NOAA FISHERIES
Protected Resources Division

This Biological Opinion is no longer active.

Please visit http://www.nero.noaa.gov/Protected/section7/BiOps/ to find active Biological Opinions.

DRAFT

NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

Agency: US Department of Transportation, Maritime Administration
Washington, DC

Activity: Reinitiation of consultation on issuance of license to Northeast Gateway Energy Bridge, LLC by MARAD to construct, own, and operate an LNG deepwater port
F/NER/2007/07653

Conducted by: National Marine Fisheries Service
Northeast Regional Office

Date Issued: 11/30/07

Approved by: Rio Martinez for Patricia Kurkul

DRAFT

This constitutes NOAA's National Marine Fisheries Service's (NMFS) biological opinion (BO) on the effects of the Maritime Administration's (MARAD) issuance of a license to Northeast Gateway Energy Bridge LLC (NEG) to own, construct, and operate a liquefied natural gas (LNG) deepwater port off the coast of Massachusetts on threatened and endangered species in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). MARAD has served as the lead Federal action agency for this consultation, but this BO also considers the effects of permits issued by the Federal Energy Regulatory Commission (FERC) for the NEG pipeline lateral, the Army Corps of Engineers (ACOE) for the construction of the port and portions of the pipeline, and the Environmental Protection Agency (EPA) for permits under the Clean Water Act and Clean Air Act. This BO is based on information provided in the NEG LNG Deepwater Port License Draft Environmental Impact Statement (DEIS) and Final Environmental Impact Statement (FEIS), correspondence with MARAD, the previous BO dated February 5, 2007 on the issuance of a license to NEG to construct, own, and operate an LNG deepwater port (F/NER/2006/04293) and other sources of information. A complete administrative record of this consultation will be kept at the NMFS Northeast Regional Office. Formal consultation was reinitiated on November 29, 2007.

TABLE OF CONTENTS

CONSULTATION HISTORY 3

DESCRIPTION OF THE PROPOSED ACTION 4

STATUS OF AFFECTED SPECIES 18

ENVIRONMENTAL BASELINE 59

EFFECTS OF THE PROPOSED ACTION 81

CUMULATIVE EFFECTS 119

INTEGRATION AND SYNTHESIS OF EFFECTS 121

CONCLUSION 122

INCIDENTAL TAKE STATEMENT 122

CONSERVATION RECOMMENDATIONS 125

REINITIATION OF CONSULTATION 127

LITERATURE CITED 128

APPENDICES

APPENDIX A: SBNMS Passive Acoustic Buoy Proposals 157
APPENDIX B: Vessel Operating Procedures 164

DRAFT

1.0 CONSULTATION HISTORY

On June 13, 2005, NEG LNG submitted an application to the US Coast Guard (USCG) and MARAD under the Deepwater Port Act (DWPA) for all federal authorizations required for a license to own, construct, and operate a deepwater port off the coast of Massachusetts. In accordance with the interagency Memorandum of Understanding (MOU) Related to the Licensing of Deepwater Ports signed by the Department of Commerce on February 2, 2004, the USCG requested comments on NEG's application from NOAA in order to assist the USCG in their "completeness review" determination and allow NOAA to provide recommendations about additional information required to evaluate the project's impacts on NOAA's programs and areas of responsibility. In a letter dated June 28, 2005, NOAA submitted recommendations to the USCG regarding several programs under NMFS jurisdiction, including the Endangered Species Act of 1973 (ESA), as amended. Comments regarding the ESA indicated that the application addressed the range of anticipated impacts on all listed species in the project area, and it was evident from this information that the construction and operation of the proposed port may affect listed species. NOAA indicated that consultation pursuant to section 7 of the ESA would be required due to the project's potential to affect listed species. Based on the input provided by NOAA and other Federal agencies, in a letter dated August 19, 2005, the USCG informed NEG that the application had been deemed complete, and review under the DWPA and the National Environmental Policy Act (NEPA) could begin.

In a letter dated December 22, 2005, the USCG submitted a request to NMFS for information on the presence of species protected under the ESA in the vicinity of the proposed deepwater port and initiation of informal consultation pursuant to section 7 of the ESA. NMFS responded in a letter dated January 27, 2006 that several species of threatened and endangered sea turtles and whales were known to be present in the vicinity of the project location, and reiterated the statements made in NOAA's completeness review comments. NMFS indicated that no additional information had been provided since NOAA's June 28, 2005 completeness letter, and that consultation could continue once the USCG provided NMFS with a biological assessment (BA) for the proposed NEG project. On May 19, 2006, the USCG issued the DEIS for the NEG project. The DEIS identified potential adverse effects to listed whales from construction and operational noise and the increased risk of ship strike due to increased vessel traffic at the port. In a letter dated June 22, 2006, NMFS recommended that the USCG/MARAD initiate formal ESA consultation for the NEG project as soon as possible in order to prevent delays in the regulatory timelines under the DWPA.

In response to this recommendation, MARAD submitted a letter to NMFS dated June 28, 2006 (received on June 29, 2006) requesting initiation of formal consultation for potential adverse effects to the North Atlantic right whale, and requesting that the DEIS be considered as the BA for purposes of consultation. However, MARAD elected not to identify a preferred alternative in the DEIS for the NEG project. NMFS staff met with the USCG and NEG on July 20, 2006 to clarify elements of the project that should be used as the project description for the formal consultation process. NMFS staff also identified additional information that would be necessary to initiate formal consultation.

DRAFT

NEG and the USCG provided the necessary information to NMFS by August 21, 2006. In a letter dated September 18, 2006, NMFS confirmed August 21, 2006 as the date of initiation of formal consultation.

During this consultation, NMFS assessed the impacts of construction and operation of the NEG port on listed species, and issued a biological opinion (BO) on February 5, 2007. The BO concluded that project activities were likely to result in take of Northern right (*Eubalaena glacialis*), humpback (*Megaptera novaeaengliae*), and fin (*Balaenoptera physalus*) whales in the form of harassment, but were not likely to jeopardize the continued existence of these species. Because takes had not yet been authorized pursuant to section 101(a)(5) of the Marine Mammal Protection Act (MMPA), the February 5, 2007 BO did not include an incidental take statement (ITS). NEG was issued an Incidental Harassment Authorization (IHA) on May 7, 2007. Subsequently, an ITS was appended to the BO on May 14, 2007.

NEG began construction as scheduled in May 2007. On November 15, 2007, NMFS received a letter from NEG indicating that although construction work was substantially completed, a limited amount of work would need to extend past the November 30 construction window described and evaluated in the original project description for the NEG port. After evaluating the description of the remaining work to be done under the revised permits (allowing construction through December) and the marine mammal monitoring reports submitted to date, NMFS determined that the project had been modified in a manner that may affect endangered whales to an extent not previously considered, and that the anticipated take level described in the incidental take statement (ITS) appended to the February 5, 2007 BO had likely been exceeded. Therefore, after discussions with MARAD and other Federal agencies with permitting authorities for the NEG project, consultation was reinitiated on November 29, 2007.

2.0 DESCRIPTION OF THE PROPOSED ACTION

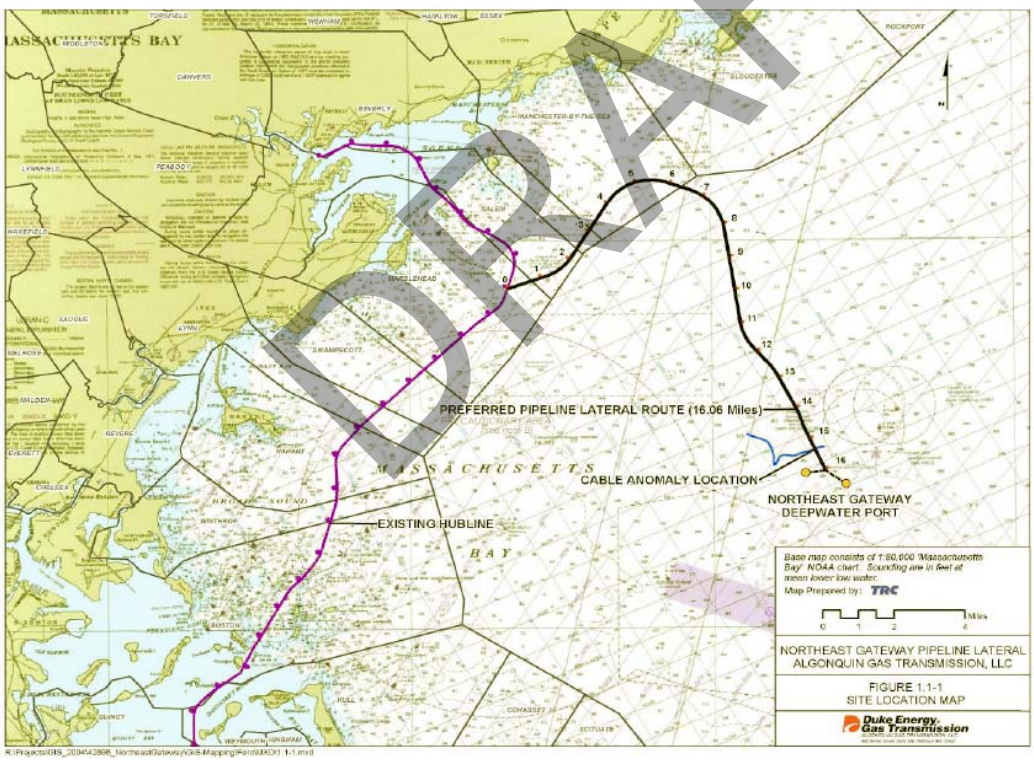
MARAD proposes to issue a deepwater port (DWP) license pursuant to the Deepwater Port Act (DWPA) to NEG LNG LLC (NEG) to construct, own, and operate a liquefied natural gas (LNG) deepwater port in the Federal waters of the Outer Continental Shelf (OCS), approximately 13 miles (21 km) south-southeast of Gloucester, Massachusetts (Figure 1) in federal waters approximately 250-270 feet deep (76-82 m). The port would consist of two submerged turret loading (STL) buoys separated by approximately 1 nautical mile, each capable of mooring an Energy Bridge Regasification Vessel (EBRV) custom designed to store, transport, and vaporize approximately 4.9 million cubic feet (138,000 cubic meters) of LNG. The port is also designed to accommodate 2nd generation EBRVs with larger capacities of up to 3.2 billion cubic feet. Once vaporized, the LNG would be sent out through conventional subsea pipelines. Each buoy would be anchored to the sea floor by eight suction anchors connected to wire rope and chain mooring lines (Figure 2). When not connected to an EBRV, the unloading buoys would be submerged approximately 82 ft (25 m) below the sea surface. When an EBRV arrives at the port, the unloading buoy would be retrieved and locked into position, after which the natural gas would be vaporized and unloaded directly into a connecting pipeline and delivered to the northeast US market through the existing pipeline infrastructure. In conjunction with NEG's

DRAFT

application for a deepwater port license, Algonquin Gas Transmission, LLC (Algonquin), a subsidiary of Duke Energy Gas Transmission, also submitted an application to the Federal Energy Regulatory Commission (FERC) for the construction and operation of the 24-inch diameter, 16.1 mile pipeline lateral that will connect the port to the existing HubLine natural gas pipeline in Massachusetts Bay.

