower Bay of Fundy. Sightings data indicate seasonal shifts in distribution (Northridge et al. 1997). During January to May, low numbers of white-sided dolphins are found from GB to Jeffreys Ledge (off New Hampshire), and even lower numbers are found south of GB, as documented by a few strandings observed on beaches of Virginia and North Carolina. From June through September, large numbers of white-sided dolphins are found from GB to the lower Bay of Fundy. From October to December, white-sided dolphins occur at intermediate densities from southern GB to southern GOM (Payne and Heinemann 1990). Sightings south of GB, particularly around Hudson Canyon, have been made at all times of the year but at low densities. The Virginia and North Carolina observations appear to represent the southern extent of the species range.

Prior to the 1970s, white-sided dolphins in US waters were found primarily offshore on the continental slope, while **white-beaked dolphins** (*L. albirostris*) were found on the continental shelf. During the 1970s, there was an apparent switch in habitat use between these two species. This shift may have been a result of the decrease in herring and increase in sand lance in the continental shelf waters (Katona et al. 1993; Kenney et al. 1996). Atlantic white-sided dolphins have been incidentally taken in several US and foreign bottom and mid-water trawl fisheries off the northeast US coast (Waring et al. 1990; Waring et al. 2007, 2008; Fertl and Leatherwood 1997). Because of their known interactions with commercial trawl fisheries there is some likelihood of interactions with NEFSC trawl activities.

4.4.2.2.3 There are two morphologically and genetically distinct **bottlenose dolphin** morphotypes (Duffield et al. 1983; Duffield 1986) described as the coastal and offshore forms. Both inhabit waters in the western north Atlantic Ocean (Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997) along the US Atlantic coast. The two morphotypes are genetically distinct based upon both mitochondrial and nuclear markers (Hoelzel et al. 1998). The offshore form is distributed primarily along the outer continental shelf and continental slope in the northwest Atlantic Ocean; however the offshore morphotype has been documented to occur relatively close to shore over the continental shelf south of Cape Hatteras. Bottlenose dolphins which stranded alive in the western north Atlantic in areas with direct access to deep oceanic waters had hemoglobin profiles that matched that of the offshore morphotype (Hersh and Duffield 1990). Hersh and Duffield (1990) also described morphological differences between offshore morphotype dolphins and dolphins with hematological profiles matching the coastal morphotype which had stranded in the Indian/Banana River in Florida. North of Cape Hatteras, there is separation of the two morphotypes across bathymetry during summer months. Aerial surveys flown during 1979-1981 indicated a concentration of bottlenose dolphins in waters < 25 m deep, corresponding to the coastal morphotype, and an area of high abundance along the shelf break, corresponding to the offshore stock (CeTAP 1982; Kenney 1990). Biopsy tissue sampling and genetic analysis demonstrated that bottlenose dolphins concentrated close to shore were of the coastal morpho-type, while those in waters > 40 m depth were from the offshore morphotype (Garrison et al. 2003). However, during winter months and south of Cape Hatteras, the range of the coastal and offshore morphotypes overlap to some degree. Torres et al. (2003) found a statistically significant break in the distribution of the morphotypes at 34 km from shore, based upon the genetic analysis of tissue samples collected in nearshore and offshore waters. The offshore morphotype was found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal morphotype. More recently, offshore morphotype animals have been sampled as close as 7.3 km from shore, in water depths of 13 m (Garrison et al. 2003). Systematic biopsy collection surveys were conducted coastwide during the summer and winter, between 2001-2005, to evaluate the degree of spatial overlap between the two morphotypes. Over the continental shelf south of Cape Hatteras, the two morphotypes overlap spatially, and the probability of a sampled group being from the offshore morphotype increased with increasing depth, based upon a logistic regression analysis (Garrison et al. 2003). Seasonally, bottlenose dolphins occur over the outer continental shelf and inner slope as far north as GB (CeTAP 1982; Kenney 1990). Sightings occurred along the continental shelf break from GB to Cape Hatteras during spring and summer (CeTAP 1982; Kenney 1990).

Both morphotypes have been bycaught in a variety of fisheries off the northeast US coast (Waring et al. 2008), but only the offshore form has been documented in bottom and pelagic trawl fisheries (Gerrior et al. 1994; Waring et al. 2008). Because of their known interactions with commercial trawl fisheries (Fertl and Leatherwood 1997) there is some likelihood of interactions with NEFSC trawl activities.

4.4.2.2.4 Harbor porpoises exhibit strong seasonal distribution patterns off the northeast US coast. During summer (July to September), harbor porpoises are concentrated in the northern GOM and southern Bay of Fundy region, generally in waters less than 150 m deep (Gaskin 1977; Kraus et al. 1983; Palka 1995a, 1995b), with a few sightings in the upper Bay of Fundy and on the northern edge of GB (Palka 2000). During fall (October-December) and spring (April-June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south. They are seen from the coastline to deep waters (>1800 m; Westgate et al. 1998), although the majority of the population is found over the continental shelf. During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New

Brunswick, Canada. Harbor porpoise bycatch has been documented in several US sink gillnet fisheries and bottom trawl catches (Waring et al. 2007, 2008). Because of their known interactions with commercial trawl fisheries (Fertl and Leatherwood 1997) there is some likelihood of interactions with NEFSC trawl activities.

4.4.2.3 Seals

4.4.2.3.1 Harbor seals occupy all nearshore waters of the Atlantic Ocean and adjoining seas above about 30º N (Katona et al. 1993). In the western north Atlantic, they are distributed from the eastern Canadian Arctic and Greenland south 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). Although the stock structure of the western north Atlantic population is unknown, it is thought that harbor seals found along the eastern US and Canadian coasts represent one population (Temte et al. 1991). In US waters, breeding and pupping normally occur in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte et al. 1991; Katona et al. 1993). Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona et al. 1993), and occur seasonally along the SNE and New York coasts from September through late May (Schneider and Payne 1983). In recent years, their seasonal interval along the SNE to New Jersey coasts has increased (Barlas 1999; Hoover et al. 1999; Slocum et al. 1999; Schroeder 2000; deHart 2002). Scattered sightings and strandings have been recorded as far south as Florida (NMFS unpublished data). A general southward movement from the Bay of Fundy to SNE waters occurs in autumn 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, which takes place from mid-May through June along the Maine coast (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Kenney 1994; deHart 2002). No pupping areas have been identified in SNE (Payne and Schneider 1984; Barlas 1999). More recent information suggests that some pupping is occurring at high-use haulout sites off Manomet, Massachusetts. Harbor seals have been bycaught in several fisheries, including bottom trawls, off the northeast US coast (Waring et al. 2007). We are aware of one occasion of a harbor seal incidentally taken during NEFSC bottom trawl survey near GB (Protected Species Branch, pers. comm.). Because of their known interactions with commercial trawl fisheries there is some likelihood of interactions with NEFSC trawl activities.

4.4.2.3.2 Harp seals occur throughout much of the north Atlantic and Arctic Oceans (Ronald and Healey 1981; Lavigne and Kovacs 1988). The world's harp seal population is divided into 3 separate stocks, each identified with a specific breeding site (Bonner 1990; Lavigne and Kovacs 1988). The largest stock is located off eastern Canada and is divided into 2 breeding herds which breed on the pack ice. The Front herd breeds off the coast of Newfoundland and Labrador, and the Gulf herd breeds near the Magdalen Islands in the middle of the Gulf of St. Lawrence (Sergeant 1965; Lavigne and Kovacs 1988). The second stock breeds on the West Ice off eastern Greenland (Lavigne and Kovacs 1988). The third stock breeds on the ice in the White Sea off the coast of Russia. The Front/Gulf stock is equivalent to western north Atlantic stock.

Harp seals are highly migratory (Sergeant 1965; Stenson and Sjare 1997). Breeding occurs at different times for each stock between mid-February and April. Adults then assemble north of their whelping patches to undergo the annual molt. The migration then continues north to Arctic summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals of the western north Atlantic stock migrate southward along the Labrador coast, usually reaching the entrance to the Gulf of St. Lawrence by early winter. There they split into two groups, one moving into the Gulf and the other remaining off the coast of Newfoundland. The southern limit of the harp seal's habitat extends into the US Atlantic EEZ during winter and spring.

In recent years, numbers of sightings and strandings have been increasing off the east coast of the US from Maine to New Jersey (Katona et al. 1993; Stevick and Fernald 1998; McAlpine 1999; Lacoste and Stenson 2000; B. Rubinstein, pers. comm., New England Aquarium). These extralimital appearances usually occur in January-May (Harris, D.E. et al. 2002), when the western north Atlantic stock of harp seals is at its most southern point of migration. Concomitantly, a southward shift in winter distribution off Newfoundland was observed during the mid-1990s, which was attributed to abnormal environmental conditions (Lacoste and Stenson 2000).

Harp seals have been bycaught in several fisheries, including bottom trawls, off the northeast US coast (Waring et al. 2007, 2008). Because of their known interactions with commercial trawl fisheries there is some likelihood of interactions with NEFSC trawl activities.

4.4.2.3.3 Gray seals are found on both sides of the north Atlantic, with 3 major populations: 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). There are two breeding concentrations in eastern Canada: one at Sable Island, and one on the pack ice in the Gulf of St. Lawrence (Laviguer and Hammill 1993). Tagging studies indicate that there is little intermixing between the 2 breeding groups (Zwanenberg and Bowen 1990), and for management purposes, they are treated by the Canadian DFO as separate stocks (Mohn and Bowen 1996). In the mid 1980s, small numbers of animals and pupping were observed on several isolated islands along the Maine coast and in Nantucket-Vineyard Sound, Massachusetts (Katona et al. 1993; Rough 1995; J. R. Gilbert, pers. comm., University of Maine, Orono, ME). In the late 1990s, a year-round breeding population of approximately 400+ animals was documented on outer Cape Cod and Muskeget Island (D. Murley, pers. comm., Massachusetts Audubon Society, Wellfleet, Massachusetts). In December 2001, NMFS initiated aerial surveys to monitor gray seal pup production on Muskeget Island and at the Monomoy National Wildlife Refuge (Wood, pers. comm., University of Massachusetts, Boston, Massachusetts). Gilbert (pers. comm.) has also documented resident colonies and pupping in Maine since 1994. Bycatch of gray seals has been documented in sink gillnet fisheries off the US northeast coast (Waring et al. 2007). To date, bycatch has not been documented in US trawl fisheries, but the population is both increasing and expanding its range. Therefore, like harbor and harp seals, there is some likelihood of interactions with NEFSC trawl activities.

4.4.2.4 Sea Turtles

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 US Fish and Wildlife Service (USFWS) 1995; Hirth 1997; USFWS 1997; marine Turtle Expert Working Group (TEWG) 1998, 2000), and recovery plans for the loggerhead sea turtle (NMFS and USFWS 1991a), leatherback sea turtle (NMFS and USFWS 1992, 1998a), Kemp's ridley sea turtle (USFWS and NMFS 1992), and green sea turtle (NMFS and USFWS 1991b, 1998b).

4.4.2.4.1 Leatherback turtles are widely distributed throughout the oceans of the world and are found in waters of the Atlantic, Pacific, Caribbean, and the Gulf of Mexico (Ernst and Barbour 1972). 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 1992). In the US, 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.

Impacts to the leatherback population include 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 also 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. Leatherbacks are also susceptible to entanglement in lobster and crab pot gear.

4.4.2.4.2 The **Kemp's ridley** is the most endangered of the world's sea turtle species. Of the 7 extant species of sea turtles, the Kemp's ridley has declined to the lowest population level. Juvenile Kemp's ridleys use northeastern and Mid-Atl coastal waters of the US 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 CCB 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 by sea sampling coverage in the northeast otter trawl fishery, pelagic longline fishery, and southeast shrimp and summer flounder bottom trawl fisheries. Kemp's ridleys may also be affected by large-mesh gillnet fisheries.

4.4.2.4.3 Green 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 US occurs on the Atlantic Coast of Florida (Ehrhart 1979).

As is the case for loggerhead and Kemp's ridley sea turtles, green sea turtles use Mid-Atl 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 above for other sea turtles species. As with the other 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.

4.4.2.4.4 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 (NMFS and USFWS 1991a). Horseshoe crabs are known to be a favorite prey item in the Chesapeake Bay area (Lutcavage and Musick 1985).

The threatened loggerhead sea turtle is the most abundant of the sea turtles listed as threatened or endangered in the US 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 3 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 1 or 2 months south of Cape Hatteras.

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-Atl 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 22 to 49 m 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 7-12 years before settling into benthic environments. Once loggerheads enter the benthic environment in waters off the coastal US, 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-Atl and Chesapeake Bay, in gillnet fisheries in the Mid-Atl and elsewhere, and in multispecies, monkfish, spiny dogfish, and northeast sink gillnet fisheries.

The impact of NEFSC trawl/dredge survey operations on sea turtles is fully described and evaluated in a BO that was completed on August 20, 2007, to comply with the provisions of the ESA. For sea turtles NMFS anticipates the incidental take of 9–18 sea turtles per year in the NEFSC research surveys based on varying rates of effort and bycatch rates from previous NEFSC survey data and observer data from commercial sea scallop dredges. Although only loggerheads have been observed to date in the NEFSC surveys, it is expected that the trawl and the sea scallop dredge survey gear have the potential to take other sea turtles (i.e., leatherback, Kemp's ridley, and green sea turtles).

4.4.3 Actions to Minimize Interactions with Protected Species

Many of the factors that serve to mitigate the impacts of the survey operation on protected species are currently being implemented in the northeast region under either the ALWTRP or the Harbor Porpoise Take Reduction Plan (HPTRP). In addition, the surveys conducted by the NEFSC have undergone a consultation pursuant to Section 7 of the ESA, with the most recent BO prepared by NMFS on August 20, 2007. The conclusion in the BO states that the operation of the surveys are not likely to jeopardize the continued existence of threatened or endangered species or critical habitat. The BO includes an Incidental Take Statement (ITS) that provides the NEFSC surveys with an exemption to the take prohibitions established in Section 9 of the ESA.

For right whales, the following protocol is included in all Cruise Instructions: When northern right whales are encountered, and if the scientific party is unavailable, bridge officers are requested to observe and collect data per the protocols described in the NEFSC Sighting Network Manual, dated 9 October 1997.

For all other marine mammals new instructions have been developed (i.e., as feasible, avoid setting gear in the vicinity of marine mammal aggregations; if cetaceans are observed following fishing trawls, take evasive action during haul-back operations to avoid incidental bycatch). Any marine mammal caught and retrieved in trawl/dredge gear must be identified to species, and if feasible the carcass should be frozen and returned to Woods Hole, Massachusetts. At a minimum, Level A stranding data (specific measurements and photographs) will be requested.

The NEFSC has been working cooperatively with industry partners to redesign the sea scallop survey dredge to increase its capture efficiency and consistency. The Center also recently completed a 4 year study on the effects of chain mats on survey dredge efficiency. As a result of these processes, the Center intends to adopt and utilize survey dredges outfitted with chain mats beginning in 2008. The chain mats are intended to exclude large rocks from the dredge, but were also intentionally designed to comply with turtle chain excluder regulations implemented for the commercial fishery.

NMFS has determined that the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of sea turtles.

- Any sea turtles caught during the survey must be handled and resuscitated according to established procedures.

- Any sea turtle caught and retrieved in dredge gear must be identified to species.

- NMFS Northeast Regional Office (NERO) must be notified by telephone or e-mail within 24 hours of an interaction between any endangered or threatened species, including but not limited to sea turtles, and the gear and/or vessel used in the surveys.

- NMFS NERO must receive written reports regarding endangered or threatened species interactions with dredge gear and/or vessels used in the surveys.

4.5 Social and Economic Environment

The impact of the proposed surveys on social and economic resources is small. As such, details of these resources are only generally described here.

The affected resources include the fisheries and associated businesses that occur within the affected survey area. The fisheries are managed under 15 Federal FMPs that are developed by the two fishery management councils and implemented by NMFS under the Magnuson-Stevens Act (Table 3). The primary target species of the surveys and associated fisheries are listed in Section 4.3. Several of these species, (e.g. summer flounder, scup, and black sea bass), are managed by both a Federal plan and ASMFC (state waters) plan. Other species collected in the normal operations of the survey are processed as well and these data are provided to the ASMFC for non-Federal assessments.

Commercial fishermen who harvest species that inhabit the NEFSC survey area operate in Federal waters (3-200 miles) with Federal permits and in state waters (0-3 miles) under Federal or state-only permits. The information provided by the surveys is important for all commercial fishermen who target federally managed species and/or Federal data-dependent ASMFC species whether or not they have a Federal permit. Also affected are the associated businesses that support commercial and recreational fisheries and the communities in which these fishermen live and/or do business. Federally permitted or state-only permitted party and charter businesses with some of the same species targets and their associated communities and businesses are also affected.

The federal component of these groups consists of approximately 5940 unique vessels holding Federal fishing permits (as of 2006) in the northeast region. The number of state-only permitted commercial and party/charter vessels dependent on these targets is estimated to be larger than those federally permitted. Taken together these vessels, home-ported in communities from the Canadian border to and including North Carolina, had total finfish landings (of all species) valued at almost $290 million dollars and shellfish and other invertebrate landings valued at $1.0 billion in 2006.

An initial detailing of the makeup of this social and economic environment, identified using northeast Federal permits from Maine to North Carolina, has recently been completed and is contained as Section 15, Appendix F and Appendix G to the Draft Supplemental Environmental Impact Statement (DSEIS) for the Essential Fish Habitat Amendment (Part 1). This can be found at www.nefmc.org/habitat/index.html. It covers the vast majority of the communities potentially affected either directly or indirectly by the existence or cessation of NEFSC's vessel-based resource survey activity. Included is a list of 127 communities or counties meeting one or more criteria, such as having 5% or more of Federal permits (2000-2005), 5% or more of landed pounds or value, etc. Each port/county contains information on its history, regional orientation, demographic profile (sex, race, ethnic makeup), marine resource issues of concern, cultural attributes, current economy, fishery related infrastructure, employment structure, fishing associations, fishing assistance centers, fishery involvement in government, other fishery institutions, involvement in northeast fisheries, recent landings and value by species groups, number of vessels, and New England and Mid-Atl species revenue to vessels home ported there versus those landing there.

Recreational fishermen pursue fish predominantly in state waters, are not required to have a Federal or state permit and target a small subset of the large number of species whose assessments depend on Federal survey data, particularly scup, black sea bass, and summer flounder. Northeast region recreational fisheries are important with more than 4.5 million anglers making fishing related expenditures exceeding $5 billion dollars in 2006. These expenditures include rentals of the 2000 for-hire vessels in the region estimated by the Marine Recreational Fisheries Statistics Survey (MRFSS). Extensive information about this sector by Steinback, Gentner and Castle (2004) is at http://spo.nwr.noaa.gov under the Professional Papers link.

5.0 Environmental Consequences of the Proposed Action and Alternatives

5.1 Impacts on the Physical Environment

5.1.1 Impacts on thee Physical Environment of the No Action Alternative

The no-action alternative would not result in any further impacts on the physical environment due to surveys. Currently occurring fishing activities would continue to contribute to alteration of the physical environment within the area covered by the surveys, at a much greater frequency and intensity than that contributed by the surveys.

5.1.2 Impacts on the Physical Environment of Alternative 1 - Conduct the NEFSC Research Surveys through the Issuance of a Scientific Research Permit

This section summarizes the physical impact of otter trawls, sea scallop dredges, and hydraulic surfclam dredges on the physical habitat in the survey area, based upon the work of Stevenson et al. (2004) and Sherman et al. (1996). Unless noted, all 3 gear types cause the following alterations:

- furrowing
- smoothing of geological and biogenic features (primarily by otter trawls)
- exposure and mortality of infauna
- removal, dispersal, mortality of epifauna
- suspension of fine sediments and benthic algae
- alteration of the geochemistry due to suspension and turnover of the sediment
- relocation of rocks and boulders (primarily by sea scallop dredges)

Stevenson et al. (2004) lists a compendium of studies examining the extent of these impacts. In many cases, follow up observations estimate recovery times. Generally, other than for the relocation of rocks and boulders, the habitat recovers within 1.5 years. Additionally, in some instances furrows are apparent after several years. The expected impacts differ in various substrate types and natural disturbance regimes. Substantial parts of the US northeast continental shelf from GB to Cape Hatteras are highly mobile sand substrates and many are in high energy environments subject to strong tidal forces where the impact of the survey gear is expected to be low. The essential concept to consider when assessing impacts is reversibility. Thus, most impacts are reversible within 1.5 years. Furrowing, particularly in low energy habitat, may not be reversible for a longer time. The relocation of large rocks and boulders may be reversible only over geological time. The removal of cold water corals may be reversible only over hundreds of years.

Based upon the footprint of the surveys (Section 5.2.2) as compared to the effort of commercial fishing in the survey area, and the analysis presented in Section 5.2, the impact of the NEFSC surveys on the physical environment are expected to be minimal

5.2 Impacts on Habitat and EFH

5.2.1 Impacts on Habitat and EFH of the No Action Alternative

The no-action alternative would not result in any further impacts on habitat and EFH due to surveys. Currently occurring fishing activities would continue to contribute to habitat alteration within the area covered by the surveys, at a much greater frequency and intensity than that contributed by the surveys.

5.2.2 Impacts on Habitat and EFH of Alternative 1 - Conduct the NEFSC Research Surveys through the Issuance of a Scientific Research Permit

Stevenson et al. (2004) concede that the knowledge base required to quantify the physical impact of fishing on EFH species is insufficient. However, they do generate a qualitative index of vulnerability for these species. Because the geographical range of each individual EFH species comprises several survey strata, it is necessary to generate an index of gear impact for each stratum. In this way, the impact index may be compared to the range and vulnerability index of a species to determine significant impacts.

Because recovery time is expressed in years, we need to generate an impact index expressed in years. This is can be done by dividing the annual footprint of a survey into the total area of some specified habitat unit. For example, assume that the area of a survey stratum is 2500 m^2, and the annual footprint of the survey in the area is 250 m^2/year. It thus would take 10 years for the survey to affect the entire survey stratum if no tows covered old ground. If we were going to take an arbitrary worst-case scenario, we could assume that instead of 10 years, it would somehow take only 5 years for the survey to affect the entire area (and that no tows covered old ground). We will term this worst-case scenario duration the "impact half-life."

If it took 2.5 years for the surveyed habitat to recover, under the initial scenario, one quarter of the survey stratum would be in perpetually recovery. If an impact half-life was 1000 years, and recovery time was estimated at two years, then under the worst case scenario, 0.2% of the survey stratum area would be recovering.

Impact half-life were generated for the bottom trawl (offshore and inshore) survey, the northern shrimp trawl survey, and the sea scallop survey. The surfclam/ocean quahog survey, besides being conducted in quickly recovering substrate, has such a small footprint (143 m^2 every 3 years) compared to the 100,000+ km^2 of the survey area, the impact approaches zero. Therefore, a metric was not generated for this survey. The impact half-life is calculated separately for each of the sampling strata, HAPCs, and closed areas in the following tables.

5.2.2.1 Offshore Bottom Trawl Survey

The strata for the bottom trawl survey are presented in Figure 17. The offshore and inshore components of the bottom trawl survey are presented separately, purely for readability purposes. The footprint of a bottom trawl survey tow is taken to be equal to the door spread multiplied by the length of the tow. Door spread is conservatively estimated as 25 m. The tow length can be conservatively estimated as 6.5 km/hr times 35 minutes (tow time is designed to be 30 minutes, but the gear may tend bottom on either side of set and haul back). Thus, the footprint of a survey tow is estimated as 0.095 km^2. The impact half-life of each offshore stratum is presented in Table 10. Because 2008 is a calibration year, these numbers represent a "worst case scenario." The effort in 2008 will be twice the standard annual effort.

Table 10. Calculated impact half-life of the 2008 offshore Bottom Trawl Survey by sampling strata.

Stratum	Area (sq km)	Tows per year	Footprint (sq km)	Impact half-life (yrs)		Stratum	Area (sq km)	Tows per year	Footprint (sq km)	Impact half-life (yrs)
1010	8380	28	2.66	1575		1340	5882	24	2.28	1290
1020	6921	28	2.66	1301		1350	3654	16	1.52	1202
1030	1885	12	1.14	827		1360	13552	32	3.04	2229
1040	626	12	1.14	275		1370	7021	20	1.9	1848
1050	4913	20	1.9	1293		1380	8526	20	1.9	2244
1060	8506	32	3.04	1399		1390	2431	20	1.9	640
1070	1712	12	1.14	751		1400	1925	12	1.14	844
1080	766	12	1.14	336		1410	5229	24	2.28	1147
1090	5069	20	1.9	1334		1420	520	8	0.76	342
1100	9066	32	3.04	1491		1430	2864	16	1.52	942
1110	2072	12	1.14	909		1440	3111	20	1.9	819
1120	586	12	1.14	257		1450	500	8	0.76	329
1130	7907	36	3.42	1156		1460	823	8	0.76	541
1140	2185	16	1.52	719		1470	3860	16	1.52	1270
1150	766	12	1.14	336		1480	3943	16	1.52	1297
1160	9925	40	3.8	1306		1490	659	12	1.14	289
1170	1199	16	1.52	394		1610	4390	12	1.14	1925
1180	573	12	1.14	251		1620	809	8	0.76	532
1190	8173	36	3.42	1195		1630	286	8	0.76	188
1200	4067	24	2.28	892		1640	200	8	0.76	131
1210	1412	16	1.52	465		1650	9432	28	2.66	1773
1220	1512	16	1.52	497		1660	1848	12	1.14	811
1230	3384	20	1.9	891		1670	286	8	0.76	188
1240	8556	24	2.28	1876		1680	173	8	0.76	114
1250	1299	16	1.52	427		1690	8103	24	2.28	1777
1260	3377	20	1.9	889		1700	3411	16	1.52	1122
1270	2398	16	1.52	789		1710	936	8	0.76	616
1280	7491	28	2.66	1408		1720	350	8	0.76	230
1290	10808	32	3.04	1778		1730	7144	20	1.9	1880
1300	2062	12	1.14	904		1740	4240	16	1.52	1395
1310	7277	28	2.66	1368		1750	463	8	0.76	305
1320	2182	20	1.9	574		1760	200	8	0.76	131
1330	2868	16	1.52	943		**TOTAL**	**246696**	**1160**	**110**	

5.2.2.2 Inshore Bottom Trawl Survey

Table 11 shows the impact half-life of the inshore component of the bottom trawl survey. Because 2008 is a calibration year these numbers represent a "worst case scenario."

Table 11. Calculated impact half-life of the 2008 inshore Bottom Trawl Survey by sampling strata.

Stratum	Area (sq km)	Tows per year	Footprint (sq km)	Impact half-life (yrs)		Stratum	Area (sq km)	Tows per year	Footprint (sq km)	Impact half-life (yrs)
3010	151	4	0.38	199		3470	154	4	0.38	204
3020	213	8	0.76	140		3480	388	0	0	
3030	45	4	0.38	59		3490	0	0	0	
3040	89	8	0.76	59		3500	51	0	0	
3050	213	8	0.76	140		3510	401	0	0	
3060	89	4	0.38	118		3520	1787	16	1.52	589
3070	120	8	0.76	79		3530	487	0	0	
3080	514	8	0.76	339		3540	950	0	0	
3090	137	4	0.38	181		3550	1698	16	1.52	560
3100	165	8	0.76	109		3560	196	4	0.38	258
3110	830	8	0.76	547		3570	117	0	0	
3120	151	4	0.38	199		3580	302	4	0.38	398
3130	302	8	0.76	199		3590	319	4	0.38	421
3140	377	8	0.76	249		3600	432	8	0.76	285
3150	75	4	0.38	100		3610	456	8	0.76	301
3160	213	8	0.76	140		3620	213	8	0.76	140
3170	816	8	0.76	538		3630	268	4	0.38	353
3180	333	4	0.38	439		3640	309	4	0.38	407
3190	741	8	0.76	488		3650	257	4	0.38	339
3200	1221	8	0.76	805		3660	518	8	0.76	341
3210	75	4	0.38	100		3670	17	0	0	
3220	528	8	0.76	348		3680	137	4	0.38	181
3230	573	8	0.76	378		3690	196	4	0.38	258
3240	182	4	0.38	240		3700	34	0	0	
3250	590	8	0.76	389		3710	247	4	0.38	326
3260	528	8	0.76	348		3720	442	8	0.76	292
3270	120	4	0.38	158		3730	106	0	0	
3280	755	8	0.76	498		3740	233	4	0.38	308
3290	635	8	0.76	418		3750	261	4	0.38	344
3300	257	4	0.38	339		3760	69	0	0	
3310	1026	8	0.76	676		3770	117	4	0.38	154
3320	364	8	0.76	240		3780	151	4	0.38	199
3330	316	4	0.38	416		3790	117	0	0	
3340	573	8	0.76	378		3800	199	4	0.38	262
3350	302	8	0.76	199		3810	130	4	0.38	172
3360	408	4	0.38	538		3820	717	0	0	
3370	1070	8	0.76	706		3830	274	4	0.38	362
3380	768	8	0.76	507		3840	470	0	0	
3390	120	4	0.38	158		3850	364	4	0.38	479
3400	604	8	0.76	398		3860	206	0	0	
3410	1314	8	0.76	866		3870	525	8	0.76	346
3420	137	4	0.38	181		3880	117	0	0	
3430	590	8	0.76	389		3890	202	4	0.38	267
3440	1043	8	0.76	687		3900	429	8	0.76	283
3450	583	8	0.76	384		**TOTAL**	**36251**	**472**	**45**	
3460	936	8	0.76	617						

5.2.2.3 Sea Scallop Survey

The strata for the sea scallop survey are depicted in Figure 5. Table 12 indicates the impact half-life of the sea scallop survey. The footprint of a sea scallop tow is taken to be 0.0045 km^2. Non-sequential strata indicate that some strata are not sampled during the sea scallop survey.

Table 12. Calculated impact half-life of the Sea Scallop Survey by sampling strata.

Stratum	Area (sq km)	Tows per year	Footprint (sq km)	Impact half-life (yrs)		Stratum	Area (sq km)	Tows per year	Footprint (sq km)	Impact half-life (yrs)
6	213	5	0.25	4726		50	514	16	0.8	3573
7	158	5	0.25	3506		51	477	12	0.6	4414
10	521	8	0.4	7241		52	1053	12	0.6	9750
11	785	8	0.4	10909		53	919	7	0.35	14591
14	751	12	0.6	6955		54	954	7	0.35	15135
15	1351	12	0.6	12513		55	1248	10	0.5	13872
18	854	10	0.5	9489		56	717	0	0	
19	940	12	0.6	8702		58	1029	8	0.4	14291
22	1070	8	0.4	14863		59	1845	12	0.6	17086
23	2449	16	0.8	17007		60	2799	12	0.6	25915
24	1633	6	0.3	30234		61	1976	8	0.4	27439
25	2223	4	0.2	61738		621	1890	12	0.6	17499
26	645	14	0.7	5118		622	514	6	0.3	9528
27	1547	20	1	8594		631	1183	7	0.35	18783
28	511	10	0.5	5678		632	1262	8	0.4	17531
29	3759	6	0.3	69614		64	3389	16	0.8	23533
30	2295	15	0.75	16997		651	394	12	0.6	3652
31	3197	24	1.2	14799		652	206	10	0.5	2287
33	1245	10	0.5	13834		661	418	12	0.6	3875
34	696	14	0.7	5526		662	593	8	0.4	8241
35	2061	10	0.5	22904		71	501	6	0.3	9273
46	1427	6	0.3	26423		72	1729	6	0.3	32012
47	2987	12	0.6	27662		74	1485	8	0.4	20627
49	837	9	0.45	10332		**Total**	**61251**	**471**	**24**	

5.2.2.4 Surfclam/Ocean Quahog Survey

The strata for the surfclam/ocean quahog survey are depticed in Figure 5. The total footprint of this survey is estimated at 103 m^2 and is conducted only every 3 years. The total area covered in this survey is 114,257 km^2. Most of the sampling occurs in high energy coarse grain substrates, which recover in hours and days. The survey has minimal impact. Thus, for any HAPC or closed area, the surfclam/ocean quahog survey impact is likewise minimal.

5.2.2.5 Northern Shrimp Survey

Figure 3 represents the strata occupied during the northern shrimp trawl survey. The footprint of the shrimp trawl is based upon a 38 m door spread, a tow speed of 3.65 km/hr, and a 15-minute tow duration. This is equal to 0.0347 km^2. Table 13 shows that the impact of the shrimp trawl survey is minimal.

Table 13. Calculated impact half-life of the Northern Shrimp Survey by sampling strata.

Stratum	Area (sq km)	Tows per year	Footprint (sq km)	Impact half-life (yrs)
1	1531	6	0.21	3678
2	1814	0	0	0
3	2945	9	0.31	4715
4	1548	2	0.07	11155
5	3704	3	0.1	17790
6	4401	10	0.35	6341
7	3766	4	0.14	13565
8	5009	7	0.24	10311
9	2266	2	0.07	16328
10	5637	5	0.17	16244
11	4318	4	0.14	15555
12	6914	6	0.21	16604
TOTAL	**43853**	**58**	**2**	

5.2.2.6 Ecosystem Monitoring Survey

The EcoMon survey collects zooplankton and ichthyoplankton over the entire ecosystem and represents a minimal use of planktonic resources. One method to evaluate this resource is to compare the volume of water sampled with plankton nets to the volume of water in the ecosystem. Shelf water volume in the ecosystem is estimated as ~7 x 10^{12} m^3 (Mountain 1991). The volume of water sampled by the 61 cm bongo nets during one EcoMon survey is ~2.4 x 10^4 m^3 or 3.4 x 10^{-7}% of the shelf water volume. Shelf water is not static and is continually entering and exiting the system. The estimated average flux of shelf water is 1.2 x 10^{13} m^3 (Mountain 1991), and thus the six EcoMon surveys per year (4 dedicated and 2 piggybacked on trawl survey) sample 1.1 x 10^{-6}% of the supply of water to the northeast US shelf ecosystem. This small volume should have no effect on resource species in the ecosystem.

5.2.3 Summary of Impacts

As analyzed in this section, the total annual footprint of the NEFSC surveys is 181 km^2 for 2008 (accounting for an increase in effort as a result of calibration of the new survey vessel). In future years (2009-2012), the footprint would be 126 km^2. As a rough comparison, data provided in National Research Council (NRC) 2002 indicates that commercial trawling in the northeast region has a footprint[2] of approximately 137.2x10^3 km^2 (40,000 nm^2). This rough comparison further illustrates the negligible impact of the NEFSC surveys in the northeast region, as the surveys footprint is equal to 0.123% of the area trawled by commercial fishing (this does not include dredging activities). Furthermore, almost all of the impact half lives shown in Tables 9-12 are measured in the hundreds or thousands of years. In comparison to recovery times of 1.5

[2] The estimated area swept by bottom trawls in New England in 1993 and in the Mid-Atlantic region in 1985 was 58,118 square nautical miles. Since then, fishing effort has declined fairly dramatically. Assuming that it has declined by one third, the current figure was estimated to be about 40,000 nm^2. This does not include the area swept by sea scallop and surfclam dredges.

years for many habitat variables and 5-20 years for others, it can be concluded that all of the surveys have a negligible impact.

For areas open to commercial fishing operations the analysis of impact half-life (Table 14) demonstrates that the direct impact of the NEFSC survey bottom trawl, shrimp trawl and sea scallop cruises on EFH and habitat is negligible. The footprint of the surfclam/ocean quahog survey is so small that its impact is basically zero and is not shown in a table. Overall, habitat recover time far exceeds the frequency of disturbance by survey tows. When this analysis is considered in the context of ongoing commercial fishing activities in open areas, the impact of the survey is negligible and indistinguishable from current fishing operations.

Management areas are shown in Figures 9-11. Tables 5-9 identify the number of survey stations in each of the specific management areas during the last 5 years (2003-2007). Based upon the overall analysis of each survey's impact half-life, it can be concluded that no HAPC or closed area unit would experience a significant impact this year or in future years. The same number of survey stations would be anticipated over the next 5 years, based upon the analysis of the last 5 years and on the randomized sampling design of the surveys. An analysis of such units is presented in Table 14 to verify this. Of the HAPCs and specific closed areas identified and analyzed, the habitat closed areas are the most sensitive to bottom disturbance because the operation of mobile bottom tending gear is prohibited in these areas. Some of the habitat closure areas overlap with multispecies closure areas that have been in place for 10 years or more.

Although the overall impact of the surveys throughout the region is negligible, sampling effort in habitat closed areas or multispecies closed areas should be evaluated separately from sampling activity in areas that experience chronic impacts from commercial fishing. This separate consideration is necessary because NEFSC survey tows represent the only source of bottom disturbances from mobile fishing gear in habitat closed areas and/or multispecies closed areas. Based on the impact half-life calculations (Table 13) and the small annual footprint of NEFSC surveys in each closed area, it is still expected that the direct overall impact of the surveys is minimal and temporary and the habitat would recover quickly. Furthermore, recovery is enhanced because survey tows are made in different locations every year, and commercial fishing operations tend to tow repeatedly over the same area of bottom. However, even the minimal and temporary effects of the individual survey tows would be evident in areas closed to bottom tending mobile gear.