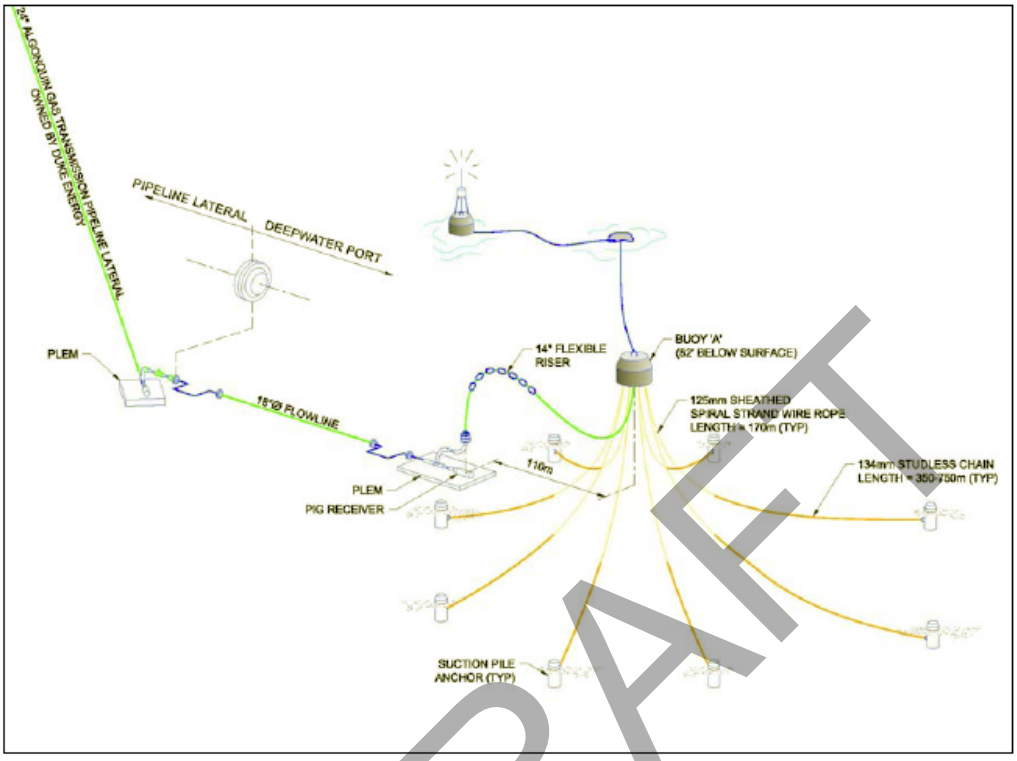
The dual buoy design would allow natural gas to be delivered in a continuous flow without interruption by having a brief overlap between arriving and departing EBRVs. The port is designed to deliver a baseload delivery of 400 million standard cubic feet per day (MMscfd), with a peak capacity of 800 MMscfd per day with two vessels simultaneously unloading natural gas. At the average capacity of 400 MMscfd per day, 65 EBRV roundtrips per year would be required to supply the port with a continuous flow of LNG. An EBRV would typically moor at the deepwater port for approximately 7-8 days. As the EBRV is concluding the unloading process, a second EBRV would arrive at the unoccupied buoy, attach to the buoy, and begin unloading as the first EBRV detaches from the buoy and departs. Both buoys would be occupied simultaneously approximately 10% of the time.

Figure 1. Project location



DRAFT

Figure 2. NEG port schematic



DRAFT

2.1 Port Operations

Vessel Activity

EBRVs calling at the NEG port will consist of both EBRVs owned and operated by NEG and vessels chartered under long-term contracts. Current first generation EBRVs are double-hulled, approximately 277 m (909 ft) in length and 43 m (141 ft) breadth, with a draft of 12.3 m (40.4 ft) and a storage capacity of approximately 138,000 m^3. Future 2nd generation EBRVs will be approximately 291 m (955 ft) in length, 43.4 m (142.4 ft) breadth, have a draft of approximately 12.4 m (40.7 ft), and a capacity of approximately 150,900 m^3 (3.2 BCF). Two bow thrusters and one stern thruster will provide improved maneuvering when approaching the buoys.

As stated previously, 65 roundtrip EBRV transits will take place each year to supply a continuous flow of natural gas into the pipeline. Supply locations have not yet been determined, but will come from areas such as Trinidad, northern Europe, and the Middle East. EBRVs transiting to the NEG port from cargo sources generally south of Gibraltar or coming north from areas such as Trinidad would most likely be traversing the Great South Channel right whale critical habitat area and would enter the Boston TSS near the entry point of the TSS as soon as practicable. EBRVs transiting to the NEG port from cargo sources in northern Europe or the Middle Eastern region will generally follow the Great Circle approach to North America. The most practical point at which the EBRVs might enter the Boston TSS will be in the Off Race

Point area generally north of the point before the TSS angles to the southeast. Figure 3 shows the typical routes from Egypt and Trinidad, which represents the broadest probable range within which EBRVs may be transiting.

Figure 3. Approximate EBRV routes from Egypt and Trinidad

DRAFT

EBRVs carrying LNG typically travel at speeds up to 19.5 knots. However, NEG EBRVs would reduce speed to 12 knots within the TSS year-round, and to a maximum of 10 knots from April 1-July 31 in the Great South Channel (GSC) seasonal management area (SMA), January 1-May 15 in Cape Cod Bay, and from March 1-April 30 in the Off Race Point SMA, as defined in section 2.4.

Regasification System

Once an EBRV is connected to a buoy, the vaporization of LNG and send-out of natural gas can begin. The LNG would first be pressurized using high pressure LNG pumps and would then be injected into deck-mounted shell-and-tube vaporization units which would warm and vaporize the LNG to natural gas. Approximately 2.5% of the EBRV's LNG would be used to fuel on-board natural gas-fired boilers, which would produce steam to heat fresh water circulated through the shell-and-tube vaporizers in a closed-loop system. Each EBRV has six shell-and-tube vaporizers on board, with up to five typically in operation at any one time, with the sixth available as back up, or for use during peak demand.

Water withdrawal and discharge

Because the NEG regasification system will operate on a closed-loop system, seawater withdrawal will not be necessary for warming and vaporizing the LNG. However, seawater

intake will be necessary for ballasting purposes as the EBRV cargo is offloaded, and for cooling water for the engines powering the regasification process.

The EBRVs would use a total of approximately 39.78 million gallons of seawater per regasification cycle, i.e. every 7-8 days, for an average withdrawal of about 4.97 million gallons per day (mgd). Seawater will be taken in through four screened sea chests with gratings 0.20 inches in diameter with 0.83 inches of open space between the gratings. The sea chests are located at starboard high, starboard low, port high, and port low. The high sea chests are located about 23 feet below the surface of the water and draw water horizontally through the grids, while the low sea chests are approximately 38 feet below the water surface and draw water vertically through the grids. Under normal operating conditions, the calculated through-screen velocity of the water withdrawn would be 0.82 feet per second (fps), and would occur only on the first and last day of each regasification cycle. Once the closed-loop process commences, through-screen velocity would be reduced to less than 0.5 fps.

The EBRV would also discharge an average of about 3.08 mgd. Much of this discharge will be cooling water, which is discharged at an average temperature of 10°F warmer than the intake temperature. Other discharges would be attributed to galley, hotel services, and sanitary wastes, and would include food waste reduced to small fragments, gray water, and treated black water. Approximately 0.005 mgd of treated wastewater would be discharged at the port location. All other waste would be retained aboard for disposal in accordance with MARPOL regulations.

2.2 Project Construction

Schedule

On-site construction/installation activities in Massachusetts Bay are scheduled to take place from May-December 2007. These activities include the installation of the "hot tap" on the existing HubLine Pipeline; the lay, burial, and commissioning of the Pipeline Lateral commencing at the hot tap and extending to a location near the Northeast Port; and the installation of the Northeast Port buoys, risers, pipeline end manifolds (PLEMs), and flowlines.

The anticipated offshore construction sequence is as follows:

- Hot tapping of the HubLine Pipeline
- Preparation of the Hibernia cable crossing and removal of any obstructions along the pipeline route
- Fabrication and laying of the Pipeline Lateral on the seafloor
- Trenching in or lowering of the Pipeline Lateral by plowing will be done following pipe lay. Some short sections will require use of a jetting tool to lower the pipeline.
- Filling pipe with seawater prior to backfilling
- Covering the pipe in the trench with sediment using a backfill plow
- Hydrotesting, tying-in and drying the pipeline following burial of the pipeline and its components
- Placement sand and/or rock at discrete tie-ins, side taps and other remedial locations and the performing final surveying activities.
- Installation of port components

DRAFT

Port Installation
The components of the port include the STL buoys, risers, pipeline end manifolds (PLEMs), and flowlines. Construction of the port will involve the placement of suction anchors into the seafloor, connection of anchor lines, installation of flow lines from the Algonquin pipeline, and placement of PLEMs at the end of the flow lines which connect with the flexible riser and the STL buoys.

The suction anchors would be installed in an array within a radius of 1738-3050 ft (530-930 m) of the center of each unloading buoy. Suction anchors would be approximately 20 ft (6 m) in diameter and 40 ft (12 m) long.

Pipeline Installation
The Algonquin Pipeline Lateral to connect the NEG port to the existing HubLine natural gas pipeline would consist of 16.1 miles of 24-inch diameter pipeline. The pipeline would originate at the existing HubLine in waters approximately 3 miles east of Marblehead, Massachusetts, then extend toward the northeast, crossing Salem, Beverly, and Manchester-by-the-Sea for approximately 6.3 miles. The route would then start a bend to the east and southeast for approximately 6.2 miles, where it would leave state waters and enter federal waters and continue south for another 3.6 miles before terminating at the proposed flowline for Buoy A of the NEG port (see Figure 1 for pipeline route).

Construction of the pipeline includes pipeline laying, plowing to lower the pipeline below the seabed, backfill plowing to cover the pipeline, and tie-in to the existing HubLine. The pipeline would have at least 1.5 feet of cover. Post-lay plowing is the primary method of pipe lowering, involving an anchored lay barge and a burial plow. Transition sections and other areas where the plow cannot lower the pipeline would use an ROV or diver-assisted jetting tool or a diver-operated hand jet to excavate the pipeline trench. At the Hibernia crossing, the cable anomaly at milepost 15.3, and at sites where plowing and trenching would not be feasible, the pipeline would be laid on the surface and armored with rock or concrete mats.

Hydrostatic Pipeline Integrity Testing
Following laying, trenching, and burial of the pipeline, hydrostatic pipeline integrity testing will take place. Hydrostatic testing of the pipeline involves withdrawal of 1.9 million gallons of seawater injected with a biocide to inhibit corrosion. The flowlines would require one-time use of 85,000 gallons of seawater, also treated with a biocide. Prior to discharge, the test water would be pumped onto a barge and neutralized and aerated. Residual biocide concentrations would be monitored.

Construction Vessels
Most construction vessel transits will occur between construction sites and local ports, i.e. vessels will be transiting Massachusetts Bay. However, some vessels and pipeline deliveries may originate from the Gulf of Mexico. During the seven month construction period, a total of approximately 209 construction vessel roundtrip transits would occur, including the lay barge and all support and supply vessels.

DRAFT

While transiting to and from the construction sites, all vessels 300 gross tons and larger would travel at 10 knots or less. Crew and supply boats less than 300 gross tons would move at speeds up to 15 knots, but would follow all ship strike minimization measures described in section 2.4, including reduced speeds of ten knots or less during seasonal periods of right whale occurrence. Vessels transiting through the Cape Cod Canal and Cape Cod Bay from the Gulf of Mexico will follow the recommended routes charted by NOAA to minimize risk of collision with right whales.

2.3 Decommissioning

The NEG deepwater port would have an expected operating life of 40 years, although the license will be issued for a 25-year period. Operations continuing beyond the initial 25-year license would require review and approval of a new license at that time. At the conclusion of the useful life of the port, the decommissioning of the NEG port would involve the following steps:

- All port components in the water column would be retrieved, including the STL buoys, flexible risers, and wire rope mooring segments
- Each suction pile anchor would be recovered by reverse pumping, with its respective ground chain segment retrieved.
- Spool pieces connecting the PLEMs to the flowlines would be disconnected and retrieved to the surface.
- Each PLEM would be retrieved from the seabed.
- The portion of each flowline that was not buried would be recovered by mechanically severing each flowline where it began burial, and retrieving the unburied reach.
- Diver jetting operations would lower the end of each flowline to at least 18 inches below the mud line, and any depressions would be restored with sand or equivalent
- Spoolpieces connecting the flowlines to the Pipeline Lateral would remain buried.

At the end of the pipeline's useful life, Algonquin would be required to obtain the necessary permission to abandon its facilities. The pipeline would be purged and flooded with seawater. Blind flanges would be installed on each end and the pipe would be abandoned in place.

2.4 Mitigation Measures

MARAD/USCG and NEG have proposed to incorporate several mitigation measures into the project design to minimize impacts on endangered species. Since this BO covers activities under the authority of several Federal agencies that issue permits for various portions of the construction and operation of the proposed NEG DWP, MARAD/USCG, as the lead Federal action agency for this consultation, has agreed to ensure that the following mitigation measures proposed by NEG or MARAD/USCG are implemented either through the DWP license, the NEG port operations manual, or the appropriate Federal permit. Prior to the start of construction or operation, MARAD/USCG will inform NMFS how these measures have been implemented and which Federal agency is responsible for monitoring these items as conditions of their permit.

DRAFT

Construction Mitigation Measures

General

- Northeast Gateway and Algonquin will employ two (2) NMFS-approved endangered species observers (marine mammal observers, MMOs) on each pipeline lay barge, bury barge and diving support vessel for visual shipboard surveys during construction activities. Qualifications for these individuals will include direct field experience on a marine mammal/sea turtle vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico. The observers (one primary and one secondary) are responsible for visually locating marine mammals and sea turtles at the ocean's surface and to the extent possible, identifying the species. The primary observer will act as the identification specialist and the secondary observer will serve as data recorder and also assist with identification; however, both observers will have responsibility for monitoring for the presence of marine mammals and sea turtles. All observers will meet the experience requirements established by NMFS.

- The shipboard observers will monitor the construction area beginning at daybreak using 7x power binoculars and/or hand-held binoculars. Northeast Gateway and Algonquin assume a conservative effective search range of 0.5 miles during clear weather conditions for the shipboard observers. The observer will scan the ocean surface by eye for a minimum of 40 minutes every hour. All sightings will be recorded on marine mammal field sighting logs. Observations of marine mammals and sea turtles will be identified to species or the lowest taxonomic level and their relative position will be recorded.

- To demonstrate and document that whales are not being exposed to sound levels that exceed permitted thresholds, one archival and one near real-time array of passive acoustic detection buoys will be installed and operated around the construction site that meets the requirements developed by NOAA (see Appendix A). The near real-time array will be monitored by A NMFS-approved bioacoustic technician (through both listening and a visual spectrogram display) and notify the MMOs of whale presence in the project area.

- During construction, the following procedures will be followed upon detection of a marine mammal or sea turtle within 0.5 miles of the construction vessels.

    - If any marine mammals or sea turtles are visually detected within 0.5-mile of the construction vessel, the vessel superintendent or on-deck supervisor will be notified immediately. The vessel's crew will be put on a heightened state of alert. The marine mammal will be monitored constantly to determine if it is moving toward the construction area. The observer is required to report all right whale sightings to NMFS. This contact is to be made as soon as possible. The phone numbers for NMFS are 978-281-9351(entangled, dead, ship-struck, or injured whales), or 978-585-8473 (general sightings).

DRAFT

- Construction vessel(s) in the vicinity of the sighting will be directed to cease any movement and/or stop noise emitting activities that exceed 120 decibels ("dB") in the event that a right whale comes to within 500 yards of any operating construction vessel. For other whales and sea turtles this distance will be established at 100 yards. Vessels transiting the construction area such as pipe haul barge tugs will also be required to maintain these separation distances.

- Construction will resume after the marine mammal/sea turtle is positively reconfirmed outside the established zones (either 500 yards or 100 yards depending upon species).

- Operations involving excessively noisy equipment will "ramp-up" sound sources, allowing whales a chance to leave the area before sounds reach maximum levels. Contractors will be required to utilize vessel quieting technologies that minimize noise.
- During construction, weekly status reports will be provided to NMFS utilizing standardized reporting forms.

- At the conclusion of the construction period, a report will be submitted to NMFS summarizing the construction activities, endangered species sightings (both visual and acoustic), and any mitigative actions taken.

Vessel strike avoidance

- All construction and support vessels will report their activities to the mandatory ship reporting system (MSR) of the U.S. Coast Guard to remain apprised of North Atlantic right whale movements within the area. All vessels entering and exiting the MSR will report their activities to WHALESNORTH. Vessel operators will contact the USCG either by email (RightWhale.MSR@noaa.gov) or Telex (236737831). If they are unable to use satellite communications equipment, they will contact the USCG Communication Area Master Station Chesapeake VA via SITOR/NBDP on 8426.3 kHz, 12590.8 kHz, or 16817.8 kHz 24 hours per day, or 6314.3 kHz from 2300 GMT until 1100 GMT and 22387.8 kHz from 1100 GMT until 2300 GMT.

- While under way, all construction vessels will remain 500 yards away from right whales, and 100 yards away from all other whales to the extent physically feasible given navigational constraints as required by NMFS.
- All construction vessels greater than 300 gross tons will maintain a speed of 10 knots or less. Crew and supply boats, which move at up to 15 knots, when smaller than 300 gross tons will not be restricted to 10 knots; however, the crew members will be required to monitor the area for marine mammals and report any sightings to the other construction vessels operating in the area.

- Vessels transiting through the Cape Cod Canal and Cape Cod Bay between January 1-May 15 will reduce speed to ten knots or less, follow the recommended routes charted by NOAA to reduce interactions between right whales and shipping traffic, and avoid

DRAFT

identified aggregations of right whales in the eastern portion of Cape Cod Bay. To the extent practicable, pipe deliveries will be avoided during the January to May timeframe. In the unlikely event the Canal is closed during construction, the pipe haul barges would transit around Cape Cod following the TSS and all measures agreed to below for the EBRVs when transiting to the Port.

- Vessels will remain 500 yards away from North Atlantic right whales and 100 yards away from all other marine mammals and sea turtles to the extent possible.

Impingement and entrainment

- Mesh grates will be used during flooding and hydrostatic testing of the pipeline and flowline to minimize the risk of impingement and entrainment of marine mammals and sea turtles.

Marine debris/pollution

- During construction, individual crew members will be responsible for ensuring that debris is not discharged into the marine environment. Additionally, training of construction crews will include a requirement explaining that the discharge of trash and debris overboard is harmful to the marine mammals, and the environment, and is illegal under the Act to Prevent Pollution from Ships and the Ocean Dumping, depending on the type of material. Discharge of debris will therefore be prohibited, and violations will be subject to enforcement actions.

- Northeast Gateway and Algonquin will require its contractors to maintain individual Spill Prevention Control and Countermeasure ("SPCC") Plans in place for construction vessels during construction.

- In accordance with MMS NTL 2003-G11, Marine Trash and Debris placards will be placed in prominent places on all fixed and floating production facilities that have sleeping or food preparation capabilities and on mobile vessels. These notices would be referenced, and their contents explained, during any initial orientation given on the facility for visitors or occupants. Placards would be sturdy enough to withstand the local environment and would be replaced when damage or wear compromised readability.

Additional Measures for Construction in December

In addition to all of the mitigation measures described above for port and pipeline construction activities, the following measures will be implemented for work continuing into December:

- If on-board MMOs do not have at least 0.5 mile visibility, they shall call for a shutdown. If dive operations are in progress, then they shall be halted and brought on board until visibility is adequate to see a half mile range. At the time of shutdown, the use of thrusters must be minimized. If there are potential safety problems due to the shutdown, the captain will decide what operations can safely be shut down.

DRAFT

- Prior to leaving the Quincy dock to begin transit, the barge will contact one of the MMOs on watch to receive an update of sightings within the visual observation area. If the MMO has observed a North Atlantic right whale within 30 minutes of the transit start, the vessel will hold for 30 minutes and again get a clearance to leave from the MMOs on board. MMOs will assess whale activity and visual observation ability at the time of the transit request to clear the barge for release.

- A ½ day training course will be provided by the current MMO provider to designated crew members assigned to the transit barges and other support vessels. These designated crew members will be required to keep watch on the bridge and immediately notify the navigator of any whale sightings. All watch crew will sign into a bridge log book upon start and end of watch. Transit route, destination, sea conditions and any protected species sightings/mitigation actions during watch will be recorded in the log book. Any whale sightings within 1,000 m of the vessel will result in a high alert and slow speed of 4 knots or less and a sighting within 750 m will result in idle speed and/or ceasing all movement.

- MMOs will record the distances of sighted marine mammals from the dynamic positioning (DP) vessel whenever possible, along with any construction activities being conducted when animals are sighted. When possible, NEG or MMOs will obtain detailed information regarding the use of the dynamic positioning vessel thrusters (such as how many thrusters are being used) from the captain of the vessel.

- For any remaining backfill work between Mile Post (MP) 16 and MP 10 cannot be completed by November 30, Northeast Gateway shall shift DP vessel effort to MP 10 – 12.5, and upon completion of commissioning activities, the *Atlantic Horizon* (which is anchored and therefore does not generate thruster noise), could attend to backfilling between MPs 14 - 16.

- Northeast Gateway must ensure that vessel captains understand that noise generated from thrusters during DP is the most likely source of a 'take' to North Atlantic right whale, therefore, DP vessel captains shall focus on reducing thruster power to the maximum extent practicable, taking into account diver safety. Likewise, vessel captains shall shut down thrusters whenever they are not needed.

- Construction vessel(s) must cease any movement and/or cease all non-essential activities that emit noises with source level of 139 dB re 1 μPa or higher when a right whale is sighted within or approaching at 0.5 mile (805 m) from the construction vessel.

- Construction vessel(s) must cease any movement and/or cease all non-essential activities that emit noises with source level of 139 dB re 1 μPa or higher when a marine mammal other than a right whale is sighted within or approaching at 100 yd (91 m) from the construction vessel.

DRAFT

- Construction must not resume before the marine mammal is positively reconfirmed outside the established zones (either 0.5 mile (805 m) or 100 yd (91 m) range, depending upon species).

- The material barges and tugs used to transport the sand to the dive support vessels along the route shall transit from the operations dock to the work sites during daylight hours when possible provided the safety of the vessels is not compromised. Should transit at night be required, the maximum speed of the tug will be 5 knots.

- Consistent with navigation safety, all construction vessels must maintain a speed of 10 knots or less during daylight hours. All vessels will operate at 5 knots or less at all times within 5 km of the construction area.

- Northeast Gateway shall provide source level data (either empirically measured from the acoustic recording units deployed in the LNG Port construction area or referenced from similar construction projects) for construction activities in a reasonable time to NMFS.

- The weekly report shall indicate whether the marine mammals observed are within a 2 mile radius of the construction site when construction activities are ongoing, and detail, to the extent practicable, the types of construction activities that are coincident with each sighting.

DRAFT

Operational Mitigation Measures

Vessel strike avoidance

- An array of passive acoustic detection buoys will be installed in the Boston TSS that meets the criteria specified in the recommendations developed by NOAA through consultation with the USCG under the National Marine Sanctuaries Act (see Appendix A). The system will provide near real-time information on the presence of vocalizing whales in the shipping lanes.