Due to the intent of habitat closed areas to protect sensitive habitats, NMFS carefully considers any proposal to utilize prohibited gears in these areas. NMFS has determined that the benefit of the scientific information generated by the NEFSC surveys outweighs any adverse impact to habitat, particularly considering the minimal and temporary nature of the impacts. Modifying the survey design to preclude randomized sampling stations within the habitat closed areas would bias the data produced by the surveys, and as such, would impact the continuity of a program that has been producing such data for over 40 years.

Table 14. The impact half-life of the Bottom Trawl (BTS), Shrimp Trawl (ST), and Sea Scallop (SS) Surveys, 2003-2007.

Management Unit	Area (km2)	# BTS Tows	Footprint (sq km/yr)	Impact (yrs)	# ST Tows	Footprint (sq km/yr)	Impact (yrs)	# SS Tows	Footprint (sq km/yr)	Impact (yrs)
Western Gulf Of Maine Closed Area, Rolling Closure Area 3	188	3	0.057	1653	2	0.038	6790		0	
Jeffery's Bank Hab. Closure, Rolling Closure Area 3	248	1	0.019	6525	1	0.019	17863		0	
Cashes Ledge Closure Area, Cashes Ledge Hab. Closure Rolling Closure Area 3	18	1	0.019	468		0			0	
Cashes Ledge Closure Area, Cashes Ledge Hab. Closure, Rolling Closure Area 2, Rolling Closure Area 3	282		0		1	0.019	20347		0	
Rolling Closed Area 2, Rolling Closure Area 3	1879	19	0.361	2603	21	0.399	6447		0	
Rolling Closure Area 4	10901	67	1.273	4281	26	0.494	30206		0	
Jeffery's Bank Hab. Closure, Rolling Closure Area 4	246	4	0.075	1617	6	0.114	2951		0	
Rolling Closure Area 3, Rolling Closure Area 4	1986	18	0.342	2904	8	0.152	17886		0	
Western Gulf Of Maine closed Area, Western GOM Habitiat Closure, Rolling Closure Area 3, Rolling Closure Area 4	565	10	0.19	1487	13	0.247	3131		0	
Rolling Closure Area 2, Rolling Closure Area 3, Rolling Closure Area 4	734	13	0.247	1485		0			0	
Rolling Closure Area 1, Rolling Closure Area 2, Rolling Closure Area 3, Rolling Closure Area 5	16	2	0.033	208		0			0	
Rolling CA2, Rolling CA3, Rolling CA5	1484	38	0.722	1028		0			0	
Tilefish HAPC	13437	199	3.781	1777		0		33	0.627	226220
Hudson Canyon Scallop Access Area	3442	52	0.983	1742		0		176	3.344	10865
Hudson Canyon Scallop Access Area Tilefish HAPC	931	13	0.247	1884		0		43	0.817	12025
Elephant Trunk Scallop Access Area	4683	85	1.615	1450		0		287	5.453	9065
Hudson Canyon Scallop Access Area Elephant Trunk Scallop Access Area	697	8	0.152	2293		0		48	0.912	8068
DelMarVa Scallop Access Area	7472	122	2.313	1612		0		170	3.23	24419
Sandbar Shark HAPC Deleware Bay	1939	10	0.19	5102		0			0	
Sandbar Shark HAPC Chesapeake Bay	8052	11	0.209	19263		0			0	
Sandbar Shark HAPC NJ	568	1	0.019	14954		0			0	
Sandbar Shark HAPC Cape Hatteras	2146	37	0.703	1526		0			0	
Closed Area 1, Georges Bank PSP	746	11	0.209	1785		0		46	0.874	9010
Closed Area 1, Closed Area 1,Northern Habitiat Closure, Georges Bank PSP	1137	10	0.19	2991	1	0.019	81890	52	0.988	12144
Closed Area 1,Closed area 1Southern Hab Closure, Georges Bank PSP	587	7	0.133	2207		0		13	0.247	25092
Closed Area 2_Closed Area 2 Hab Closure, Georges Bank PSP	636	11	0.209	1522		0		75	1.425	4712
Closed Area 2 Northeast peak Georges Bank PSP	155	1	0.019	4091		0			0	
Closed Area 2, Georges Bank PSP	2231	26	0.494	2258		0		26	0.494	47664
Rolling Closed Area 1 Rolling Closed Area 2, Georges Bank PSP	1531	12	0.228	3357	6	0.114	18381		0	
Closed Area 1, Closed Area 1 Scallop Access Area, Georges Bank PSP	681	13	0.247	1379		0		53	1.007	7143
CA2_CA2SAA_GBKPSP	3851	53	1.007	1912		0		184	3.496	11627
Georges Bank PSP	71960	236	4.484	8024		0		189	3.591	211522
Georges Bank PSP, Georges Bank Rolling Closure Area North	11269	134	2.545	2213	6	0.114	135312	168	3.192	37264
Georges Bank PSP, Georges Bank RCA South	1522	22	0.413	1821		0		59	1.121	14332
Closed Area 1, Emergency PSP	2		0			0		1	0.019	875
Nantucket LightShip Hab Closure, Emergency PSP	649	8	0.152	2135		0			0	
Closed Area 1, Closed Area 1 North Hab Closure, Emergency PSP	803	3	0.057	7041		0		23	0.437	19387
Nantucket Lightship Closed Area , Nantucket Lightship Hab Closure, Emergency PSP	2350	29	0.551	2133		0		54	1.026	24180
Georges Bank Rolling Closure Area, Emergency PSP	8201	136	2.584	1587	10	0.19	59087	301	5.719	15137
Nantucket Lightship Closed Area, Emergency PSP West	1043	9	0.171	3051		0			0	
Nantucket Lightship Closed Area, Emergency PSP East	1190	20	0.38	1566		0		15	0.285	44071
Rolling Closure Area 1, Rolling Closure Area 2, Emergency PSP	4370	35	0.665	3286	24	0.456	13120	5	0.095	485604
Western Gulf Of Main Closure Area, Rolling Closure Area 1, Rolling Closure Area 2, Emergency PSP	191	1	0.019	5020		0			0	
Western Gulf Of Maine Closed Area, Rolling Closure Area 2 Rolling Closure Area 3, Emergency PSP	379	4	0.075	2495	6	0.114	4554		0	
Cashes Ledge Closed Area Cashes ledge Hab Closure, Rolling Closed Area 2, Rolling Closed Area 3, Emergency PSP	112	1	0.019	2955		0			0	
Cahses Ledge Closed Area_Rolling Closed Area 2, Rolling Closed Area 3, Emergency PSP	748	7	0.133	2812	8	0.152	6737		0	
Rolling Closure Area 2, Rolling Closure Area 3, Emergency PSP	3303	29	0.551	2997	37	0.703	6432		0	
Western Gulf Of Maine Closure Area, Western Gulf Of Maine Hab Closure, Rolling Closure Area 2, Rolling Closure Area 3, Rolling Closure Area 4, Emergency PSP	1137	22	0.413	1360	9	0.171	9101		0	
Rolling Closure Area 2, Rolling Closure Area 3, Rolliing Closure Area 4, Emergency PSP	1655	40	0.76	1089	21	0.399	5678		0	
Western Gulf Of Maine Clousure Area, Western Gulf Of Maine, Habitiat Closure, Rolling Closure Area 2, Rolling Closure Area 3, Rolling Closure Area 5, Emergency PSP	558	6	0.114	2447	1	0.019	40195		0	
Rolling Closure Area 2, Rolling Closure Area 3, Rolling Closure Area 5, Emergency PSP	1652	48	0.912	905	4	0.076	29748		0	
Tilefish HAPC, Emergency PSP	4199	69	1.311	1601		0			0	
Nantucket Lightship Closed Area, Tilefish HAPC, Emergency PSP	524	7	0.133	1968		0			0	
Nantucket Lightship Closed Area Nantucket Lightship Scallop Access Area Emergency PSP	1160	16	0.304	1908		0		79	1.501	8157
Emergency PSP north west	6021	94	1.785	1686		0			0	
Emergency PSP north east	130	3	0.057	1139		0			0	
Emergency PSP south	3148	46	0.874	1801		0			0	
Rolling Closure Area 1 Rolling Closure Area 2 West	20	2	0.038	261		0			0	
Rolling Closure Area1 Rolling Closure Area 2 East	763	7	0.133	2867	4	0.076	13738		0	
Rolling Closure Area3	6186	37	0.703	4400	92	1.748	4844		0	
TOTAL	208713	1929	37		307	6		2100	40	

5.3 Impacts on Fishery Resources

5.3.1 Impacts on Fishery Resources of the No Action Alternative

The no-action alternative would not result in any additional impacts on fishery resources. Currently occurring fishing activities would continue to impact stocks within the area covered by the surveys, at a greater intensity than that of the surveys. The impacts of currently occurring and expected fishing activities are evaluated through the fishery management processes of fishery management councils or states.

5.3.2 Impacts on Fishery Resources of Alternative 1 – Conduct the NEFSC Research Surveys through the Issuance of a Scientific Research Permit

As described in Section 4.3, over 600 marine species have been collected on the bottom trawl surveys over the last 45 years. The analysis of impacts to finfish is focused on species that are either currently federally or state managed, may possibly be the subject of future management, or have experienced relatively high survey bycatch (in either total weight or number).

Commercial and recreational fisheries that operate in the geographic scope of the proposed survey areas include bottom and pelagic trawl, gillnet, longline, seine, shellfish dredge, trap, rod and reel, and hand net fisheries. A list of state and federally regulated fisheries in the northeast region and the status of their respective stocks are available in Section 4.3 and Table 15. Other regulated fisheries include nearshore gillnet, trawl and trap fisheries from Maine to North Carolina including Maine scallop divers, horseshoe crab, whelk, and Virginia pound net fisheries. Non-commercially and recreationally important fishery resources impacted negligibly by survey activities may include bay anchovy, cancer crab, fourspot flounder, Icelandic scallop, northern sand lance, northern sea robin, roughtail stingray, round herring, sea raven, smooth dogfish, spotted hake and striped anchovy.

The impacts of the NEFSC research surveys on local and regional fisheries is negligible when compared to the size and scope of associated commercial and recreational fisheries. The magnitude of the survey populations and the limited scope of surveying activities, including overall annual survey tow duration, results in a trivial impact to fish stocks that is virtually indistinguishable from current fishing operations. In fact, the functional effect of the past, present, and proposed survey activity is approximately equivalent to adding 1.2 vessels to the groundfish fleet, 0.2 vessels to the commercial sea scallop fleet, 0.5 vessels to the commercial northern shrimp trawling fleet in the GOM, and 0.1 vessels to the commercial surfclam fleet on an annual basis. It is important to note that because one of the key objectives of surveys is to estimate abundance and distribution of juvenile fish before they reach harvestable size, the body and codend mesh size on survey gear is generally smaller than regulated and utilized in commercial fisheries. In some cases, this results in the capture of larger numbers of smaller sized fish in comparison with commercial landings.

Table 15. Stock status and comparative Bottom Trawl survey catch and commercial landings values, 2002-2006.*

Species	Stock	Overfishing Stock Status	Overfished	Council	Fishery Management Plan	Average Annual NEFSC BTS	Catch Weights Commercial Landings (kg)	Survey to Commercial Ratio*100
American eel		unknown	unknown	ASMFC	Interstate FMP	2	320390	0.0006
American lobster		no	no	ASMFC	Interstate FMP	4785	33168439	0.0144
Atlantic croaker		no	no	ASMFC	Interstate FMP	5257	10340335	0.0508
Atlantic medhaden		no	no	ASMFC	Interstate FMP	19	184686836	0.0000
Atlantic sturgeon		no	yes	ASMFC	Interstate FMP		2	0.0000
Horseshoe crab		unknown	unknown	ASMFC	Interstate FMP	164	852541	0.0193
Northern shrimp		no	no	ASMFC	Interstate FMP	1349	1235147	0.1092
Red drum		yes	no	ASMFC	Interstate FMP	89	13427	0.6634
Spanish mackerel		no	no	ASMFC	Interstate FMP	8	218834	0.0036
Spot		unknown	unknown	ASMFC	Interstate FMP	1082	1533199	0.0705
Spotted trout		unknown	unknown	ASMFC	Interstate FMP	0	24257	0.0020
Striped bass		no	no	ASMFC	Interstate FMP	889	2874415	0.0309
Tautog		yes	yes	ASMFC	Interstate FMP	14	147789	0.0096
Weakfish		depleted	no	ASMFC	Interstate FMP	1563	791399	0.1975
Alewife		unknown	unknown	ASMFC	Interstate Shad & River Herring FMP	2138	427530	0.5002
American shad		unknown	unknown	ASMFC	Interstate Shad & River Herring FMP	149	246853	0.0604
Blueback herring		unknown	unknown	ASMFC	Interstate Shad & River Herring FMP	360	6134	5.8735
Atlantic mackere		no	no	MAFMC	Atl. Mackerel/Squid/Butterfish FMP	4120	42934203	0.0096
Butterfish		no	yes	MAFMC	Atl. Mackerel/Squid/Butterfish FMP	2726	583754	0.4669
Long-fin squid		no	no	MAFMC	Atl. Mackerel/Squid/Butterfish FMP	6041	15265398	0.0396
Short-fin squid		no	unknown	MAFMC	Atl. Mackerel/Squid/Butterfish FMP	546	12242973	0.0045
Atlantic surfclam		no	no	MAFMC	Atl. Surfclam & Ocean Quahog FMP	1977	153585380	0.0013
Ocean quahog		no	no	MAFMC	Atl. Surfclam & Ocean Quahog FMP	947	137293713	0.0007
Golden tilefish		no	no	MAFMC	Tilefish FMP	41	955860	0.0043
Bluefish		no	no	MAFMC & ASMFC	Bluefish FMP	2419	3050262	0.0793
Black sea bass		no	no	MAFMC & ASMFC	Summer Flounder/Scup/Black Sea Bass	944	1397920	0.0675
Scup		yes	yes	MAFMC & ASMFC	Summer Flounder/Scup/Black Sea Bass	5659	4068854	0.1391
Summer flounder		yes	yes	MAFMC & ASMFC	Summer Flounder/Scup/Black Sea Bass	11526	7057890	0.1633
Atlantic salmon		no	yes	NEFMC	Atlantic Salmon FMP			
American plaice		no	yes	NEFMC	NE Multispecies FMP	3686	2002776	0.1841
Atlantic cod	GOM	yes	yes	NEFMC	NE Multispecies FMP	25693	8632275	0.2976
Atlantic cod	GB	yes	yes	NEFMC	NE Multispecies FMP			
Haddock	GOM	no	yes	NEFMC	NE Multispecies FMP	23567	6699453	0.3518
Haddock	GB	no	yes	NEFMC	NE Multispecies FMP			
Halibut		unknown	yes	NEFMC	NE Multispecies FMP	291	13759	2.1180
Ocean pout		no	yes	NEFMC	NE Multispecies FMP	10319	10373	99.4745
Pollock		no	no	NEFMC	NE Multispecies FMP	9069	5204081	0.1743
Redfish		no	no	NEFMC	NE Multispecies FMP	22978	437992	5.2462
White hake		yes	yes	NEFMC	NE Multispecies FMP	2104	3116347	0.0675
Windowpane flounder	GOM/GB	no	no	NEFMC	NE Multispecies FMP	2241	87962	2.5479
Windowpane flounder	SNE/mid Atl.	no	yes	NEFMC	NE Multispecies FMP			
Winter flounder	GOM	no	no	NEFMC & ASMFC	NE Multispecies FMP	12488	4620471	0.2703
Winter flounder	GB	yes	no	NEFMC & ASMFC	NE Multispecies FMP			
Winter flounder	SNE/mid-Atl.	yes	yes	NEFMC & ASMFC	NE Multispecies FMP			
Yellowtail flounder	Cape Cod/GOM	yes	yes	NEFMC	NE Multispecies FMP	6939	4837443	0.1434
Yellowtail flounder	GB	yes	yes	NEFMC	NE Multispecies FMP			
Yellowtail flounder	SNE/mid-Atl.	yes	yes	NEFMC	NE Multispecies FMP			
Witch flounder		no	no	NEFMC	NE Multispecies FMP	1514	2750546	0.0550
Offshore hake		unknown	no	NEFMC	NE Multispecies - Small Mesh FMP	125	18148	0.6884
Red hake	GOM/N. GB	unknown	no	NEFMC	NE Multispecies - Small Mesh FMP	4082	653685	0.6245
Red hake	S.GB/mid-Atl.	unknown	no	NEFMC	NE Multispecies - Small Mesh FMP			
Silver hake	GOM/N. GB	no	no	NEFMC	NE Multispecies - Small Mesh FMP	7686	7619351	0.1009
Silver hake	S.GB/mid-Atl.	no	no	NEFMC	NE Multispecies - Small Mesh FMP			
Red crab		no	unknown	NEFMC	Red Crab FMP	377	1966739	0.0192
Atlantic sea scallop		no	no	NEFMC	Sea Scallop FMP	43654	217991840	0.0200
Barndoor skate		no	no	NEFMC	Skate FMP			
Clearnose skate		no	no	NEFMC	Skate FMP			
Little skate		no	no	NEFMC	Skate FMP			
Rosette skate		no	no	NEFMC	Skate FMP	140686	14870265	0.9461
Smooth skate		no	no	NEFMC	Skate FMP			
Thorny skate		no	yes	NEFMC	Skate FMP			
Winter skate		no	yes	NEFMC	Skate FMP			
Atlantic herring		no	no	NEFMC & ASMFC	Herring FMP	18158	94148515	0.0193
Spiny dogfish		no	no	NEFMC & MAFMC	Spiny Dogfish FMP	210688	1549163	13.6001
Monkfish	GOM/N. GB	no	no	NEFMC & MAFMC	Monkfish FMP	10888	20751816	0.0525
Monkfish	S. GB/mid-Atl.	no	no	NEFMC & MAFMC	Monkfish FMP			
Cusk					Possible Future Management Action	180	99515	0.1811
Hagfish					Possible Future Management Action	9	989437	0.0009
Wolffish					Possible Future Management Action	319	120288	0.2648
Bay anchovy					Significant Bycatch	631	48	1306.7061
Cancer crab					Significant Bycatch	3757	3245139	0.1158
Fourspot flounder					Significant Bycatch	9497	3147	301.8169
Icelandic scallop					Significant Bycatch	40		
Northern sand lance					Significant Bycatch	64	3090	2.0691
Northern sea robin					Significant Bycatch	1510	43102	3.5033
Roughtail stingray					Significant Bycatch	1078		
Round herring					Significant Bycatch	873		
Sea raven					Significant Bycatch	1739	1236	140.6435
Smooth dogfish					Significant Bycatch	9966	497694	2.0025
Spotted hake					Significant Bycatch	1101		
Striped anchovy					Significant Bycatch	620		

*Stock status provided as in "Fish Stock Sustainability Index, Q4 2007 Update" (N. Thompson, action item 08-086). Landings are from the NEFSC commercial landings database ar average of data from 2002-2006. The survey catches are from all NEFSC surveys and are averaged from 2002-2006 data.

We note that comparison of survey and fishery catches provide a convenient and useful metric to gauge potential impacts of survey activities. However, the actual impact of survey activities on resource species is dependent on the survey removals measured against population size. For species under restrictive management or for which limited markets exist, the population sizes are substantially higher than the fishery removals.

Table 15 provides a comparison of the 2002-2006 annual removals by the NEFSC bottom trawl surveys for 71 species representing managed species and noticeable survey bycatch species. Generally, survey catches are far less than 1% of reported commercial landings (which do not include commercial discards, or recreational landings and discards). For commercially important invertebrate species (Atlantic sea scallop, northern shrimp, Atlantic surfclam, ocean quahog, longfin squid, shortfin squid, horseshoe crab, red crab), survey catches were generally less than 0.05% of reported commercial landings except for northern shrimp (0.11%).

Species where the average annual survey catch exceeded 1% of the reported commercial landings over the same period included blueback herring, halibut, ocean pout, redfish, windowpane flounder, spiny and smooth dogfish, fourspot flounder, northern sand lance, northern sea robin, and sea raven. Blueback herring catches (annual average 360 kg in 2002-2006 NEFSC surveys) represented 5.9% of the commercial landings, but reported landings do not include blueback herring identified as alewife in landings, blueback herring caught and discarded in midwater trawl fisheries and blueback herring landed and utilized as bait in recreational fisheries. The survey halibut catches (annual average 291 kg in 2002-2006 NEFSC surveys) represented 2.1% of the reported US landings, but the vast majority of survey catches of halibut occur in Canadian waters along the Scotian Shelf and near the mouth of the Bay of Fundy. As such, the reported US landings do not accurately reflect the overall commercial halibut fishery in the GOM. Since commercial landings data likely do not reflect total fishery removals for blueback herring and halibut, survey catches of less than 0.5 mt are likely to have a low impact on these populations.

Survey catches of ocean pout (annual average 10,319 kg in the 2002-2006 NEFSC surveys) were functionally equal to the commercial landings during this period. There is only a small scale fishery for ocean pout and stock assessment results indicate stable populations for this species and the relative exploitation rate has been well below F_{MSY}. Survey catches of spiny dogfish (annual average 210,688 kg in the 2002-2006 NEFSC surveys) is 13.6% of the reported commercial landings, but the majority of the commercial and recreational fishery induced mortality is due to discarding, as currently there is no directed Federal fishery for spiny dogfish, and incidental catch landings are highly regulated by trip limits. Therefore, survey catch is likely minimal compared to the actual mortality from commercial and recreational fishing operations. Survey catches of smooth dogfish (annual average 9,966 kg in the 2002-2006 NEFSC surveys) represents 2.0 % of reported commercial catch, but are likely negligible relative to overall resource biomass.

Survey catches of redfish (annual average 22,978 kg in the 2002-2006 NEFSC surveys) represented 5.2% of the reported commercial landings. Survey catches likely do represent a noteworthy mortality source for this resource, which is currently at or near all time record high levels of biomass and abundance. Stock assessment results indicate that exploitation rates on this resource are currently at low levels. Survey catches are reflective of the high abundance level of redfish stocks, and likely have a minimal impact on overall biomass levels.

Windowpane flounder, fourspot flounder, northern sea robin, and sea raven all represent species that are frequently caught but incidentally landed in the commercial fisheries. Survey catches of windowpane flounder (annual average 2241 kg), fourspot flounder (annual average 9497 kg), northern sea robin (annual average 1510 kg), and sea raven (annual average 1739 kg) are all likely insignificant relative to commercial discards and overall biomass levels of these resources. In terms of forage species, survey catches of bay anchovy (annual average 631 kg) and northern sand lance (annual average 64 kg) appear significant relative to commercial landings, but are likely very insignificant relative to the total biomass of the resource.

Over the next 5 years, the impacts of the NEFSC surveys are expected to be the same as described herein. The comparison of survey catches to commercial catches provided in Table 15 evaluated data from a recent 5-year period (2002-2006), and the level of catches for the surveys are expected to be similar over the next 5-year period. Planned bottom trawl survey activities during 2008 include significant paired towing activity utilizing the FRV *Albatross IV* and FSV *Henry B. Bigelow* to calibrate changes in survey vessels and gear. Once this calibration effort is completed, we anticipate that bottom trawl survey activity will return to approximately the baseline levels that have occurred for the past 4 decades. As such, it is anticipated that the surveys would continue to result in negligible impacts to fish populations over the next 5 years.

In summary, survey activities generally utilize sampling gear that have a neglible effect relative to commercial standards, and survey activities are limited in scope relative to the overall area of the habitat and resource size for most fish stocks. As a result, survey catches are generally negligible relative to other sources of removals and overall resource abundance, and do not represent a measurable adverse impact to any fish population.

5.4 Impacts on Protected Resources

5.4.1 Impacts on Protected Resources of the No Action Alternative

The no action alternative, that no NEFSC surveys could be conducted, would not result in impacts to protected species beyond those identified and evaluated by fishery management action analytical documents and consultations conducted under ESA Section 7.

5.4.2 Impacts on Protected Resources of Alternative 1 - Conduct the NEFSC Research Surveys through the Issuance of a Scientific Research Permit

The NEFSC surveys have the potential to interact with a number of protected species, as described in Section 4.4. These species include: minke and pilot whales; common and white-sided dolphins; harbor, harp, and gray seals; leatherback, Kemp's ridley, green, and loggerhead sea turtles. Most of the following information regarding sea turtles was extracted from the Section 7 BO that was completed on August 20, 2007.

There are many factors that might contribute to the likelihood of a sea turtle becoming captured in trawl and sea scallop gear, including a sea turtle's reaction to oncoming gear, attraction to the project area because of the presence of prey, and geographical or oceanographic features. Based on the knowledge of seasonal migrations of sea turtles and their temperature dependent movements, it is expected that 2 of the 4 species (leatherback and loggerhead) are more likely to occur in the spring, summer, and fall seasons while the NEFSC research activities are taking place off New York, New Jersey, and Maryland, while the waters off of North Carolina and Virginia may have all 4 endangered and threatened species of sea turtles present during all phases of sampling (Shoop and Kenney 1992; Department of the Navy 2005).

There are two risks to sea turtles as a result of interaction with gears used in the NEFSC surveys. These are forced submergence and contact injuries. Sea turtles forcibly submerged in any type of restrictive gear eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lung (Lutcavage et al. 1997). Mortality due to forced submergence is strongly dependent upon trawling duration, with the proportion of dead or comatose turtles rising from 0% for the first 50 minutes of capture to 70% after 90 minutes of capture (Henwood and Stuntz 1987). Contact injuries include cracks to the carapace and/or plastron during interactions with bottom trawl and dredge gear; however, contact injuries are less likely to occur in trawl gear. When interacting with dredge gear, a turtle may be struck by the dredge or struck by the dredge and enter into the dredge bag. Once in the dredge bag, a turtle may be injured by large rocks in the bag or may sustain an injury when the dredge bag is hauled up and emptied on deck. To date, only 1 of the 61 sea turtles (all loggerheads) captured in the NEFSC bottom trawl and dredge surveys has been reported as injured. The lethally injured loggerhead sea turtle was captured in 1999 during a bottom trawl survey, and was brought onboard with a cracked carapace likely as a result from colliding with the trawl doors (Wesley Patrick per. comm. with Linda Despres, NEFSC, Memo to the Record July 31, 2007).

As noted in Section 4.4.3 and in the 2007 BO interactions between sea turtles with the NEFSC survey gear are likely when sea turtle distribution overlaps with operation of the NEFSC surveys. Based on information regarding previous interactions between sea turtles and the gears used during the NEFSC surveys, the 2007 BO concluded that the NEFSC surveys are not likely to result in jeopardy to any ESA-listed species under NMFS jurisdiction. Takes of loggerhead, leatherback, Kemp's ridley, and green sea turtles are expected to occur. Only1 take each year is expected to be a leatherback, Kemp's ridley or green sea turtle, with the remainder of takes being loggerheads. NMFS anticipates the capture of 9–18 loggerhead turtles annually as a result of the NEFSC research activities, with1 of these captures resulting in immediate death or injuries for which death is inevitable (Section 5.8, 2007 BO). The ITS issued with the 2007 BO anticipates the take as follows:

- In 2007, 18 sea turtles (17 released alive and 1 dead; 17 in trawl gear and 1 in dredge gear)
- In 2008, 16 sea turtles (15 released alive and 1 dead; 14 in trawl gear and 1 in dredge gear)
- In 2009 and each year thereafter, 9 sea turtles (8 released alive and 1 dead; 8 in trawl gear and 1 in dredge gear)

The above expected and anticipated level of interaction (9–18 each year, only 1 lethal take each year) will not have short or long-term adverse effects (i.e., no negative impact to the species' numbers, distribution, or reproduction), therefore is not likely to reduce appreciably the likelihood of both the survival and recovery of loggerhead, leatherback, Kemp's ridley, or green sea turtles.

The origin, age class, and sex of the turtle seriously injured or killed in the past during the NEFSC survey (i.e., only 1 in 1999) is unknown. As a result, the past lethal capture cannot inform the analysis of the origin, age class, and sex of the turtles expected to be captured and killed or seriously injured during the survey work in the coming years. However, based on two genetic studies that examined the origin of loggerhead sea turtles collected from the Pamlico Sound, North Carolina (Bass et al. 2004), and more northern locations (Virginia to Massachusetts; Rankin-Baransky et al. 2001), NMFS anticipates that the lethal take will likely originate from the south Florida (59–80% chance) or northern subpopulations (12–25% chance) given the size of these subpopulations relative to the other three.

For ESA listed species, the NEFSC will abide by the non-discretionary terms and conditions incorporated in the 2007 BO. These items are designed to provide NERO with timely information pertaining to bycaught species. The 2007 BO also contains discretionary Conservation Recommendations that are designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, and thus help implement recovery plans. In summary, Terms & Conditions and Conservation Recommendations include recording Global Positioning System (GPS) location, animal identification, measurements, and condition, as well as the resuscitation and timely reporting of incidental takes. Further, NEFSC scientists must abide by several conservation requirements, which include: notification to other fishing vessels of the presence of a listed species; notification and instruction for survey vessel crew to implement precautionary methods when handling and emptying trawls to minimize injury to bycaught animals; tagging and tag detection of bycaught animal, and collection of tissue samples for genetic analyses.

NEFSC vessels, in the future, will employ one of two sonar systems. The Simrad SX90 forward looking sonar (frequency range > 22-30 kHz in 1 kHz steps; source level in Omni mode 219 dB / 1µPa) will be audible to odontocetes and seals, but is unlikely to cause temporary threshold shift, permanent threshold shift, or even real masking. The Simrad SH80 sonar (frequency range > 110-120 kHz in 1 kHz steps; source level in Omni mode 210 dB / 1µPa), is in the hearing range of harbor porpoises (Verboom and Kastelein 1997; Southall et al.). For both systems, there may be minor behavioral effects (e.g., vessel avoidance).

ADCP operations take place aboard NEFSC vessels during EcoMon surveys and GoMOOS cruises. In addition, these mooring cruises support the deployment of ADCPs on moorings in the Gulf of Maine by the University of Maine as part of GoMOOS activities. These ADCP systems are in the frequency range of 150-600 kHz, which is in the hearing range of harbor porpoises (Verboom and Kastelein 1997, Southall et al.). However, owing to the relatively high frequency, the acoustic beam will only travel relatively short distances (<1000 m). There may be minor behavioral effects (e.g., vessel or mooring avoidance).

NMFS has determined (Section 3 and Section 7, 2007 BO) that the action being considered is not likely to adversely affect ESA listed marine mammal stocks. The impact on MMPA species is expected to be minimal, and thus will not adversely impact the stock of any species. This is due to a combination of factors including: survey design (i.e., random station selection does not target marine mammal high use habitats), short duration of survey tows (20-30 minutes), and spatial/temporal mismatch between some surveys and the distribution of marine mammals likely to be affected. It is well known that marine mammal distribution is not random, but patchy, due to their association with prey (Gaskin 1985). Therefore, mitigation measures recommended by the 2007 BO and described in Section 4.4.3 should help NEFSC vessels minimize interactions. As such, negative impacts to marine mammal populations are expected to be negligible. Further, all serious injuries or incidental mortalities attributed to NEFSC research vessels will be incorporated into annual stock assessment reports, and the effect of removals will be evaluated under the potential biological removal process (Wade and Angliss 1997).

5.5 Impacts on Social and Economic Environment

The impacts of the two alternatives on the social and economic environment consist of direct physical (and subsequent financial) impacts and the important, indirect science and management support, or information impacts.

5.5.1 Impacts on the Social and Economic Environment of the No Action Alternative

Under the "No Action" alternative, state-run surveys and NEFSC's vessel trip report (VTR) - a fishery-dependent information collection system - would continue to be used for assessments and science. By definition, the state surveys do not capture the range of most of the resources important to stakeholders. The VTR system relies on vessel and dealer reporting of catches and minimal biological sampling (length-weight measurements, otolith harvest, etc.).

Fishery-dependent data are vital to our ability to monitor stocks, and for some species are often the only reliable source of data. However, use of fishery-dependent data alone may severely limit our ability to evaluate and make predictions about the status of some stocks. For example, in fisheries heavily dependent on the yearly incoming age group (the new recruits), fishery data alone cannot be used to forecast catches because very small fish are generally not taken with standard fishing gear. Likewise, CPUE may not be a reliable measure of abundance for schooling species, or when the increase in fishing technology cannot be factored into the relationship between catch and fishing effort. Consequently, fishery scientists throughout the world are conducting research vessel sampling programs to gather fishery-independent information (Clark 1981).

Without the Federal fishery-independent research surveys under the "No Action" alternative, the statistical confidence surrounding advice to management is greatly reduced for given measures. More sophisticated assessment techniques may have to be abandoned. This, in turn, could require use of ever more precautionary advice which could contract fishing opportunities, either through reduced DAS, reduced TACs, extended closures, etc. The preferred alternative, on the other hand, would provide the opportunity for fleets to exploit available resources to a greater extent in the context of stock rebuilding programs than would be scientifically and legislatively feasible under the "No Action" alternative.

If a precautionary approach is necessary, reductions in fishing opportunities and allowable catches would have a direct impact on vessel crew and their families as well as on owners, their families, and the support industries. The impacts of reduced fishing income and opportunities have been thoroughly described in many of the regional FMPs. For many of the stocks, recognition of overfished conditions and of overfishing activity sooner rather than later (when conditions would likely have been worse) was attributable to improved stock assessment techniques supported by survey data. Corrective measures for all but a few important regional species were enacted earlier given this information. The enhanced information has allowed for sophisticated programs which meet rebuilding requirements while attempting to make the most of rebuilt components of the stocks. All of these impacts would have been exacerbated had management decisions been based on information which lacked the contribution of survey activities. Cessation of survey data collection and information development for the next 5 years would gradually undermine the statistical basis for use of more sophisticated models, leading to a reliance on more blunt management instruments.

5.5.2 Impacts on Social and Economic Environment of Alternative 1 - Conduct the NEFSC Research Surveys through the Issuance of a Scientific Research Permit

As discussed in Section 4.5 of this document, the direct impact of these surveys would have negligible impact on the fish stocks, habitat, and protected species within the survey area. However, the cost to fishing firms of damage to or loss of commercial gear or vessels as a result of interaction with survey vessels or gear can be substantial to the specific firms involved, but is minimal in the larger scheme. NOAA-funded compensation programs exist to mitigate the impact of these interactions, if necessary.

The various surveys that are conducted by the NEFSC are designed to improve the quality of fish, shellfish, invertebrate, and benthic resource data that are ultimately used for assessment, habitat designation, and management/regulatory purposes (Reid et al. 1999). The preferred alternative, continuation of the NEFSC fishery-independent surveys, would have a positive impact by supporting the provision of a very significant amount of additional information that provides the infrastructure for use of more advanced assessment models utilizing the stocks' age structures, among other features. In general, more information provides for greater confidence in parameter estimates of future stock assessments.

Specifically, the NEFSC fishery-independent surveys would continue to provide indirect, downstream positive impacts to individuals and the fishing communities that rely upon commercial fisheries and the marine environment by allowing managers and scientists to collect data on and to:

- **Monitor recruitment** in order to predict future landings and stock sizes. 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.

- **Monitor abundance and survival of harvestable sizes:** 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. 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. 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.

- **Monitor the geographic distribution of species:** Some species lead sedentary lives while others are highly migratory. Research vessel surveys over multiple seasons per year are a major source of data on the movement patterns and geographic extent of stocks. Distribution maps can be drawn from reports of fishermen, but these may give a biased picture of the stock, emphasizing only where high density fishable concentrations exist. Distribution data are important not only for fishery management, but also for evaluating the population level effects of pollution and environmental change.

- **Monitor ecosystem changes:** With few exceptions, surveys conducted by the NEFSC are designed to be multipurpose. Bottom trawl surveys are not directed at one species, but rather generate data on over 600 species of fish and invertebrates in northeastern US continental shelf waters (Appendix 1a-g). Many of these species are relatively rare, and have little or no commercial or recreational value. However, when we evaluate the effect of intensive harvesting on selected species, we can observe the response of the entire animal community. The dramatic changes in the system reflect the depletion of several important commercial fishery species, such as, haddock, yellowtail flounder, pollock and American plaice and an increase in winter skate, spiny dogfish, and other commercial fishery catches. 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 the 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, sexual maturity, and feeding. Changes in growth and maturity parameters directly influence assessment calculations related to spawning stock biomass, yield per recruit, and percent of maximum spawning potential. Over the past 4 decades, these parameters have changed dramatically for some species.

- **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, pollution levels, etc.) and to allow other researchers to piggyback on surveys to collect a host of data not directly related to the 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.

5.6 Cumulative Effects

According to CEQ NEPA regulations, cumulative effects are effects that result from the incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency (Federal or nonfederal) or person undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions that take place over a period of time. In general, a cumulative effects assessment should address:

- the area in which the effects of the proposed action will occur;
- the impacts that are expected in that area from the proposed action;
- other past, present, and reasonably foreseeable actions that have or are expected to have impacts in the area;
- the impacts or expected impacts from other action, and
- the overall impact that can be expected if the individual impacts are allowed to accumulate.

Although predictions of synergistic effects from multiple sources are inherently less certain than predicted effects of individual actions, cumulative effects analyses are intended to alert decision makers to potential "hidden" consequences of the proposed actions. The analysis is generally qualitative in nature because of the limitations of determining effects over the large geographic areas under consideration.

The information presented in Sections 2.0 and 4.0 describe the relevant history, natural history, and current status of the environmental components that help characterize the environmental baseline, against which to evaluate cumulative effects and which serves as a starting point for the cumulative effects analysis. The baseline does not represent a static 'snapshot' of the resource. Instead, it represents the trend of the resource, incorporating the past history of influences on the resources. The cumulative past effects of fish conservation measures in the NEFSC survey area, as well as effects external to Federal management actions, such as state fishery impacts, human-induced impacts, and climatic events influencing the resource, all contribute to the state of the baseline condition.

Valued Ecosystem Components

The cumulative effects analysis focuses on VECs identified as important to this action and described in the Affected Environment (Section 4.0) section.

1. Physical Environment
2. Habitat and EFH
3. Fishery Resources
4. Protected Resources
5. Social and Economic Environment

Temporal and Geographic Scope of Cumulative Impacts Analysis

This analysis is limited to the geographical area, defined in Sections 3.0 and 4.0, within which the 11 NEFSC surveys operate. In all instances, the analysis attempts to take into account both present and reasonably foreseeable future actions that are occurring or may occur in the next 5 years that could affect the identified VECs. The discussion of past actions and events reflects underlying differences in the availability of historical information as well as differences in the period of time that must be considered to provide adequate context to understand the current circumstances. In all cases, the information presented and analysis conducted is commensurate with the overall impacts associated with this action. The analysis of impacts considers information primarily focused on the last decade. Recovery plans for sea turtles were completed in the early 1990s; however, the collection of more detailed information did not begin until the mid-1990s. The analysis of impacts related to the other resources components is primarily focused on the last 5 years. All analyses were projected for 5 years into the future.

5.6.1 Summary of Impacts of Proposed Action

5.6.1.1 Physical Environment

The proposed action will likely impact the physical environment due to increased disturbance of bottom sediments from the bottom trawls and dredges. However, this impact is expected to be minimal and temporary because of the minimal effort of the surveys as a whole (Section 5.1). As the surveys are unlikely to substantially affect the physical environment, they will not contribute to or result in cumulative effects on this ecosystem component.

5.6.1.2 Habitat and EFH

Operation of the NEFSC surveys is expected to have negligible impacts on habitat and EFH based upon the information and analysis presented in Sections 5.1 and 5.2. Current and future operation of the NEFSC survey activities is likely to have a negligible impact on habitat of living marine resources including water column temperature patterns, ocean chemistry, or local or global water circulation patterns. Proposed actions are likely to have negligible effects on physical environmental features, as discussed in Section 5.1. Likewise, proposed actions are likely to have negligible effects on biotic components of habitat. Planned future alterations to the NEFSC scallop survey will increase the reliance on sensing methodologies and reduce reliance on sampling involving direct dredge contact with habitat components. In addition, we can expect a reduction in interaction with the physical habitat by benthic habitat cruises as these programs start to integrate multibeam acoustics sampling approaches into scientific programs.

5.6.1.3 Fishery Resources

The impacts of the NEFSC surveys on local and regional fisheries is negligible when compared to the size and scope of associated commercial and recreational fisheries as described in Section 5.3. The magnitude of the surveyed populations and the limited scope of surveying activities, including overall annual survey tow duration, results in a trivial impact to fish stocks that is virtually indistinguishable from current fishing operations. In fact, the functional effect of the past, present and proposed survey activity is approximately equivalent to adding 1.2 vessels to the groundfish fleet, 0.2 vessels to the commercial sea scallop fleet, 0.5 vessels to the commercial northern shrimp trawling fleet in the GOM, and 0.1 vessels to the commercial surfclam fleet on an annual basis. This impact is not expected to change over the next 5 years.

Due to the ship's draft and safety requirements, the FSV *Henry B. Bigelow*, will not be able to conduct survey operations in waters shallower than ten fathoms. Approximately 30-35 inshore stations will not be sampled between Long Island, New York and Cape Fear, North Carolina. This area will now, and in the future, be covered by the NEAMAP which primarily operates in waters between 3-18 fm.

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5.6.1.4 Protected Resources

The preferred alternative is not expected to result in negative impacts on marine mammal stocks. Potential impacts on sea turtles are summarized in Section 5.4 and are further described in the 2007 BO. The NEFSC surveys are not likely to result in jeopardy to any ESA-listed species under NMFS jurisdiction, though takes of loggerhead, leatherback, Kemp's ridley, or green sea turtles may occur.

5.6.1.5 Social and Economic Environment

Operation of the NEFSC surveys would not result in direct impacts to the social and economic environment (Section 5.5), such as imposing or resulting in any changes to fishing operations, fishing behavior, fishing gears used, or areas fished, that would impact those directly affected by the resources within the survey area. Each year the survey data is fed into the assessment cycles to provide updates of the progress being made and to recommend changes in regulations as appropriate. As such, the data produced by the surveys would directly benefit communities that depend upon or value the marine environment by providing the best available scientific information to support management measures designed toward continued rebuilding of overfished stocks reaching, ultimately, long-term potential yield.

5.6.2 Past, Present, and Reasonably Foreseeable Future Actions

5.6.2.1 Physical Environment

Activities that adversely effect or otherwise modify the physical marine environment within the NEFSC survey area have occurred and are expected to continue to occur in the future. The greatest cause of impact to the physical environment is commercial and recreational fishing operations. Also of concern are non-fishing related activities that occur in the survey area and generally are the same as those described in Section 5.6.2.2.

5.6.2.2 Habitat and EFH

Commercial and recreational fishing is a leading cause of negative impacts to marine habitat and EFH. Fishing operations are expected to continue over the next 5 years and beyond, and continue to contribute to adverse impacts to habitat and EFH, though the intensity and degree of these impacts cannot be predicted. Management measures implemented through Federal and state management of fisheries, such as the creation of closed or protected areas (described in Section 4.2), have mitigated some of the negative impacts of fishing.

The effects of mobile bottom-tending gear (trawls and dredges) on fish habitat have been recently reviewed by the NRC 2002. This study determined that repeated use of trawls/dredges reduces the bottom habitat complexity by the loss of erect and sessile epifauna, and the smoothing of sedimentary bedforms and bottom roughness. This activity, when repeated over a long term, also results in discernable changes in benthic communities, which involve a shift from larger-bodied long-lived benthic organisms to smaller shorter-lived ones. This shift also can result in loss of benthic productivity and thus biomass available for fish predators. Thus, such changes in bottom structure and loss of productivity can reduce the value of the bottom habitat for demersal fish, such as haddock and cod.

These fishing impacts can interact with non-fishing impacts to cause cumulative effects as well. The most likely cumulative interactions that have occurred and are occurring in the area covered by the NEFSC resource surveys are: changes in ocean climate; effects of nutrient enrichment (eutrophication) in outwelling from large estuaries/rivers; increase in invasive species; introduction of physical structures (i.e., renewable energy infrastructure within the US EEZ); chemical spills (oil and hazardous wastes); sand and gravel extraction; and presence of marine debris. These human non-fishing threats are discussed in Section 5.0 of the NEFMC Habitat Amendment (1998). One of the challenges in evaluating cumulative effects is the shifting environmental baseline (due primarily to fishing and climate change) in the marine environment, which makes it hard to evaluate the magnitude of any cumulative impacts and/or the direction of change in space and time (since the ocean ecosystem is dynamic and can undergo regime shifts from natural causes or as a consequence of human stressors). In the coastal ocean the human stressors can include: pollution; habitat loss/change; nutrient enrichment; invasive species; sand/gravel removal; renewable energy infrastructure; etc. The seasonal and interannual changes in the water column is more variable than that in the offshore ocean and some of this variability is transmitted at a lower dynamic range to the benthic environment. Some inshore EFH is adapted to this variable physical/chemical environment and thus exhibits greater resilience to the cumulative effects resulting from the interaction of fishing and non-fishing impacts.

Though largely unquantifiable, it is likely that the non-fishing activities noted above could have negative impacts on habitat quality from disturbance and construction activities immediately within the affected area. Given the wide geographic area of the proposed action, minor overall negative effects to offshore habitat are anticipated since the affected areas are limited to the project sites, which involve a small percentage of the total area in which the surveys operate. Any impacts to inshore water quality from permitted projects and other non-fishing activities, including impacts to planktonic, juvenile, and adult life stages, are unknown but likely to be negative in the immediate vicinity of the activity.

An EFH Omnibus Amendment is currently under development, initiated in 2003, for all of the NEFMC's FMPs. This Omnibus Amendment will fulfill the 5 year EFH review and revision requirement specified in 50 CFR Section 600.815(a)(10). The purpose of the amendment is to review and revise EFH components of the FMPs, and to develop a comprehensive EFH management plan that will successfully minimize adverse effects of fishing on EFH through actions that will apply to all NEFMC-managed FMPs. The NEFMC is considering several measures for inclusion in the Omnibus Amendment, including a review and update of the following:

- Description and identification of EFH;
- Non-fishing activities that may adversely impact EFH;
- Identification and consideration of new HAPCs; and
- Integration of alternatives to minimize any adverse effects of fishing on EFH.

Although it is not known at this time how the EFH Omnibus Amendment might change fisheries or fisheries management, the intention is to provide additional habitat and species protection where it is needed. Phase 1 of the EFH Omnibus Amendment has been substantially completed by the NEFMC, and includes new EFH designations for all species and life stages under management by the NEFMC, designation (but no management restrictions) of several HAPCs, an evaluation of the major prey species for species in the NEFMC fishery management units, and an evaluation of the potential impacts of nonfishing activities on EFH. Although the NEFMC has completed Phase 1, the document and corresponding actions will not be submitted for implementation until the completion of Phase 2, sometime in 2008. The potential exists for changes to the management measures designed to minimize adverse impacts on EFH and/or for additional measures to be implemented.

5.6.2.3 Fishery Resources

Historic state and Federal fishery management practices have generally resulted in overall positive impacts on the health of the commercial and recreational stocks present in the NEFSC survey area. The cumulative impacts of past, present, and reasonably foreseeable future fishery management actions on the fish stocks evaluated in this EA should generally be associated with positive long-term outcomes. Constraining fishing effort through regulatory actions is often necessary to bring about long-term sustainability of a given resource, and as such, should, in the long-term, promote positive effects on fish stocks. However, many of the non-fishing impacts, such as marine pollution, coastal development, habitat loss/change, nutrient enrichment, invasive species, sand/gravel removal, and renewable energy infrastructure, have also resulted in some adverse impacts to fish stocks (Section 5.6.2.2).

Most of the NEFSC survey activities have been conducted for several decades without significant impacts on fish and invertebrate populations. Planned future alterations to the NEFSC shellfish dredge surveys would increase the reliance on sensing methodologies and reduce reliance on sampling involving direct impacts to fish populations and direct dredge contact with habitat components.

5.6.2.4 Protected Resources

Several actions have impacted and will likely continue to impact protected resources found within the geographic area of the NEFSC research surveys. Fishing activities have and are expected to continue operations in the future, and protected species in the survey area would continue to be impacted by fishing gear, though to an unknown degree. Bycatch of MMPA species will be included in annual stock assessment reports, and the affect of removals will be evaluated under the potential biological removal (PBR) process (Wade and Angliss 1997). Bycatch or take of species listed under the ESA are evaluated through the Section 7 process.

Natural mortality of sea turtles and marine mammals, including disease (parasites), predation, and cold-stunning (turtles), occurs in the affected area. ESA listed sea turtle, fish, bird, and marine mammal species have been and currently are negatively impacted by a variety of anthropogenic activities including: fishery bycatch, vessel strikes, gear entanglement, ingestion of marine debris, power plant entrainment, and effects related to accumulation of synthetic chemicals and heavy metals (NRC 1990; Simmonds and Lopez-Jurado 1991; Reijnders et al. 1999; Lewison and Crowder 2006; Nelson et al. 2007; Waring et al. 2007; Sea turtle recovery plans: http://www.nmfs.noaa.gov/pr/recovery/plans.htm). Sea turtles are also affected by direct harvest of adults and eggs and by commercial dredging. Deliberate shooting is an additional source of seal mortality. These activities are reasonably certain to occur over the next 5 years, although NMFS does not have information indicating the degree and extent of the expected impact to protected species.

The 2007 BO summarizes incidental taking of sea turtles in past NEFSC trawl/dredge survey operations. Potential impacts on sea turtles are summarized in Section 5.4. Past NEFSC trawl/dredge survey operations have had a negligible impact on all marine mammal populations. In the future, based on the 2007 BO, the NEFSC surveys were expected to take 18 sea turtles in 2007 (17 released alive and 1 dead), and are expected to take16 sea turtles in 2008 (15 released alive and 1 dead), and 9 sea turtles in 2009 and each year thereafter (8 released alive and 1 dead). These takes are not likely to jeopardize any ESA-listed species under NMFS jurisdiction.

A number of actions are being undertaken by NMFS to mitigate negative impacts and reduce threats to protected species. These actions include the ALWTRP, the HPTRP, Atlantic Pelagic Longline Take Reduction Plan, the Atlantic Trawl Gear Take Reduction Plan, and the Bottlenose Dolphin Take Reduction Plan. Other activities include education and outreach, research, and the STSSN. These plans and activities are designed to prevent or alleviate negative impacts to protected species now and in the future.

The NEFSC has been working cooperatively with industry partners to redesign the sea scallop survey dredge to increase its capture efficiency and consistency. The Center also recently completed a 4 year study on the effects of chain mats on survey dredge efficiency. As a result of these processes, the Center intends to adopt and utilize survey dredges outfitted with chain mats beginning in 2008. The chain mats are intended to exclude large rocks from the dredge, but were also intentionally designed to comply with turtle chain excluder regulations implemented for the commercial fishery.

5.6.2.5 Social and Economic Environment

Activities under the NEFSC surveys have been conducted since 1963. Over the years additional components have been added to meet legislated mandates under the Magnuson-Stevens Act, as revised. These mandates now include determination of various biological reference points and specification of time constrained rebuilding programs for all federally managed species.

State and Federal fishery management practices have resulted in overall positive impacts on the health of the commercial and recreational stocks present in the NEFSC survey area. Often, however, regulations taken to protect fish stocks, such as effort reductions, result in concomitant negative economic and social impacts to the individuals, businesses and communities that rely upon these stocks. The cumulative impacts of past, present, and reasonably foreseeable future fishery management actions on the communities that rely upon commercial and recreational fisheries should generally be associated with positive long-term outcomes, despite short-term economic hardship or losses. The impacts are usually necessary to bring about long-term sustainability of a given resource, and as such, should, in the long-term, promote positive effects on human communities, especially those that are economically dependent upon federally and state managed stocks.

5.6.3 Cumulative Impacts

5.6.3.1 Physical Environment

Over the next 5 years, the NEFSC survey activities are likely to have a negligible impact on physical habitat characteristics. Survey activities do include deployment of sampling gear that makes physical contact with the bottom. These gears include bottom trawls, scallop dredges, clam dredges, and benthic substrate sampling dredges. Impact made by these gears is usually ephemeral and small in scale. Since most sampling programs involve randomized rather than fixed sampling designs, sampled areas are rarely subjected to repeated impacts over a short period of time. Planned future alterations to the NEFSC scallop survey will increase the reliance on sensing methodologies and reduce reliance on sampling involving direct dredge contact with the physical habitat. In addition, we can expect a reduction in interaction with the physical habitat by benthic habitat cruises as these programs start to integrate multibeam acoustics sampling approaches into scientific programs. Long term modification of the physical environment would continue to occur as a result of fishing operations and other anthropogenic activities in the survey area, however, because of the minimal direct impact of the surveys, this action would not contribute to cumulative impacts to the physical environment.

5.6.3.2 Habitat and EFH

While reductions in overall fishing effort, as a result of past and current fishery management actions, is thought to have had a positive impact on habitat and EFH, the repeated use of trawls and dredges reduces bottom habitat complexity, ultimately decreasing the value of habitat for demersal fish. Identification of additional areas for restricted habitat interactions though the EFH Omnibus Amendment would have a positive effect, as would decreased interactions brought about by decreased effort and gear engineering. The NEFSC surveys would not contribute to these cumulative impacts in areas open to fishing, because the increase in fishing effort by NEFSC survey tows is minimal to the degree that it is virtually indistinguishable from current fishing operations.

Many of the cumulative effects in the northwest Atlantic Ocean are evaluated based upon field observations of open and closed areas (GOM/GB) and modeling results. It is difficult to extrapolate laboratory studies of interacting stressors or small scale field experiments (Stellwagen Bank National Marine Sanctuary) to the temporal/spatial scales at which fisheries are managed. Also we lack level 3 (growth, reproduction, or survival rate comparisons between habitats) and level 4 (habitat-dependent production rates as a function of habitat quantities, qualities, and specific locations) data that link EFH to fish productivity, which makes it hard to analyze the impacts of fishing or non-fishing stressors, or their cumulative effects on EFH. The HAPC environmental degradation criteria can refer to fishing or non-fishing effects, or a combination of the two, either in the present or expected in the future. Thus the cumulative effects of concern on HAPCs may differ from those on EFH (and the resulting protections incorporated into the FMPs to mitigate fishing effects). NMFS' role for non-fishing impacts on EFH is a consultative function with actions proposed/permitted by other Federal/state agencies.

In the future, the NEFSC surveys are likely to have negligible effects on water column temperature patterns, ocean chemistry or local or global water circulation patterns. Proposed actions are likely to have negligible effects on physical environmental features, as discussed in the previous section. Likewise, proposed actions are likely to have negligible effects on biotic components of habitat. Planned future alterations to the NEFSC sea scallop survey will increase the reliance on sensing methodologies and reduce reliance on sampling involving direct dredge contact with habitat components. In addition, we can expect a reduction in interaction with physical habitat by benthic habitat cruises as these programs start to integrate multibeam acoustics sampling approaches into scientific programs.

5.6.3.3 Fishery Resources

Past fishery management actions taken through the FMP and annual specification process have had a positive cumulative effect on the managed resources. It is anticipated that future management actions would result in additional indirect positive effects on the managed species through actions which reduce and monitor bycatch, protect habitat, and protect ecosystem services. The specifications of annual catch limits for managed resources supports the long-term sustainability of fishery stocks and is consistent with the guidance of the Magnuson-Stevens Act. Because the additional mortality to fish species resulting from the NEFSC surveys would not adversely impact the stock of any species, the NEFSC surveys are not expected to contribute to cumulative impacts or to have any significant effect on any managed or non-managed resources in the survey area, either individually or in conjunction with other anthropogenic activities.

The operation of the NEFSC survey activities in the future are likely to have a negligible impact on living marine resources. Most of these survey activities have been conducted for several decades without significant impacts on fish and invertebrate populations. Future impacts on living marine resources would be remedied much more effectively by restrictions on fishing effort and resource exploitation than by modifications to survey work. Planned future alterations to the NEFSC shellfish dredge surveys will increase the reliance on sensing methodologies and reduce reliance on sampling involving direct dredge contact with habitat components.

5.6.3.4 Protected Resources

Several actions have impacted and will likely continue to impact protected resources found within the geographic area of the NEFSC surveys, including vessel operations, hopper dredging, fisheries, and marine pollution. Overall, these actions and anthropogenic activities have had some adverse impact on sea turtles, marine mammals and other protected species.

Past NEFSC trawl/dredge survey operations have had a negligible impact on all marine mammal populations. The impact on ESA listed sea turtles is described in the 2007 BO. No impacts are expected on ESA listed marine mammal stocks. Potential impacts on sea turtles are summarized in Section 5.4. Both ESA listed sea turtles and marine mammal and MMPA species have and continue to be negatively impacted by a variety of anthropogenic activities including: fishery bycatch, vessel strikes, gear entanglement, ingestion of marine debris, power plant entrainment, and effects related to accumulation of synthetic chemicals and heavy metals (NRC 1990; Simmonds and Lopez-Jurado 1991; Reijnders et al. 1999; Lewison and Crowder 2006; Waring et al. 2007; Sea turtle recovery plans: http://www.nmfs.noaa.gov/pr/recovery/plans.htm). Sea turtles are also affected by direct harvest of adults and eggs and by commercial dredging. Deliberate shooting is an additional source of seal mortality. The operation of NEFSC survey activities would have a negligible impact on marine mammals and have been determined to have a very minimal negative impact on sea turtles, but would not jeopardize any listed species. As such, the surveys are not expected to result in a measurable contribution to cumulative impacts in the survey area.

5.6.3.5 Social and Economic Environment

Each year the survey data is fed into the assessment cycles to provide updates of the progress being made and to recommend changes in regulations as appropriate. The principle tools include closed areas, effort controls, trip limits and TACs. The VTR program provides a census of fishing effort and landings which is reinforced with detailed dealer reports. This collection of information has provided for significant complexity in fishery regulation design. The complexity is designed to focus regulations as tightly as possible on specific resource problems while at the same time allowing exploitation of healthy components as fully as possible. The benefits of the surveys, including providing the best scientific information available to marine resource scientists and managers, are expected to continue in the future. One may view this complexity in the FMPs resident on either Federal fishery management Council website (www.NEFMC.org, and www.MAFMC.org). The target of better scientific information coupled with maturing management is an increase in available resources for harvest as compared to today, and continued rebuilding of overfished stocks reaching, ultimately, long term potential yield.

Past fishery management actions taken by state and Federal agencies have had both positive and negative cumulative effects on fishery resources by benefiting domestic stocks through sustainable fishery management practices while at the same time potentially reducing the availability of the resource to all participants. Sustainable management practices are, however, expected to yield broad positive impacts to fishermen, their communities, businesses, and the nation as a whole. It is anticipated that future fishery management actions would result in positive effects for human communities due to sustainable management practices, although additional indirect negative effects on the human communities could occur through management actions that will incur costs for the fishermen. Overall, the past, present, and reasonably foreseeable future actions that are truly meaningful to human communities have had an overall positive cumulative effect. Operation of the NEFSC surveys contribute to direct positive cumulative impacts by supporting a program that provides important fisheries and ecosystem data.

5.6.4 Summary of Cumulative Impacts

Past, present, and future NEFSC survey activities likely have had a negligible impact on physical habitat, essential fish habitat, fish, social and economic environments and protected resources (Table 16). The contributions of the NEFSC surveys to cumulative overall effects, taking into consideration the past, present, and reasonably foreseeable future actions that affect the resources within the survey area, have also been negligible. Proposed actions are of similar magnitude to what the agency has conducted over the past 40-45 years. The current and future functional effect of the past, present, and proposed action is approximately equivalent to adding 1.2 vessels to the groundfish fleet, 0.2 vessels to the commercial sea scallop fleet, 0.5 vessels to the commercial northern shrimp trawling fleet in the GOM, and 0.1 vessels to the commercial surfclam fleet on an annual basis. Proposed actions are likely to have a low negative impact on sea turtle populations (Table 16), where individuals are infrequently captured and rarely killed due to the survey effort and short duration of survey tows. Future surveys are likely to strive to shift to less reliance on resource capture techniques (trawls, dredges) and more dependence on sensing techniques (acoustic, optical). These trends will likely result in a reduction in the overall impact on living marine resources and their habitat.

Table 16. Cumulative impacts including the preferred alternative and past, present and reasonably foreseeable future actions

Action	Impact on Physical Environment	Impact on Habitat/EFH	Impact on Fish	Impact on Social and Economic Environment	Impact on Protected Resources
NEFSC Research Surveys 2008-2012 – Preferred Alternative	Negligible	Negligible – areas open to fishing; Minimal and temporary – habitat closed areas	Low indirect positive impacts on regulated fish stocks. Unknown but likely negligible impacts on non-regulated fish stocks	Low positive – support continued rebuilding of healthy resources	Negligible on non-ESA species. Low negative impact on turtles.
NEFSC Research Surveys [P]	Negligible	Negligible – areas open to fishing; Minimal and temporary – habitat closed areas	Low indirect positive impacts on regulated fish stocks. Unknown but likely negligible impacts on non-regulated fish stocks	Low positive - supported complex management programs which focused on specific problems and allowed for sophisticated assessment models.	Negligible on non-ESA species. Low negative impact on turtles
Federal and State Managed Fisheries [P, Pr, RFFA]	Low negative (P); Low negative (Pr); Negligible (RFFA)	Low negative (P); Low negative (Pr); Negligible (RFFA)	Likely to be low negative impact to fish populations; Positive (RFFA)	Positive (P); Low negative (Pr); Positive (RFFA)	Negative (P, Pr and RFFA) PBR is exceeded for some species in some fisheries and entanglement is a serious issue for ESA listed large whales. Negative impacts on sea turtles in several fisheries. Negligible impact on listed fish stocks.
Other Fishing Operations [P, Pr, RFFA]	Negligible (P, Pr, RFFA)	Negligible (P, Pr, RFFA)	Negligible - provides some background data for management	Negligible	Unknown impact (not monitored) (P, Pr and RFFA)
Non-Fishing Activities [P, Pr, RFFA]	Low negative (P); Low negative (Pr); Negative (RFFA)	Low negative (P); Low negative (Pr); Negative (RFFA)	Low negative (P); Low negative (Pr); Negative (RFFA) - can exacerbate resource recovery and assessments	Negligible - can exacerbate resource recovery and assessments, but activities provide direct benefit	Negative (P, Pr and RFFA) PBR is exceeded for some species in some fisheries and entanglement is a serious issue for ESA listed large whales. Negative impacts on sea turtles in several fisheries. Negligible impact on listed fish stocks.
Sea Turtle Conservation Measures [Pr, RFFA]	Negligible (Pr, RFFA)	Negligible (Pr, RFFA)	Low (Pr, RFFA) positive or negligible – could change management measures	Low negative economic – may be cost for gear; Positive social	Positive impacts on sea turtles (Pr and RFFA); Negligible (Pr, RFFA)
Atlantic Large Whale Take Reduction Plan [Pr, RFFA]	Negligible (Pr, RFFA)	Negligible (Pr, RFFA)	Negligible – no changes to fishing operations	Negative economic – new gear requirements; Positive social	Positive impacts on large whales (Pr and RFFA)small (Pr, RFFA)
Harbor Porpoise Take Reduction Plan [Pr, RFFA]	Negligible (Pr, RFFA)	Negligible (Pr, RFFA)	Negligible – no changes to fishing operations	Potentially negative economic – possible closures; Positive social	Positive impacts on harbor porpoises (Pr and RFFA)
Habitat Omnibus Amendment [Pr, RFFA]	Positive (Pr, RFFA)	Positive (Pr, RFFA)	Negligible – no changes to fishing operations	Negligible – potential benefit for life stages of important species and may improve stocks in the future	Positive (Pr and RFFA)
CUMULATIVE IMPACTS	**Low Negative**	**Low Negative**	**Low Positive**	**Low Positive**	**Low Positive**

[P, Pr, RFFA] P, Pr, RFFA indicates Past, Present and/or Reasonably Foreseeable Future Action, an action that has occurred (P), is currently occurring (Pr) and/or is expected to continue occurring in the future (RFFA)

Impact Definitions used in Table 24:

Fish and Protected Species: Positive - actions that increase stock/population size; Negative - actions that decrease stock/population size

Physical Environment and EFH/Habitat: Positive -actions that improve the quality or reduce disturbance of habitat; Negative -actions that degrade the quality or increase disturbance of habitat

Social and Economic Environment: Positive - actions that increase revenue and well being of fishermen and/or associated businesses; Negative - actions that decrease revenue and well being of fishermen and/or associated businesses

Impact Qualifiers used in the Table 24:

Low (as in *low* positive or *low* negative): to a lesser degree

High (as in *high* positive or *high* negative): to a greater degree

Negligible: a degree of impact immeasurably small

Potentially: some of degree uncertainty associated with the impact

6.0 Applicable Law

6.1 Endangered Species Act (ESA)

Section 7 of the ESA requires Federal agencies conducting, authorizing, or funding activities that affect threatened or endangered species to ensure that those effects do not jeopardize the continued existence of listed species. For further information on the potential impact of the surveys, see Section 5.0 of this document. NMFS has determined that the surveys conducted by the NEFSC are not likely to result in jeopardy to any ESA-listed species under NMFS jurisdiction, or alter or modify any critical habitat, based on the analysis in this document and in the Section 7 Consultation BO dated August 20, 2007.

6.2 Information Quality Act

Pursuant to NOAA guidelines implementing Section 515 of Public Law 106-554 (the Data Quality Act), all information products released to the public must first undergo a Pre-Dissemination Review to ensure and maximize the quality, objectivity, utility, and integrity of the information (including statistical information) disseminated by or for Federal agencies. The following section addresses these requirements.

Utility

The information presented in this document is helpful to the intended users (the affected public) by presenting a clear description of the purpose and need of the proposed action, the measures proposed, and the impacts of those measures. A discussion of the reasons for selecting the proposed action is included so that intended users may have a full understanding of the proposed action and its implications.

This document is the principal means by which the information contained herein is available to the public. The information provided in this document is based on the most recent available information from the relevant data sources. The development of this document and the decisions made by NMFS to propose this action are the result of a multi-stage public process.

This document is available in several formats, including printed publication and CD-ROM, upon request.

Integrity

Prior to dissemination, information associated with this action, independent of the specific intended distribution mechanism, is safeguarded from improper access, modification, or destruction, to a degree commensurate with the risk and magnitude of harm that could result from the loss, misuse, or unauthorized access to or modification of such information. All electronic information disseminated by NMFS adheres to the standards set out in Appendix III, "Security of Automated Information Resources," of OMB Circular A-130; the Computer Security Act; and the Government Information Security Act. All confidential information (e.g., dealer purchase reports) is safeguarded pursuant to the Privacy Act; Titles 13, 15, and 22 of the US Code (confidentiality of census, business, and financial information); the Confidentiality of Statistics provisions of the Magnuson-Stevens Act; and NOAA Administrative Order 216-100, Protection of Confidential Fisheries Statistics.

Objectivity
For purposes of the Pre-Dissemination Review, this document is considered to be a "Natural Resource Plan." Accordingly, the document adheres to the published standards of the Magnuson-Stevens Act; the Operational Guidelines, Fishery Management Plan Process; the Essential Fish Habitat Guidelines; the National Standard Guidelines; and NOAA Administrative Order 216-6, Environmental Review Procedures for Implementing the National Environmental Policy Act.

This information product uses information of known quality from sources acceptable to the relevant scientific and technical communities. Stock status (including estimates of biomass and fishing mortality) reported in this product are based on either assessments subject to peer-review through the Stock Assessment Review Committee or on updates of those assessments prepared by scientists of the NEFSC. Landing information is based on information collected through the NEFSC Commercial Fisheries database. In addition to these sources, additional information is presented that has been accepted and published in peer-reviewed journals or by scientific organizations.

Despite current data limitations, the measures proposed for this action were selected based upon the best scientific information available. The analyses conducted in support of the proposed action were conducted using information from the most recent complete calendar years, from 2002 through 2006. Complete landings data for 2007 were not available at the time during which these analyses were conducted. The data used in the analyses provide the best available information on the landings of the relevant species in the northeast region.

The policy choices are clearly articulated, in sections of this document, as the management alternatives considered in this action. The supporting science and analyses, upon which the policy choices are based have been documented. All supporting materials, information, data, and analyses within this document have been, to the maximum extent practicable, properly referenced according to commonly accepted standards for scientific literature to ensure transparency.

The review process used in preparation of this document involved staff from the NEFSC and the NERO. The Center's technical review was conducted by senior level scientists with specialties in population dynamics, stock assessment methods, demersal resources, population biology, and the social sciences. All stock assessment data used in this document has gone through the Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC) review process. Review by staff at the NERO was conducted by those with expertise in fisheries management and policy, habitat conservation, protected species, and compliance with the applicable law. Final approval of the action proposed in this document and clearance of any rules prepared to implement resulting regulations was conducted by staff at NMFS Headquarters, the Department of Commerce, and the US Office of Management and Budget.

6.3 Magnuson-Stevens Conservation and Management Act

The proposed action meets the definition of scientific research activity conducted by a scientific research vessel and is therefore exempt from the requirements of the Magnuson-Stevens Act. Section 404 of the Magnuson-Stevens Act requires the Secretary of Commerce to initiate and maintain, in cooperation with the Councils, a comprehensive program of fishery research to carry out and further the purposes, policy, and provisions of the Magnuson-Stevens Act. The proposed action is part of a comprehensive program to address this requirement.

6.4 Marine Mammal Protection Act

NMFS has reviewed the impacts of the various NEFSC surveys on marine mammals and concluded that the surveys are conducted and consistent with the provisions of the MMPA and would not alter existing measures to protect the species likely to inhabit the survey area. For further information on the potential impacts on marine mammals, see Section 5.0.

6.5 National Environmental Policy Act

National Oceanic and Atmospheric Administration Administrative Order 216-6 (May 20, 1999) contains criteria for determining the significance of the impacts of a proposed action. In addition, the Council on Environmental Quality regulations at 40 C.F.R.1508.27 state that the significance of an action should be analyzed both in terms of "context" and "intensity." Each criterion listed below is relevant to making a finding of no significant impact and has been considered individually, as well as in combination with the others. The significance of this action is analyzed based on the NAO 216-6 criteria and CEQ's context and intensity criteria. These include:

1) Can the proposed action reasonably be expected to jeopardize the sustainability of any target species that may be affected by the action?

> Response:
> The proposed measures are not reasonably expected to jeopardize the sustainability of any target species that may be affected. Removal and mortality of target organisms by the multispecies bottom trawl, northern shrimp trawl, surfclam/ocean quahog dredge and sea scallop dredge surveys are small, and are insignificant relative to removals by managed commercial and recreational fisheries (Section 5.0).

2) Can the proposed action reasonably be expected to jeopardize the sustainability of any non-target species?

> Response:
> The proposed measures are not reasonably expected to jeopardize the sustainability of any non-target species that may be affected. Removal and mortality of non-target organisms by the bottom trawl, northern shrimp trawl, surfclam/ocean quahog dredge and sea scallop dredge surveys are insignificant relative to removals by managed commercial and recreational fisheries (Section 5.0).

3*) Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs?*

Response:
Conduct of surveying activities does cause damage to ocean habitats and essential fish habitat through the operation of dredges and trawls, but such activity is negligible and temporary relative to total available habitat. Furthermore, because of likely recovery times and other commercial fishing activity that is currently occurring in the NEFSC survey area (Section 5.0), the impact of the various research cruises will be negligible.

4*) Can the proposed action reasonably be expected to have a substantial adverse impact on public health or safety?*

Response:
The research activities conducted by the various NEFSC surveys are not expected to have a substantial impact on public health or safety. Information collected on future surfclam/ocean quahog and sea scallop dredge surveys related to Paralytic Shellfish Poison (PSP) contamination of shellfish is likely to indirectly contribute positively to public health and safety by informing scientists and managers of the presence of PSP, such that appropriate management measures, if necessary, may be taken.

5*) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species?*

Response:
The proposed actions are not reasonably expected to have an adverse impact on endangered or threatened species, marine mammals, or critical habitat. The proposed surveys occasionally intercept or take threatened or endangered species, marine mammals and other non-target species (Section 5.0). The surveys conducted by the NEFSC are not likely to result in jeopardy to any ESA-listed species under NMFS jurisdiction, though takes of loggerhead, leatherback, Kemp's ridley, and green sea turtles are expected to occur. Often, scientific staff are able to collect valuable data from these specimens and return them to their environments alive. Occasionally, organisms are inadvertently killed and in these cases, we ensure that the organisms are transferred to the most appropriate scientific institution to maximize the opportunity for scientific data collection. Interactions of this type are relatively infrequent and insignificant relative to what occurs during commercial and recreational fishing operations and other activities in the survey area.

6*) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?*

Response:
The NEFSC surveys are expected to have a negligible impact on biodiversity and ecosystem function. The proposed survey activities have negligible direct and indirect impacts on habitat, fish stocks and protected species (Section 5.0), and as such, do not contribute to impacts to the function of the natural resource communities and relationships within the affected area. Instead, the overall purpose of the surveys is to produce important information required to both understand and monitor biodiversity and ecosystem function within the affected area.

7*) Are significant social or economic impacts interrelated with natural or physical environmental effects?*

Response:
The proposed actions cannot be reasonably expected to have significant negative social or economic impacts, and as such would not result in significant negative social or economic impacts that are interrelated with natural or physical environmental effects (Section 5.0). However, the NEFSC research surveys can reasonably be expected to result in indirect positive social or economic impacts. Much of what we know about the status of fisheries and invertebrate resources and their habitats has resulted from the collection of biological and habitat data during scientific resource surveys. These surveys have the potential to result in positive social and economic benefits to society because they support the management of living marine resources and their habitats that is based upon the best scientific information available.

8*) Are the effects on the quality of the human environment likely to be highly controversial?*

Response:
The proposed actions are not expected to result in impacts on the human environment that are highly controversial. The impacts of the NEFSC survey activities are well documented and have been on-going for more than 40 years. As such, the interaction of the survey with elements of the human environment, including protected species, fish, and the physical environment and habitat are known and described in Section 5.0. The effects on the quality of the human environment are likely to be negligible and not controversial.

9*) Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas?*

Response:
The proposed actions are expected to have negligible impacts on unique areas or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas. Vessel operations around the unique historical and cultural resources encompassed by the Stellwagen Bank National Marine Sanctuary would not likely be altered by these actions. As a result, no substantial impacts are expected from this action.

10) Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

Response:
The proposed actions cannot be reasonably expected to result in substantial impacts on human environments or involve unique or unknown risks. Many of these surveys have been conducted for more than 4 decades and the effects on human habitat are both known and negligible. We are not aware of any unique or unknown risks.