- All EBRVs approaching or departing the port will comply with the MSR system to keep apprised of right whale sightings in the vicinity. Vessel operators will also receive active detections from the passive acoustic array prior to and during transit through the northern leg of the Boston TSS where the buoys are installed.

- In response to active right whale sightings (detected acoustically or reported through other means such as the MSR or SAS), and taking into account safety and weather conditions, EBRVs will take appropriate actions to minimize the risk of striking whales, including reducing speed to 10 knots or less and alerting personnel responsible for navigation and lookout duties to concentrate their efforts.

- All individuals onboard the EBRVs responsible for the navigation and lookout duties will receive training, a component of which will be training on marine mammal

sighting/reporting and vessel strike avoidance measures (see Appendix B for recommended vessel strike avoidance procedures). Crew training of EBRV personnel will stress individual responsibility for marine mammal awareness and reporting.

- If a marine mammal or sea turtle is sighted by a crew member, an immediate notification will be made to the Person-in-Charge on board the EBRV and the NEG Port Manager, who would ensure that the required reporting procedures were followed.

- EBRVs transiting to the NEG port from cargo sources generally south of Gibraltar or coming north from areas such as Trinidad would most likely be traversing the Great South Channel right whale critical habitat area and would try to enter the Boston TSS near the entry point of the TSS as soon as practicable. EBRVs transiting to the NEG port from cargo sources in northern Europe or the Middle Eastern region will generally follow the Great Circle approach to North America. The most practical point at which the EBRVs might enter the Boston TSS will be in the Off Race Point area generally north of the point before the TSS angles to the southeast. EBRVs will maintain speeds of 12 knots or less while in the TSS until reaching the vicinity of the buoys (except during the seasons and areas defined below, when speed will be limited to 10 knots or less). At 1.86 miles from the NEG port, speed will be reduced to 3 knots, and to less than 1 knot at 1640 feet from the buoy.

- EBRVs will reduce transit speed to 10 knots or less (unless hydrographic, meteorological, or traffic conditions dictate an alternative speed to maintain the safety or maneuverability of the vessel) from March 1-April 30 in all waters bounded by straight lines connecting the following points in the order stated below. This area will hereafter be referred to as the Off Race Point Seasonal Management Area (SMA).

  42°30′ N 70°30′ W
  42°30′ N 69°45′ W
  41°40′ N 69°45′ W
  41°40′ N 69°57′ W
  42°04.8′ N 70°10′ W
  42°12′ N 70°15′ W
  42°12′ N 70°30′ W
  42°30′ N 70°30′ W

- EBRVs will reduce transit speed to 10 knots or less (unless hydrographic, meteorological, or traffic conditions dictate an alternative speed to maintain the safety or maneuverability of the vessel) from April 1-July 31 in all waters bounded by straight lines connecting the following points in the order stated below. This area will hereafter be referred to as the Great South Channel Seasonal Management Area (SMA).

  42°30′ N 69° 45′ W
  42°30′ N 67°27′ W
  42°09′ N 67°08.4′ W

DRAFT

41°00′ N 69°05′ W
41°40′ N 69°45′ W
42°30′ N 69°45′ W

- EBRVs are not expected to transit Cape Cod Bay. However, in the event transit through Cape Cod Bay is required, EBRVs will reduce transit speed to 10 knots or less (unless hydrographic, meteorological, or traffic conditions dictate an alternative speed to maintain the safety or maneuverability of the vessel) from January 1-May 15 in all waters in Cape Cod Bay, extending to all shorelines of Cape Cod Bay, with a northern boundary of 42° 12' N latitude.

- In such cases where speeds in excess of the ten knot speed maximums as described above are required, the reasons for the deviation, the speed at which the vessel is operated, the area, and the time and duration of such deviation will be documented in the logbook of the vessel and reported to the NMFS NER Ship Strike Coordinator.

Noise

- An archival array of passive acoustic detection buoys ("pop-ups") will be installed around the port site that meets the criteria specified in the program developed by NOAA in consultation with the USCG under the National Marine Sanctuaries Act (see Appendix A). The array will be in place for five years following initiation of operations to monitor the actual acoustic output of port operations and alert NOAA to any unanticipated adverse effects of port operations, such as large-scale abandonment of the area or greater acoustic impacts than predicted through modeling.

Injured/Dead Protected Species Reporting

- During all phases of project construction and operation, sightings of any injured or dead protected species (sea turtles and marine mammals) should be reported immediately, regardless of whether the injury or death is caused by project activities. Sightings of injured or dead whales and sea turtles not associated with project activities can be reported to the USCG on VHF Channel 16, or to NMFS Stranding and Entanglement Hotline: (978) 281-9351.

- In addition, if the injury or death was caused by a project vessel (EBRV, support vessel, or construction vessel), USCG must be notified immediately and a full report will be provided to NMFS NERO. The report should include the following information:

  a. the time, date, and location (latitude/longitude) of the incident;
  b. the name and type of the vessel involved;
  c. the vessel's speed during the incident;
  d. a description of the incident;
  e. water depth;

DRAFT

f. environmental conditions (e.g., wind speed and direction, sea state, cloud cover, and visibility);
g. the species identification or description of the animal, if possible; and
h. the fate of the animal.

2.5 Action Area

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this consultation includes the two buoy sites, the pipeline route, and surrounding waters that will be ensonified by noise levels exceeding NMFS' criteria for acoustic harassment. In addition, the action area of this consultation includes the vessel transit paths for all vessel traffic associated with the project, including the Boston TSS and the approaches to the TSS from the EBRVs point of entry into the US EEZ (see Figure 3), as well as the route of construction vessel transits from Boston, MA and Gloucester, MA to the pipeline and port sites.

Table 1: NEG Port buoy locations

	Latitude	**Longitude**
Buoy A	42° 23' 40"	70° 35' 38"
Buoy B	42° 23' 59"	70° 36' 54"

The gas transmission pipeline would begin at the existing HubLine pipeline approximately 3 miles east of Marblehead Neck, Massachusetts. From this point, the pipeline would extend toward the northeast crossing the territorial waters of the town of Marblehead, the city of Salem, the city of Beverly, and the town of Manchester-by-the-Sea for approximately 6.1 miles. The transmission line route would continue to the southeast for approximately 4.8 miles crossing state and federal waters. (See Figure 1)

DRAFT

3.0 STATUS OF AFFECTED SPECIES

The following endangered or threatened species under NMFS' jurisdiction are known to be present in the action area for this consultation, and may be affected by the proposed action:

Cetaceans

Right whale (*Eubalaena glacialis*)	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered
Fin whale (*Balaenoptera physalus*)	Endangered
Sei whale (*Balaenoptera borealis*)	Endangered
Blue whale (*Balaenoptera musculus*)	Endangered
Sperm whale (*Physeter macrocephalus*)	Endangered

Sea Turtles

Loggerhead sea turtle (*Caretta caretta*)	Threatened
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered

Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered
Green sea turtle (*Chelonia mydas*[1])	Endangered/Threatened

The hawksbill turtle (*Eretmochelys imbricata*) is relatively uncommon in the waters of the continental US. Hawksbills prefer coral reefs, such as those found in the Caribbean and Central America. However, there are accounts of hawksbills in south Florida and a number are encountered in Texas each year. Most of the Texas records report small turtles, probably in the 1-2 year class range. Many captures or strandings are of individuals in an unhealthy or injured condition (Hildebrand 1982). The lack of sponge-covered reefs and the cold winters in the northern Gulf of Mexico probably prevent hawksbills from establishing a viable population in this area. No takes of hawksbill sea turtles have been recorded in northeast or mid-Atlantic fisheries covered by the NEFSC observer program. In the north Atlantic, small hawksbills have stranded as far north as Cape Cod, Massachusetts (STSSN database). Many of these strandings were observed after hurricanes or offshore storms. There have been no verified observations of hawksbills in the action area outside of rare stranding events. Based on this information, NMFS has determined that hawksbill sea turtles are not likely to occur in the action area. As such, effects of the action on hawksbills will not be considered further in this BO.

In Massachusetts, the federally endangered shortnose sturgeon (*Acipenser brevirostrum*) is only known to occur in the Merrimack and Connecticut Rivers (NMFS 1998a), neither of which are in the vicinity of the buoy locations. As such, shortnose sturgeon are not likely to be present in the action area and will not be considered further in this BO.

Critical habitat for right whales has been designated for Cape Cod Bay (CCB), Great South Channel (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. Although a portion of right whale critical habitat overlaps with the action area (GSC portion of the Boston TSS), there is no evidence to suggest that construction and operation of the proposed LNG terminal would have any adverse effects on the habitat features in the specific areas designated as right whale critical habitat. Ship traffic is the only portion of the action that will occur in right whale critical habitat, and the transient passage of vessels will have no effect on copepod distribution. Right whale critical habitat will, therefore, not be considered further in this BO.

This section will focus on the status of the various species within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action. Background information on the range-wide status of these species and a description of critical habitat can be found in a number of published documents including recent sea turtle (NMFS and USFWS 1995, USFWS 1997, TEWG 2000, NMFS SEFSC 2001) status reviews and stock assessments, Recovery Plans for the humpback whale (NMFS 1991a), right

[1] Pursuant to NMFS regulations at 50 CFR 223.205, the prohibitions of Section 9 of the Endangered Species Act apply to all green turtles, whether endangered or threatened.

DRAFT

whale (NMFS 1991b, 2005), fin and sei whale (NMFS 1998b), and the 2005 marine mammal stock assessment report (Waring et al. 2005).

The species being considered in this BO are listed under the ESA at the species level rather than as individual populations or recovery units. Since the action that is being consulted on affects only the populations in the Atlantic Ocean, this consultation will focus on the Atlantic populations of right, humpback, fin, sperm, sei, and blue whales and leatherback, Kemp's ridley, and green sea turtles, and the Atlantic subpopulations of loggerhead sea turtles. The loss of these populations/subpopulations in the Atlantic Ocean would result in a significant gap and reduction in the distribution and abundance of each species, which makes these populations/subpopulations biologically significant and would, by itself, appreciably reduce the entire species' likelihood of surviving and recovering in the wild. Since the listing under the ESA is at the species level, information on the range-wide status of each species is included to provide the reader with information on the status of each species, overall.

3.1 Right Whale

Right whales were probably the first large whale to be hunted on a systematic, commercial basis (Clapham et al. 1999). Records indicate that right whales in the North Atlantic were subject to commercial whaling as early as 1059 (Aguilar 1986). Commercial whaling for right whales along the U.S. Atlantic coast peaked in the 18th century, but right whales continued to be taken opportunistically along the coast and in other areas of the North Atlantic into the early 20th century (Kenney 2002). Right whales have occurred historically in all the world's oceans from temperate to subarctic latitudes (Perry et al. 1999). In both hemispheres, they are observed at low latitudes and in nearshore waters where calving takes place in the winter months, and in higher latitude foraging grounds in the summer (Clapham et al. 1999; Perry et al. 1999).

In 2000, the IWC reviewed the taxonomic nomenclature for right whales. Based on the results of genetic studies, the IWC formally recognized North Pacific, North Atlantic, and southern hemisphere right whales as three separate species (Best et al. 2001). In April 2003, NMFS published a final rule in the Federal Register (68 FR 17560) that amended the ESA-listing for right whales by recognizing three separate species: North Atlantic right whale (*Eubalaena glacialis*), North Pacific right whale (*Eubalaena japonica*), and southern right whale (*Eubalaena australis*). However, on January 11, 2005, another final rule was published (70 FR 1830) that removed the April 2003 final rule on the grounds that it was procedurally and substantively flawed. As a result, the ESA-listing for right whales has reverted to that in effect prior to the April 2003 rule; all right whales are listed as endangered either as Northern right whales (*Eubalaena glacialis*) or Southern right whales (*Eubalaena australis*). On December 27, 2006, NMFS issued two proposed rules to designate the North Atlantic right whale (71 FR 77704) and the North Pacific right whale (71 FR 77694) each separately as an endangered species. The proposed rules are currently undergoing public and peer review. Once these comment periods are complete, the agency will consider all comments received and finalize the proposed rule in accordance with the time frame specified by the ESA.