11*) Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?*

The proposed actions cannot be reasonably expected to contribute to cumulatively significant impacts. The proposed action is similar to commercial fishing activities permitted in the NEFSC survey area and does contribute to the cumulative impacts of these activities. The functional effect of the proposed action is approximately equivalent to adding 1.2 vessels to the groundfish fleet, 0.2 vessels to the commercial sea scallop fleet, 0.5 vessels to the commercial northern shrimp trawling fleet in the GOM, and 0.1 vessels to the commercial surfclam fleet on an annual basis (Section 5.0).

12*) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historical resources?*

Response:
The proposed actions are not likely to affect objects listed in the National Register of Historic Places or cause significant impact to scientific, cultural, or historical resources. The only objected listed in the National Register of Historic Places present in the affected area is the wreck of the steamship Portland within the Stellwagen Bank National Marine Sanctuary. The current commercial fishing regulations allow fishing within the Stellwagen Bank National Marine Sanctuary. Research surveys generally avoid operations near known wrecks to avoid tangling gear. Because surveys (and the commercial fleet) operate within the boundaries of Stellwagon National Marine Sanctuary, the survey occasionally intercepts objects from previously unknown or previously non-disclosed ship wrecks protected by sanctuary regulations (most recently a 100 year old anchor). These objects are turned over to the Sanctuary staff and provide important archeological information about the area.

13) Can the proposed action reasonably be expected to result in the introduction or spread of a nonindigenous species?

Response:
The NEFSC survey activities proposed cannot reasonably be expected to result in the introduction or spread of non-indigeneous species. Organisms are sampled from the environment and no new organisms are introduced through these activities. Some vessel operations will occur in deep water environments off the continental shelf, but live organisms are not transported to other areas.

14*) Is the proposed action likely to establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration?*

Response:
There is some probability that the proposed actions will establish a precedent or represent a decision in principle about the future consideration of the issuance of a SRP. Permitting of the proposed NEFSC research surveys may set a precedent for future permitting of long-term, broad scale scientific monitoring of living marine resources and

their habitats. However, it would be reasonable to consider that the impacts of scientific surveys similar to the surveys conducted by the NEFSC would likely have negligible impacts on the human environment, as demonstrated by the impact assessment of this action. As such, the issuance of a SRP to support the NEFSC would not set a precedent for consideration of an action with *significant* impacts. Furthermore, the research conducted by the NEFSC surveys provide a unique platform specifically designed to meet a number of unique objectives; NMFS would consider future actions that may be similar in the same way.

15) Can the proposed action reasonably be expected to threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment?

Response:
To our knowledge, the proposed actions cannot be reasonably expected to threaten a violation of Federal, State or local law or requirements imposed for the protection of the environment.

16) Can the proposed action reasonably be expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?

Response:
The proposed actions are expected to have a negligible cumulative effect that could result in a substantial effect on target and non-target species (Section 5.0). The proposed actions produce important information required to both understand and evaluate cumulative mortality and population status of both target and non-target species. The direct impact of survey activity is negligible on target and non-target species (Section 5.0). As such, the surveys conducted by the NEFSC do not contribute to or result in the cumulative adverse impact of other past, present and reasonably foreseeable future activities occurring within the survey area.

DETERMINATION

In view of the information presented in this document and the analysis contained in the supporting EA prepared for the issuance of a SRP to support the NEFSC's research activities, it is hereby determined that the NEFSC research surveys will not significantly impact the quality of the human environment as described above and in the EA. In addition, all beneficial and adverse impacts of the proposed action have been addressed to reach the conclusion of no significant impacts. Accordingly, preparation of an EIS for this action is not necessary.

Patricia A. Kurkul
Regional Administrator
National Marine Fisheries Service

3/31/08
Date

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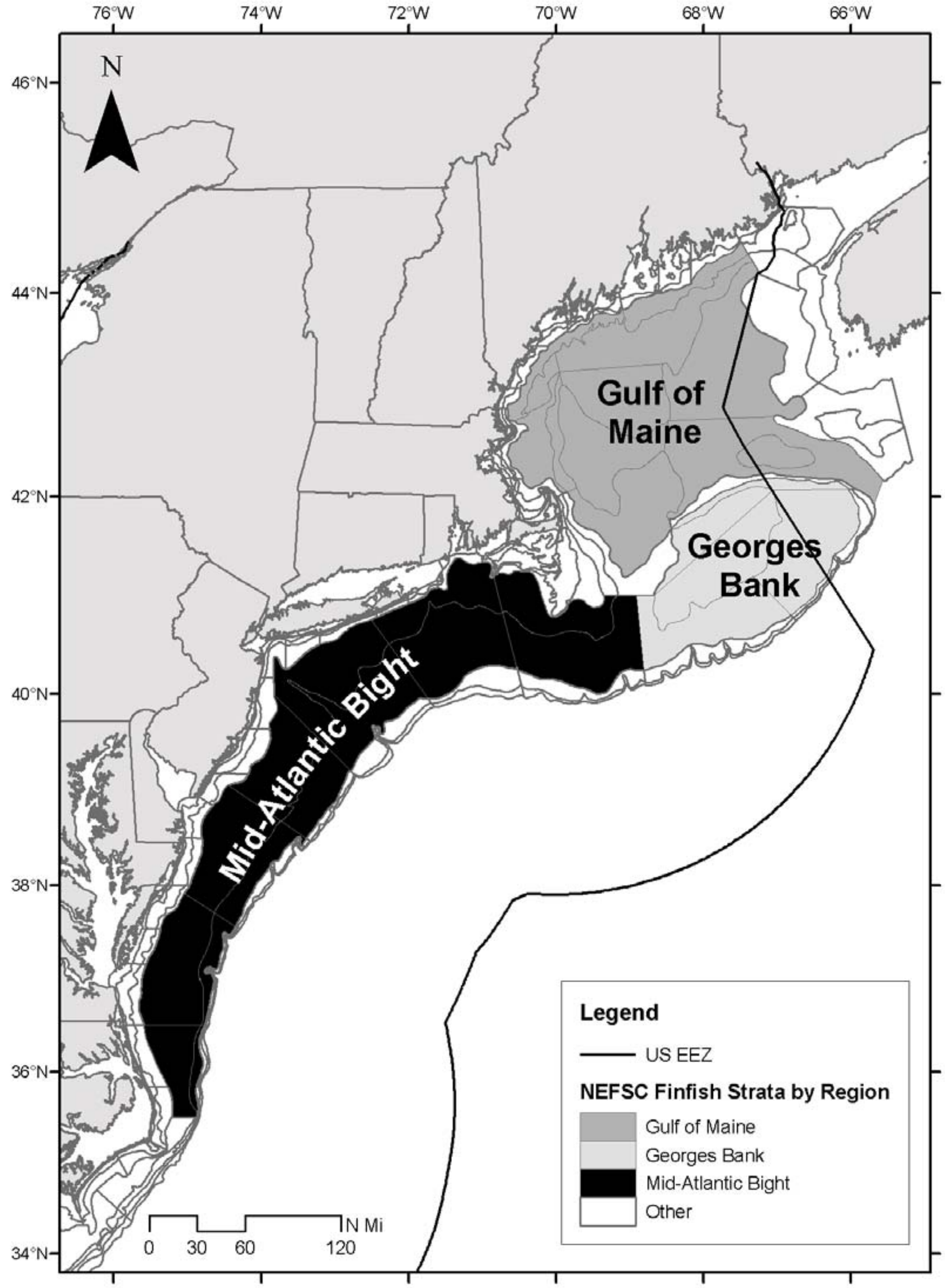

Figure 1. NEFSC Bottom Trawl and Ecosystem Monitoring survey area of operation – Cape Hatteras to the Gulf of Maine.

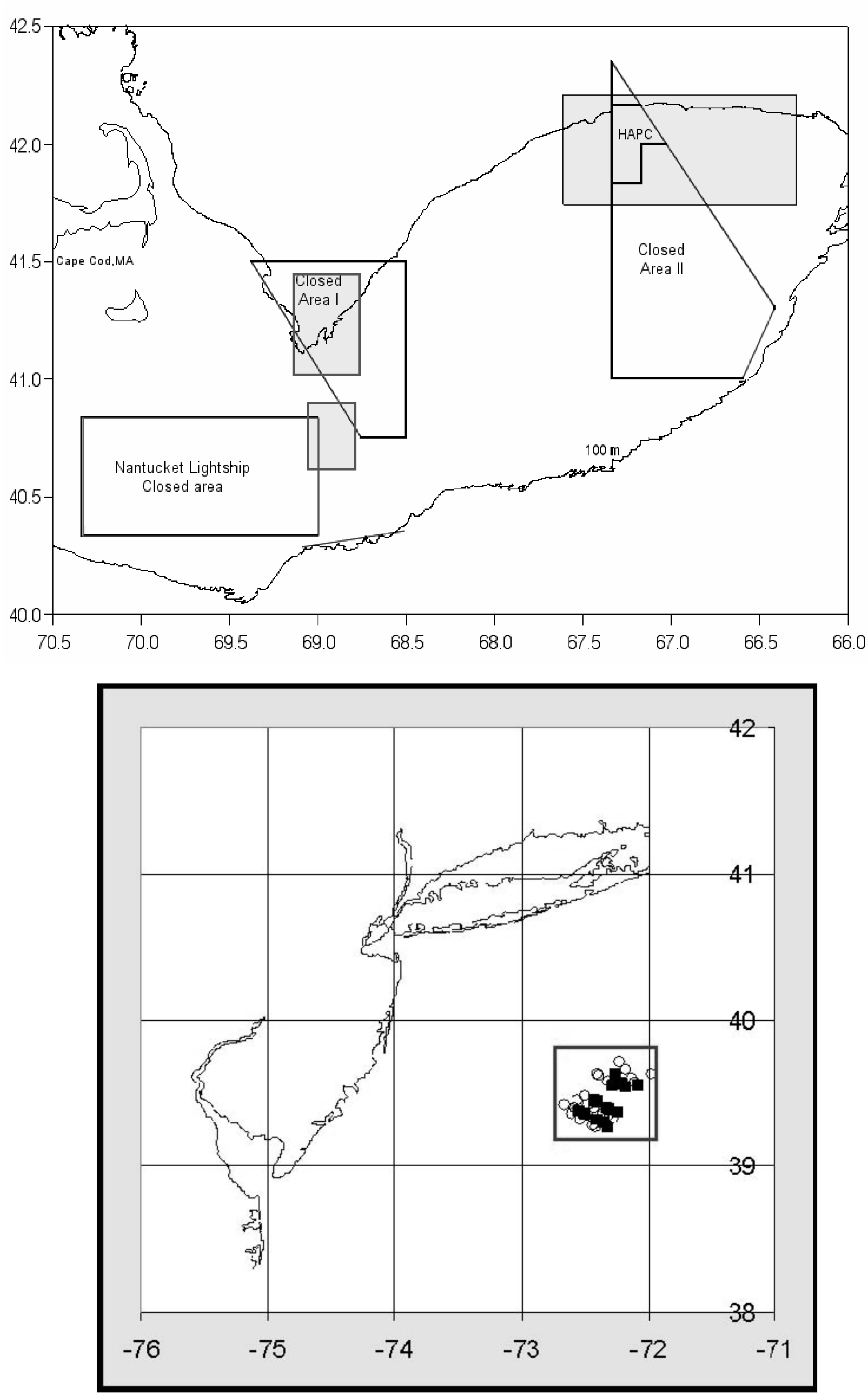

Figure 2. NEFSC Benthic Habitat survey area of operation – Georges Bank (top figure, shaded) and Mid-Atlantic (bottom figure, outlined in black). Circles and squares represent sampling sites from previous cruises.

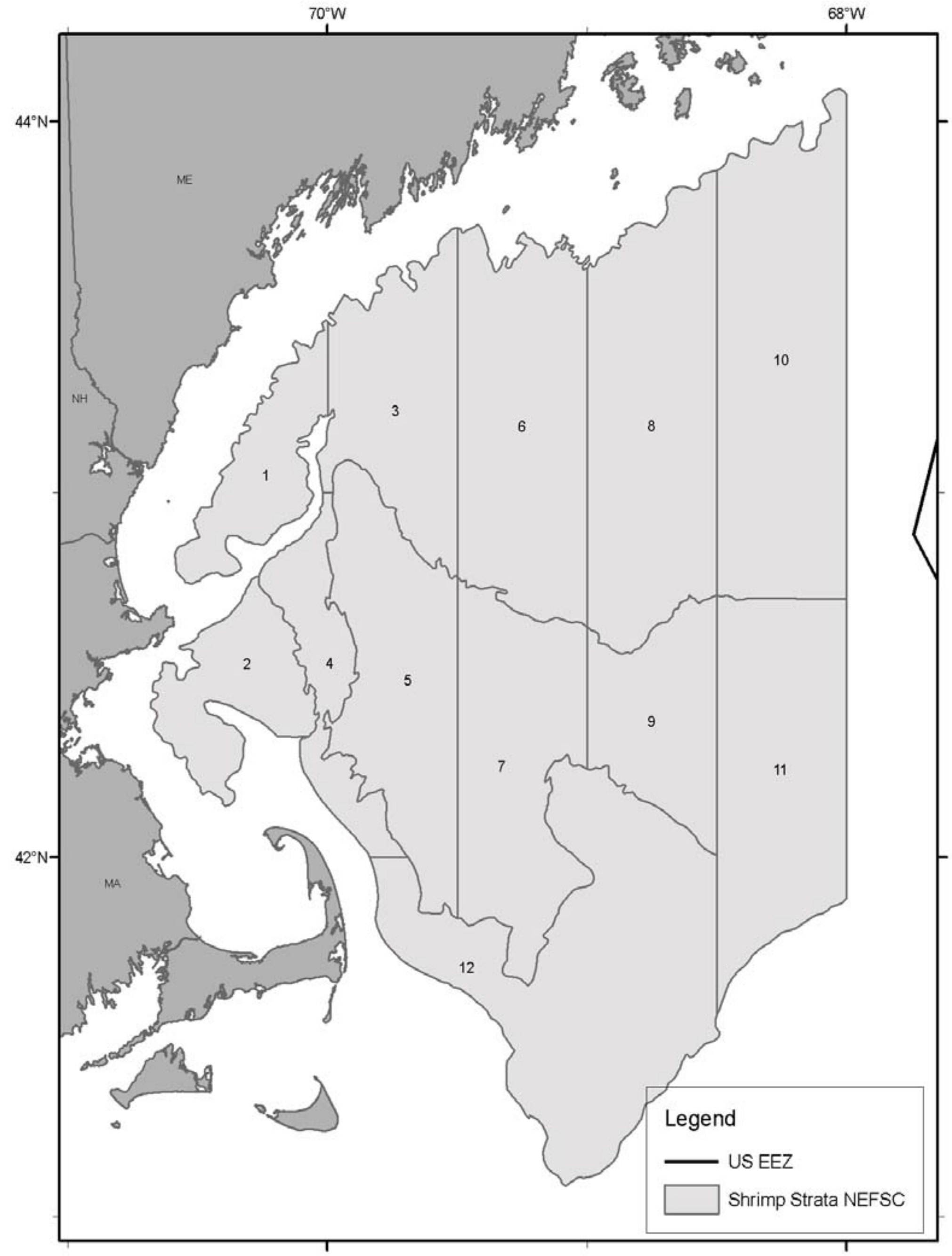

Figure 3. NEFSC Northern Shrimp survey strata and area of operation - Gulf of Maine.

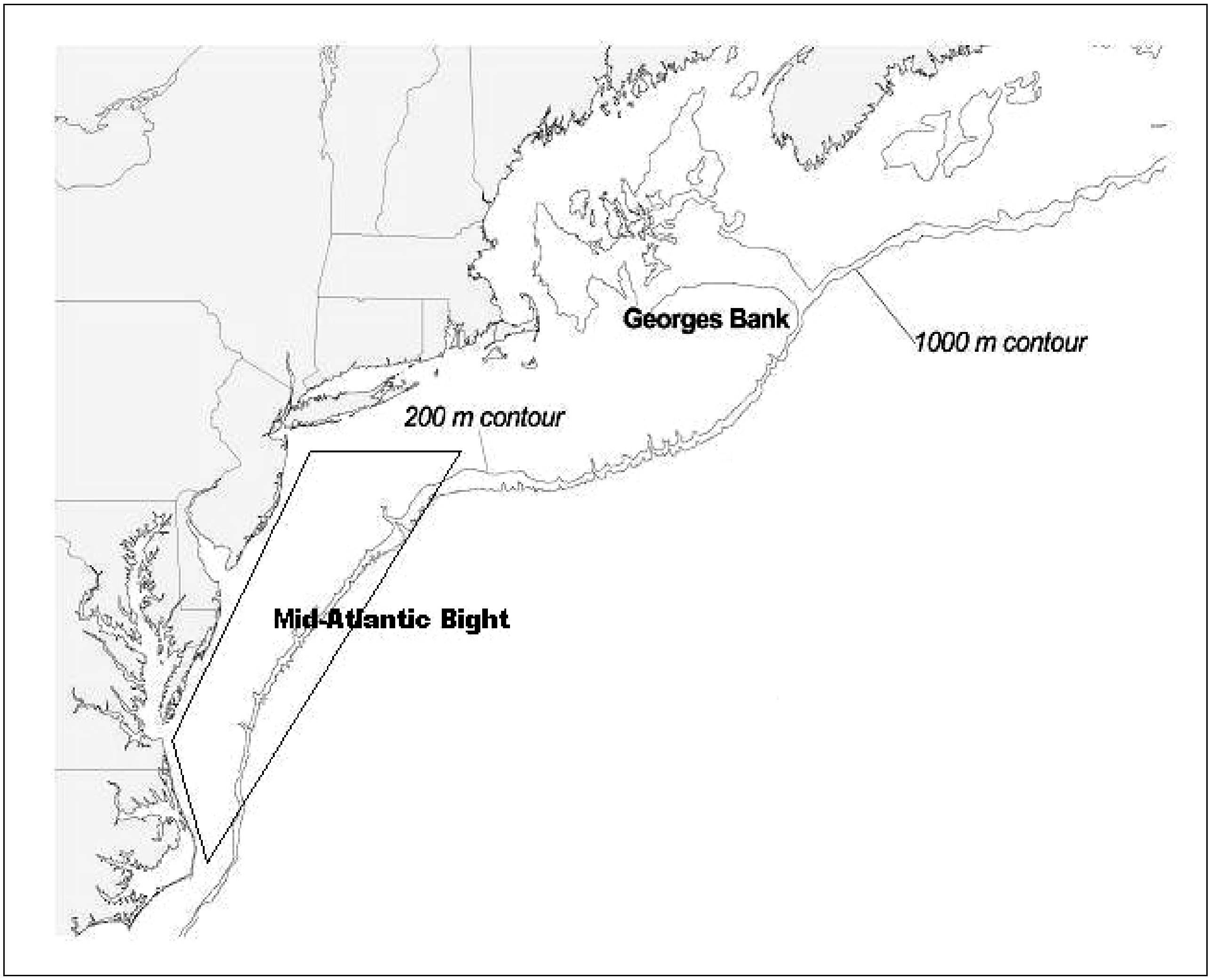

Figure 4. NOAA's Living Marine Resources Cooperative Science Center survey area of operation - mid-Atlantic region (outlined in black).

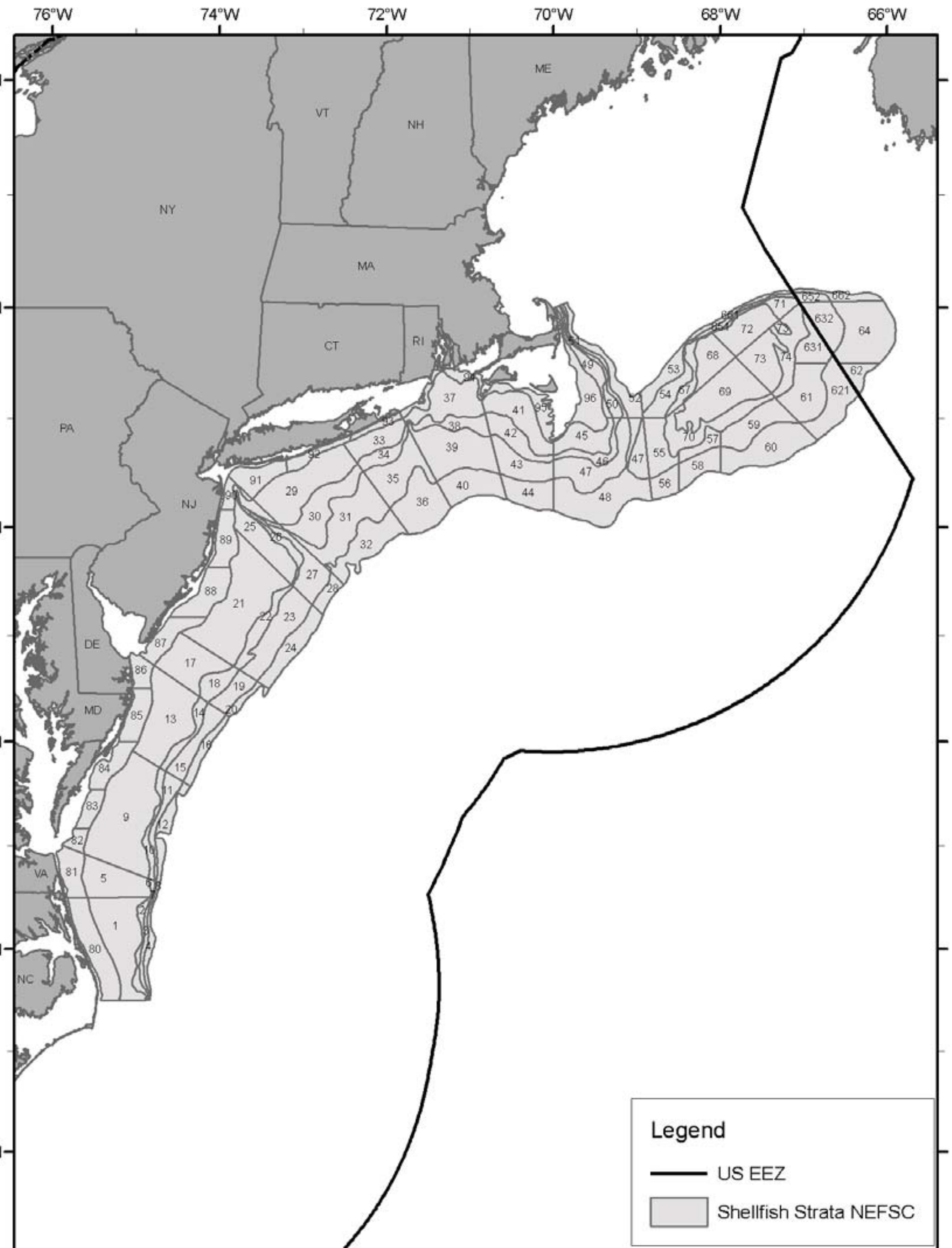

Figure 5. NEFSC Shellfish survey strata and area of operation - mid-Atlantic to Georges Bank.

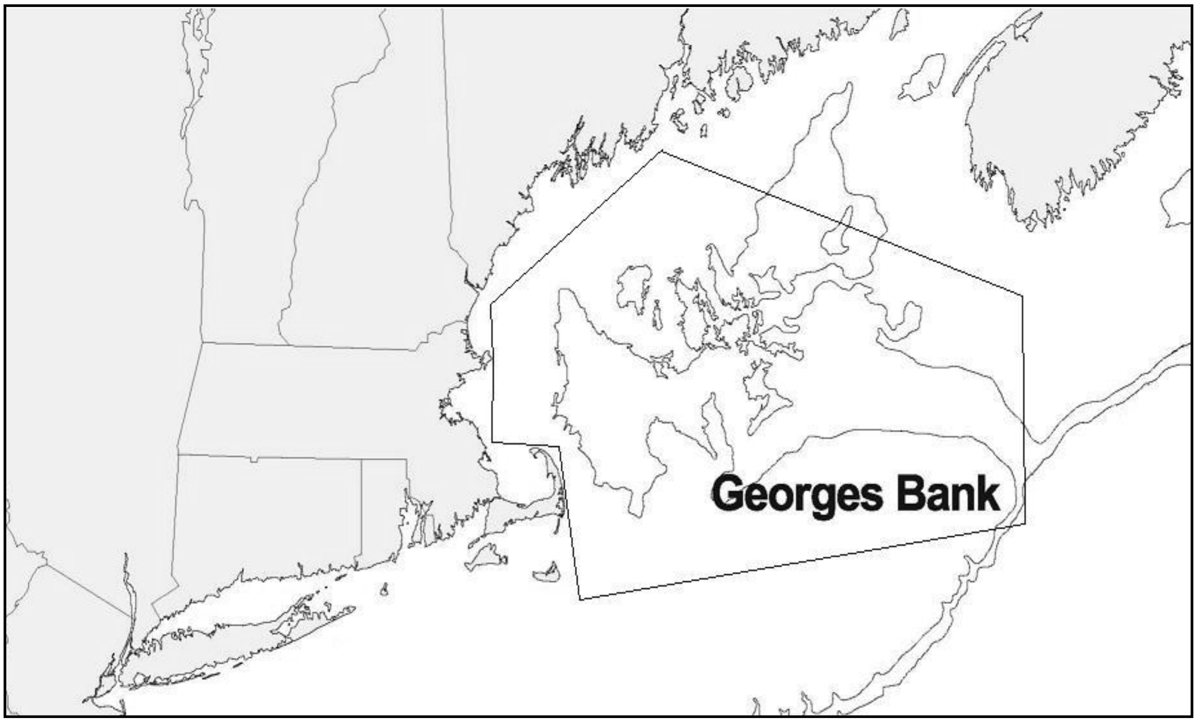

Figure 6. NEFSC Atlantic Herring survey area of operation – Northern Georges Bank to Western Gulf of of Maine.

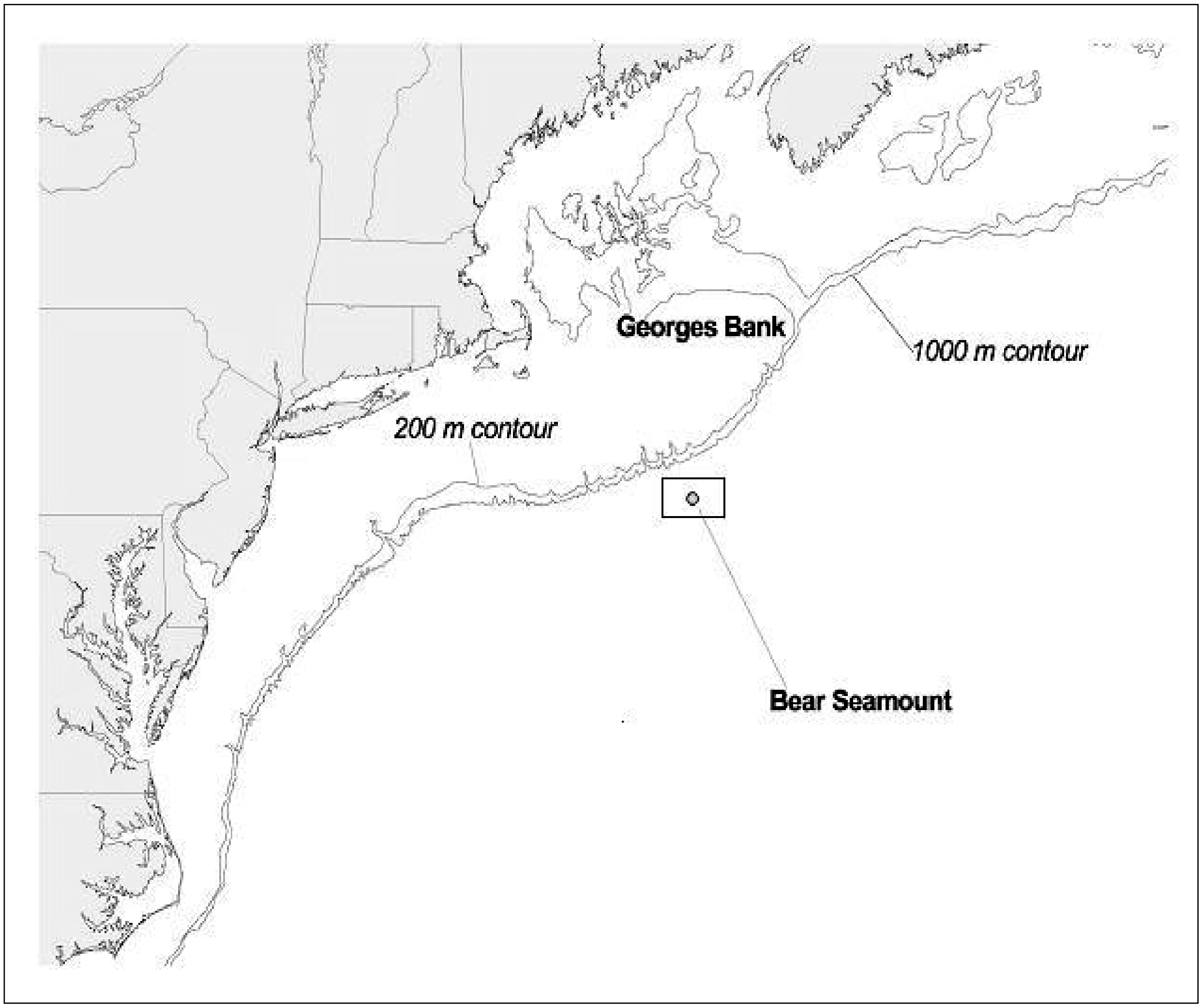

Figure 7. NEFSC Deepwater Biodiversity survey area of operation (outlined in black) – Bear Seamount.

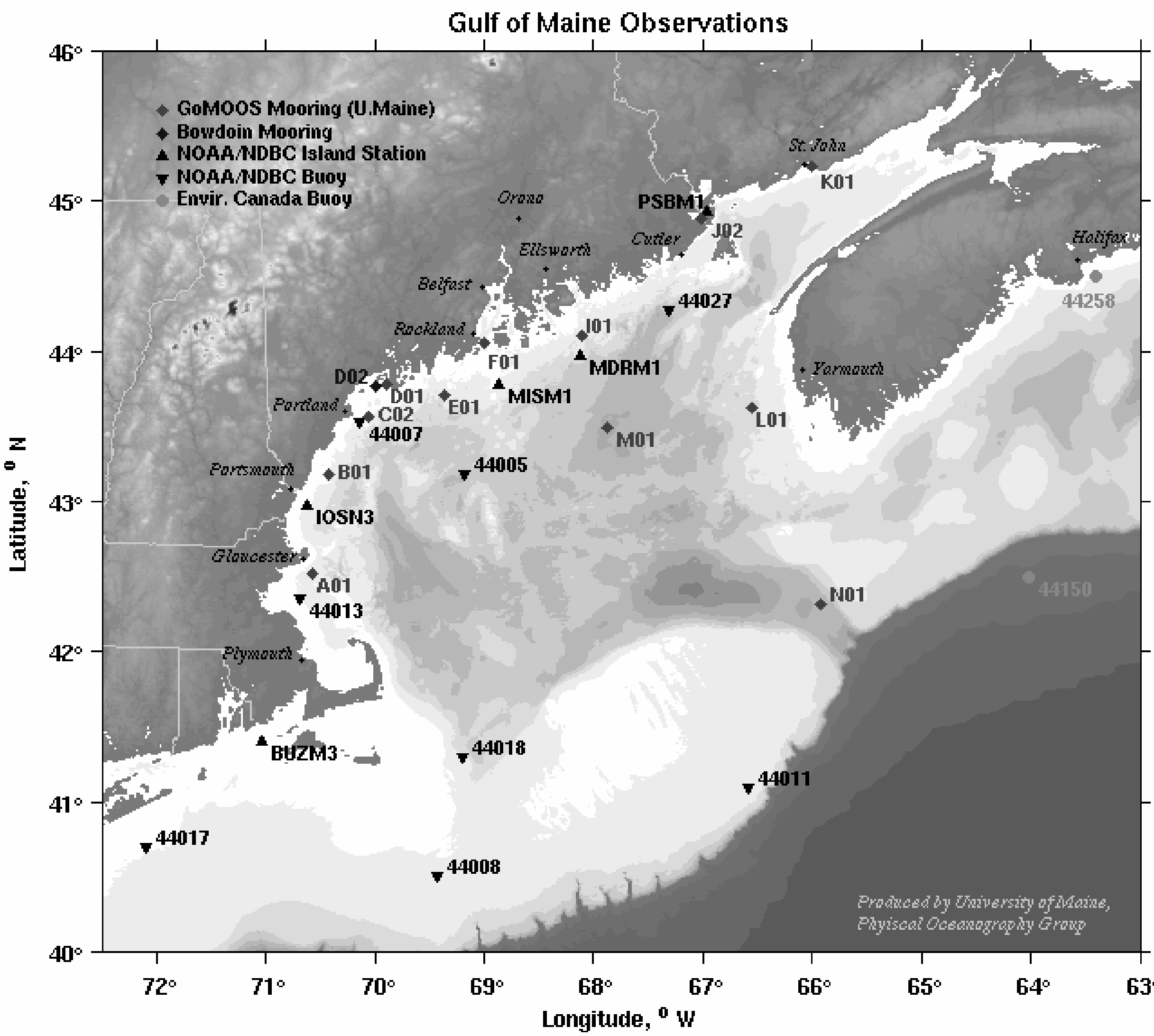

Figure 8. GoMOOS cruise area of operation – Gulf of Maine.

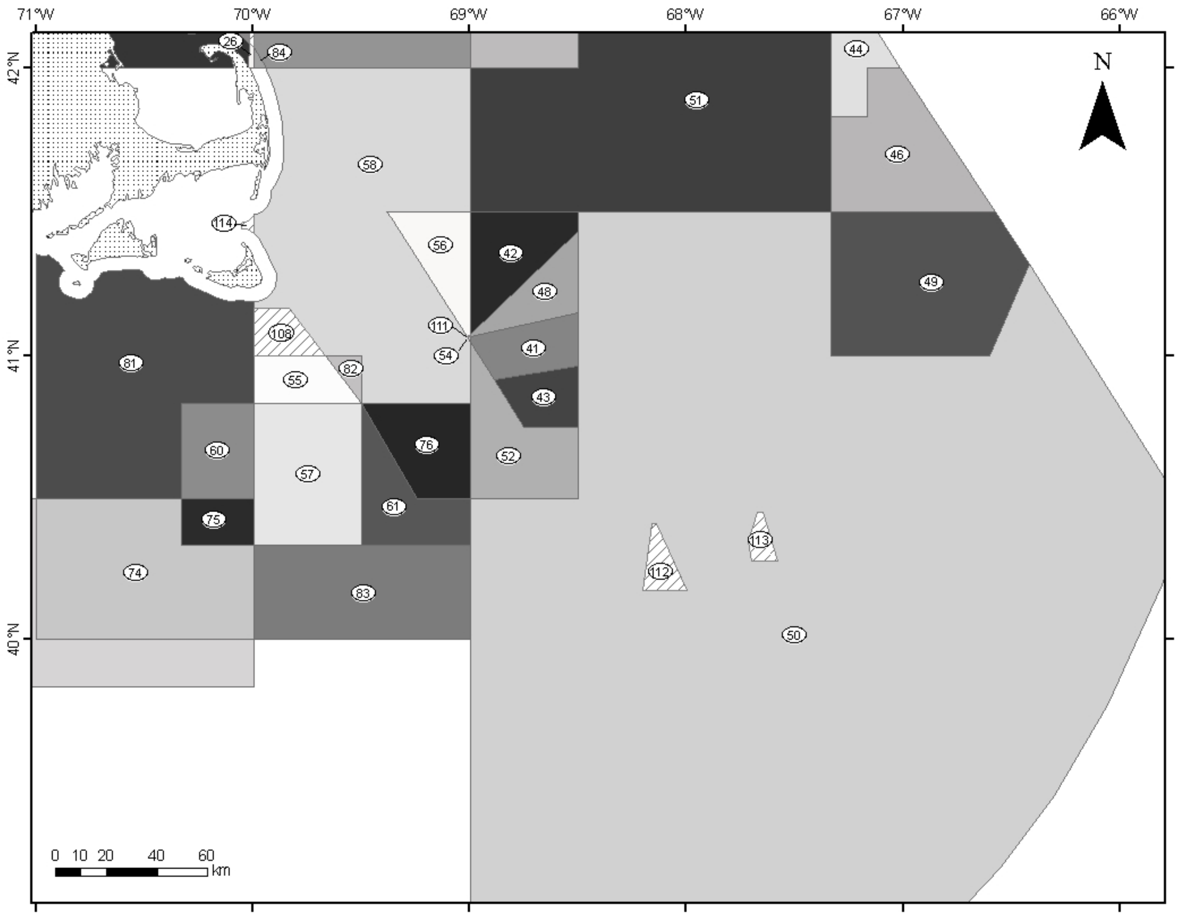

Figure 9. Georges Bank Management Areas identified by polygon number.