DRAFT

Pacific Ocean. Very little is known of the size and distribution of the North Pacific right whale stocks. Two stocks are generally recognized: a western Pacific stock in the Sea of Okhotsk and an eastern Pacific stock. The number of right whales for each stock are considered to be very low. In the eastern Pacific, sightings have been made along the coasts of Washington, Oregon, California, and Baja California south to about 27° N (Scarff 1986; NMFS 1991b) and also in Hawaii (Herman et al. 1980). However, right whales were not sighted consistently in any of these areas. In 1996, a group of 3 to 4 right whales were observed in the middle shelf of the Bering Sea, west of Bristol Bay and east of the Pribilof Islands (Goddard and Rugh 1998). Surveys conducted in July of 1997–2000 in Bristol Bay reported observations of lone animals or small groups of right whales in the same area as the 1996 sighting (Hill and DeMaster 1998, Perry et al. 1999). In 2004, the National Marine Mammal Laboratory undertook a North Pacific right whale tagging project as part of the Cetacean Assessment and Ecology Program to further investigate the presence of right whales in the eastern North Pacific (Mellinger et al. 2004). Researchers used sonobuoys to locate right whales (Mellinger et al. 2004). Two whales were located and satellite tagged (Mellinger et al. 2004). While tracking one of these whales, the scientists located 25 individual whales, more than doubling the number of known whales in the North Pacific (AFSC 2004). Although no estimate of abundance can be made at this time, all indications are that the number of eastern North Pacific right whales and, in general, all North Pacific right whales is very small.

Southern Hemisphere. A review of southern hemisphere right whales is provided in Perry et al. (1999). Since these right whales do not occur in U.S. waters, there is no recovery plan or stock assessment report for southern hemisphere right whales. Southern hemisphere right whales appear to be the most numerous of the right whales. Perry et al. (1999) provide a best estimate of abundance for southern hemisphere right whales as 7,000 based on estimates from separate breeding areas. In addition, unlike North Pacific or North Atlantic right whales, southern hemisphere right whales have shown some signs of recovery in the last 20 years. However, like other right whales, southern hemisphere right whales were heavily exploited (Perry et al. 1999). In addition, Soviet catch records made available in the 1990s (Zemsky et al. 1995) revealed that southern hemisphere right whales continued to be targeted well into the 20th century. Therefore, any indications of recovery should be viewed with caution.

Atlantic Ocean. As described above, scientific literature on right whales has historically recognized distinct eastern and western populations or subpopulations in the North Atlantic Ocean (IWC 1986). Current information on the eastern stock is lacking and it is unclear whether a viable population in the eastern North Atlantic still exists (Brown 1986, NMFS 1991b). Photo-identification work has shown that some of the whales observed in the eastern Atlantic were previously identified as western Atlantic right whales (Kenney 2002). This BO will focus on the western North Atlantic subpopulation of right whales which occurs in the action area.

Life history, habitat and distribution

Western North Atlantic right whales (hereafter referred to as "right whales") generally occur from the southeast U.S. to Canada (e.g., Bay of Fundy and Scotian Shelf) (Kenney 2002; Waring et al. 2005). Like other right whale species, they follow an annual pattern of migration between low latitude winter calving grounds and high latitude summer foraging grounds (Perry et al.

DRAFT

1999; Kenney 2002). Telemetry data have shown lengthy and somewhat distant excursions into deep water off of the continental shelf (Mate et al. 1997) as well as extensive movements over the continental shelf during the summer foraging period (Mate et al. 1992; Mate et al. 1997; Baumgartner and Mate 2005). Photo-identification data have also indicated excursions of animals as far as Newfoundland, the Labrador Basin, southeast of Greenland (Knowlton et al. 1992), and Norway (Best et al. 2001). In the winter, only a portion of the known right whale population is seen on the calving grounds. The winter distribution of the remaining right whales remains uncertain (Waring et al. 2005). Results from winter surveys and passive acoustic studies suggest that animals may be dispersed in several areas including Cape Cod Bay (Brown et al. 2002) and offshore waters of the southeastern U.S. (Waring et al. 2005).

Unknowns about right whale habitat persist. For example, some female right whales have never been observed on the Georgia/Florida calving grounds but have been observed with a calf on the summer foraging grounds (Best et al. 2001). It is unknown whether these females are calving in an unidentified calving area or have just been missed during surveys off of Florida and Georgia (Best et al. 2001). The absence of some known (photo-identified) whales from identified habitats for months or years at a time suggests the presence of an unknown feeding ground (Kenney 2002). Finally, while behavior suggestive of mating is frequently observed on the foraging grounds, conception is not likely to occur at that time given the known length of gestation in other baleen whales. More likely, mating and conception occur in the winter (Kenney 2002). Based on genetics data, it has been suggested that two mating areas may exist with a somewhat different population composition (Best et al. 2001). The location of the mating area(s) is unknown.

Critical habitat for right whales has been designated in accordance with the ESA. Following a petition from the Right Whale Recovery Team, NMFS designated three critical habitat areas for right whales in 1994. These areas are: (1) portions of Cape Cod Bay and Stellwagen Bank, (2) the Great South Channel, and (3) coastal waters off of Georgia and Florida's east coast (NMFS 1994). Right whale critical habitat in Northeast waters were designated for their importance as right whale foraging sites while the southeast critical habitat area was identified for its importance as a calving and nursery area (NMFS 1994). In 2002, NMFS received a petition to revise designated critical habitat for right whales by combining and expanding the existing Cape Cod Bay and Great South Channel critical habitats in the Northeast and by expanding the existing critical habitat in the Southeast (NMFS 2003). In response to the petition, NMFS (2003) recognized that there was new information on right whale distribution in areas outside of the designated critical habitat. However, the ESA requires that critical habitat be designated based on identification of specific habitat features essential to the conservation of the species rather than just known distribution (NMFS 2003). NMFS, therefore, denied the petition to revise critical habitat as requested by the petitioner, but also outlined an approach to investigate factors that may lead to other revisions to critical habitat (NMFS 2003).

Distribution in the action area

New England waters include important foraging habitat for right whales. At least some right whales are present in these waters throughout most months of the year, with concentrations observed in the Cape Cod Bay and Great South Channel critical habitat areas. Right whales are

DRAFT

most abundant in Cape Cod Bay between February and April (Hamilton and Mayo 1990; Schevill et al. 1986; Watkins and Schevill 1982) and in the Great South Channel in May and June (Kenney et al. 1986; Payne et al. 1990) where they have been observed feeding predominantly on copepods, largely of the genera *Calanus* and *Pseudocalanus* (Waring et al. 2005). Right whales also frequent Stellwagen Bank and Jeffrey's Ledge, as well as Canadian waters including the Bay of Fundy and Browns and Baccaro Banks, in the spring and summer months. Recent data collected by passive acoustic buoys in the SBNMS indicate that right whales may use the sanctuary, particularly the northern portion, more heavily and over a broader range of seasons than previously thought (NEFSC unpublished data). Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are thus likely a primary characteristic of the spring, summer, and fall right whale habitats (Kenney et al. 1986, 1995). The characteristics of acceptable prey distribution in these areas are not well known (Waring et al. 2005).

Status and population trends

There are relatively few right whales remaining in the western North Atlantic, although the exact number is unknown. As is the case with most wild animals, an exact count cannot be obtained. However, abundance can be reasonably estimated as a result of the extensive study of this subpopulation. IWC participants from a 1999 workshop agreed that it was reasonable to state that the number of western North Atlantic right whales as of 1998 was probably around 300 (+/- 10%) (Best et al. 2001). This conclusion was principally based on a photo-identification catalog that, as of July 1999, was comprised of more than 14,000 photographed sightings of 396 individuals, 11 of which were known to be dead and 87 of which had not been seen in more than 6 years. In addition, it was noted that relatively few new non-calf whales (whales that were never sighted and counted in the population as calves) had been sighted in recent years (Best et al. 2001), which suggests that the 396 individuals was a close approximation of the entire population.

A total of 125 right whale calves has been observed since the 1999 workshop, including a record calving season in 2000/2001 with 31 right whale births (B. Pike, New England Aquarium, pers. comm.). Calving numbers have been sporadic, with large differences among years. The three calving years (1997-2000) prior to the record year in 2000/2001 provided low recruitment with only 10 calves born, while the last six calving seasons (2000-2006) have been remarkably better with 31, 21, 19, 16, 28, and 19 births, respectively. The calf count of 19 animals for the latest calving season (2005/2006) is still preliminary and additional calves may be observed on the summer foraging grounds (B. Zoodsma, SERO, pers. comm.). However, the subpopulation has also continued to experience losses of calves, juveniles and adults. As of December 1, 2004, there were 459 individually identified right whales in the photo-identification catalog of which 18 were known to be dead, and 330 had been sighted during the previous six years (B. Pike pers. comm.)[2].

2 Note that these data do not include four known dead right whales reported during the time period of January 2005 through June 2005.

DRAFT

As is the case with other mammalian species, there is an interest in monitoring the number of females in this right whale subpopulation since their numbers will affect the subpopulation trend (whether declining, increasing or stable). Participants at the 1999 IWC workshop reviewed the sex composition of the right whale subpopulation based on sighting and genetics data (Best et al. 2001). Of the 385 right whales presumed alive at the end of 1998 (excludes the 11 known to have died but includes the 87 that had not been seen in at least 6 years), 157 were males, 153 were females, and 75 were of unknown sex (Best et al. 2001). Sightings data were also used to determine the number of presumably mature females (females known to be at least 9 years old) in the subpopulation and the number of females who had been observed with a calf at least once. For the period 1980-1998, there were at least 90 (presumed live) females age 9 years or greater. Of these, 75 had produced a calf during that same period (Best et al. 2001; Kraus et al. 2001). As described above, the 2000/2001 - 2004/2005 calving seasons have had relatively high calf production and have included additional first time mothers (e.g., eight new mothers in 2000/2001). These potential "gains" have been offset, however, by continued losses to the subpopulation including the death of mature females as a result of anthropogenic mortality (Cole et al. 2006). Twenty right whale mortalities were confirmed from 2000-2004 (Cole et al. 2006). Included in this number were two pregnant females and two other females of breeding age. An additional ten right whale mortalities were documented between January 2005 and October 2006. The 2005-2006 mortalities have been documented by NMFS, but have not been fully examined and verified by the ASRG process. A determination of the total levels of anthropogenic mortality and serious injury for 2005 and 2006 will be made following the ASRG's review of all of the available data and information.

Data collected in the 1990s suggested that right whales were experiencing a slow but steady recovery (Knowlton et al. 1994). However, Caswell et al. (1999) used photo-identification data and modeling to estimate survival and concluded that right whale survival decreased from 1980 to 1994. Modified versions of the Caswell et al. (1999) model as well as several other models were reviewed at the 1999 IWC workshop (Best et al. 2001). Despite differences in approach, all of the models indicated a decline in right whale survival in the 1990s relative to the 1980s with female survival, in particular, affected (Best et al. 2001; Waring et al. 2005). In 2002, NMFS' NEFSC hosted a workshop to review right whale population models to examine: (1) potential bias in the models and (2) changes in the subpopulation trend based on new information collected in the late 1990s (Clapham 2002). Three different models were used to explore right whale survivability and to address potential sources of bias. Although biases were identified that could negatively affect the results, all three modeling techniques resulted in the same conclusion; survival, particularly of females, has continued to decline (Clapham 2002). Based on the information currently available, for the purposes of this BO, NMFS believes that the western North Atlantic right whale subpopulation numbers 300 (+/- 10%) and is declining.

While modeling work suggests a decline in right whale abundance as a result of reduced survival, particularly for females, some researchers have also suggested that the subpopulation is being affected by a decreased reproductive rate (Best et al. 2001; Kraus et al. 2001). Kraus et al. (2001) reviewed reproductive parameters for the period 1980-1998 and found that calving intervals increased from 3.67 years in 1992 to 5.8 years in 1998. In addition, as of 1999, only

DRAFT

70% of presumably mature females (females aged 9 years or older) were known to have given birth (Best et al. 2001).

Factors that have been suggested as affecting the right whale reproductive rate include reduced genetic diversity, pollutants, and nutritional stress. However, there is currently no evidence available to determine their potential effect, if any, on right whales. The size of the western North Atlantic subpopulation of right whales at the termination of whaling is unknown but is generally believed to have been very small. Such an event may have resulted in a loss of genetic diversity which could affect the ability of the current population to successfully reproduce (i.e., decreased conceptions, increased abortions, and increased neonate mortality). Studies by Schaeff et al. (1997) and Malik et al. (2000) indicate that western North Atlantic right whales are less genetically diverse than southern right whales. However, several apparently healthy populations of cetaceans, such as sperm whales and pilot whales, have even lower genetic diversity than observed for western North Atlantic right whales (IWC 2001). Similarly, while contaminant studies have confirmed that right whales are exposed to and accumulate contaminants, researchers could not conclude that these contaminant loads were negatively affecting right whale reproductive success since concentrations were lower than those found in marine mammals proven to be affected by PCBs and DDT (Weisbrod et al. 2000). Finally, although North Atlantic right whales seem to have thinner blubber than right whales from the South Atlantic (Kenney 2000), there is no evidence at present to demonstrate that the decline in birth rate and increase in calving interval is related to a food shortage. These concerns were also discussed at the 1999 IWC workshop, where it was pointed out that since *Calanus* sp. are the most common zooplankton in the North Atlantic and current right whale abundance is greatly below historical levels, the proposal that food limitation was the major factor seemed questionable (IWC 2001). Nevertheless, a connection among right whale reproduction and environmental factors may yet be found. Modeling work by Caswell et al. (1999) and Fujiwara and Caswell (2001) suggests that the North Atlantic Oscillation (NAO), a naturally occurring climactic event, does affect the survival of mothers and the reproductive rate of mature females, and it also seems to affect calf survival (Clapham 2002). Further work is needed to assess the magnitude and manner in which the NAO may affect right whale reproductive success.

Threats to right whale recovery

There is general agreement that right whale recovery is negatively affected by anthropogenic mortality, primarily due to collisions with vessels and entanglement in fishing gear. Right whales may also be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources due to trophic effects resulting from a variety of activities. Of the 50 dead right whales reported since 1986, at least 19 were killed by vessel collisions, and at least six were killed by fishing gear entanglements (Moore et al. 2005). Also during this period, there were 61 confirmed cases of whales carrying fishing gear, including the six mortalities (Kraus et al. 2005). Death is suspected in 12 cases, because of an animal's subsequent disappearance and/or the extremely poor health condition observed at the time of last sighting. Another eight animals are still entangled; their fate is uncertain. Thirty-three animals either shed the gear or were disentangled, and the remaining cases involved unidentifiable individuals (Kraus et al. 2005). Of the 20 verified right whale mortalities from 2000-2004, three were due to entanglement and six were due to ship strike (Cole et al. 2006). An additional ten

DRAFT

right whale mortalities were documented between January 2005 and October 2006 (NMFS unpublished data). The 2005-2006 mortalities have been documented by NMFS, but have not been fully examined and verified by the ASRG process. A determination of the total levels of anthropogenic mortality and serious injury for 2005 and 2006 will be made following the ASRG's review of all of the available data and information.

These reported numbers represent an absolute minimum number of the right whale mortalities for this period. Given the range and distribution of right whales in the North Atlantic, it is highly unlikely that all carcasses have been observed. In addition, the incidence of mortality from ship strikes and entanglements is underrepresented because, of the carcasses that are observed, many cannot be retrieved for necropsy or further analysis. Of the carcasses retrieved, many are too decomposed or damaged to provide the evidence necessary to determine whether a ship strike or entanglement may have occurred. Nonetheless, considerable effort has been made to examine right whale carcasses for the cause of death. Moore et al. (2005) provide information on the examination of 30 right whale carcasses during the period of 1970-2002. Of the 30 animals examined, ship strike was identified as the cause of death or probable cause of death for 14 (9 adults/juveniles; 4 calves; 1 unknown) and entanglement in fishing gear was identified as the cause of death for 4 (all adults/juveniles) (Moore et al. 2005). A cause of death was undeterminable for 12 animals, 8 of which were calves (Moore et al. 2005).

Ship strikes and entanglements are not always fatal to right whales. Scarification analysis of living animals provides additional information on the frequency of right whale interactions with vessels and rope/line. Based on photographs of catalogued animals from 1959 and 1989, Kraus (1990) estimated that 57 percent of right whales exhibited scars from entanglement and 7 percent from ship strikes (propeller injuries). Based on photographs of catalogued animals from 1935 through 1995, Hamilton et al. (1998) estimated that 61.6 percent of right whales exhibit injuries caused by entanglement and 6.4 percent exhibit signs of injury from vessel strikes. In addition, several whales have apparently been entangled on more than one occasion. Right whales may suffer long term effects of such interactions even when they survive the initial interaction. For example, some right whales that have been entangled were subsequently involved in ship strikes (Hamilton et al. 1998) suggesting that the animal may have become debilitated by the entanglement to such an extent that it was less able to avoid a ship. A necropsy of a right whale found dead in 2005 suggests that the animal died of an infection after the scars from a previous ship strike interaction opened up during her first pregnancy.

The number of right whale deaths due to entanglement and ship strike is of great concern given the critical status of the North Atlantic right whale population. In spite of efforts to address these concerns, including fishing gear restrictions under the ALWTRP, the disentanglement program, and education and outreach activities, right whales continue to be impacted by ship strikes and entanglements.

3.2 Humpback Whale

Humpback whales inhabit all major ocean basins from the equator to subpolar latitudes. They generally follow a predictable migratory pattern in both hemispheres, feeding during the summer

DRAFT

in the higher near-polar latitudes and migrating to lower latitudes where calving and breeding takes place in the winter (Perry et al. 1999).

North Pacific. Humpback whales range widely across the North Pacific during the summer months; from Port Conception, CA, to the Bering Sea (Johnson and Wolman 1984, Perry et al. 1999). Although the IWC recognizes only one stock (Donovan 1991) there is evidence to indicate multiple populations or stocks occur within the North Pacific Basin (Perry et al. 1999, Carretta et al. 2001). For the purposes of managing this species under the MMPA, NMFS recognizes three management units within the U.S. EEZ: the eastern North Pacific stock, the central North Pacific stock and the western North Pacific stock (Carretta et al. 2001). There are indications that the eastern North Pacific stock is increasing in abundance (Carretta et al. 2001) and the central North Pacific stock appears to have increased in abundance between the 1980s -1990s (Angliss et al. 2001). There is no reliable population trend data for the western North Pacific stock (Angliss et al. 2001).

Indian Ocean. Little or no research has been conducted on humpbacks in the Northern Indian Ocean, so information on their current abundance does not exist (Perry et al. 1999). Since these humpback whales do not occur in U.S. waters, there is no recovery plan or stock assessment report for the northern Indian Ocean humpback whales. Likewise, there is no recovery plan or stock assessment report for southern hemisphere humpback whales, and there is also no current estimate of abundance for humpback whales in the southern hemisphere although there are estimates for some of the six southern hemisphere humpback whale stocks recognized by the IWC (Perry et al. 1999). Like other whales, southern hemisphere humpback whales were heavily exploited for commercial whaling. Although they were given protection by the IWC in 1963, Soviet whaling data made available in the 1990s revealed that 48,477 southern hemisphere humpback whales were killed from 1947-1980 (Zemsky et al. 1995, IWC 1995, Perry et al. 1999).

North Atlantic. Six separate feeding areas are utilized in northern waters during the summer months (Waring et al. 2005). Humpbacks feed on a number of species of small schooling fishes, particularly sand lance and Atlantic herring, by targeting fish schools and filtering large amounts of water for the associated prey. Humpback whales have also been observed feeding on krill (Wynne and Schwartz 1999). Most of the humpbacks that forage in the Gulf of Maine visit Stellwagen Bank and the waters of Massachusetts and Cape Cod Bays. Sightings are most frequent from mid-March through November between 41EN and 43EN, from the Great South Channel north along the outside of Cape Cod to Stellwagen Bank and Jeffrey's Ledge (CeTAP 1982), and peak in May and August. Small numbers of individuals may be present in this area year-round, including the waters of Stellwagen Bank. Since feeding is the primary activity of humpback whales in New England waters, their distribution is correlated to prey species and abundance. For example, humpback whales were few in nearshore Massachusetts waters in the 1992-93 summer seasons, but when sand lance became more abundant in the Stellwagen Bank area in 1996 and 1997, humpback abundance also increased (Waring et al. 2005).

In winter, whales from the six feeding areas mate and calve primarily in the West Indies where spatial and genetic mixing among these groups occurs (Waring et al. 2005). Various papers

DRAFT

(Clapham and Mayo 1990; Clapham 1992; Barlow and Clapham 1997; Clapham et al. 1999) summarized information gathered from a catalogue of photographs of 643 individuals from the western North Atlantic population of humpback whales. These photographs identified reproductively mature western North Atlantic humpbacks wintering in tropical breeding grounds in the Antilles, primarily on Silver and Navidad Banks, north of the Dominican Republic. The primary winter range also includes the Virgin Islands and Puerto Rico (NMFS 1991a). Calves are born from December through March and are about 4 meters at birth. Females give birth approximately every 2 to 3 years. Sexual maturity is reached between 4 and 6 years of age for females and between 7 and 15 years for males. Size at maturity is about 12 meters.

Humpback whales use the mid-Atlantic as a migratory pathway to and from the calving/mating grounds, but it may also be an important winter feeding area for juveniles. Since 1989, observations of juvenile humpbacks in the mid-Atlantic have been increasing during the winter months, peaking from January through March (Swingle et al. 1993). Biologists theorize that non-reproductive animals may be establishing a winter feeding range in the mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. Swingle et al. (1993) identified a shift in distribution of juvenile humpback whales in the nearshore waters of Virginia, primarily in winter months. Identified whales using the mid-Atlantic area were found to be residents of the Gulf of Maine and Atlantic Canada (Gulf of St. Lawrence and Newfoundland) feeding groups, suggesting a mixing of different feeding populations in the mid-Atlantic region. Strandings of humpback whales have increased between New Jersey and Florida since 1985 consistent with the increase in mid-Atlantic whale sightings. Strandings were most frequent during September through April in North Carolina and Virginia waters, and were composed primarily of juvenile humpback whales of no more than 11 meters in length (Wiley et al. 1995).

Photographic mark-recapture analyses from the Years of the North Atlantic Humpback (YONAH) project gave an ocean-basin-wide estimate of 10,600 (95% c.i. = 9,300 - 12,100) (Waring et al. 2005). For management purposes under the MMPA, the estimate of 10,600 is regarded as the best available estimate for the North Atlantic population (Waring et al. 2005).