Closed Area I	41, 42, 43, 48, 54, 56, 111
Closed Area I Habitat Closed Area	42, 43, 56
Closed Area I Scallop Access Area	48, 111
Closed Area II	44, 46, 49
Closed Area II Scallop Access Area	49
Georges Bank Rolling CA (May 1 - May 31)	51, 52, 58, 108
Georges Bank PSP	41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 112, 113
Monkfish Closure Lydonia Canyon	113
Monkfish Closure Oceanographer Canyon	112
Nantucket Lightship Closed Area	57, 60, 61, 75, 76
Nantucket Lightship Habitat Closed Area	55, 57, 108
Nantucket Lightship Scallop Access Area	76
PSP Area Emergency Rule (December 2007)	54, 55, 56, 57, 58, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 73, 74, 75, 76, 81, 82, 83, 108, 109, 110, 111, 114
Rolling Closed Area II (April 1 - April 30)	26, 84
Rolling Closed Area V (Oct 1- Nov 30)	26

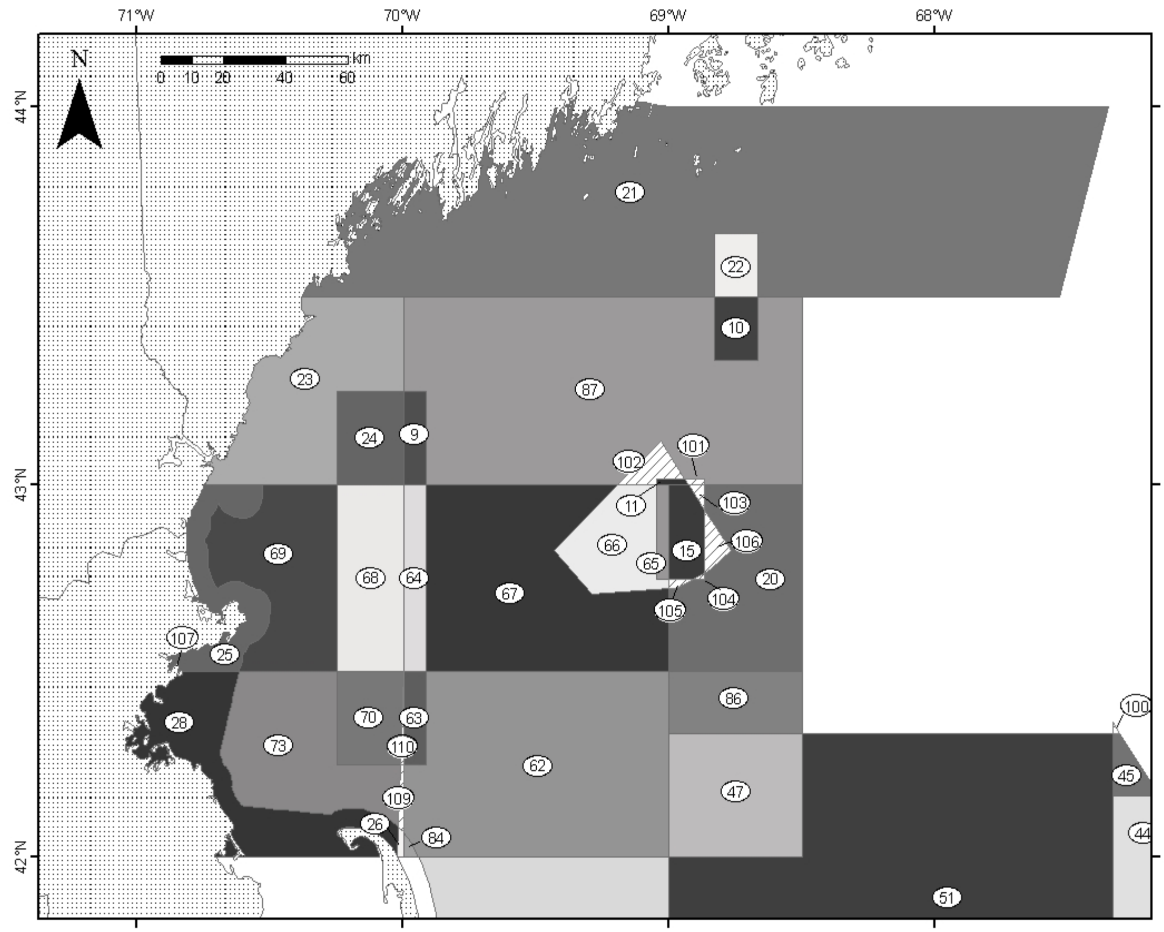

Figure 10. Gulf of Maine management areas identified by polygon number.

Cashes Ledge Closed Areas	11, 15, 65, 66, 102, 105, 106
Cashes Ledge Habitat Closure Area	11, 15, 65, 101, 103, 104
Closed Area II	44, 45, 100
Closed Area II Habitat Closure Area (as amended)	44
Georges Bank Rolling CA (May 1 - May 31)	51
Jeffreys Bank Habitat Closure Area	10, 22
Rolling Closed Area I (Mar 1 - Mar 31)	26, 47, 62, 63, 84, 86, 109, 110
Rolling Closed Area II (Apr 1 - Apr 30)	15, 20, 25, 26, 28, 47, 62, 63, 64, 65, 66, 67, 68, 69, 70, 73, 84, 86, 103, 104, 105, 106, 107, 109, 110
Rolling Closed Area III (May 1 - May 31)	9, 10, 11, 15, 20, 23, 24, 25, 26, 28, 64, 65, 66, 67, 68, 69, 70, 73, 87, 101, 102, 103, 104, 105, 106, 107, 109, 110
Rolling Closed Area IV (June 1 - June 30)	21, 22, 23, 24, 25, 68, 69
Rolling Closed Area V (Oct 1- Nov 30)	26, 28, 70, 73, 107, 109, 110
Western Gulf of Maine Closed Area	9, 24, 63, 64, 68, 70, 110
Western GOM Habitat Closure Area	24, 68, 70, 110

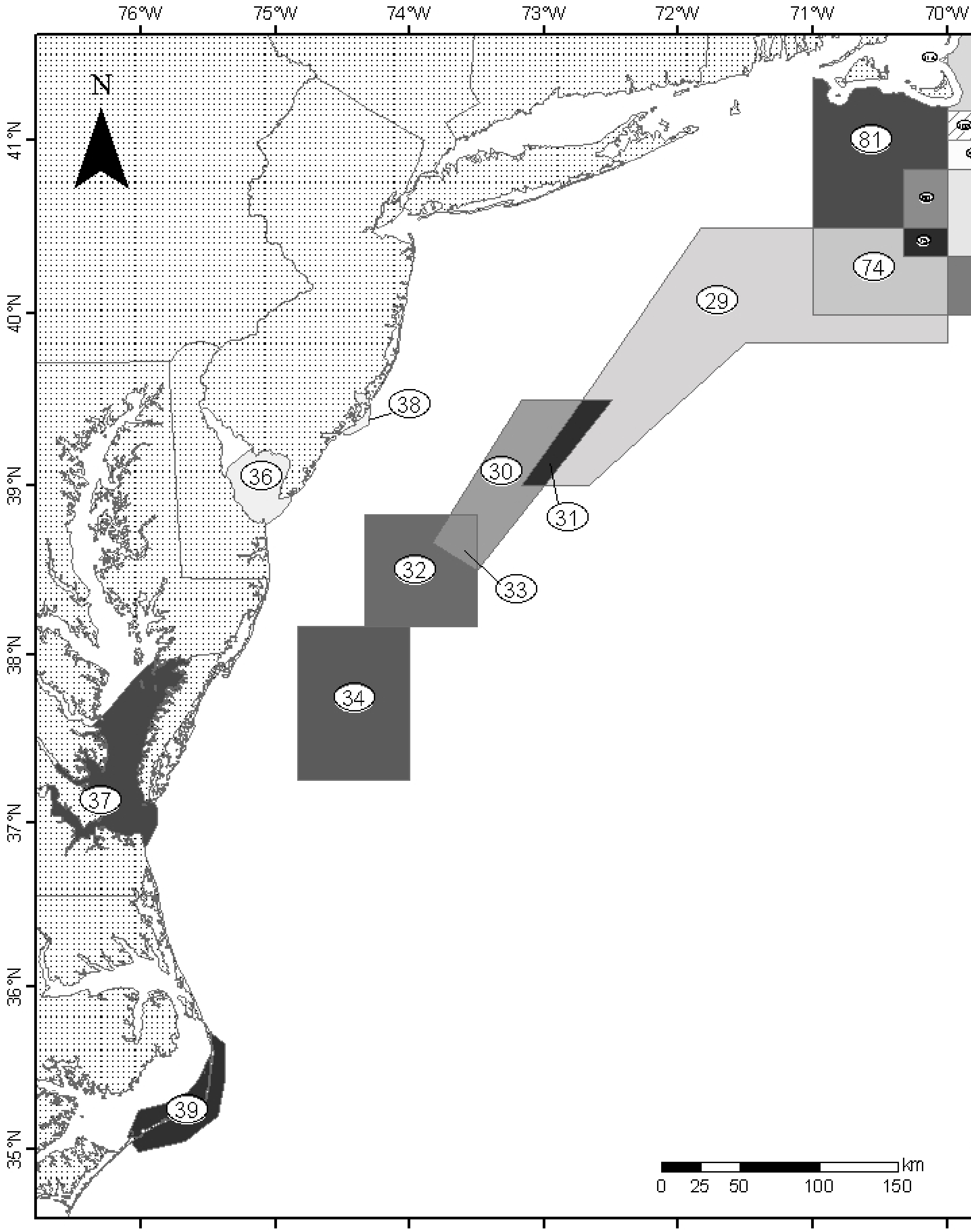

Figure 11. Mid-Atlantic Management Areas identified by polygon number.

Tilefish HAPC	29, 31, 74, 75
Sandbar Shark HAPC	36, 37, 38, 39
PSP Area Emergency Rule (December 2007)	74, 81
Hudson Canyon Scallop Access Area	30, 31, 33
Delmarva Scallop Access Area	34
Elephant Trunk Scallop Access Area	32, 33

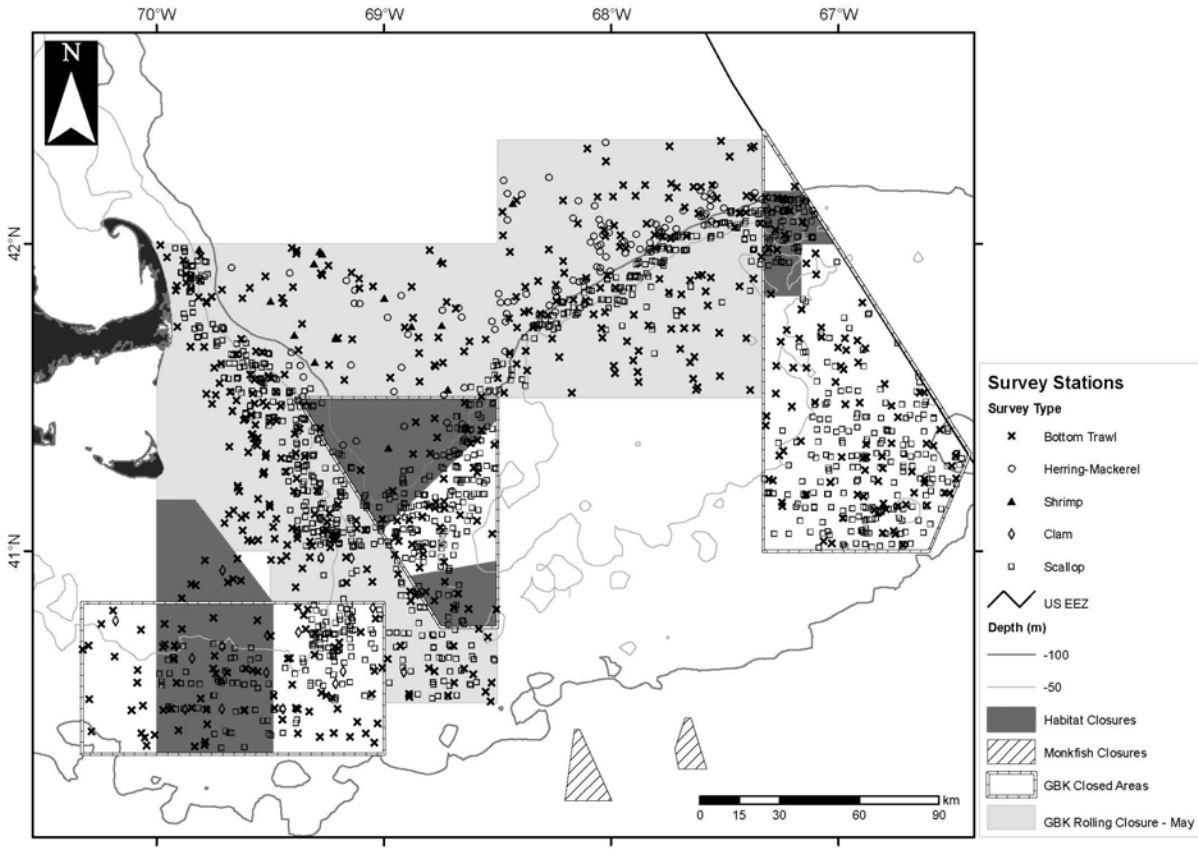

Figure 12. Stations from various cruise types plotted within different Georges Bank Management Areas, 2003-2007.

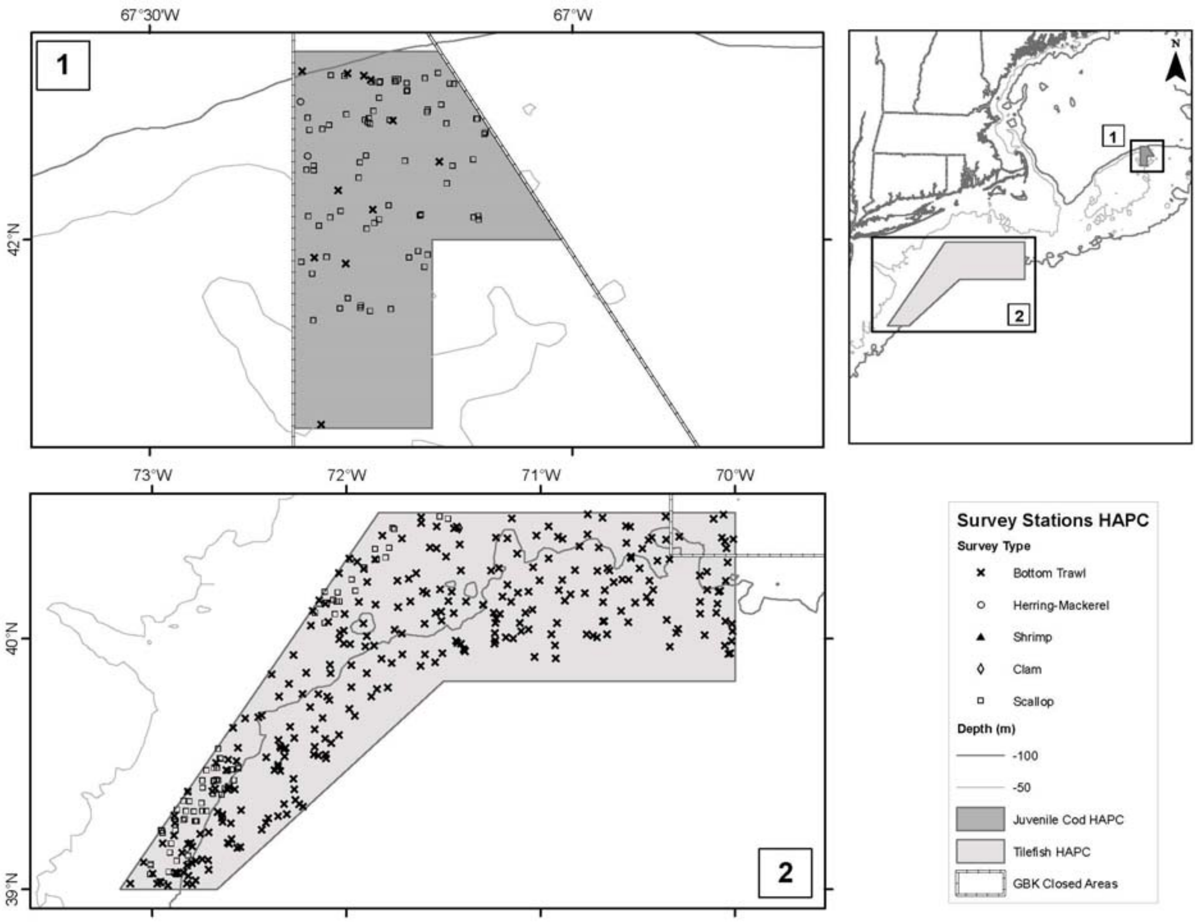

Figure 13. Stations from various cruise types plotted within the Juvenile Cod and Tilefish HAPCs, 2003-2007.

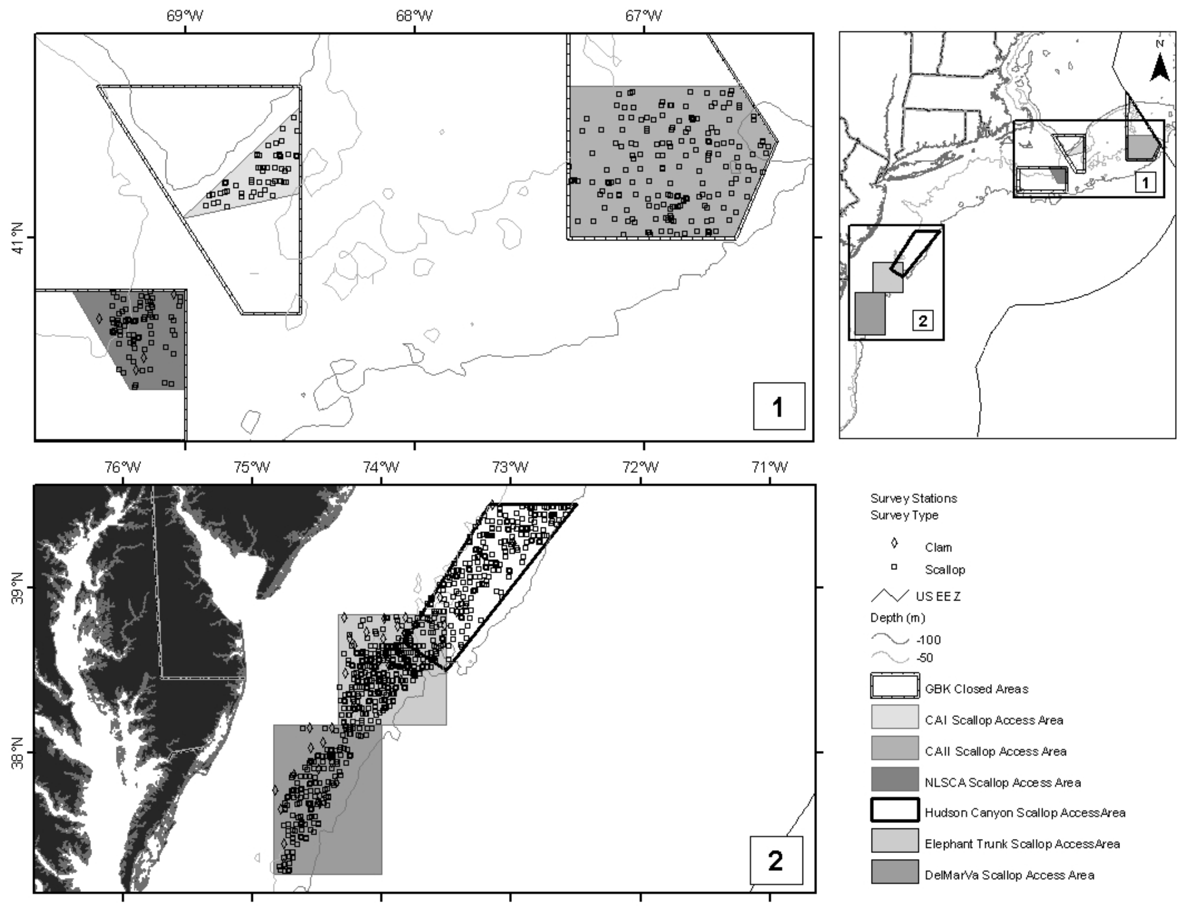

Figure 14. Stations from various cruise types plotted within Sea Scallop Access Areas, 2003-2007

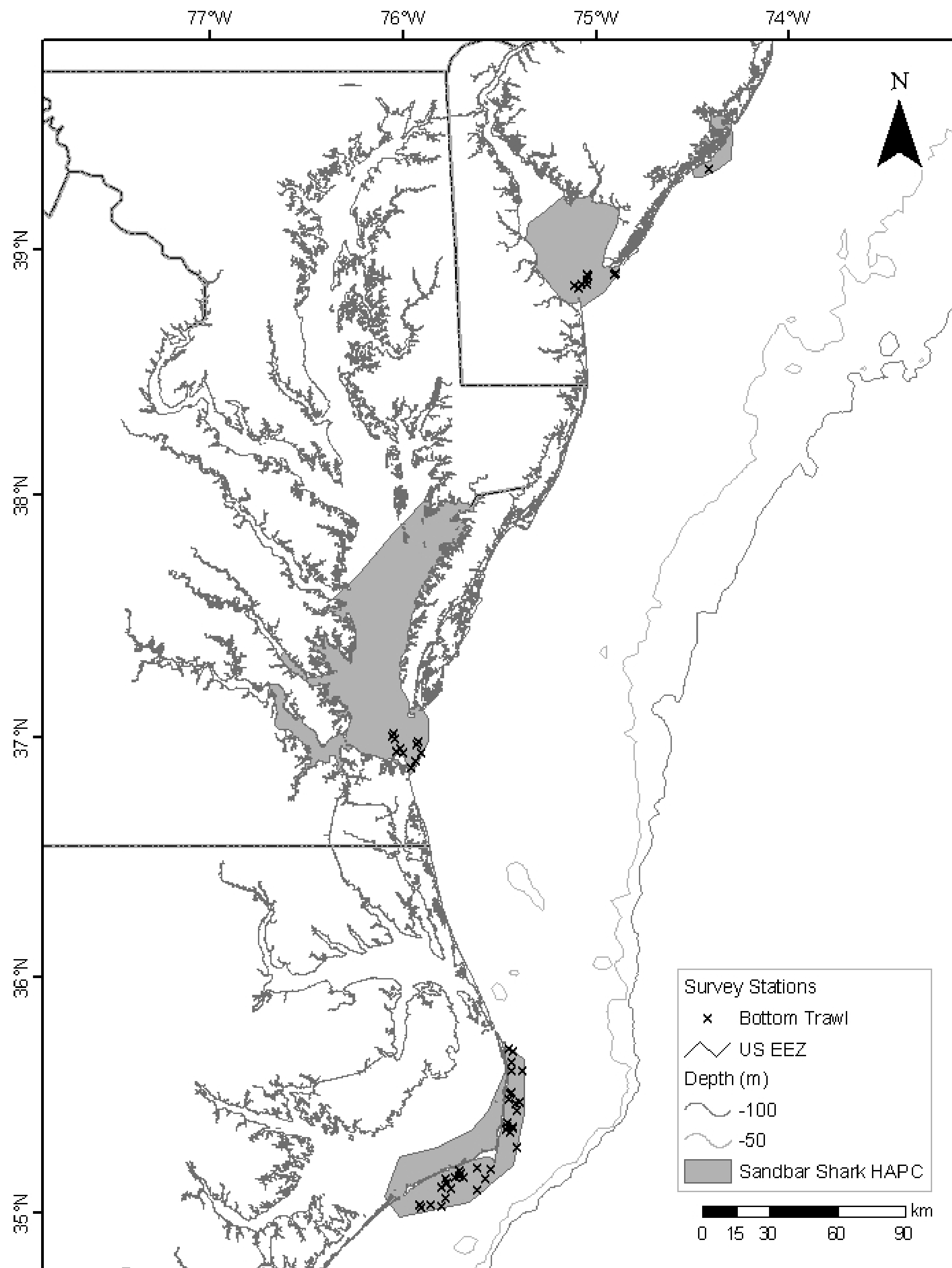

Figure 15. Stations from various cruise types plotted within Sandbar Shark HAPCs, 2003-2007.

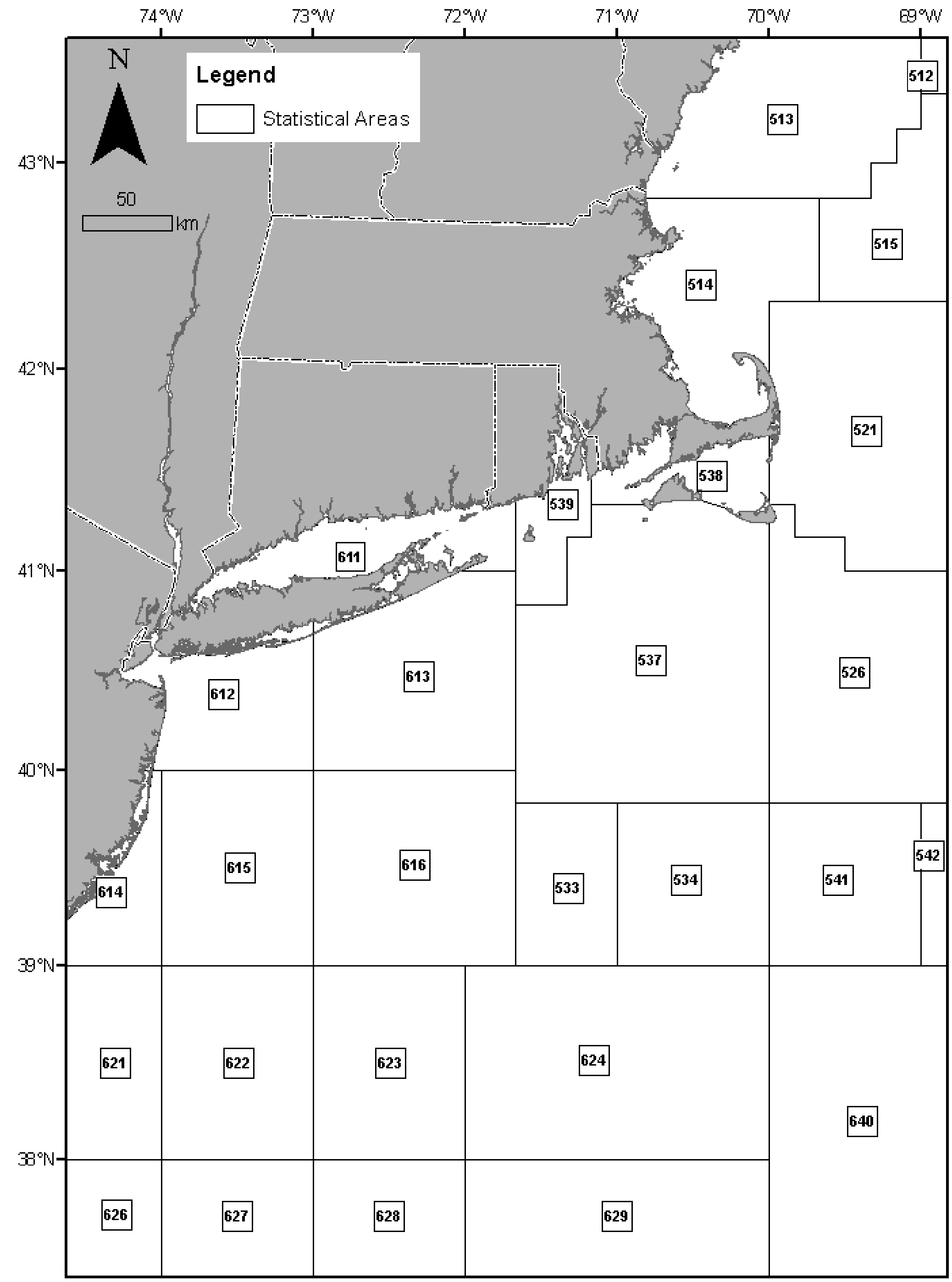

Figure 16. Mid-Atlantic and Southern New England statistical areas.

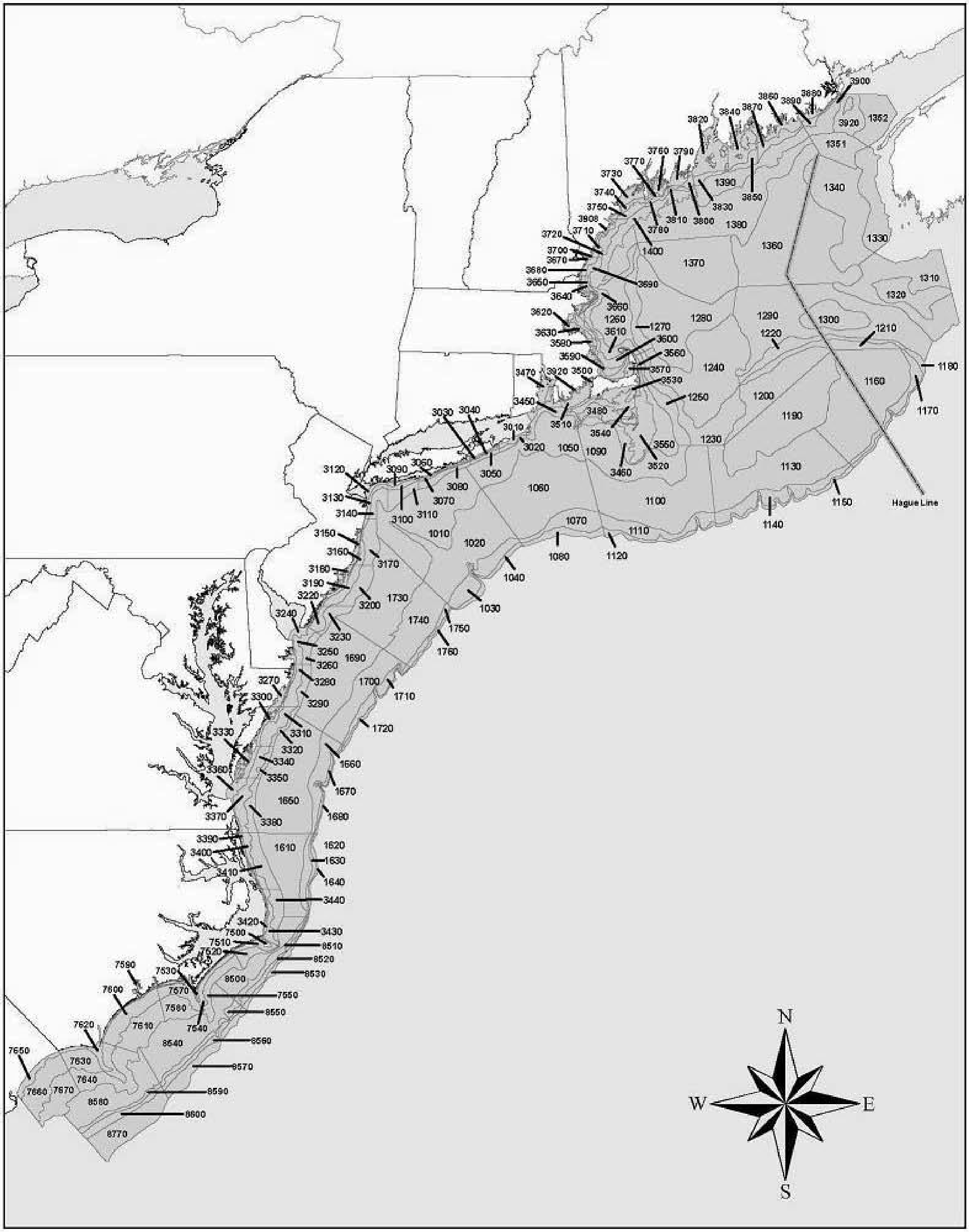

Figure 17. NEFSC offshore and inshore Bottom Trawl survey strata.

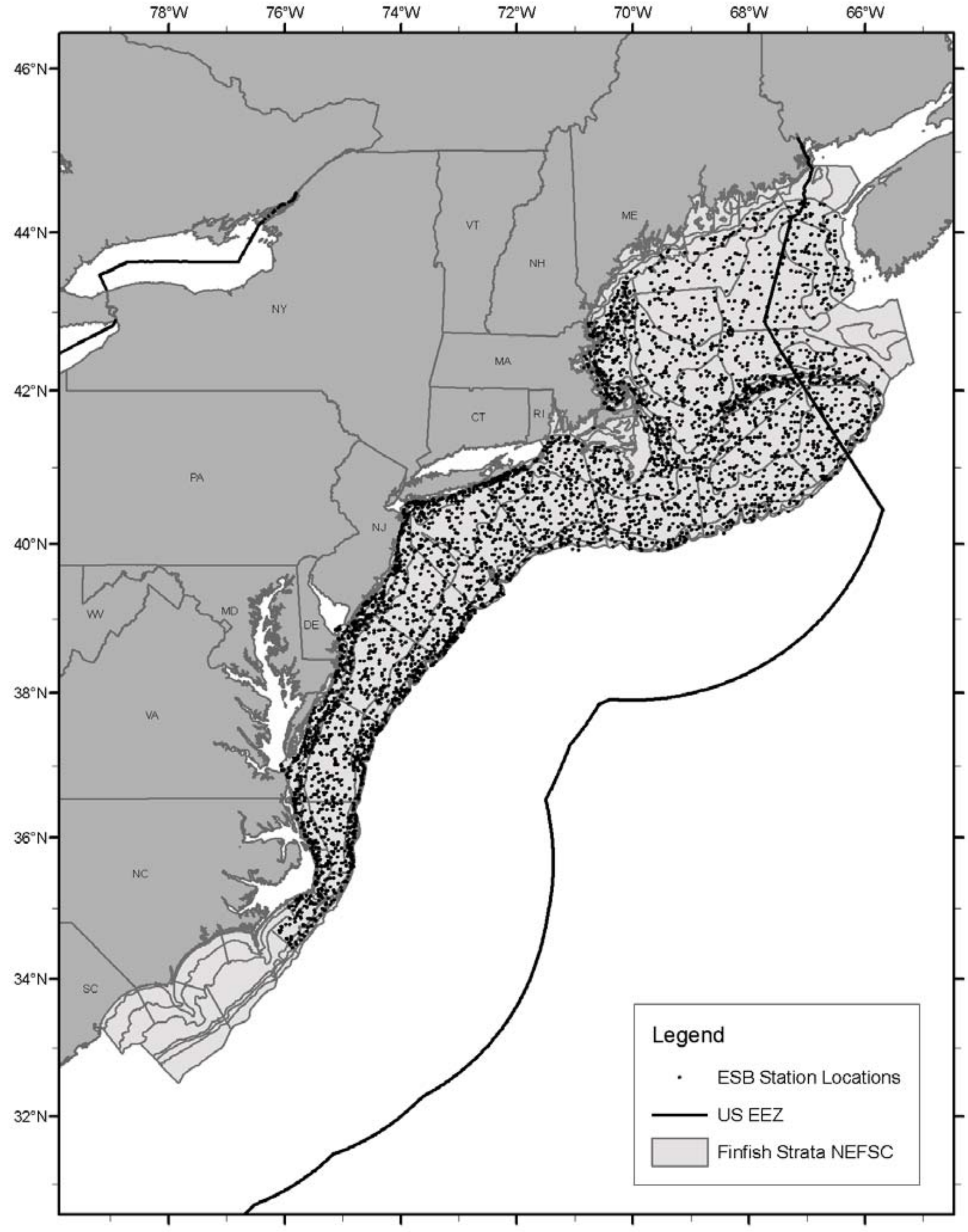

Figure 18. NEFSC Bottom Trawl and Atlantic Herring survey stations, 2003-2007.

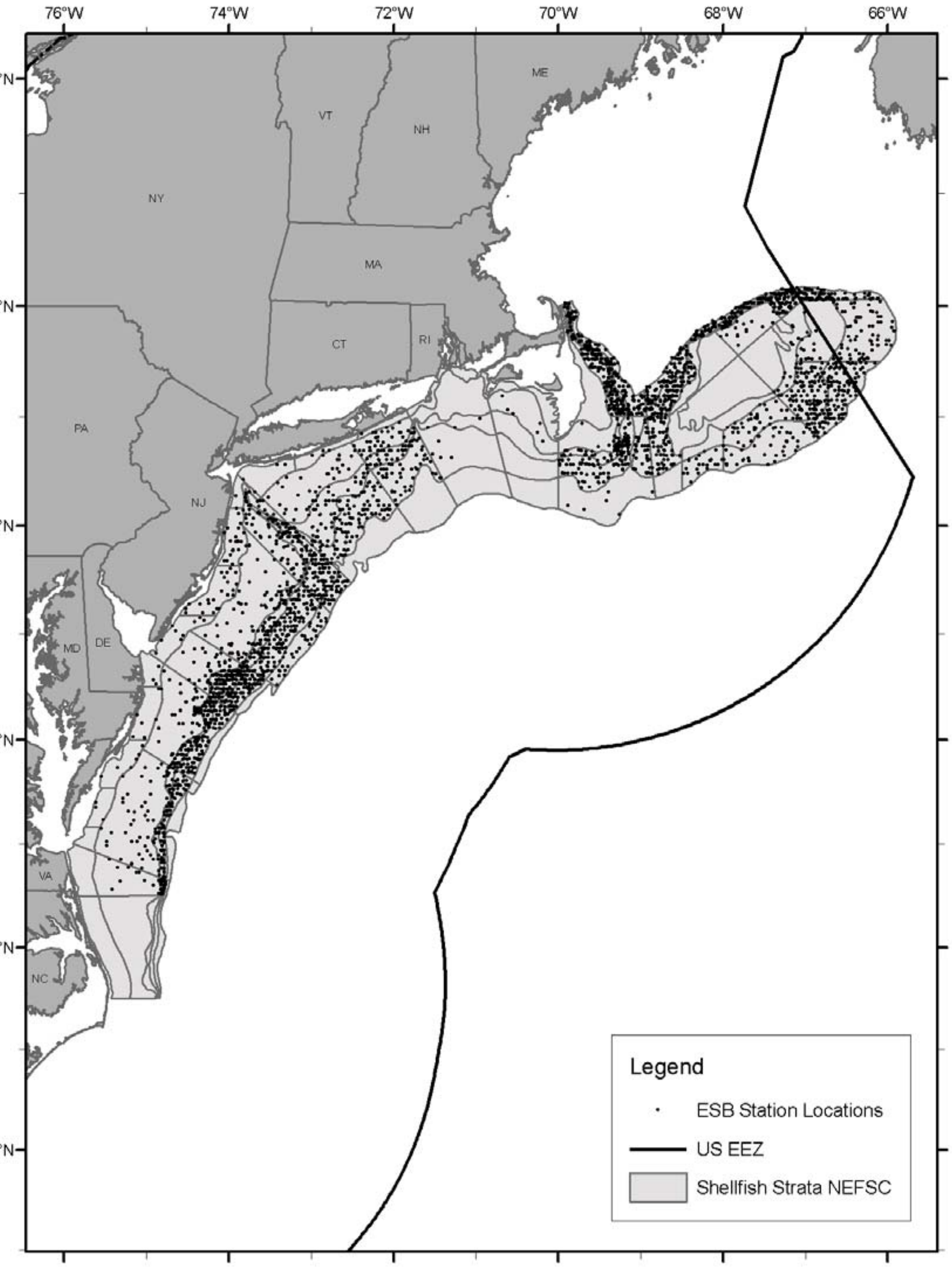

Figure 19. NEFSC Sea Scallop and Surfclam/Ocean Quahog survey stations, 2003 – 2007.

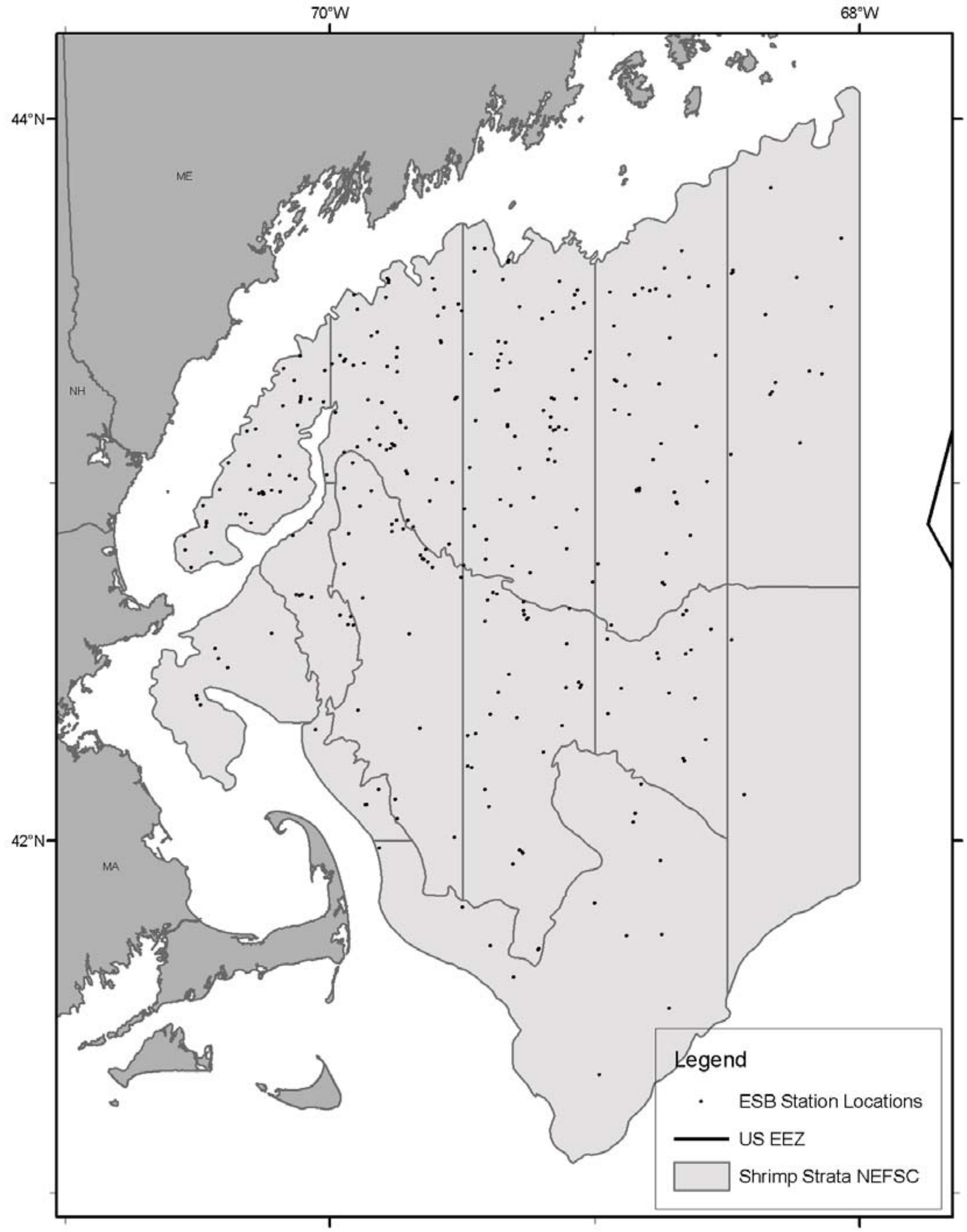

Figure 20. NEFSC Northern Shrimp survey stations, 2003 – 2007.

Appendix 1 a. Bottom Trawl Survey catches sorted by catch weight and catch number, 1963-2007

Common Name	Catch Weight (kg)	Catch Number
SPINY DOGFISH	2272223.757	1629023
HADDOCK	262026.894	441670
LITTLE SKATE	251203.467	604970
WINTER SKATE	225915.476	136755
ATLANTIC COD	180778.986	87793
SMOOTH DOGFISH	153783.451	61414
ACADIAN REDFISH	143724.216	464561
LONGFIN SQUID	111535.921	5346429
SILVER HAKE	105758.409	1311844
BUTTERFISH	99667.694	3271634
ATLANTIC CROAKER	88209.953	677490
ATLANTIC HERRING	77686.968	807641
GOOSEFISH	69442.463	27302
WHITE HAKE	69142.482	72310
POLLOCK	66653.165	36346
RED HAKE	61250.492	332647
SCUP	56315.07	1339676
YELLOWTAIL FLOUNDER	54721.988	186320
WINTER FLOUNDER	54365.264	132726
ATLANTIC MACKEREL	52941.947	337815
SPOT	51791.428	802770
OCEAN POUT	50691.304	78544
THORNY SKATE	46886.949	23183
LONGHORN SCULPIN	45286.872	250073
AMERICAN PLAICE	43123.509	182892
SUMMER FLOUNDER	42664.991	65021
NORTHERN SHORTFIN SQUID	40292.642	258220
NORTHERN SEAROBIN	38942.136	399878
ROUGHTAIL STINGRAY	36204.074	967
WEAKFISH	34824.178	499019
CLEARNOSE SKATE	34131.209	29075
WINDOWPANE	32622.429	166505
AMERICAN LOBSTER	32506.141	55572
FOURSPOT FLOUNDER	31641.854	208138
SEA SCALLOP	26490.184	461064
SEA RAVEN	21047.527	26346
SPOTTED HAKE	19796.68	486556
ALEWIFE	18883.349	183124
BLUEFISH	18779.63	82270
SPINY BUTTERFLY RAY	18527.905	1105
ROUND HERRING	18126.248	1058141
WITCH FLOUNDER	17429.648	42983
BLUNTNOSE STINGRAY	16488.668	2534
HORSESHOE CRAB	16245.506	10473
STRIPED ANCHOVY	14704.647	2789448
BAY ANCHOVY	14204.356	9500484
BULLNOSE RAY	13604.063	3406
BARNDOOR SKATE	11089.888	4045
ATLANTIC WOLFFISH	10669.491	3869
SCUP	10627.8	237958
CUSK	10399.083	3442
STRIPED BASS	10053.27	2589
SHRIMP UNCL	9976.455	160965
BLACK SEA BASS	9154.585	56886
STRIPED SEAROBIN	7208.065	29821
NORTHERN SAND LANCE	6841.658	745838
ATLANTIC ANGEL SHARK	6654.533	1471
SAND TIGER	6588.04	130
ROUND SCAD	4699.841	248776
ATLANTIC ROCK CRAB	4530.298	65933
LOGGERHEAD SEATURTLE	4192.2	62
SANDBAR SHARK	3973.574	350
SOUTHERN STINGRAY	3857.878	284
NORTHERN SHRIMP	3721.09	632214
ATLANTIC HALIBUT	3719.596	1226
BLUEBACK HERRING	3677.092	58830
ATLANTIC SHARPNOSE SHARK	3514.58	1499
JONAH CRAB	3230.649	19280
SMOOTH SKATE	3022.17	6298
OFFSHORE HAKE	2869.273	11581
BASKING SHARK	2816	2
COWNOSE RAY	2754.85	721
ATLANTIC ARGENTINE	2751.791	14806
ROSETTE SKATE	2387.741	10274
SQUID, CUTTLEFISH, AND OCTOPUS	2371.574	70485
AMERICAN SHAD	2186.147	9505
DUSKY SHARK	2137.4	319
COBIA	2022.98	263
ATLANTIC TORPEDO	1995.48	138
CUNNER	1977.006	5330
ATLANTIC STURGEON	1864.21	117
SPANISH SARDINE	1819.23	134997
BLACKBELLY ROSEFISH	1805.28	26458
TOMTATE	1676.144	35161
ANCHOVY UNCL	1497.927	609961
SOUTHERN KINGFISH	1458.767	12512
PINFISH	1424.358	36965
BUCKLER DORY	1328.868	3121
SQUALIDAE	1302.101	66
RED DEEPSEA CRAB	1244.183	3340
PLANEHEAD FILEFISH	1136.96	29743
LUMPFISH	1114.921	484

Common Name	Catch Weight (kg)	Catch Number
BAY ANCHOVY	14204.356	9500484
LONGFIN SQUID	111535.921	5346429
BUTTERFISH	99667.694	3271634
STRIPED ANCHOVY	14704.647	2789448
SPINY DOGFISH	2272223.757	1629023
SCUP	56315.07	1339676
SILVER HAKE	105758.409	1311844
ROUND HERRING	18126.248	1058141
ATLANTIC HERRING	77686.968	807641
SPOT	51791.428	802770
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ATLANTIC CROAKER	88209.953	677490
NORTHERN SHRIMP	3721.09	632214
ANCHOVY UNCL	1497.927	609961
LITTLE SKATE	251203.467	604970
WEAKFISH	34824.178	499019
SPOTTED HAKE	19796.68	486556
ACADIAN REDFISH	143724.216	464561
SEA SCALLOP	26490.184	461064
HADDOCK	262026.894	441670
BRISTLED LONGBEAK	666.648	402182
NORTHERN SEAROBIN	38942.136	399878
ATLANTIC MACKEREL	52941.947	337815
RED HAKE	61250.492	332647
NORTHERN SHORTFIN SQUID	40292.642	258220
LONGHORN SCULPIN	45286.872	250073
ROUND SCAD	4699.841	248776
SCUP	10627.8	237958
FOURSPOT FLOUNDER	31641.854	208138
YELLOWTAIL FLOUNDER	54721.988	186320
ALEWIFE	18883.349	183124
AMERICAN PLAICE	43123.509	182892
WINDOWPANE	32622.429	166505
SHRIMP UNCL	9976.455	160965
AESOP SHRIMP	320.208	143123
WINTER SKATE	225915.476	136755
SPANISH SARDINE	1819.23	134997
WINTER FLOUNDER	54365.264	132726
SILVER ANCHOVY	524.76	90617
ATLANTIC COD	180778.986	87793
BLUEFISH	18779.63	82270
GULF STREAM FLOUNDER	948.406	81531
OCEAN POUT	50691.304	78544
LANTERNFISH UNCL	148.047	74496
WHITE HAKE	69142.482	72310
SQUID, CUTTLEFISH, & OCTOPUS	2371.574	70485
ATLANTIC ROCK CRAB	4530.298	65933
SUMMER FLOUNDER	42664.991	65021
SMOOTH DOGFISH	153783.451	61414
BLUEBACK HERRING	3677.092	58830
BLACK SEA BASS	9154.585	56886
AMERICAN LOBSTER	32506.141	55572
WITCH FLOUNDER	17429.648	42983
WEITZMANS PEARLSIDES	55.807	40006
DUSKY ANCHOVY	64.3	38968
PINFISH	1424.358	36965
ATLANTIC THREAD HERRING	1070.357	36717
POLLOCK	66653.165	36346
PINK GLASS SHRIMP	75.022	35813
TOMTATE	1676.144	35161
LONGNOSE ANCHOVY	25.9	32057
SILVER PERCH	777.018	30037
STRIPED SEAROBIN	7208.065	29821
PLANEHEAD FILEFISH	1136.96	29743
ROUGH SCAD	596.071	29538
CLEARNOSE SKATE	34131.209	29075
GOOSEFISH	69442.463	27302
MOUSTACHE SCULPIN	164.886	27298
FAWN CUSK-EEL	690.725	26628
BLACKBELLY ROSEFISH	1805.28	26458
SEA RAVEN	21047.527	26346
VERMILION SNAPPER	1042.347	23797
THORNY SKATE	46886.949	23183
ARROW SQUID	388.2	21451
SEVENSPINE BAY SHRIMP	10.257	20214
JONAH CRAB	3230.649	19280
FLAT ANCHOVY	36.9	16728
SMALLMOUTH FLOUNDER	42.298	16392
ATLANTIC SILVERSIDE	55.644	15841
ATLANTIC ARGENTINE	2751.791	14806
PIGFISH	899.049	14662
PANDULUS PROPINQUUS	37.139	14053
ATLANTIC MENHADEN	750.401	13613
INSHORE LIZARDFISH	624.251	13260
SOUTHERN KINGFISH	1458.767	12512
OFFSHORE HAKE	2869.273	11581
LADY CRAB	496.977	11562
BANDED DRUM	503.278	11172
CHUB MACKEREL	977.212	10585
HORSESHOE CRAB	16245.506	10473
MACKEREL SCAD	99.959	10460
ROSETTE SKATE	2387.741	10274

Appendix 1 b. continued.

Common Name	Catch Weight (kg)	Catch Number
ATLANTIC THREAD HERRING	1070.357	36717
VERMILION SNAPPER	1042.347	23797
RAY AND SKATE UNCL	994.92	74
CHUB MACKEREL	977.212	10585
SMOOTH BUTTERFLY RAY	973.515	245
GRAY TRIGGERFISH	949.025	1428
GULF STREAM FLOUNDER	948.406	81531
PIGFISH	899.049	14662
ORANGE FILEFISH	894.1	977
OCEAN SUNFISH	879	7
RED DRUM	850.16	414
SPANISH MACKEREL	845.954	3026
SHEEPSHEAD	784.16	440
SILVER PERCH	777.018	30037
ATLANTIC MENHADEN	750.401	13613
SHARK UNCL	699.06	21
WHITEBONE PORGY	693.46	1535
FAWN CUSK-EEL	690.725	26628
BRISTLED LONGBEAK	666.648	402182
TILEFISH	660.563	421
INSHORE LIZARDFISH	624.251	13260
ROUGH SCAD	596.071	29538
NORTHERN KINGFISH	581.936	4232
SEA BASS UNCL	575.904	249
LONGFIN HAKE	568.227	8048
CHAIN DOGFISH	567.252	2994
ATLANTIC STINGRAY	544.3	124
HARVESTFISH	542.529	9777
GREATER AMBERJACK	537.88	294
SILVER ANCHOVY	524.76	90617
BANDED DRUM	503.278	11172
LADY CRAB	496.977	11562
ATLANTIC SPADEFISH	491.007	1337
TAUTOG	453.346	479
CONGER EEL	451.202	1005
BLACK DRUM	430.764	210
ARROW SQUID	388.2	21451
ARMORED SEAROBIN	382.417	2601
BLUE RUNNER	377.794	6409
FOURBEARD ROCKLING	368.611	6576
DEEPBODY BOARFISH	352.765	3810
SOUTHERN EAGLE RAY	332.28	28
SPOTTAIL PINFISH	325.7	5848
AESOP SHRIMP	320.208	143123
RED PORGY	314.607	1041
NORTHERN PUFFER	304.292	4226
SCALLOPED HAMMERHEAD SHARK	304.2	24
KING MACKEREL	291.849	522
BIGEYE SCAD	268.625	5913
SPOTTED EAGLE RAY	250.7	35
ATLANTIC BUMPER	244.2	7090
WHITE GRUNT	234.5	754
SAND PERCH	226.64	1112
SPIDER CRAB UNCL	225.754	2033
SCAMP	222.2	49
RED SNAPPER	217.1	91
HOGCHOKER	216.254	2598
UNKNOWN 01	213.932	1782
WRYMOUTH	210.192	660
SNOWY GROUPER	204.33	20
SKATE UNCL	189.164	375
BIGEYE	188.043	958
WARSAW GROUPER	187.77	21
GAG	186.7	57
BEARDFISH	181.463	6842
ATLANTIC HAGFISH	176.09	3032
BANDED RUDDERFISH	173.984	765
NORTHERN STONE CRAB	172.229	655
MOUSTACHE SCULPIN	164.886	27298
ALMACO JACK	162.56	39
KNOBBED PORGY	152.1	208
BLUE CRAB	149.629	1682
LANTERNFISH UNCL	148.047	74496
UNCLASSIFIED FISH	136.403	850
SNAKEFISH	136.36	2907
PARALICHTHYS UNCL	133.2	317
HOGFISH	126.2	75
SEAROBIN UNCL	112.284	2430
ATLANTIC CUTLASSFISH	105.041	2422
YELLOWFIN BASS	104.653	1241
CANCER CRAB UNCL	103.655	1644
MACKEREL SCAD	99.959	10460
COARSEHAND LADY CRAB	99.842	2438
NORTHERN SENNET	99.704	1420
THRESHER SHARK	98.34	9
SCORPIONFISH AND ROCKFISH	98	2142
SHRIMP (PINK,BROWN,WHITE)	95.877	5593
ATLANTIC MIDSHIPMAN	95.32	2831
NORTHERN STARGAZER	89.327	128
GRUNT UNCL	86.11	4041
STRIPED CUSK-EEL	84.372	2605

Common Name	Catch Weight (kg)	Catch Number
HARVESTFISH	542.529	9777
RAINBOW SMELT	63.514	9559
AMERICAN SHAD	2186.147	9505
SHORTNOSE GREENEYE	33.534	9044
LONGFIN HAKE	568.227	8048
ATLANTIC MOONFISH	61.815	7630
ATLANTIC BUMPER	244.2	7090
BEARDFISH	181.463	6842
FOURBEARD ROCKLING	368.611	6576
BLUE RUNNER	377.794	6409
SMOOTH SKATE	3022.17	6298
BIGEYE SCAD	268.625	5913
SPOTTAIL PINFISH	325.7	5848
DAUBED SHANNY	13.889	5810
SHRIMP (PINK,BROWN,WHITE)	95.877	5593
BOBTAIL UNCL	17.228	5402
CUNNER	1977.006	5330
UNKNOWN 02	6.787	5074
OFFSHORE LIZARDFISH	38.258	4824
SIMONYS FROSTFISH	54.807	4672
ATLANTIC BRIEF SQUID	22.764	4465
LING UNCL	7.443	4348
NORTHERN KINGFISH	581.936	4232
NORTHERN PUFFER	304.292	4226
ATLANTIC SOFT POUT	10.081	4164
BARNDOOR SKATE	11089.888	4045
GRUNT UNCL	86.11	4041
ATLANTIC WOLFFISH	10669.491	3869
DEEPBODY BOARFISH	352.765	3810
PORGY AND PINFISH UNCL	28.37	3766
CUSK	10399.083	3442
BULLNOSE RAY	13604.063	3406
RED DEEPSEA CRAB	1244.183	3340
LONGSNOUT BUTTERFLYFISH	12	3329
LIZARDFISH UNCL	77.155	3328
ETROPUS UNCL	7.786	3143
BUCKLER DORY	1328.868	3121
ATLANTIC HAGFISH	176.09	3032
SPANISH MACKEREL	845.954	3026
HOOKEAR SCULPIN UNCL	8.531	2995
CHAIN DOGFISH	567.252	2994
LEFTEYE FLOUNDER UNCL	6.979	2914
SNAKEFISH	136.36	2907
ATLANTIC MIDSHIPMAN	95.32	2831
BROWN ROCK SHRIMP	53.476	2720
STRIPED CUSK-EEL	84.372	2605
ARMORED SEAROBIN	382.417	2601
HOGCHOKER	216.254	2598
STRIPED BASS	10053.27	2589
BLUNTNOSE STINGRAY	16488.668	2534
SWIMMING CRAB UNCL	25.209	2490
COARSEHAND LADY CRAB	99.842	2438
SEAROBIN UNCL	112.284	2430
ATLANTIC CUTLASSFISH	105.041	2422
ALLIGATORFISH	7.112	2410
GALATHEID UNCL	12.283	2280
NORTHERN PIPEFISH	2.577	2192
SCORPIONFISH AND ROCKFISH	98	2142
HAKE UNCL	5.8	2045
SPIDER CRAB UNCL	225.754	2033
HERRING UNCL	22.892	1929
SCHOOL BASS	8.1	1855
SNAKEBLENNY	24.632	1829
WHIFF UNCL	6.892	1805
UNKNOWN 01	213.932	1782
GRUBBY SCULPIN	5.092	1747
RADIATED SHANNY	7.1	1731
BLUE CRAB	149.629	1682
LONGSPINE SNIPEFISH	16.003	1677
CANCER CRAB UNCL	103.655	1644
STRIATED ARGENTINE	15.495	1590
GRENADIER UNCL	49.132	1540
WHITEBONE PORGY	693.46	1535
WHITING UNCL	72.003	1530
ATLANTIC SHARPNOSE SHARK	3514.58	1499
ATLANTIC ANGEL SHARK	6654.533	1471
BLACKCHEEK TONGUEFISH	35.527	1455
GRAY TRIGGERFISH	949.025	1428
NORTHERN SENNET	99.704	1420
TATTLER	79.57	1411
GREENEYE UNCL	5.406	1406
ATLANTIC SPADEFISH	491.007	1337
BANK CUSK-EEL	63.040	1300
BLACKMOUTH BASS	18.436	1272
YELLOWFIN BASS	104.653	1241
ATLANTIC HALIBUT	3719.596	1226
SILVER SEATROUT	25.7	1199
SAND PERCH	226.64	1112
SPINY BUTTERFLY RAY	18527.905	1105
SPOONARM OCTOPUS	37.889	1092
RED PORGY	314.607	1041

Appendix 1 c. continued.

Common Name	Catch Weight (kg)	Catch Number
ATLANTIC BONITO	82.28	68
CREVALLE JACK	80.854	697
TATTLER	79.57	1411
LIZARDFISH UNCL	77.155	3328
PINK GLASS SHRIMP	75.022	35813
BLUE ANGELFISH	72.4	100
WHITING UNCL	72.003	1530
DUSKY FLOUNDER	70.308	993
CONGER EEL UNCL	69.587	474
MANTA	67	2
DUSKY ANCHOVY	64.3	38968
BLUELINE TILEFISH	64.047	28
RAINBOW SMELT	63.514	9559
BANK CUSK-EEL	63.048	1300
ATLANTIC MOONFISH	61.815	7630
NORTHERN HORSEMUSSEL	58.3	64
WEITZMANS PEARLSIDES	55.807	40006
ATLANTIC SILVERSIDE	55.644	15841
BLACK GROUPER	55.162	8
SIMONYS FROSTFISH	54.807	4672
BROWN ROCK SHRIMP	53.476	2720
SHEEPSHEAD PORGY	52.4	275
SHORT BIGEYE	52.37	322
CUBBYU	51.498	600
SAUCEREYE PORGY	50.5	89
MARLIN-SPIKE	50.021	938
GRENADIER UNCL	49.132	1540
RED CORNETFISH	48.709	138
BANK SEA BASS	46.539	969
STRIPED BURRFISH	46.318	216
SNAPPER UNCL	44.6	30
YELLOW JACK	44.4	953
NIGHT SHARK	44.3	3
SMALLMOUTH FLOUNDER	42.298	16392
OFFSHORE LIZARDFISH	38.258	4824
REMORA	38.227	86
SPOONARM OCTOPUS	37.889	1092
FLORIDA POMPANO	37.469	146
PANDULUS PROPINQUUS	37.139	14053
FLAT ANCHOVY	36.9	16728
BLACKCHEEK TONGUEFISH	35.527	1455
SHORTNOSE GREENEYE	33.534	9044
RIDGED SLIPPER LOBSTER	33.073	220
SHORTFIN MAKO	33	1
SCRAWLED COWFISH	32.86	86
SWORDFISH	32.1	5
SOUTHERN FLOUNDER	29.647	101
BLACKNOSE SHARK	29.15	4
BIGHEAD SEAROBIN	28.378	756
PORGY AND PINFISH UNCL	28.37	3766
ATLANTIC SAURY	28.261	319
JACK POMPANO UNCL	27.991	163
SILKY SHARK	27.66	7
BLACKTIP SHARK	26.8	2
LEOPARD SEAROBIN	26.349	578
LONGNOSE ANCHOVY	25.9	32057
SILVER SEATROUT	25.7	1199
SWIMMING CRAB UNCL	25.209	2490
SNAKEBLENNY	24.632	1829
JOLTHEAD PORGY	23.1	25
HERRING UNCL	22.892	1929
CUSK-EEL UNCL	22.794	997
ATLANTIC BRIEF SQUID	22.764	4465
SPINY SEAROBIN	22.229	602
BIGEYE CIGARFISH	22.2	841
HICKORY SHAD	21.999	211
OCTOPUS UNCL	21.866	673
UNICORN FILEFISH	21	47
SEA LAMPREY	20.623	304
GREENLAND HALIBUT	20.454	52
CONEJO	19.9	117
STRIPED GRUNT	19.8	470
BLACKMOUTH BASS	18.436	1272
RED GOATFISH	18.329	498
STAR DRUM	18.093	587
ROCK SEA BASS	17.768	592
LOOKDOWN	17.707	954
BARBFISH	17.4	199
BOBTAIL UNCL	17.228	5402
BATHYAL SWIMMING CRAB	17.068	295
SQUIRRELFISH	17.045	90
YELLOWMOUTH GROUPER	16.9	7
HONEYCOMB COWFISH	16.596	23
ROYAL RED SHRIMP	16.411	665
BIG ROUGHY	16.13	9
LANCER STARGAZER	16.087	202
LONGSPINE SNIPEFISH	16.003	1677
SCRAWLED FILEFISH	15.9	110
SHORTHORN SCULPIN	15.791	238
STRIATED ARGENTINE	15.495	1590
HARDHEAD CATFISH	14.2	106
DAUBED SHANNY	13.889	5810
REDEYE GAPER	13.643	18

Common Name	Catch Weight (kg)	Catch Number
CONGER EEL	451.202	1005
TONGUEFISH UNCL	12.883	1005
CUSK-EEL UNCL	22.794	997
DUSKY FLOUNDER	70.308	993
ORANGE FILEFISH	894.1	977
BANK SEA BASS	46.539	969
ROUGHTAIL STINGRAY	36204.074	967
BIGEYE	188.043	958
LOOKDOWN	17.707	954
YELLOW JACK	44.4	953
MARLIN-SPIKE	50.021	938
SPINY LEBEEID	1.52	905
POLAR LEBEEID	0.837	871
UNCLASSIFIED FISH	136.403	850
BIGEYE CIGARFISH	22.2	841
ATLANTIC SEASNAIL	1.589	821
SLENDER SNIPE EEL	10.977	780
SEA STAR, BRITTLE STAR	13.1	775
BANDED RUDDERFISH	173.984	765
BIGHEAD SEAROBIN	28.378	756
WHITE GRUNT	234.5	754
COWNOSE RAY	2754.85	721
CARDINALFISH UNCL	5.977	714
CREVALLE JACK	80.854	697
LONGNOSE GREENEYE	4.719	696
OCTOPUS UNCL	21.866	673
ROYAL RED SHRIMP	16.411	665
WRYMOUTH	210.192	660
TWOSPOT CARDINALFISH	2.2	657
NORTHERN STONE CRAB	172.229	655
SHORTJAW LIZARDFISH	5.172	606
SPINY SEAROBIN	22.229	602
CUBBYU	51.498	600
ROCK SEA BASS	17.768	592
STAR DRUM	18.093	587
LEOPARD SEAROBIN	26.349	578
KING MACKEREL	291.849	522
RED GOATFISH	18.329	498
HORNED LANTERNFISH	0	488
CHLOROPHTHALMUS SP	0.4	486
LUMPFISH	1114.921	484
TAUTOG	453.346	479
CONGER EEL UNCL	69.587	474
STRIPED GRUNT	19.8	470
CAPELIN	6.1	470
UNKNOWN 03	3.287	452
MACKEREL AND TUNA UNCL	2.004	445
SHEEPSHEAD	784.16	440
ATLANTIC CALICO SCALLOP	3.761	440
TILEFISH	660.563	421
FRIENDLY BLADE SHRIMP	0.333	419
RED DRUM	850.16	414
HATCHETFISH UNCL	0.638	390
NORWEGIAN SHRIMP	0.46	384
BLACKWING SEAROBIN	8.715	382
BOA DRAGONFISH	8.623	378
SKATE UNCL	189.164	375
SNAKE EEL UNCL	11.074	372
SANDBAR SHARK	3973.574	350
SILVER JENNY	5.223	345
THREESPINE STICKLEBACK	0.453	326
SHORT BIGEYE	52.37	322
DUSKY SHARK	2137.4	319
ATLANTIC SAURY	28.261	319
AMERICAN SAND LANCE	2.85	319
SHORTSPINE TENPLATE	0.3	319
PARALICHTHYS UNCL	133.2	317
SILVER RAG	11.623	306
SEA LAMPREY	20.623	304
SILVERSIDE UNCL	4.9	298
BATHYAL SWIMMING CRAB	17.068	295
GREATER AMBERJACK	537.88	294
SOUTHERN STINGRAY	3857.878	284
WOLF EELPOUT	1.783	284
DWARF GOATFISH	7.272	282
SHEEPSHEAD PORGY	52.4	275
EPIGONUS PANDIONIS	7.444	275
BARRACUDINA UNCL	3.592	274
PIPEFISH SEAHORSE UNCL	1.241	271
COBIA	2022.98	263
MARGINED SNAKE EEL	5.551	258
SAND DIVER	9.422	257
SEA BASS UNCL	575.904	249
SMOOTH BUTTERFLY RAY	973.515	245
BLOTCHED SWIMMING CRAB	1.821	243
SPOTFIN MOJARRA	4.822	241
SCALY DRAGONFISH UNCL	2.2	241
SHORTHORN SCULPIN	15.791	238
COMMON OCTOPUS	10.303	228
UNKNOWN 04	2.896	221
RIDGED SLIPPER LOBSTER	33.073	220
SHORTWING SEAROBIN	3.157	217
STRIPED BURRFISH	46.318	216

Appendix 1 d. Continued.

Common Name	Catch Weight (kg)	Catch Number
CAROLINA HAKE	13.6	46
MISTY GROUPER	13.6	2
SOUTHERN STARGAZER	13.461	49
SEA STAR, BRITTLE STAR	13.1	775
TONGUEFISH UNCL	12.883	1005
JACKKNIFE-FISH	12.8	90
CORNETFISH UNCL	12.604	31
CARIBBEAN SPINY LOBSTER	12.3	5
GALATHEID UNCL	12.283	2280
LONGSPINE SQUIRRELFISH	12.2	28
DOTTEREL FILEFISH	12.153	60
LONGSNOUT BUTTERFLYFISH	12	3329
PALESPOTTED EEL	11.765	81
SILVER RAG	11.623	306
SMOOTH PUFFER	11.613	138
QUEEN TRIGGERFISH	11.6	10
RED GROUPER	11.3	3
STREAMER BASS	11.132	63
SNOW CRAB	11.087	107
SNAKE EEL UNCL	11.074	372
SLENDER SNIPE EEL	10.977	780
LONGSPINE SCORPIONFISH	10.919	138
REQUIEM SHARK UNCL	10.9	4
BLACKMOUTHED ALFONSIN	10.635	124
COMMON OCTOPUS	10.303	228
SEVENSPINE BAY SHRIMP	10.257	20214
ICELAND SCALLOP CLAPPER	10.2	63
ATLANTIC SOFT POUT	10.081	4164
OCELLATED FLOUNDER	9.972	127
MARBLED PUFFER	9.874	206
FLYING GURNARD	9.77	33
ATLANTIC SURFCLAM	9.653	45
SAND DIVER	9.422	257
AFRICAN POMPANO	8.956	79
HERMIT CRAB UNCL	8.8	26
BLACKWING SEAROBIN	8.715	382
ATLANTIC GUITARFISH	8.7	12
BOA DRAGONFISH	8.623	378
HOOKEAR SCULPIN UNCL	8.531	2995
BONNETHEAD SHARK	8.1	4
SCHOOL BASS	8.1	1855
SPOTFIN DRAGONET	8.008	193
PEARLY RAZORFISH	8	138
REEF BUTTERFLYFISH	7.901	152
ETROPUS UNCL	7.786	3143
SHARKSUCKER	7.55	21
EPIGONUS PANDIONIS	7.444	275
LING UNCL	7.443	4348
DWARF GOATFISH	7.272	282
SPOTTED SEATROUT	7.169	24
ALLIGATORFISH	7.112	2410
RADIATED SHANNY	7.1	1731
GULF FLOUNDER	7.007	12
LEFTEYE FLOUNDER UNCL	6.979	2914
SPINYCHEEK SCORPIONFISH	6.9	63
WHIFF UNCL	6.892	1805
SPOTFIN BUTTERFLYFISH	6.881	111
RED HIND	6.8	4
YELLOWTAIL REEFFISH	6.8	193
UNKNOWN 02	6.707	5074
AMERICAN EEL	6.567	42
EEL UNCL	6.407	211
EYED FLOUNDER	6.37	206
STRIPED BONITO	6.3	2
CAPELIN	6.1	470
CARDINALFISH UNCL	5.977	714
SEA URCHIN AND SAND DOLLAR	5.9	198
HAKE UNCL	5.8	2045
SILK SNAPPER	5.7	13
MORA UNCL	5.639	197
MARGINED SNAKE EEL	5.551	258
SMOOTHHEAD SCORPIONFISH	5.5	132
GREENEYE UNCL	5.406	1406
BLUESPOTTED CORNETFISH	5.379	36
SILVER JENNY	5.223	345
SHORTJAW LIZARDFISH	5.172	606
TWOSPOT FLOUNDER	5.104	70
GRUBBY SCULPIN	5.092	1747
LESSER ELECTRIC RAY	5	11
GREAT BARRACUDA	5	76
CERO	5	15
SILVERSIDE UNCL	4.9	298
SPOTFIN MOJARRA	4.022	241
LONGNOSE GREENEYE	4.719	696
GLASSEYE SNAPPER	4.677	18
EELPOUT UNCL	4.562	19
LESSER AMBERJACK	4.531	20
SAND SEATROUT	4.3	5
KEELCHEEK BASS	4.241	159
BROAD FLOUNDER	4.225	12
GUAGUANCHE	4.2	108
DAMSELFISH UNCL	4.1	119

Common Name	Catch Weight (kg)	Catch Number
HICKORY SHAD	21.999	211
EEL UNCL	6.407	211
LONGNOSE GRENADIER	3.729	211
BLACK DRUM	430.764	210
BLOTCHED CUSK-EEL	3.235	210
KNOBBED PORGY	152.1	208
MARBLED PUFFER	9.874	206
EYED FLOUNDER	6.37	206
GOBY UNCL	0.069	205
RED BARBIER	2.92	203
LANCER STARGAZER	16.087	202
BARBFISH	17.4	199
SEA URCHIN AND SAND DOLLAR	5.9	198
MOJARRA UNCL	2.56	198
MORA UNCL	5.639	197
PANCAKE BATFISH	0.925	195
SPOTFIN DRAGONET	8.008	193
YELLOWTAIL REEFFISH	6.8	193
DEEPWATER FLOUNDER	2.04	179
ROCK GUNNEL	0.412	167
JACK POMPANO UNCL	27.991	163
SCULPIN UNCL	2.026	163
HORNED SEAROBIN	1.345	161
GLADIATOR BOX CRAB	3.11	160
KEELCHEEK BASS	4.241	159
VIPERFISH	1.27	159
REEF BUTTERFLYFISH	7.901	152
WHITE BARRACUDINA	1.405	152
FLORIDA POMPANO	37.469	146
HYGOPHUM TAANINGI	0.3	144
ATLANTIC TORPEDO	1995.48	138
RED CORNETFISH	48.709	138
SMOOTH PUFFER	11.613	138
LONGSPINE SCORPIONFISH	10.919	138
PEARLY RAZORFISH	8	138
RUPPELL'S ABRALIA	0.299	137
SMOOTHHEAD SCORPIONFISH	5.5	132
SPOTTED WHIFF	1.619	132
SAND TIGER	6588.04	130
NORTHERN STARGAZER	89.327	128
OCELLATED FLOUNDER	9.972	127
POLKA-DOT CUSK-EEL	1.221	126
ATLANTIC STINGRAY	544.3	124
BLACKMOUTHED ALFONSIN	10.635	124
LINED SEAHORSE	0.126	123
LONGNOSE BATFISH	1.852	121
ARCTIC EUALID	0.06	120
DAMSELFISH UNCL	4.1	119
ATLANTIC STURGEON	1864.21	117
CONEJO	19.9	117
SHORTNOSE BATFISH	1.2	115
SPOTFIN BUTTERFLYFISH	6.881	111
SCRAWLED FILEFISH	15.9	110
GUAGUANCHE	4.2	108
SNOW CRAB	11.087	107
HARDHEAD CATFISH	14.2	106
MANTIS SHRIMP UNCL	1.614	106
LIGHTFISH UNCL	0.017	103
SOUTHERN FLOUNDER	29.647	101
BLUE ANGELFISH	72.4	100
SILVER HATCHETFISH	0.008	99
BLACK DOGFISH	4.086	94
ATLANTIC BATFISH	2.456	94
BROWN SHRIMP	1.107	94
RED SNAPPER	217.1	91
FRINGED FLOUNDER	0.112	91
SQUIRRELFISH	17.045	90
JACKKNIFE-FISH	12.8	90
SAUCEREYE PORGY	50.5	89
REMORA	38.227	86
SCRAWLED COWFISH	32.86	86
PEARLFISH	0.1	86
LONGSNOUT SEAHORSE	0.4	85
PALESPOTTED EEL	11.765	81
SPOTTED GOATFISH	3.2	81
AFRICAN POMPANO	8.956	79
DRUM UNCL	0.704	78
ROUGH SILVERSIDE	0.5	77
STREAMER SEAROBIN	0.219	77
SPOTTED LANTERNFISH	0	77
GREAT BARRACUDA	5	76
HOGFISH	126.2	75
WAHOO	1.5	75
RAY AND SKATE UNCL	994.92	74
METALLIC CODLING	4.037	73
TWOSPOT FLOUNDER	5.104	70
LARGESCALE LIZARDFISH	0.19	70
ATLANTIC BONITO	82.28	68
ROUGH SAGRE	1.4	67
SQUALIDAE	1302.101	66
LANE SNAPPER	0.9	66
NORTHERN HORSEMUSSEL	58.3	64

Appendix 1 e. continued.