Threats to Humpback Whale Recovery

As is the case with other large whales, the major known sources of anthropogenic mortality and injury of humpback whales are commercial fishing gear entanglements and ship strikes. Sixty percent of mid-Atlantic humpback whale mortalities that were closely investigated showed signs of entanglement or vessel collision (Wiley et al. 1995). Based on photographs of the caudal peduncle of humpback whales, Robbins and Mattila (1999) estimated that at least 48 percent, and possibly as many as 78 percent, of animals in the Gulf of Maine exhibit scarring caused by entanglement. These estimates are based on sightings of free-swimming animals that initially survive the encounter. Because some whales may drown immediately, the actual number of interactions may be higher. From 2000 through 2004, at least 74 humpback whale entanglements (8 fatal; 11 serious injuries) and 11 ship strikes (7 fatal) were confirmed (Cole et al. 2006). Since 2004, an additional 24 new entanglements and 3 indications of ship strike have been preliminarily reported; however, numbers from 2005-present are awaiting confirmation by the NEFSC. There were also many carcasses that washed ashore or were spotted floating at sea for which the cause of death could not be determined.

DRAFT

Humpback whales, like other baleen whales, may also be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources due to trophic effects resulting from a variety of activities including the operation of commercial fisheries, coastal development and vessel traffic. However, evidence of these is lacking. There are strong indications that a mass mortality of humpback whales in the southern Gulf of Maine in 1987/1988 was the result of the consumption of mackerel whose livers contained high levels of a red-tide toxin. It has been suggested that red tides are somehow related to increased freshwater runoff from coastal development but there is insufficient data to link this with the humpback whale mortality (Clapham et al. 1999). Changes in humpback distribution in the Gulf of Maine have been found to be associated with changes in herring, mackerel, and sand lance abundance associated with local fishing pressures (Waring et al. 2005). However, there is no evidence that humpback whales were adversely affected by these trophic changes.

3.3 Fin Whale

Fin whales inhabit a wide range of latitudes between 20-75° N and 20-75° S (Perry et al. 1999). The fin whale is ubiquitous in the North Atlantic and occurs from the Gulf of Mexico and Mediterranean Sea northward to the edges of the arctic ice pack (NMFS 1998b). The overall pattern of fin whale movement is complex, consisting of a less obvious north-south pattern of migration than that of right and humpback whales. Based on acoustic recordings from hydrophone arrays, Clark (1995) reported a general southward flow pattern of fin whales in the fall from the Labrador/Newfoundland region, south past Bermuda, and into the West Indies. The overall distribution may be based on prey availability as this species preys opportunistically on both invertebrates and fish (Watkins et al. 1984). Fin whales feed by filtering large volumes of water for the associated prey. Fin whales are larger and faster than humpback and right whales and are less concentrated in nearshore environments.

Pacific Ocean. Within U.S. waters of the Pacific, fin whales are found seasonally off of the coast of North America and Hawaii, and in the Bering Sea during the summer (Angliss et al. 2001). NMFS recognizes three fin whale stocks in the Pacific for the purposes of managing this species under the MMPA. These are: Alaska (Northeast Pacific), California/Washington/Oregon, and Hawaii (Angliss et al. 2001). Reliable estimates of current abundance for the entire Northeast Pacific fin whale stock are not available (Angliss et al. 2001). Stock structure for fin whales in the southern hemisphere is unknown. Prior to commercial exploitation, the abundance of southern hemisphere fin whales is estimated to have been at 400,000 (IWC 1979, Perry et al. 1999). There are no current estimates of abundance for southern hemisphere fin whales. Since these fin whales do not occur in U.S. waters, there is no recovery plan or stock assessment report for the southern hemisphere fin whales.

North Atlantic. NMFS has designated one population of fin whale in U.S. waters of the North Atlantic (Waring et al. 2005). This species is commonly found from Cape Hatteras northward. A number of researchers have suggested the existence of fin whale subpopulations in the North Atlantic based on local depletions resulting from commercial overharvesting (Mizroch and York 1984) or genetics data (Bérubé *et al.* 1998). Photoidentification studies in western North

DRAFT

Atlantic feeding areas, particularly in Massachusetts Bay, have shown a high rate of annual return by fin whales, both within years and between years (Seipt *et al.* 1990) suggesting some level of site fidelity. In 1976, the IWC's Scientific Committee proposed seven stocks (or populations) for North Atlantic fin whales: (1) North Norway, (2) West Norway-Faroe Islands, (3) British Isles-Spain and Portugal, (4) East Greenland-Iceland, (5) West Greenland, (6) Newfoundland-Labrador, and (7) Nova Scotia (Perry *et al.* 1999). However, it is uncertain whether these boundaries define biologically isolated units (Waring *et al.* 2005).

Species Description, Distribution and Population Structure

Fin whales achieve sexual maturity at 5-15 years of age (Perry *et al.* 1999), although physical maturity may not be reached until 20-30 years (Aguilar and Lockyer 1987). Conception is believed to occur during the winter with birth of a single calf after a 12 month gestation (Mizroch and York 1984). The calf is weaned 6-11 months after birth (Perry *et al.* 1999). The mean calving interval is 2.7 years (Agler *et al.* 1993).

The predominant prey of fin whales varies greatly in different geographical areas depending on what is locally available (IWC 1992). In the western North Atlantic, fin whales feed on a variety of small schooling fish (*i.e.*, herring, capelin, sand lance) as well as squid and planktonic crustaceans (Wynne and Schwartz 1999). New England waters represent a major feeding ground for the fin whale (Waring et al. 2005). Seipt et al. (1990) reported that 49% of identified fin whales on Massachusetts Bay area feeding grounds were resighted within the same year, and 45% were resighted in multiple years. These authors suggested that fin whales on these grounds exhibited patterns of seasonal occurrence and annual return that are in some respects similar to those shown for humpback whales. This was reinforced by Clapham and Seipt (1991), who showed maternally directed site fidelity by fin whales in the Gulf of Maine. Fin whales feed by filtering large volumes of water for their prey through their baleen plates.

Like right and humpback whales, fin whales are believed to use North Atlantic waters primarily for feeding, and more southern waters for calving. However, evidence regarding where the majority of fin whales winter, calve, and mate is still scarce. As noted above, Clark (1995) reported a general pattern of fin whale movements in the fall from the Labrador/Newfoundland region, south past Bermuda and into the West Indies, but neonate strandings along the U.S. Mid-Atlantic coast from October through January suggest the possibility of an offshore calving area (Hain *et al.* 1992).

During 1978-1982 aerial surveys, fin whales accounted for 24% of all cetaceans and 46% of all large cetaceans sighted over the continental shelf between Cape Hatteras and Nova Scotia (Waring *et al.* 2005). Underwater listening systems have also demonstrated that the fin whale is the most acoustically common whale species heard in the North Atlantic (Clark 1995). The single most important area for this species appeared to be from the Great South Channel, along the 50m isobath past Cape Cod, over Stellwagen Bank, and past Cape Ann to Jeffrey's Ledge (Hain *et al.*1992).

Population trends and status

DRAFT

Various estimates have been provided to describe the current status of fin whales in western North Atlantic waters. One method used the catch history and trends in Catch Per Unit Effort to obtain an estimate of 3,590 to 6,300 fin whales for the entire western North Atlantic (Perry *et al.* 1999). Hain *et al.* (1992) estimated that about 5,000 fin whales inhabit the Northeastern U.S. continental shelf waters. The 2005 SAR gives a best estimate of abundance for fin whales of 2,814 (CV = 0.21). The minimum population estimate for the western North Atlantic fin whale is 2,362 (Waring *et al.* 2005). However, this is considered an underestimate since the estimate was derived from surveys over a limited portion of the western North Atlantic. The 2005 SAR indicates that there are insufficient data at this time to determine population trends for the fin whale.

Threats to fin whale recovery

The major known sources of anthropogenic mortality and injury of fin whales include entanglement in commercial fishing gear and ship strikes. Of 18 fin whale mortality records collected between 1991 and 1995, four were associated with vessel interactions, although the proximal cause of mortality was not known. From 1996-July 2001, there were nine observed fin whale entanglements and at least four ship strikes. From 2000-2004, the NEFSC has confirmed 9 entanglements (3 fatal; 1 serious injury) and 5 ship strikes (all fatal) (Cole et al. 2006). Since 2004, there have been an additional 2 new entanglements and 4 indications of ship strike reported (NMFS unpublished data), although these numbers are awaiting confirmation by the NEFSC. Fin whales are believed to be the most commonly struck cetacean by large vessels (Laist *et al.* 2001). In addition, hunting of fin whales continued well into the 20th century. Fin whales were given total protection in the North Atlantic in 1987 with the exception of a subsistence whaling hunt for Greenland (Gambell 1993, Caulfield 1993). However, Iceland reported a catch of 136 whales in the 1988/89 and 1989/90 seasons, and has since ceased reporting fin whale kills to the IWC (Perry *et al.* 1999). In total, there have been 239 reported kills of fin whales from the North Atlantic from 1988 to 1995. Fin whales may also be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources due to trophic effects resulting from a variety of activities.

DRAFT

3.4 Sperm Whale

Sperm whales are the largest of the odontocetes (toothed whales) and the most sexually dimorphic cetaceans, with males considerably larger than females. Sperm whales are found throughout the world's oceans in deep waters between about 60° N and 60° S latitudes. During the past two centuries, commercial whalers took about 1,000,000 sperm whales. Despite this high level of take, the sperm whale remains the most abundant of the large whale species. Currently, there is no reliable estimate for the total number of sperm whales worldwide. The best estimate, that there are between 200,000 and 1,500,000 sperm whales, is based on extrapolations from only a few areas that have useful estimates. The sperm whale was listed as endangered throughout its range on June 2, 1970 under the Endangered Species Conservation Act of 1969.

Species Description, Distribution and Population Structure

Sperm whales tend to inhabit areas with a water depth of 600 meters or more, and are uncommon in waters less than 300 meters deep. Female sperm whales are generally found in deep waters (at least 1000 m) of low latitudes (less than 40°, except in the North Pacific where they are found as high as 50°). These conditions generally correspond to sea surface temperatures greater than 15°C, and while female sperm whales are sometimes seen near oceanic islands, they are typically far from land. Immature males will stay with female sperm whales in tropical and subtropical waters until they begin to slowly migrate towards the poles, anywhere between ages 4 and 21 years old. Older, larger males are generally found near the edge of pack ice in both hemispheres. On occasion, however, these males will return to the warm water breeding area.

In winter, sperm whales are concentrated east and northeast of Cape Hatteras. In spring, the center of distribution shifts northward to east of Delaware and Virginia, and is widespread throughout the central portion of the mid-Atlantic bight and the southern portion of Georges Bank. In summer, the distribution is similar but also includes the areas east and north of Georges Bank and into the Northeast Channel region, as well as the continental shelf (inshore of the 100 m isobath) south of New England. In the fall, sperm whale occurrence south of New England on the continental shelf if at its highest levels, and there remains a continental shelf edge occurrence in the mid-Atlantic bight.

While they may be encountered almost anywhere on the high seas their distribution shows a preference for continental margins, sea mounts, and areas of upwelling, where food is abundant (Leatherwood and Reeves 1983). Waring *et al.* (2005) suggest sperm whale distribution is closely correlated with the Gulf Stream edge. Sperm whales migrate to higher latitudes during summer months, when they are concentrated east and northeast of Cape Hatteras. Bull sperm whales migrate much farther poleward than the cows, calves, and young males. Because most of the breeding herds are confined almost exclusively to warmer waters many of the larger mature males return in the winter to the lower latitudes to breed.