Common Name	Catch Weight (kg)	Catch Number
BLACK DOGFISH	4.086	94
METALLIC CODLING	4.037	73
SPOTTED MORAY	3.9	19
BLACKFIN GOOSEFISH	3.807	8
ATLANTIC CALICO SCALLOP	3.761	440
LONGNOSE GRENADIER	3.729	211
SPOTTED SCORPIONFISH	3.7	46
BALLOONFISH	3.7	12
SPANISH SLIPPER LOBSTER	3.61	21
SMOOTH HAMMERHEAD SHARK	3.6	1
BARRACUDINA UNCL	3.592	274
STARGAZER UNCL	3.565	32
ARCTIC EELPOUT	3.5	9
SNAKE MACKEREL UNCL	3.474	53
COTTONMOUTH JACK	3.401	7
SPOTFIN FLOUNDER	3.357	42
OCEAN QUAHOG	3.3	25
CHANNEL FLOUNDER	3.3	50
UNKNOWN 03	3.287	452
BLOTCHED CUSK-EEL	3.235	210
SPOTTED GOATFISH	3.2	81
SHORTWING SEAROBIN	3.157	217
SOUTHERN HAKE	3.148	12
GLADIATOR BOX CRAB	3.11	160
SPOTTED SPOON-NOSE EEL	3	9
RED BARBIER	2.92	203
UNKNOWN 04	2.896	221
AMERICAN SAND LANCE	2.85	319
BLACKEDGE MORAY	2.7	27
LONGNOSE LANCETFISH	2.7	3
QUEEN ANGELFISH	2.7	5
HONEYCOMB MORAY	2.7	17
NORTHERN PIPEFISH	2.577	2192
MOJARRA UNCL	2.56	198
BANDTAIL PUFFER	2.522	40
MOON SNAIL, SHARK EYE	2.5	23
ATLANTIC BATFISH	2.456	94
TRUMPETFISH	2.4	4
ROUGHBACK BATFISH	2.306	43
MORAY UNCL	2.227	13
OYSTER TOADFISH	2.203	11
SCALY DRAGONFISH UNCL	2.2	241
LONGFIN SQUID EGG MOPS	2.2	1
TWOSPOT CARDINALFISH	2.2	657
BARRELFISH	2.101	12
DEEPWATER FLOUNDER	2.04	179
SCULPIN UNCL	2.026	163
MACKEREL AND TUNA UNCL	2.004	445
OCEAN TRIGGERFISH	2	3
SINGLESPOT FROGFISH	1.998	17
LITTLE TUNNY	1.98	1
PUFFER UNCL	1.901	52
SOUTHERN PUFFER	1.868	32
LONGNOSE BATFISH	1.852	121
SPOTTED BURRFISH	1.84	2
BLOTCHED SWIMMING CRAB	1.821	243
GREAT HAMMERHEAD SHARK	1.8	1
WOLF EELPOUT	1.783	284
BULLEYE	1.72	19
BROADBAND DOGFISH	1.715	51
NAKED SOLE	1.707	28
SPOTTED WHIFF	1.619	132
MANTIS SHRIMP UNCL	1.614	106
GIZZARD SHAD	1.6	2
ATLANTIC SEASNAIL	1.589	821
SPINY LEBBEID	1.52	905
ROUGHHEAD GRENADIER	1.5	35
WAHOO	1.5	75
WENCHMAN	1.5	40
LITTLEHEAD PORGY	1.5	2
LONGFIN SCORPIONFISH	1.42	48
WHITE BARRACUDINA	1.405	152
ROUGH SAGRE	1.4	67
GAFFTOPSAIL CATFISH	1.4	11
DOCTORFISH	1.4	3
HORNED SEAROBIN	1.345	161
ROCK HIND	1.3	1
VIPERFISH	1.27	159
PIPEFISH SEAHORSE UNCL	1.241	271
GULF KINGFISH	1.24	9
BLUNTHEAD PUFFER	1.24	9
THREE-EYE FLOUNDER	1.223	15
POLKA-DOT CUSK-EEL	1.221	126
BANDTOOTH CONGER	1.2	18
SHORTNOSE BATFISH	1.2	115
STRIPED MULLET	1.2	14
BEARDLESS CODLING	1.173	47
BLUESPOTTED SEAROBIN	1.171	32
BANDTAIL SEAROBIN	1.123	48
BATFISH UNCL	1.122	43
BROWN SHRIMP	1.107	94
BLACKBAR SOLDIERFISH	1.061	14

Common Name	Catch Weight (kg)	Catch Number
STREAMER BASS	11.132	63
ICELAND SCALLOP CLAPPER	10.2	63
SPINYCHEEK SCORPIONFISH	6.9	63
INQUILINE SNAILFISH	0.1	63
LOGGERHEAD SEATURTLE	4192.2	62
DOTTEREL FILEFISH	12.153	60
UNKNOWN 06	0.096	60
GAG	186.7	57
BUTTERFISH UNCL	0.605	56
RIGHTEYE FLOUNDER UNCL	0.025	55
SNAKE MACKEREL UNCL	3.474	53
GREENLAND HALIBUT	20.454	52
PUFFER UNCL	1.901	52
BROADBAND DOGFISH	1.715	51
CHANNEL FLOUNDER	3.3	50
SCAMP	222.2	49
SOUTHERN STARGAZER	13.461	49
LONGFIN SCORPIONFISH	1.42	48
BANDTAIL SEAROBIN	1.123	48
UNICORN FILEFISH	21	47
BEARDLESS CODLING	1.173	47
CAROLINA HAKE	13.6	46
SPOTTED SCORPIONFISH	3.7	46
ATLANTIC SURFCLAM	9.653	45
SHIELD BOBTAIL	0.146	44
ROUGHBACK BATFISH	2.306	43
BATFISH UNCL	1.122	43
AMERICAN EEL	6.567	42
SPOTFIN FLOUNDER	3.357	42
SLENDER SEAROBIN	0.932	42
FLOUNDER UNCL	0.2	42
WESTERN SOFTHEAD GRENADIER	0.682	41
BANDTAIL PUFFER	2.522	40
WENCHMAN	1.5	40
ALMACO JACK	162.56	39
SPECKLED SWIMMING CRAB	0.609	39
PARROTFISH UNCL	0.8	37
BLUESPOTTED CORNETFISH	5.379	36
UNKNOWN 05	0.093	36
SPOTTED EAGLE RAY	250.7	35
ROUGHHEAD GRENADIER	1.5	35
GRAY FLOUNDER	0.212	35
HOPLOSTETHUS OCCIDENTALIS	0.508	34
BOX CRAB UNCL	0.466	34
LUMPFISH SNAILFISH UNCL	0.063	34
FLYING GURNARD	9.77	33
BARRACUDA UNCL	0.918	33
STARGAZER UNCL	3.565	32
SOUTHERN PUFFER	1.868	32
BLUESPOTTED SEAROBIN	1.171	32
RED LIZARDFISH	0.001	32
CORNETFISH UNCL	12.604	31
THREEBEARD ROCKLING	0.3	31
SNAPPER UNCL	44.6	30
WHITE MULLET	0.766	29
BASSLET UNCL	0.4	29
SOUTHERN EAGLE RAY	332.28	28
SNOWY GROUPER	204.33	28
BLUELINE TILEFISH	64.047	28
LONGSPINE SQUIRRELFISH	12.2	28
NAKED SOLE	1.707	28
LONGTOOTH ANGLEMOUTH	0.2	28
BLACKEDGE MORAY	2.7	27
PEACOCK FLOUNDER	0.5	27
HERMIT CRAB UNCL	8.8	26
HORSE-EYE JACK	1	26
SNUBNOSE EEL	0	26
JOLTHEAD PORGY	23.1	25
OCEAN QUAHOG	3.3	25
SPOTTED DRIFTFISH	0.5	25
POLYMETME CORYTHAEOLA	0.134	25
SCALLOPED HAMMERHEAD SHAR	304.2	24
SPOTTED SEATROUT	7.169	24
SHORTFIN SEAROBIN	0.126	24
HONEYCOMB COWFISH	16.596	23
MOON SNAIL, SHARK EYE	2.5	23
ATLANTIC SPINY LUMPSUCKER	1.001	23
BANK BUTTERFLYFISH	1	23
LAEMONEMA BARBATULUM	0.819	22
SHARK UNCL	699.06	21
WARSAW GROUPER	187.77	21
SHARKSUCKER	7.55	21
SPANISH SLIPPER LOBSTER	3.61	21
LESSER AMBERJACK	4.531	20
TRIGGERFISH FILEFISH UNCL	0.672	20
GOBY FLATHEAD	0.648	20
WRASSE UNCL	0.5	20
EELPOUT UNCL	4.562	19
SPOTTED MORAY	3.9	19
BULLEYE	1.72	19
BLUE HAKE	0.937	19
ICELAND SCALLOP	0.4	19

Appendix 1 f. continued.

Common Name	Catch Weight (kg)	Catch Number
SEA SCALLOP CLAPPER	1.045	11
ATLANTIC SPINY LUMPSUCKER	1.001	23
HORSE-EYE JACK	1	26
SILVER PORGY	1	1
BANK BUTTERFLYFISH	1	23
BUTTERFLYFISH UNCL	1	3
TRUNKFISH	0.992	1
BLUE HAKE	0.937	19
SLENDER SEAROBIN	0.932	42
MOTTLED CUSK-EEL	0.928	18
PANCAKE BATFISH	0.925	195
BARRACUDA UNCL	0.918	33
WHITE PERCH	0.9	6
UNICORNFISH	0.9	2
PILOTFISH	0.9	8
PERMIT	0.9	7
LANE SNAPPER	0.9	66
POLAR LEBBEID	0.837	871
LAEMONEMA BARBATULUM	0.819	22
BROWN DRIFTFISH	0.801	15
FLAT NEEDLEFISH	0.8	6
PARROTFISH UNCL	0.8	37
WHITE MULLET	0.766	29
DRUM UNCL	0.704	78
HOUNDFISH	0.7	7
WESTERN SOFTHEAD GRENADIER	0.682	41
TRIGGERFISH FILEFISH UNCL	0.672	20
GOBY FLATHEAD	0.648	20
HATCHETFISH UNCL	0.638	390
SPECKLED SWIMMING CRAB	0.609	39
BUTTERFISH UNCL	0.605	56
LEOPARD TOADFISH	0.6	5
ATLANTIC FLYINGFISH	0.6	3
SQUIRRELFISH UNCL	0.6	13
BAR JACK	0.6	4
PORCUPINEFISH	0.6	3
LOPHIIFORM UNCL	0.6	3
DOLPHIN	0.542	5
HOPLOSTETHUS OCCIDENTALIS	0.508	34
STOUT BEARDFISH	0.5	16
ROUGH SILVERSIDE	0.5	77
CREOLE-FISH	0.5	1
FRECKLED SOAPFISH	0.5	3
WRASSE UNCL	0.5	20
SPOTTED DRIFTFISH	0.5	25
PEACOCK FLOUNDER	0.5	27
ESCOLAR	0.5	1
LONGNOSE CUSK-EEL	0.5	13
OCELLATED FROGFISH	0.49	3
BOX CRAB UNCL	0.466	34
NORWEGIAN SHRIMP	0.46	384
THREESPINE STICKLEBACK	0.453	326
VINCIGUERRIA SP	0.441	5
ROCK GUNNEL	0.412	167
CHLOROPHTHALMUS SP	0.4	486
ICELAND SCALLOP	0.4	19
LONGSNOUT SEAHORSE	0.4	85
BASSLET UNCL	0.4	29
SERGEANT MAJOR	0.4	16
BAY WHIFF	0.4	11
UNKNOWN 07	0.397	8
ATLANTIC NEEDLEFISH	0.38	4
FRIENDLY BLADE SHRIMP	0.333	419
FRECKLED STARGAZER	0.324	2
HYGOPHUM TAANINGI	0.3	144
THREEBEARD ROCKLING	0.3	31
SHORTSPINE TENPLATE	0.3	319
CALICO CRAB UNCL	0.3	3
FLAME BOX CRAB	0.3	4
BOARFISH UNCL	0.3	4
MARGINED FLYINGFISH	0.3	2
BLACKLINE TILEFISH	0.3	1
SHRIMP FLOUNDER	0.3	5
SPOTTAIL TONGUEFISH	0.3	15
RUPPELL'S ABRALIA	0.299	137
SILVERSTRIPE HALFBEAK	0.259	13
PARALEPIS COREGONOIDES	0.248	14
STREAMER SEAROBIN	0.219	77
GRAY FLOUNDER	0.212	35
FLOUNDER UNCL	0.2	42
LONGTOOTH ANGLEMOUTH	0.2	28
SAND DOLLAR UNCL	0.2	17
LADYFISH	0.2	1
YELLOWEDGE GROUPER	0.2	1
YELLOWTAIL SNAPPER	0.2	1
EMERALD PARROTFISH	0.2	4
OCEAN SURGEON	0.2	13
HUNCHBACK SCORPIONFISH	0.2	4
SHOAL FLOUNDER	0.2	3
SPOTTEDFIN TONGUEFISH	0.2	7
ATLANTIC SALMON	0.2	1
LARGESCALE LIZARDFISH	0.19	70

Common Name	Catch Weight (kg)	Catch Number
REDEYE GAPER	13.643	18
GLASSEYE SNAPPER	4.677	18
BANDTOOTH CONGER	1.2	18
MOTTLED CUSK-EEL	0.928	18
CAREPTROCTUS RANULA	0	18
HONEYCOMB MORAY	2.7	17
SINGLESPOT FROGFISH	1.998	17
SAND DOLLAR UNCL	0.2	17
HEADLIGHTFISH UNCL	0	17
WATER HAUL	0	17
STOUT BEARDFISH	0.5	16
SERGEANT MAJOR	0.4	16
CERO	5	15
THREE-EYE FLOUNDER	1.223	15
BROWN DRIFTFISH	0.801	15
SPOTTAIL TONGUEFISH	0.3	15
CRESTED CUSK-EEL	0.1	15
LESSER SHINING BOBTAIL	0	15
STRIPED MULLET	1.2	14
BLACKBAR SOLDIERFISH	1.061	14
PARALEPIS COREGONOIDES	0.248	14
SPOTTED TINSELFISH	0.168	14
SILK SNAPPER	5.7	13
MORAY UNCL	2.227	13
SQUIRRELFISH UNCL	0.6	13
LONGNOSE CUSK-EEL	0.5	13
SILVERSTRIPE HALFBEAK	0.259	13
OCEAN SURGEON	0.2	13
ATLANTIC GUITARFISH	8.7	12
GULF FLOUNDER	7.007	12
BROAD FLOUNDER	4.225	12
BALLOONFISH	3.7	12
SOUTHERN HAKE	3.148	12
BARRELFISH	2.101	12
FRINGED FILEFISH	0.118	12
HUMBOLDTS LANTERNFISH	0.1	12
HORNED WHIFF	0.1	12
LESSER ELECTRIC RAY	5	11
OYSTER TOADFISH	2.203	11
GAFFTOPSAIL CATFISH	1.4	11
SEA SCALLOP CLAPPER	1.045	11
BAY WHIFF	0.4	11
SLICKHEAD UNCL	0	11
QUEEN TRIGGERFISH	11.6	10
SHRIMP EEL	0.1	10
SPOON-NOSE EEL UNCL	0.084	10
RED DORY	0.054	10
BLACKEAR BASS	0	10
THRESHER SHARK	98.34	9
BIG ROUGHY	16.13	9
ARCTIC EELPOUT	3.5	9
SPOTTED SPOON-NOSE EEL	3	9
GULF KINGFISH	1.24	9
BLUNTHEAD PUFFER	1.24	9
SLIPPERY DICK	0	9
BLACK GROUPER	55.162	8
BLACKFIN GOOSEFISH	3.807	8
PILOTFISH	0.9	8
UNKNOWN 07	0.397	8
GONOSTOMA ATLANTICUM	0.015	0
OCEAN SUNFISH	879	7
SILKY SHARK	27.66	7
YELLOWMOUTH GROUPER	16.9	7
COTTONMOUTH JACK	3.401	7
PERMIT	0.9	7
HOUNDFISH	0.7	7
SPOTTEDFIN TONGUEFISH	0.2	7
DWARF SAND PERCH	0.014	7
WHITE PERCH	0.9	6
FLAT NEEDLEFISH	0.8	6
CALICO BOX CRAB	0.173	6
SEAWEED BLENNY	0.1	6
PINK SHRIMP	0.019	6
HEADLIGHTFISH	0	6
COMBTOOTH BLENNY UNCL	0	6
NAKED GOBY	0	6
SWORDFISH	32.1	5
CARIBBEAN SPINY LOBSTER	12.3	5
SAND SEATROUT	4.3	5
QUEEN ANGELFISH	2.7	5
LEOPARD TOADFISH	0.6	5
DOLPHIN	0.542	5
VINCIGUERRIA SP	0.441	5
SHRIMP FLOUNDER	0.3	5
SARGASSUMFISH	0.1	5
CHAIN PIPEFISH	0	5
ANGLEFIN WHIFF	0	5
BLACKNOSE SHARK	29.15	4
REQUIEM SHARK UNCL	10.9	4
BONNETHEAD SHARK	8.1	4
RED HIND	6.8	4
TRUMPETFISH	2.4	4

Appendix 1 g. continued.

Common Name	Catch Weight (kg)	Catch Number
CALICO BOX CRAB	0.173	6
SPOTTED TINSELFISH	0.168	14
SHIELD BOBTAIL	0.146	44
POLYMETME CORYTHAECLA	0.134	25
OFFSHORE TONGUEFISH	0.13	4
LINED SEAHORSE	0.126	123
SHORTFIN SEAROBIN	0.126	24
FRINGED FILEFISH	0.118	12
FRINGED FLOUNDER	0.112	91
HUMBOLDTS LANTERNFISH	0.1	12
INQUILINE SNAILFISH	0.1	63
BLACK GEMFISH	0.1	2
BLUNTNOSE SMOOTHHEAD	0.1	2
GOLDEN DEEPSEA CRAB	0.1	1
SHRIMP EEL	0.1	10
SARGASSUMFISH	0.1	5
ATLANTIC TOMCOD	0.1	1
CRESTED CUSK-EEL	0.1	15
PEARLFISH	0.1	86
FLYING HALFBEAK	0.1	2
BIGEYE SOLDIERFISH	0.1	4
NORTHERN SHORTFIN SQUID	0.1	1
RAINBOW RUNNER	0.1	3
LEATHERJACK	0.1	1
SAND TILEFISH	0.1	1
RED HOGFISH	0.1	1
SEAWEED BLENNY	0.1	6
CRESTED BLENNY	0.1	4
HORNED WHIFF	0.1	12
UNKNOWN 06	0.096	60
UNKNOWN 05	0.093	36
SPOON-NOSE EEL UNCL	0.084	10
GOBY UNCL	0.069	205
LUMPFISH SNAILFISH UNCL	0.063	34
ARCTIC EUALID	0.06	120
HIGHFIN SCORPIONFISH	0.058	4
RED DORY	0.054	10
RIGHTEYE FLOUNDER UNCL	0.025	55
CARDINAL SOLDIERFISH	0.019	2
PINK SHRIMP	0.019	6
LIGHTFISH UNCL	0.017	103
GONOSTOMA ATLANTICUM	0.015	8
DWARF SAND PERCH	0.014	7
SHORTSPINE BOARFISH	0.01	1
SILVER HATCHETFISH	0.008	99
SADDLE BASS	0.005	2
PUNCTATE BLADE SHRIMP	0.001	1
GREEN CRAB	0.001	1
RED LIZARDFISH	0.001	32
SLICKHEAD UNCL	0	11
GLACIER LANTERNFISH	0	3
HORNED LANTERNFISH	0	488
SPOTTED LANTERNFISH	0	77
HEADLIGHTFISH UNCL	0	17
SNUBNOSE EEL	0	26
DEEPWATER DAB	0	3
SHERBORN'S CARDINALFISH	0	3
HEADLIGHTFISH	0	6
CAREPTROCTUS RANULA	0	18
MEXICAN SEAROBIN	0	1
WATER HAUL	0	17
YELLOW BOX CRAB	0	1
ASTROPECTEN SP	0	1
CHANNELED WHELK	0	1
NORTHERN MOONSNAIL	0	1
DWARF HERRING	0	1
SPINYCHEEK SOLDIERFISH	0	2
FOURSPINE STICKLEBACK	0	4
CHAIN PIPEFISH	0	5
BULL PIPEFISH	0	2
LESSER SHINING BOBTAIL	0	15
OWEN'S BOBTAIL	0	1
ROUGHTONGUE BASS	0	1
BLACKEAR BASS	0	10
FLAMEFISH	0	1
POMPANO DOLPHIN	0	1
MUTTON SNAPPER	0	2
GOLDFACE TILEFISH	0	2
HIGH-HAT	0	2
BANDED BUTTERFLYFISH	0	1
CREOLE WRASSE	0	2
SLIPPERY DICK	0	9
PUDDINGWIFE	0	1
WHITE MARLIN	0	1
CLINID UNCL	0	1
COMBTOOTH BLENNY UNCL	0	6
NAKED GOBY	0	6
BLUE TANG	0	1
BIGEYE SEAROBIN	0	4
SLENDER TONGUEFISH	0	1
NORTHERN TONGUEFISH	0	4
JAMBEAU	0	2
SHARPNOSE PUFFER	0	4
MOONEYE CUSK-EEL	0	1
ANGLEFIN WHIFF	0	5
SPOTTED SOAPFISH	0	3

Common Name	Catch Weight (kg)	Catch Number
BAR JACK	0.6	4
ATLANTIC NEEDLEFISH	0.38	4
FLAME BOX CRAB	0.3	4
BOARFISH UNCL	0.3	4
EMERALD PARROTFISH	0.2	4
HUNCHBACK SCORPIONFISH	0.2	4
OFFSHORE TONGUEFISH	0.13	4
BIGEYE SOLDIERFISH	0.1	4
CRESTED BLENNY	0.1	4
HIGHFIN SCORPIONFISH	0.058	4
FOURSPINE STICKLEBACK	0	4
BIGEYE SEAROBIN	0	4
NORTHERN TONGUEFISH	0	4
SHARPNOSE PUFFER	0	4
NIGHT SHARK	44.3	3
RED GROUPER	11.3	3
LONGNOSE LANCETFISH	2.7	3
OCEAN TRIGGERFISH	2	3
DOCTORFISH	1.4	3
BUTTERFLYFISH UNCL	1	3
ATLANTIC FLYINGFISH	0.6	3
PORCUPINEFISH	0.6	3
LOPHIIFORM UNCL	0.6	3
FRECKLED SOAPFISH	0.5	3
OCELLATED FROGFISH	0.49	3
CALICO CRAB UNCL	0.3	3
SHOAL FLOUNDER	0.2	3
RAINBOW RUNNER	0.1	3
GLACIER LANTERNFISH	0	3
DEEPWATER DAB	0	3
SHERBORN'S CARDINALFISH	0	3
SPOTTED SOAPFISH	0	3
BASKING SHARK	2816	2
MANTA	67	2
BLACKTIP SHARK	26.8	2
MISTY GROUPER	13.6	2
STRIPED BONITO	6.3	2
SPOTTED BURRFISH	1.84	2
GIZZARD SHAD	1.6	2
LITTLEHEAD PORGY	1.5	2
UNICORNFISH	0.9	2
FRECKLED STARGAZER	0.324	2
MARGINED FLYINGFISH	0.3	2
BLACK GEMFISH	0.1	2
BLUNTNOSE SMOOTHHEAD	0.1	2
FLYING HALFBEAK	0.1	2
CARDINAL SOLDIERFISH	0.019	2
SADDLE BASS	0.005	2
SPINYCHEEK SOLDIERFISH	0	2
BULL PIPEFISH	0	2
MUTTON SNAPPER	0	2
GOLDFACE TILEFISH	0	2
HIGH-HAT	0	2
CREOLE WRASSE	0	2
JAMBEAU	0	2
SHORTFIN MAKO	33	1
SMOOTH HAMMERHEAD SHARK	3.6	1
LONGFIN SQUID EGG MOPS	2.2	1
LITTLE TUNNY	1.98	1
GREAT HAMMERHEAD SHARK	1.0	1
ROCK HIND	1.3	1
SILVER PORGY	1	1
TRUNKFISH	0.992	1
CREOLE-FISH	0.5	1
ESCOLAR	0.5	1
BLACKLINE TILEFISH	0.3	1
LADYFISH	0.2	1
YELLOWEDGE GROUPER	0.2	1
YELLOWTAIL SNAPPER	0.2	1
ATLANTIC SALMON	0.2	1
GOLDEN DEEPSEA CRAB	0.1	1
ATLANTIC TOMCOD	0.1	1
NORTHERN SHORTFIN SQUID	0.1	1
LEATHERJACK	0.1	1
SAND TILEFISH	0.1	1
RED HOGFISH	0.1	1
SHORTSPINE BOARFISH	0.01	1
PUNCTATE BLADE SHRIMP	0.001	1
GREEN CRAB	0.001	1
MEXICAN SEAROBIN	0	1
ASTROPECTEN SP	0	1
CHANNELED WHELK	0	1
NORTHERN MOONSNAIL	0	1
DWARF HERRING	0	1
OWEN'S BOBTAIL	0	1
ROUGHTONGUE BASS	0	1
FLAMEFISH	0	1
POMPANO DOLPHIN	0	1
BANDED BUTTERFLYFISH	0	1
PUDDINGWIFE	0	1
WHITE MARLIN	0	1
CLINID UNCL	0	1
BLUE TANG	0	1
SLENDER TONGUEFISH	0	1
MOONEYE CUSK-EEL	0	1
YELLOW BOX CRAB	0	1

Appendix 1 h. Benthic Survey catches sorted by catch weight and catch number, 1999-2000

Common Name	Catch Weight (Kg)	Catch Number
HADDOCK	7563	5420
SEA SCALLOP	4253.7	115577
WINTER SKATE	3118.7	1926
LITTLE SKATE	2206.6	3472
LONGHORN SCULPIN	1407.8	7504
WINTER FLOUNDER	1349.9	1773
ATLANTIC HERRING	1226.2	9123
YELLOWTAIL FLOUNDER	1196.2	2675
SILVER HAKE	759.3	6058
OCEAN POUT	643.2	1118
SPINY DOGFISH	567.5	410
RED HAKE	519.7	2464
SEA RAVEN	498.9	505
ATLANTIC COD	403.3	178
BARNDOOR SKATE	319.1	97
SEA SCALLOP CLAPPER	196.3	1411
GOOSEFISH	149.4	69
FOURSPOT FLOUNDER	126.7	775
AMERICAN LOBSTER	97.8	59
JONAH CRAB	95.3	480
WINDOWPANE	86.1	400
AMERICAN PLAICE	82.1	164
ATLANTIC MACKEREL	67	351
LONGFIN SQUID	52.9	1484
SEA STAR, BRITTLE STAR	47.4	24
WITCH FLOUNDER	42.2	77
THORNY SKATE	30.3	14
WHITE HAKE	28.9	54
NORTHERN SHORTFIN SQUID	28.8	364
CUNNER	26.8	36
ATLANTIC WOLFFISH	23.3	3
POLLOCK	22.7	25
CLEARNOSE SKATE	20.1	8
BUTTERFISH	20.1	481
MOON SNAIL, SHARK EYE	19.1	38
OCEAN QUAHOG CLAPPER	19.1	6
SUMMER FLOUNDER	17.6	12
ALEWIFE	13.3	136
BOREAL ASTERIAS	10.1	0
HERMIT CRAB UNCL	7.8	242
ATLANTIC ROCK CRAB	7.1	182
SEA URCHIN & SAND DOLLAR	4.7	46
WAVED WHELK	4.7	26
NORTHERN SAND LANCE	4.5	362
ACADIAN REDFISH	2.9	10
SAND DOLLAR UNCL	2.1	86
SCUP	1.7	5
COARSEHAND LADY CRAB	1.7	11
ATL. SURFCLAM CLAPPER	1.7	0
GULF STREAM FLOUNDER	1.6	83
NORTHERN SHRIMP	1.2	0
NORTHERN HORSEMUSSEL	1.1	9
OCEAN QUAHOG	1	13
BLACK SEA BASS	0.8	3
BLUE MUSSEL	0.7	0
SHRIMP UNCL	0.6	0
SMOOTH SKATE	0.4	2
BLUEBACK HERRING	0.4	5
FAWN CUSK-EEL	0.4	12
LADY CRAB	0.3	4
ATLANTIC HAGFISH	0.2	4
SPOTTED HAKE	0.2	2
SEVENSPINE BAY SHRIMP	0.2	0
AMERICAN SHAD	0.1	4
ALLIGATORFISH	0.1	4
NORTHERN SEAROBIN	0.1	1
ROCK GUNNEL	0.1	1
AMERICAN EEL	0.1	1
BOBTAIL UNCL	0.1	6
UNCLASSIFIED FISH	0	2
LANTERNFISH UNCL	0	2
HOOKEAR SCULPIN UNCL	0	1
CANCER CRAB UNCL	0	12
SPIDER CRAB UNCL	0	2
ATLANTIC SURFCLAM	0	1
RAZOR AND JACKKNIFE CLAM	0	1
ATLANTIC BRIEF SQUID	0	1

Common Name	Catch Weight (Kg)	Catch Number
SEA SCALLOP	4253.7	115577
ATLANTIC HERRING	1226.2	9123
LONGHORN SCULPIN	1407.8	7504
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SEA RAVEN	498.9	505
BUTTERFISH	20.1	481
JONAH CRAB	95.3	480
SPINY DOGFISH	567.5	410
WINDOWPANE	86.1	400
NORTHERN SHORTFIN SQUID	28.8	364
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ATLANTIC MACKEREL	67	351
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ATLANTIC COD	403.3	178
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BARNDOOR SKATE	319.1	97
SAND DOLLAR UNCL	2.1	86
GULF STREAM FLOUNDER	1.6	83
WITCH FLOUNDER	42.2	77
GOOSEFISH	149.4	69
AMERICAN LOBSTER	97.8	59
WHITE HAKE	28.9	54
SEA URCHIN & SAND DOLLAR	4.7	46
MOON SNAIL, SHARK EYE	19.1	38
CUNNER	26.8	36
WAVED WHELK	4.7	26
POLLOCK	22.7	25
SEA STAR, BRITTLE STAR	47.4	24
THORNY SKATE	30.3	14
OCEAN QUAHOG	1	13
SUMMER FLOUNDER	17.6	12
FAWN CUSK-EEL	0.4	12
CANCER CRAB UNCL	0	12
COARSEHAND LADY CRAB	1.7	11
ACADIAN REDFISH	2.9	10
NORTHERN HORSEMUSSEL	1.1	9
CLEARNOSE SKATE	20.1	8
OCEAN QUAHOG CLAPPER	19.1	6
BOBTAIL UNCL	0.1	6
SCUP	1.7	5
BLUEBACK HERRING	0.4	5
LADY CRAB	0.3	4
ATLANTIC HAGFISH	0.2	4
AMERICAN SHAD	0.1	4
ALLIGATORFISH	0.1	4
ATLANTIC WOLFFISH	23.3	3
BLACK SEA BASS	0.8	3
SMOOTH SKATE	0.4	2
SPOTTED HAKE	0.2	2
UNCLASSIFIED FISH	0	2
LANTERNFISH UNCL	0	2
SPIDER CRAB UNCL	0	2
NORTHERN SEAROBIN	0.1	1
ROCK GUNNEL	0.1	1
AMERICAN EEL	0.1	1
HOOKEAR SCULPIN UNCL	0	1
ATLANTIC SURFCLAM	0	1
RAZOR AND JACKKNIFE CLAM	0	1
ATLANTIC BRIEF SQUID	0	1
BOREAL ASTERIAS	10.1	0
ATLANTIC SURFCLAM CLAPPE	1.7	0
NORTHERN SHRIMP	1.2	0
BLUE MUSSEL	0.7	0
SHRIMP UNCL	0.6	0
SEVENSPINE BAY SHRIMP	0.2	0

Appendix 1 i. Northern Shrimp Survey catches sorted by catch weight and catch number, 1983-2007

Common Name	Catch Weight (Kg)	Catch Number
ACADIAN REDFISH	47657.76	298180
SILVER HAKE	32783.529	589124
NORTHERN SHRIMP	25902.7	3831862
SPINY DOGFISH	14429.821	15366
WHITE HAKE	12300.46	15407
RED HAKE	8915.671	37212
AMERICAN PLAICE	8541.188	71920
ATLANTIC HERRING	6851.333	38848
GOOSEFISH	5570.982	5026
NORTHERN SHRIMP MALE	5330.541	1251876
NORTHERN SHRIMP FEMALE I	2866.179	298615
ATLANTIC COD	2785.036	2205
NORTHERN SHRIMP FEMALE II	2726.489	238311
WITCH FLOUNDER	2276.25	20073
THORNY SKATE	2153.635	947
BRISTLED LONGBEAK	1700.617	552025
POLLOCK	1489.003	1492
HADDOCK	1344.653	1576
FOURBEARD ROCKLING	1117.094	22633
JONAH CRAB	607.4	3546
UNCLASSIFIED FISH	510.5	1
PINK GLASS SHRIMP	491.494	176490
NORTHERN SHORTFIN SQUID	463.773	4265
LUMPFISH	432.568	269
OCEAN POUT	420.117	1017
SEA SCALLOP	419.978	8421
SKATE UNCL	387.603	97
AMERICAN LOBSTER	386.718	521
AESOP SHRIMP	323.988	53252
SMOOTH SKATE	310.904	713
CUSK	277.32	101
ATLANTIC WOLFFISH	224.35	59
RED DEEPSEA CRAB	210.167	873
WRYMOUTH	208.415	813
SEA RAVEN	202.458	318
WINTER SKATE	180.54	15
ALEWIFE	168.183	1666
SNOW CRAB	104.637	610
NORTHERN STONE CRAB	103.771	217
OCTOPUS UNCL	70.507	1962
ATLANTIC TORPEDO	66.26	4
SHRIMP UNCL	61.403	22557
NORWEGIAN SHRIMP	60.184	16290
LONGHORN SCULPIN	47.867	286
NORTHERN SHRIMP TRANSITION	37.595	4573
SPOONARM OCTOPUS	36.25	1528
ATLANTIC ROCK CRAB	26.485	70
BARNDOOR SKATE	24.04	6
YELLOWTAIL FLOUNDER	19.42	54
ATLANTIC HAGFISH	19.064	95
SNAKEBLENNY	18.487	167
AMERICAN SHAD	16.535	161
CLEARNOSE SKATE	14.6	31
PANDULUS PROPINQUUS	14.504	3899
BLUEBACK HERRING	13.526	92
LITTLE SKATE	11.1	9
ATLANTIC ARGENTINE	10.764	167
WINTER FLOUNDER	9.32	23
SPINY BUTTERFLY RAY	7.48	1
SEVENSPINE BAY SHRIMP	6.416	3055
FRIENDLY BLADE SHRIMP	6.085	1087
SQUID, CUTTLEFISH, AND OCTOPUS	5.7	432
SPINY LEBBEID	5.004	1759
ATLANTIC MACKEREL	4.685	72
GREENLAND HALIBUT	4.349	29
LING UNCL	3.912	1
BUTTERFISH	3.822	43
NORTHERN SHRIMP OVIGEROUS	3.781	330
FOURSPOT FLOUNDER	3.426	17
CUNNER	3.284	16
COMMON OCTOPUS	2.899	129
NORTHERN SHRIMP NON SPAWN	2.645	257
BLACKBELLY ROSEFISH	1.564	14
ATLANTIC HALIBUT	1.56	2
CUSK-EEL UNCL	1.3	22
SEA LAMPREY	1.26	2
SCULPIN UNCL	1.2	11
BOBTAIL UNCL	1.093	190
LONGFIN HAKE	0.804	18
OCEAN QUAHOG	0.8	29
SHIELD BOBTAIL	0.758	115
ALLIGATORFISH	0.743	181
LONGFIN SQUID	0.613	21
ATLANTIC SOFT POUT	0.6	98
CANCER CRAB UNCL	0.6	3

Common Name	Catch Weight (Kg)	Catch Number
NORTHERN SHRIMP	25902.7	3831862
NORTHERN SHRIMP MALE	5330.541	1251876
SILVER HAKE	32783.529	589124
BRISTLED LONGBEAK	1700.617	552025
NORTHERN SHRIMP FEMALE I	2866.179	298615
ACADIAN REDFISH	47657.76	298180
NORTHERN SHRIMP FEMALE II	2726.489	238311
PINK GLASS SHRIMP	491.494	176490
AMERICAN PLAICE	8541.188	71920
AESOP SHRIMP	323.988	53252
ATLANTIC HERRING	6851.333	38848
RED HAKE	8915.671	37212
FOURBEARD ROCKLING	1117.094	22633
SHRIMP UNCL	61.403	22557
WITCH FLOUNDER	2276.25	20073
NORWEGIAN SHRIMP	60.184	16290
WHITE HAKE	12300.46	15407
SPINY DOGFISH	14429.821	15366
SEA SCALLOP	419.978	8421
GOOSEFISH	5570.982	5026
NORTHERN SHRIMP TRANSITION	37.595	4573
NORTHERN SHORTFIN SQUID	463.773	4265
PANDULUS PROPINQUUS	14.504	3899
JONAH CRAB	607.4	3546
SEVENSPINE BAY SHRIMP	6.416	3055
ATLANTIC COD	2785.036	2205
OCTOPUS UNCL	70.507	1962
SPINY LEBBEID	5.004	1759
ALEWIFE	168.183	1666
HADDOCK	1344.653	1576
SPOONARM OCTOPUS	36.25	1528
POLLOCK	1489.003	1492
FRIENDLY BLADE SHRIMP	6.085	1087
OCEAN POUT	420.117	1017
THORNY SKATE	2153.635	947
RED DEEPSEA CRAB	210.167	873
WRYMOUTH	208.415	813
SMOOTH SKATE	310.904	713
SNOW CRAB	104.637	610
AMERICAN LOBSTER	386.718	521
SQUID, CUTTLEFISH, AND OCTOPUS	5.7	432
NORTHERN SHRIMP OVIGEROUS	3.781	330
SEA RAVEN	202.458	318
LONGHORN SCULPIN	47.867	286
LUMPFISH	432.568	269
NORTHERN SHRIMP NON SPAWN	2.645	257
NORTHERN STONE CRAB	103.771	217
BOBTAIL UNCL	1.093	190
ALLIGATORFISH	0.743	181
SNAKEBLENNY	18.487	167
ATLANTIC ARGENTINE	10.764	167
AMERICAN SHAD	16.535	161
POLAR LEBBEID	0.033	132
COMMON OCTOPUS	2.899	129
CALOCARIS TEMPLEMANI	0.217	124
SHIELD BOBTAIL	0.758	115
CUSK	277.32	101
ATLANTIC SOFT POUT	0.6	98
SKATE UNCL	387.603	97
ATLANTIC HAGFISH	19.064	95
WOLF EELPOUT	0.477	94
BLUEBACK HERRING	13.526	92
ATLANTIC MACKEREL	4.685	72
ATLANTIC ROCK CRAB	26.485	70
PUNCTATE BLADE SHRIMP	0.4	67
ATLANTIC WOLFFISH	224.35	59
ARCTIC EUALID	0.4	55
YELLOWTAIL FLOUNDER	19.42	54
UNKNOWN 01	0.038	46
BUTTERFISH	3.822	43
HOOKEAR SCULPIN UNCL	0.006	40
GULF STREAM FLOUNDER	0.212	38
CLEARNOSE SKATE	14.6	31
GREENLAND HALIBUT	4.349	29
OCEAN QUAHOG	0.8	29
WINTER FLOUNDER	9.32	23
CUSK-EEL UNCL	1.3	22
LONGFIN SQUID	0.613	21
LANTERNFISH UNCL	0.102	21
FAWN CUSK-EEL	0.4	19
LONGFIN HAKE	0.804	18
FOURSPOT FLOUNDER	3.426	17
CUNNER	3.284	16
WEITZMANS PEARLSIDES	0.004	16
WINTER SKATE	180.54	15

Appendix 1 j. continued.

Common Name	Catch Weight (Kg)	Catch Number
WOLF EELPOUT	0.477	94
FAWN CUSK-EEL	0.4	19
PUNCTATE BLADE SHRIMP	0.4	67
ARCTIC EUALID	0.4	55
ATLANTIC MENHADEN	0.3	1
GRENADIER UNCL	0.3	6
MARLIN-SPIKE	0.3	6
ICELAND SCALLOP	0.3	2
SPOTTED HAKE	0.22	2
CALOCARIS TEMPLEMANI	0.217	124
GULF STREAM FLOUNDER	0.212	38
WINDOWPANE	0.2	1
RADIATED SHANNY	0.2	10
OCEAN QUAHOG CLAPPER	0.2	2
SPIDER CRAB UNCL	0.172	7
STRIATED ARGENTINE	0.17	1
EEL UNCL	0.116	10
LANTERNFISH UNCL	0.102	21
ROUGHHEAD GRENADIER	0.1	1
SCUP	0.1	7
BARRACUDINA UNCL	0.1	1
UNKNOWN 01	0.038	46
POLAR LEBBEID	0.033	132
SHORTHORN SCULPIN	0.02	4
DAUBED SHANNY	0.014	2
HATCHETFISH UNCL	0.01	7
HOOKEAR SCULPIN UNCL	0.006	40
WEITZMANS PEARLSIDES	0.004	16
CAPELIN	0	1
GREENEYE UNCL	0	1
SEAROBIN UNCL	0	1
NORTHERN SAND LANCE	0	1
WHITE BARRACUDINA	0	1
SHORTSPINE TENPLATE	0	10
EELPOUT UNCL	0	1
PARROT SHRIMP	0	2
WATER HAUL	0	2
TEN-RIDGED WHELK	0	1
ATLANTIC BRIEF SQUID	0	2
VERRILL'S BOBTAIL	0	1
LEFTEYE FLOUNDER UNCL	0	1

Common Name	Catch Weight (Kg)	Catch Number
BLACKBELLY ROSEFISH	1.564	14
SCULPIN UNCL	1.2	11
RADIATED SHANNY	0.2	10
EEL UNCL	0.116	10
SHORTSPINE TENPLATE	0	10
LITTLE SKATE	11.1	9
SPIDER CRAB UNCL	0.172	7
SCUP	0.1	7
HATCHETFISH UNCL	0.01	7
BARNDOOR SKATE	24.04	6
GRENADIER UNCL	0.3	6
MARLIN-SPIKE	0.3	6
ATLANTIC TORPEDO	66.26	4
SHORTHORN SCULPIN	0.02	4
CANCER CRAB UNCL	0.6	3
ATLANTIC HALIBUT	1.56	2
SEA LAMPREY	1.26	2
ICELAND SCALLOP	0.3	2
SPOTTED HAKE	0.22	2
OCEAN QUAHOG CLAPPER	0.2	2
DAUBED SHANNY	0.014	2
PARROT SHRIMP	0	2
WATER HAUL	0	2
ATLANTIC BRIEF SQUID	0	2
UNCLASSIFIED FISH	510.5	1
SPINY BUTTERFLY RAY	7.48	1
LING UNCL	3.912	1
ATLANTIC MENHADEN	0.3	1
WINDOWPANE	0.2	1
STRIATED ARGENTINE	0.17	1
ROUGHHEAD GRENADIER	0.1	1
BARRACUDINA UNCL	0.1	1
CAPELIN	0	1
GREENEYE UNCL	0	1
SEAROBIN UNCL	0	1
NORTHERN SAND LANCE	0	1
WHITE BARRACUDINA	0	1
EELPOUT UNCL	0	1
TEN-RIDGED WHELK	0	1
VERRILL'S BOBTAIL	0	1
LEFTEYE FLOUNDER UNCL	0	1

Appendix 1 k. Sea Scallop Survey catches sorted by catch weight and catch number, 1966-2007.

Common Name	Catch Weight (Kg)	Catch Number
SEA SCALLOP	219036.387	3928515
GOOSEFISH	10585.756	21467
ASTROPECTEN SP	9641.867	2857195
LITTLE SKATE	6919.251	25845
WINTER SKATE	4742.209	2931
BOREAL ASTERIAS	4688.623	702772
CANCER CRAB UNCL	3671.247	100535
SEA SCALLOP CLAPPER	3052.845	72285
RED HAKE	2754.371	29105
SEA STAR, BRITTLE STAR	2734.785	701228
YELLOWTAIL FLOUNDER	1691.122	23289
SILVER HAKE	1211.716	12524
FOURSPOT FLOUNDER	1067.702	7349
LONGHORN SCULPIN	1007.2	6486
SPOTTED HAKE	782.802	17210
JONAH CRAB	708.598	4855
HADDOCK	638.034	11288
WINTER FLOUNDER	611.969	845
ATLANTIC ROCK CRAB	571.353	20036
ATLANTIC COD	533.753	2820
OCEAN POUT	495.805	2847
SEA RAVEN	335.841	606
BARNDOOR SKATE	315.603	268
WITCH FLOUNDER	254.33	699
ICELAND SCALLOP	250.416	278595
AMERICAN LOBSTER	217.381	175
WINDOWPANE	203.616	954
SPINY DOGFISH	189.876	581
GULF STREAM FLOUNDER	182.159	18016
UNKNOWN 01	159.191	101778
SMOOTH SKATE	158.985	396
AMERICAN PLAICE	135.294	628
THORNY SKATE	114.172	313
SUMMER FLOUNDER	86.827	48
NORTHERN SHORTFIN SQUID	80.35	391
WAVED WHELK	76.859	1883
WHITE HAKE	30.601	58
NORTHERN SAND LANCE	28.004	2693
ATLANTIC MACKEREL	20.825	105
ROSETTE SKATE	18.832	102
BLUEFISH	15.7	3
FAWN CUSK-EEL	15.208	697
ATLANTIC HAGFISH	14.056	202
NORTHERN HORSEMUSSEL	12.807	63
SNAKE EEL UNCL	10.553	893
BUTTERFISH	10.503	137
LONGFIN SQUID	9.68	186
FOURBEARD ROCKLING	9.08	229
CUNNER	8.966	42
ATLANTIC WOLFFISH	5.686	8
CHAIN DOGFISH	5.207	20
SPOONARM OCTOPUS	4.848	189
STRIPED SEAROBIN	3.655	56
HORSESHOE CRAB	2.814	2
TAUTOG	2.8	4
NORTHERN SEAROBIN	2.799	27
EEL UNCL	2.492	211
HOOKEAR SCULPIN UNCL	1.743	115
CONGER EEL UNCL	1.617	11
BLACK SEA BASS	1.394	13
ICELAND SCALLOP CLAPPER	1.315	10824
WRYMOUTH	1.274	15
BOBTAIL UNCL	1.068	314
SEA LAMPREY	1.04	1
ROCK GUNNEL	1.028	160
ATLANTIC HERRING	0.984	14
SPIDER CRAB UNCL	0.91	6
GRUBBY	0.847	207
ARMORED SEAROBIN	0.814	2
COMMON OCTOPUS	0.685	26
OCTOPUS UNCL	0.589	25
LADY CRAB	0.482	9
RADIATED SHANNY	0.418	53
MOUSTACHE SCULPIN	0.398	88
ACADIAN REDFISH	0.335	14
SILVERSTRIPE HALFBEAK	0.3	2

Common Name	Catch Weight (Kg)	Catch Number
SEA SCALLOP	219036.387	3928515
ASTROPECTEN SP	9641.867	2857195
BOREAL ASTERIAS	4688.623	702772
SEA STAR, BRITTLE STAR	2734.785	701228
ICELAND SCALLOP	250.416	278595
UNKNOWN 01	159.191	101778
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RED HAKE	2754.371	29105
LITTLE SKATE	6919.251	25845
YELLOWTAIL FLOUNDER	1691.122	23289
GOOSEFISH	10585.756	21467
ATLANTIC ROCK CRAB	571.353	20036
GULF STREAM FLOUNDER	182.159	18016
SPOTTED HAKE	782.802	17210
SILVER HAKE	1211.716	12524
HADDOCK	638.034	11288
ICELAND SCALLOP CLAPPER	1.315	10824
FOURSPOT FLOUNDER	1067.702	7349
LONGHORN SCULPIN	1007.2	6486
JONAH CRAB	708.598	4855
WINTER SKATE	4742.209	2931
OCEAN POUT	495.805	2847
ATLANTIC COD	533.753	2820
NORTHERN SAND LANCE	28.004	2693
WAVED WHELK	76.859	1883
WINDOWPANE	203.616	954
SNAKE EEL UNCL	10.553	893
WINTER FLOUNDER	611.969	845
WITCH FLOUNDER	254.33	699
FAWN CUSK-EEL	15.208	697
AMERICAN PLAICE	135.294	628
SEA RAVEN	335.841	606
SPINY DOGFISH	189.876	581
SMOOTH SKATE	158.985	396
NORTHERN SHORTFIN SQUID	80.35	391
BOBTAIL UNCL	1.068	314
THORNY SKATE	114.172	313
BARNDOOR SKATE	315.603	268
FOURBEARD ROCKLING	9.08	229
EEL UNCL	2.492	211
GRUBBY	0.847	207
ATLANTIC HAGFISH	14.056	202
SPOONARM OCTOPUS	4.848	189
LONGFIN SQUID	9.68	186
AMERICAN LOBSTER	217.381	175
ROCK GUNNEL	1.028	160
BUTTERFISH	10.503	137
HOOKEAR SCULPIN UNCL	1.743	115
ATLANTIC MACKEREL	20.825	105
ROSETTE SKATE	18.832	102
MOUSTACHE SCULPIN	0.398	88
CLEARNOSE SKATE	0	88
PIPEFISH SEAHORSE UNCL	0.156	66
ALLIGATORFISH	0.146	64
NORTHERN HORSEMUSSEL	12.807	63
WHITE HAKE	30.601	58
ATLANTIC CALICO SCALLOP	0	57
STRIPED SEAROBIN	3.655	56
RADIATED SHANNY	0.418	53
SUMMER FLOUNDER	86.827	48
ATLANTIC SURFCLAM	0	46
CUNNER	8.966	42
NASSARIUS SP	0.029	33
NORTHERN SEAROBIN	2.799	27
COMMON OCTOPUS	0.685	26
OCTOPUS UNCL	0.589	25
UNKNOWN 02	0.254	21
CHAIN DOGFISH	5.207	20
RIGHTEYE FLOUNDER UNCL	0.024	17
WRYMOUTH	1.274	15
ATLANTIC HERRING	0.984	14
ACADIAN REDFISH	0.335	14
BLACK SEA BASS	1.394	13
SCORPIONFISH AND ROCKFIS	0.024	13
SCUP	0.267	12

Appendix 1 I. continued.

Common Name	Catch Weight (Kg)	Catch Number
SCUP	0.267	12
UNKNOWN 02	0.254	21
SNAKEBLENNY	0.167	5
PIPEFISH SEAHORSE UNCL	0.156	66
BLACKBELLY ROSEFISH	0.148	7
ALLIGATORFISH	0.146	64
SWIMMING CRAB UNCL	0.116	1
CONGER EEL	0.09	2
INSHORE LIZARDFISH	0.075	1
LIZARDFISH UNCL	0.064	1
ALEWIFE	0.062	1
SEAROBIN UNCL	0.038	1
BLUNTHEAD PUFFER	0.037	2
SCULPIN UNCL	0.036	10
SMALLMOUTH FLOUNDER	0.03	4
LONGSNOUT SEAHORSE	0.03	7
NASSARIUS SP	0.029	33
SCORPIONFISH AND ROCKFISH	0.024	13
RIGHTEYE FLOUNDER UNCL	0.024	17
PLANEHEAD FILEFISH	0.018	1
BLACKMOUTH BASS	0.01	1
SINGLESPOT FROGFISH	0.007	3
CUSK-EEL UNCL	0.007	1
NORTHERN PUFFER	0.006	2
FLOUNDER UNCL	0.005	6
CHUB MACKEREL	0.005	1
ATLANTIC SEASNAIL	0.005	2
SKATE UNCL	0.004	2
ATLANTIC SOFT POUT	0.004	1
LONGSPINE SNIPEFISH	0.002	1
SNAPPER UNCL	0.002	1
HERRING UNCL	0.001	1
HAKE UNCL	0.001	1
PANCAKE BATFISH	0.001	1
HAKE UNCL	0.001	1
CLEARNOSE SKATE	0	88
ATLANTIC SURFCLAM	0	46
ATLANTIC CALICO SCALLOP	0	57
BLACKFIN GOOSEFISH	0	1

Common Name	Catch Weight (Kg)	Catch Number
CONGER EEL UNCL	1.617	11
SCULPIN UNCL	0.036	10
LADY CRAB	0.482	9
ATLANTIC WOLFFISH	5.686	8
BLACKBELLY ROSEFISH	0.148	7
LONGSNOUT SEAHORSE	0.03	7
SPIDER CRAB UNCL	0.91	6
FLOUNDER UNCL	0.005	6
SNAKEBLENNY	0.167	5
TAUTOG	2.8	4
SMALLMOUTH FLOUNDER	0.03	4
BLUEFISH	15.7	3
SINGLESPOT FROGFISH	0.007	3
HORSESHOE CRAB	2.814	2
ARMORED SEAROBIN	0.814	2
SILVERSTRIPE HALFBEAK	0.3	2
CONGER EEL	0.09	2
BLUNTHEAD PUFFER	0.037	2
NORTHERN PUFFER	0.006	2
ATLANTIC SEASNAIL	0.005	2
SKATE UNCL	0.004	2
SEA LAMPREY	1.04	1
SWIMMING CRAB UNCL	0.116	1
INSHORE LIZARDFISH	0.075	1
LIZARDFISH UNCL	0.064	1
ALEWIFE	0.062	1
SEAROBIN UNCL	0.038	1
PLANEHEAD FILEFISH	0.018	1
BLACKMOUTH BASS	0.01	1
CUSK-EEL UNCL	0.007	1
CHUB MACKEREL	0.005	1
ATLANTIC SOFT POUT	0.004	1
LONGSPINE SNIPEFISH	0.002	1
SNAPPER UNCL	0.002	1
HERRING UNCL	0.001	1
HAKE UNCL	0.001	1
PANCAKE BATFISH	0.001	1
HAKE UNCL	0.001	1
BLACKFIN GOOSEFISH	0	1

Appendix 1 m. Surfclam/Ocean Quahog Survey catches sorted by catch weight and catch number, 1978-2005.

Common Name	Catch Weight (Kg)	Catch Number
OCEAN QUAHOG	12000.492	638256
ATLANTIC SURFCLAM	11019.067	345268
SEA SCALLOP	369.86	8281
ATLANTIC SURFCLAM BROKEN	363.29	1689
OCEAN QUAHOG CLAPPER	296.263	21849
OCEAN QUAHOG BROKEN	225.081	2114
ATLANTIC SURFCLAM CLAPPER	184.648	12118
ATLANTIC ROCK CRAB	71.127	9789
BOREAL ASTERIAS	59.545	6737
LITTLE SKATE	34.072	574
SOUTHERN QUAHOG	33.032	2155
JONAH CRAB	20.056	1614
NORTHERN MOONSNAIL	19.452	4350
LADY CRAB	18.258	1873
HORSESHOE CRAB	14.746	628
RAZOR AND JACKKNIFE CLAM	12.901	8892
ATLANTIC MACKEREL	12.4	124
SMOOTH ASTARTE	11.102	7236
WAVED WHELK	10.444	1183
GOOSEFISH	10.342	61
NORTHERN HORSEMUSSEL	8.812	745
ASTROPECTEN SP	8.663	9154
HERMIT CRAB UNCL	8.489	2272
SEA SCALLOP CLAPPER	7.88	462
NORTHERN STARGAZER	7.344	30
KNOBBED WHELK	6.324	371
NORTHERN CYCLOCARDIA	4.63	1384
SEA STAR, BRITTLE STAR	4.5	7820
CHANNELED WHELK	3.628	622
SPIDER CRAB UNCL	2.32	791
SOUTHERN QUAHOG BROKEN	1.898	8
NORTHERN SEAROBIN	1.348	88
WINDOWPANE	1.336	169
FOURSPOT FLOUNDER	1.006	78
SHARK EYE	0.908	509
ARCTIC SURFCLAM CLAPPER	0.87	9
WINTER SKATE	0.83	41
MOON SNAIL, SHARK EYE	0.753	27
WITCH FLOUNDER	0.742	2
SUMMER FLOUNDER	0.67	17
SWIMMING CRAB UNCL	0.568	9
SOUTHERN QUAHOG CLAPPER	0.519	106
ATLANTIC HERRING	0.5	1
STARGAZER UNCL	0.44	3
UNKNOWN 03	0.284	29
RED HAKE	0.172	13
AMERICAN LOBSTER	0.17	12
SPOTTED HAKE	0.154	6
STIMPSON'S WHELK	0.142	408
UNKNOWN 04	0.126	53
COARSEHAND LADY CRAB	0.108	733
FALSE QUAHOG	0.094	916
UNKNOWN 01	0.084	2238
BUTTERFISH	0.046	2
UNKNOWN 08	0.04	6
SNAKE EEL UNCL	0.028	4
CONGER EEL UNCL	0.02	1
NORTHERN SAND LANCE	0.018	51
UNKNOWN 06	0.01	8
UNKNOWN 07	0.004	2
CANCER CRAB UNCL	0.002	1
SKATE UNCL	0	1
CLEARNOSE SKATE	0	13
THORNY SKATE	0	3
CONGER EEL	0	1
SILVER HAKE	0	1
YELLOWTAIL FLOUNDER	0	25
WINTER FLOUNDER	0	5
GULF STREAM FLOUNDER	0	3
BLACK SEA BASS	0	2
SCUP	0	1
LONGHORN SCULPIN	0	3
SEA RAVEN	0	3
STRIPED SEAROBIN	0	2
SEAROBIN UNCL	0	1
ROCK GUNNEL	0	1
POLKA-DOT CUSK-EEL	0	1
OCEAN POUT	0	1
FAWN CUSK-EEL	0	1
WATER HAUL	0	293
BLUE CRAB	0	5
BLUE MUSSEL	0	204
TEN-RIDGED WHELK	0	57
NASSARIUS SP	0	158
DUCK-BILL SHELL UNCL	0	73
ARCTIC SURFCLAM	0	110
NORTHERN QUAHOG	0	38
NORTHERN QUAHOG CLAPPER	0	3
NORTHERN PROPELLER CLAM	0	9
BLOTCHED CUSK-EEL	0	2
LONGFIN SQUID	0	1
OCTOPUS UNCL	0	2
COMMON OCTOPUS	0	2
BLOTCHED SWIMMING CRAB	0	2
LANCER STARGAZER	0	2
AMERICAN SAND LANCE	0	1
UNKNOWN 02	0	2701
UNKNOWN 05	0	9

Common Name	Catch Weight (Kg)	Catch Number
OCEAN QUAHOG	12000.492	638256
ATLANTIC SURFCLAM	11019.067	345268
OCEAN QUAHOG CLAPPER	296.263	21849
ATLANTIC SURFCLAM CLAPPER	184.648	12118
ATLANTIC ROCK CRAB	71.127	9789
ASTROPECTEN SP	8.663	9154
RAZOR AND JACKKNIFE CLAM	12.901	8892
SEA SCALLOP	369.86	8281
SEA STAR, BRITTLE STAR	4.5	7820
SMOOTH ASTARTE	11.102	7236
BOREAL ASTERIAS	59.545	6737
NORTHERN MOONSNAIL	19.452	4350
UNKNOWN 02	0	2701
HERMIT CRAB UNCL	8.489	2272
UNKNOWN 01	0.084	2238
SOUTHERN QUAHOG	33.032	2155
OCEAN QUAHOG BROKEN	225.081	2114
LADY CRAB	18.258	1873
ATLANTIC SURFCLAM BROKEN	363.29	1689
JONAH CRAB	20.056	1614
NORTHERN CYCLOCARDIA	4.63	1384
WAVED WHELK	10.444	1183
FALSE QUAHOG	0.094	916
SPIDER CRAB UNCL	2.32	791
NORTHERN HORSEMUSSEL	8.812	745
COARSEHAND LADY CRAB	0.108	733
HORSESHOE CRAB	14.746	628
CHANNELED WHELK	3.628	622
LITTLE SKATE	34.072	574
SHARK EYE	0.908	509
SEA SCALLOP CLAPPER	7.88	462
STIMPSON'S WHELK	0.142	408
KNOBBED WHELK	6.324	371
WATER HAUL	0	293
BLUE MUSSEL	0	204
WINDOWPANE	1.336	169
NASSARIUS SP	0	158
ATLANTIC MACKEREL	12.4	124
ARCTIC SURFCLAM	0	110
SOUTHERN QUAHOG CLAPPER	0.519	106
NORTHERN SEAROBIN	1.348	88
FOURSPOT FLOUNDER	1.006	78
DUCK-BILL SHELL UNCL	0	73
GOOSEFISH	10.342	61
TEN-RIDGED WHELK	0	57
UNKNOWN 04	0.126	53
NORTHERN SAND LANCE	0.018	51
WINTER SKATE	0.83	41
NORTHERN QUAHOG	0	38
NORTHERN STARGAZER	7.344	30
UNKNOWN 03	0.284	29
MOON SNAIL, SHARK EYE	0.753	27
YELLOWTAIL FLOUNDER	0	25
SUMMER FLOUNDER	0.67	17
RED HAKE	0.172	13
CLEARNOSE SKATE	0	13
AMERICAN LOBSTER	0.17	12
ARCTIC SURFCLAM CLAPPER	0.87	9
SWIMMING CRAB UNCL	0.568	9
NORTHERN PROPELLER CLAM	0	9
UNKNOWN 05	0	9
SOUTHERN QUAHOG BROKEN	1.898	8
UNKNOWN 06	0.01	8
SPOTTED HAKE	0.154	6
UNKNOWN 08	0.04	6
WINTER FLOUNDER	0	5
BLUE CRAB	0	5
SNAKE EEL UNCL	0.028	4
STARGAZER UNCL	0.44	3
THORNY SKATE	0	3
GULF STREAM FLOUNDER	0	3
LONGHORN SCULPIN	0	3
SEA RAVEN	0	3
NORTHERN QUAHOG CLAPPER	0	3
WITCH FLOUNDER	0.742	2
BUTTERFISH	0.046	2
UNKNOWN 07	0.004	2
BLACK SEA BASS	0	2
STRIPED SEAROBIN	0	2
BLOTCHED CUSK-EEL	0	2
OCTOPUS UNCL	0	2
COMMON OCTOPUS	0	2
BLOTCHED SWIMMING CRAB	0	2
LANCER STARGAZER	0	2
ATLANTIC HERRING	0.5	1
CONGER EEL UNCL	0.02	1
CANCER CRAB UNCL	0.002	1
SKATE UNCL	0	1
CONGER EEL	0	1
SILVER HAKE	0	1
SCUP	0	1
SEAROBIN UNCL	0	1
ROCK GUNNEL	0	1
POLKA-DOT CUSK-EEL	0	1
OCEAN POUT	0	1
FAWN CUSK-EEL	0	1
LONGFIN SQUID	0	1
AMERICAN SAND LANCE	0	1

Appendix 1 n. Atlantic Herring Survey catches sorted by catch weight and catch number, 1998-2006.

Common Name	Catch Weight (Kg)	Catch Number
SPINY DOGFISH	30526.551	1668
ATLANTIC HERRING	28701.962	194457
ACADIAN REDFISH	3716.578	13935
SILVER HAKE	1379.976	80032
HADDOCK	375.286	683
SHORTFIN MAKO	250	2
LUMPFISH	219.708	126
NORTHERN SEAROBIN	91.43	65
POLLOCK	83.183	17
BAY ANCHOVY	75.001	701
THRESHER SHARK	70	1
NORTHERN SHORTFIN SQUID	67.53	726
SHRIMP UNCL	60.407	6781
ATLANTIC MACKEREL	59.644	568
NORTHERN SHRIMP	49.221	3665
UNCLASSIFIED FISH	39.804	32
LONGFIN SQUID	38.794	44
BLUEFISH	36.21	12
STRIPED ANCHOVY	25.036	1258
PANDULUS PROPINQUUS	19.139	64
BUTTERFISH	16.106	779
GOOSEFISH	13.928	285
RED HAKE	12.306	318
LANTERNFISH UNCL	7.008	452
AMERICAN SHAD	5.644	19
WEITZMANS PEARLSIDES	5.1	3450
ALEWIFE	3.634	32
SHRIMP (PINK,BROWN,WHITE)	2.04	57
BARRACUDINA UNCL	1.49	94
SEA LAMPREY	1.14	2
AMERICAN PLAICE	0.894	15
SLENDER SNIPE EEL	0.8	121
SPIDER CRAB UNCL	0.742	1
WITCH FLOUNDER	0.438	49
LONGHORN SCULPIN	0.403	4
BUCKLER DORY	0.4	1
RIDGED SLIPPER LOBSTER	0.4	12
WHITE BARRACUDINA	0.397	34
ATLANTIC SAURY	0.39	5
RIGHTEYE FLOUNDER UNCL	0.301	8
SQUID, CUTTLEFISH, AND O	0.3	59
BOBTAIL UNCL	0.212	49
WHITE SHRIMP	0.194	2
SEA SCALLOP CLAPPER	0.17	1
GREENLAND HALIBUT	0.14	1
HAKE UNCL	0.101	9
SCORPIONFISH AND ROCKFISH	0.089	61
UNKNOWN 01	0.079	70
SHIELD BOBTAIL	0.071	15
SQUALIDAE	0.06	1
ATLANTIC NEEDLEFISH	0.056	1
DAUBED SHANNY	0.048	45
YELLOWTAIL FLOUNDER	0.046	2
BLUE RUNNER	0.044	1
SEA RAVEN	0.04	2
ATLANTIC SOFT POUT	0.038	41
SNAKEBLENNY	0.035	4
GULF STREAM FLOUNDER	0.034	1
ATLANTIC COD	0.033	10
WHITE HAKE	0.033	12
GRENADIER UNCL	0.032	6
LOOKDOWN	0.018	12
RAINBOW SMELT	0.015	3
BLUEBACK HERRING	0.014	1
BARRELFISH	0.008	2
BLUESPOTTED CORNETFISH	0.006	1
ROUGH SCAD	0.006	2
HATCHETFISH UNCL	0.004	1
LINED SEAHORSE	0.004	1
LEFTEYE FLOUNDER UNCL	0.004	4
SHORT BIGEYE	0.003	1
BIGEYE	0.002	2
OCEAN POUT	0.002	1
MACKEREL SCAD	0.002	1
SILVER HATCHETFISH	0.002	26
PEARLFISH	0.002	7
OCTOPUS UNCL	0.002	6
WINDOWPANE	0.001	1
ALLIGATORFISH	0.001	1
PUFFER UNCL	0.001	1
EEL UNCL	0	3
LING UNCL	0	5
ATLANTIC MOONFISH	0	5
BLACKBELLY ROSEFISH	0	1
DEEPBODY BOARFISH	0	1
ARMORED SEAROBIN	0	1
SMOOTH PUFFER	0	1
SIMONYS FROSTFISH	0	1
CHAULIODUS DANAE	0	25
PARALEPIS COREGONOIDES	0	3
BARRACUDA UNCL	0	2
WHITEBONE PORGY	0	1
LIGHTFISH UNCL	0	29
UNKNOWN 02	0	9
UNKNOWN 03	0	11

Common Name	Catch Weight (Kg)	Catch Number
ATLANTIC HERRING	28701.962	194457
SILVER HAKE	1379.976	80032
ACADIAN REDFISH	3716.578	13935
SHRIMP UNCL	60.407	6781
NORTHERN SHRIMP	49.221	3665
WEITZMANS PEARLSIDES	5.1	3450
SPINY DOGFISH	30526.551	1668
STRIPED ANCHOVY	25.036	1258
BUTTERFISH	16.106	779
NORTHERN SHORTFIN SQUID	67.53	726
BAY ANCHOVY	75.001	701
HADDOCK	375.286	683
ATLANTIC MACKEREL	59.644	568
LANTERNFISH UNCL	7.008	452
RED HAKE	12.306	318
GOOSEFISH	13.928	285
LUMPFISH	219.708	126
SLENDER SNIPE EEL	0.8	121
BARRACUDINA UNCL	1.49	94
UNKNOWN 01	0.079	70
NORTHERN SEAROBIN	91.43	65
PANDULUS PROPINQUUS	19.139	64
SCORPIONFISH AND ROCKFISH	0.089	61
SQUID, CUTTLEFISH, AND O	0.3	59
SHRIMP (PINK,BROWN,WHITE)	2.04	57
WITCH FLOUNDER	0.438	49
BOBTAIL UNCL	0.212	49
DAUBED SHANNY	0.048	45
LONGFIN SQUID	38.794	44
ATLANTIC SOFT POUT	0.038	41
WHITE BARRACUDINA	0.397	34
UNCLASSIFIED FISH	39.804	32
ALEWIFE	3.634	32
LIGHTFISH UNCL	0	29
SILVER HATCHETFISH	0.002	26
CHAULIODUS DANAE	0	25
AMERICAN SHAD	5.644	19
POLLOCK	83.183	17
AMERICAN PLAICE	0.894	15
SHIELD BOBTAIL	0.071	15
BLUEFISH	36.21	12
RIDGED SLIPPER LOBSTER	0.4	12
WHITE HAKE	0.033	12
LOOKDOWN	0.018	12
UNKNOWN 03	0	11
ATLANTIC COD	0.033	10
HAKE UNCL	0.101	9
UNKNOWN 02	0	9
RIGHTEYE FLOUNDER UNCL	0.301	8
PEARLFISH	0.002	7
GRENADIER UNCL	0.032	6
OCTOPUS UNCL	0.002	6
ATLANTIC SAURY	0.39	5
LING UNCL	0	5
ATLANTIC MOONFISH	0	5
LONGHORN SCULPIN	0.403	4
SNAKEBLENNY	0.035	4
LEFTEYE FLOUNDER UNCL	0.004	4
RAINBOW SMELT	0.015	3
EEL UNCL	0	3
PARALEPIS COREGONOIDES	0	3
SHORTFIN MAKO	250	2
SEA LAMPREY	1.14	2
WHITE SHRIMP	0.194	2
YELLOWTAIL FLOUNDER	0.046	2
SEA RAVEN	0.04	2
BARRELFISH	0.008	2
ROUGH SCAD	0.006	2
BIGEYE	0.002	2
BARRACUDA UNCL	0	2
THRESHER SHARK	70	1
SPIDER CRAB UNCL	0.742	1
BUCKLER DORY	0.4	1
SEA SCALLOP CLAPPER	0.17	1
GREENLAND HALIBUT	0.14	1
SQUALIDAE	0.06	1
ATLANTIC NEEDLEFISH	0.056	1
BLUE RUNNER	0.044	1
GULF STREAM FLOUNDER	0.034	1
BLUEBACK HERRING	0.014	1
BLUESPOTTED CORNETFISH	0.006	1
HATCHETFISH UNCL	0.004	1
LINED SEAHORSE	0.004	1
SHORT BIGEYE	0.003	1
OCEAN POUT	0.002	1
MACKEREL SCAD	0.002	1
WINDOWPANE	0.001	1
ALLIGATORFISH	0.001	1
PUFFER UNCL	0.001	1
BLACKBELLY ROSEFISH	0	1
DEEPBODY BOARFISH	0	1
ARMORED SEAROBIN	0	1
SMOOTH PUFFER	0	1
SIMONYS FROSTFISH	0	1
WHITEBONE PORGY	0	1

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