For management purposes, sperm whales inhabiting U.S. waters have been divided into five stocks: California-Oregon-Washington Stock, North Pacific (Alaska), Hawaii, Northern Gulf of Mexico Stock, and North Atlantic Stock. Only whales from the North Atlantic stock are likely to occur in the action area. In the western North Atlantic the species ranges from Greenland to the Gulf of Mexico and the Caribbean. The sperm whales that occur in the eastern U.S. EEZ are believed to represent only a portion of the total stock. The best available abundance estimate for the North Atlantic stock is 4,804 with a minimum population estimate of 3,539 (Waring et al. 2005).

Sperm whale sightings recorded from the NOAA vessel Oregon II from 1991 - 1997 are concentrated just beyond the 100 m depth contour in the northern Gulf of Mexico, east of the Mississippi River Delta. Recent studies conducted jointly by researchers from NMFS and Texas A&M indicate that these offshore waters are an important area for Gulf sperm whales. This is the only known breeding and calving area in the Gulf, for what is believed to be an endemic population.

DRAFT

Sperm whales feed primarily on medium to large-sized mesopelagic squids *Architeuthis* and *Moroteuthis*. Sperm whales, especially mature males in higher latitude waters, also take significant quantities of large demersal and mesopelagic sharks, skates, and bony fishes (Clarke 1962, 1980). Sperm whale populations are organized into two types of groupings: breeding schools and bachelor schools. Older males are often solitary (Best 1979). Breeding schools consist of females of all ages and juvenile males. The mature females ovulate April through August in the Northern Hemisphere. During this season one or more large mature bulls temporarily join each breeding school. A single calf is born at a length of about 4 meters after a 15 month gestation period. A mature female will produce a calf every 3-6 years. Females attain sexual maturity at the mean age of nine years and a length of about nine meters. Males have a prolonged puberty and attain sexual maturity at about age 20 and a body length of 12 meters. Bachelor schools consist of maturing males who leave the breeding school and aggregate in loose groups of about 40 animals. As the males grow older they separate from the bachelor schools and remain solitary most of the year (Best 1979).

Threats to Sperm Whale Recovery

Sperm whales were hunted in America from the 17th century through the early 1900's. The International Whaling Commission (IWC) estimates that nearly a quarter-million sperm whales were killed worldwide in whaling activities between 1800 and 1900 (IWC 1971). With the advent of modern whaling the larger rorqual whales were targeted. However as their numbers decreased, greater attention was paid to smaller rorquals and sperm whales. From 1910 to 1982 there were nearly 700,000 sperm whales killed worldwide from whaling activities (Clarke 1954; Committee for Whaling Statistics 1959 -1983). In recent years the catch of sperm whales has been drastically reduced as a result of the imposition of catch quotas.

Because of their generally more offshore distribution and their benthic feeding habits, sperm whales are less subject to entanglement than right or humpback whales. However, sperm whales have been taken in the pelagic drift gillnet fishery for swordfish. Also, interactions between sperm whales and longlines for sable fish have been noted in Alaska waters. Three sperm whale entanglements in the North Atlantic have been documented from August 1993 to May 1998.

Due to their offshore distribution, sperm whales tend to strand infrequently. Eighteen sperm whale strandings have been documented along the US Atlantic coast during 1994-2000 (Waring et al 2005). From 2001-2003, ten sperm whale strandings were reported along the US Atlantic coast (Waring et al. 2005). In eastern Canada, 40 strandings were reported between 1970-1998 (Waring et al. 2005). Two ship strikes, one in 1994 and one in 2000 have been reported (Waring et al. 2005).

As noted above, there are estimated to be 4,804 sperm whales in the North Atlantic. According to the 2005 Stock Assessment Report, there are insufficient data to determine the population trends for this species.

3.5 Sei Whale

Sei whales are distributed in all of the world's oceans, except the Arctic Ocean. They migrate

DRAFT

between high-latitude summer feeding areas to relatively low-latitude winter breeding areas. Sei whales do not associate with coastal features, but prefer deeper waters associated with the continental shelf edge (Hain et al. 1985) and may tend to remain in temperate waters more than other rorquals (Gambell 1985; Horwood 1987; Perry et al. 1999; Rice 1998). Like other rorquals, they undertake long migrations during spring and fall, but are less likely to be found in very cold polar waters with pack ice. One significant difficulty with sei whale data is that they are extremely similar in appearance to Bryde's whales, difficult to differentiate at sea, and often combined in sighting data (Slijper et al. 1964; Rice 1998). Sei whales are also known for occasional irruptive occurrences in areas where they are not typically seen (Horwood 1982; Gambell 1985; unpublished NARWC data).

Species Description, Distribution and Population Structure

There are two populations of sei whales, one in the North Atlantic and one in the North Pacific. For management purposes, the North Atlantic population is assumed to consist of three stocks: Nova Scotian Shelf, Iceland-Denmark Strait, and Northeast Atlantic. The overall range extends from Georges Bank to Labrador, Iceland, and Norway. In the northwest Atlantic, whales travel along the eastern Canadian coast in autumn, June and July on their way to and from the Gulf of Maine and Georges Bank, where they occur in winter and spring. Sei whales are most common on Georges Bank and into the Gulf of Maine/Bay of Fundy region during spring and summer, primarily in deeper waters. In the northeast Atlantic, sei whales winter south of Spain and summer off north Norway, west Norway, and the Shetland Islands, the Hebrides, and the Faeroe Islands (Perry et al. 1999).

The winter range is poorly known, but includes scattered sighting and stranding records from the southeast U.S., Gulf of Mexico, Bay of Campeche, northern Caribbean Sea, West Indies, and off Morocco and Mauritania (Leatherwood et al. 1976; Mead 1977; Gambell 1985; Rice 1998). They may extend further into tropical waters than other rorquals, with the exception of Bryde's whales (Leatherwood et al. 1976a; Mead 1977).

The IWC's SC groups all of the sei whales in the entire North Pacific Ocean into one stock (Donovan 1991). However, some mark-recapture, catch distribution, and morphological research indicated that more than one stock exists; one between 175°W and 155°W longitude, and another east of 155° W longitude (Masaki 1976; Masaki 1977). During the winter, sei whales are found from 20°- 23° N and during the summer from 35°-50° N (Masaki 1976; Masaki 1977). In the North Pacific Ocean, sei whales have been reported primarily south of the Aleutian Islands, in Shelikof Strait and waters surrounding Kodiak Island, in the Gulf of Alaska, and inside waters of southeast Alaska (Leatherwood et al. 1982; Nasu 1974).

Reproductive activities for sei whales occur primarily in winter. Gestation is about 12.7 months and the calving interval is about 3 years (Rice 1977). Endoparasitic helminths are commonly found in sei whales and can result in pathogenic effects when infestations occur in the liver and kidneys (Rice 1977).

Sei whales are usually found in small groups of up to 6 individuals, but they commonly form

DRAFT

larger groupings when they are on feeding grounds (Gambell 1985). Sei whales feed in the relatively high latitudes of both hemispheres particularly along the cold eastern currents of the North Pacific, North Atlantic and Antarctic. Sei whales seems to be less selective of their prey than and seem to have the greatest flexibility relative to blue and fin whales. Evidence supporting this is the use of two feeding strategies, engulfing and skimming (see Kawamura 1980). Although known to take piscine prey, sei 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 Great South Channel (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (Waring et al. 2005; Payne et al. 1990). An influx of sei whales into the southern Gulf of Maine occurred in the summer of 1986 (Schilling et al. 1993). Such episodes, often punctuated
by years or even decades of absence from an area, have been reported for sei whales from various places worldwide.

Population Status and Trends
The current size of the sei whale population is poorly understood. However, Mitchell and Chapman (1977 in Waring et al. 2005), based on tag-recapture data, estimated the Nova Scotia, Canada, stock to contain between 1,393 and 2,248 sei whales. Based on census data, they estimated a minimum Nova Scotian population of 870 sei whales. This estimate is more than 20 years out of date, has a high degree of uncertainty, and was estimated just after cessation of extensive foreign fishing operations, and thus almost certainly does not reflect the current true population size (Waring et al. 2005). There are no recent abundance estimates for the sei whale. As such, there are insufficient data to determine population trends for this species.

Threats to Sei Whale Recovery
The sei whale was not exploited until the era of modern whaling at the end of the 19th century (Horwood 2002). Between 1885 and 1900, 4000 sei whales were killed off north Norway. In the North Atlantic, sei whales have been caught from stations in Canada, Faeroes, Iceland, Ireland, Iberia, Norway, and Scotland. Between 1960 and 1970, after the numbers of blue and fin whales had been reduced, over 110,000 sei whales were killed (Horwood 2002). Whaling for sei whales ceased in the Southern Hemisphere in 1979, and in the North Pacific in 1975, but continued in the North Atlantic until 1986. The IWC has set a catch limit of zero for all stocks as of 1985, but limited catches have continued under a scientific research permit issued to Iceland, and under subsistence whaling from Greenland. Twelve takes of sei whales occurred from 1988 to 1995 in the North Atlantic off Iceland and West Greenland.

There have been no reported serious injuries or mortalities for sei whales due to fishery interactions. There have been a total of 6 documented ship strikes involving sei whales since 1885 (Jensen and Silber 2003; Cole et al. 2006; NMFS unpublished data).

3.6 Blue Whale

Species Description, Distribution and Population Structure
Blue whales are the largest living mammal species. They can measure over 30 meters in length

DRAFT

and weigh close to 200 tons. Blue whales are found in all major oceans including the continental shelf areas and far offshore in pelagic environments from the pack ice in both hemispheres to temperate and tropical waters.

Morphological and geographical variability have led to the designation of three subspecies of blue whale. *Balaenoptera musculus intermedia* is the largest subspecies and occurs in the southern hemisphere. *B. m. musculus* inhabits the Northern Hemisphere and is slightly smaller than *B. m. intermedia*. *B. m. brevicauda* (the pygmy blue whale) is generally accepted as the third subspecies of blue whale. Pygmy blue whales are significantly smaller and morphologically distinct from the other two subspecies and ranges north of the Antarctic Convergence to the mid latitude waters of the southern Indian Ocean and the southwestern Pacific Ocean (Sears and Larsen 2002).

Population structure is complex and not well understood. The current distributional information on blue whales is still scarce with migratory behavior of different classes of individuals further confusing population structure. In many cases as described below stocks or populations have been defined by aggregations in feeding areas or breeding areas and have not undergone acoustic or genetic analyses to validate those delineations. Therefore, there is no way to determine whether the current stock designations represent the true population structure and if and to what extent those populations intermingle.

North Pacific. Based on whaling data, sighting reports, and recorded vocalizations, blue whales in the North Pacific have historically ranged from southern Japan to Kamchatcka and the western Aleutian Islands in the western North Pacific, Hawaii to the Aleutian Islands in the central North Pacific, and from the Eastern Tropical Pacific to the Gulf of Alaska in the eastern North Pacific (COSEWIC 2002). The International Whaling Commission (IWC) has formally considered only one management stock for blue whales in the North Pacific Ocean (Donovan 1991). As many as five populations have been proposed (NMFS 1998c), however, recent analyses of recordings throughout the North Pacific Ocean have identified two distinct blue whale call types, suggesting two stocks: an eastern (including those feeding off California) and a western (including those feeding off Alaskan waters) (Stafford 2000, Stafford 2003). The discovery of these distinct call types in the eastern and western North Pacific does not preclude the existence of other populations, some of which may have been hunted to extinction by whaling (COSEWIC 2002).

Indian Ocean. Blue whales have been reported year-round in the northern Indian Ocean with sightings in the Gulf of Aden, Persian Gulf, Arabian Sea, and across the Bay of Bengal to Burma and the Strait of Malacca (Mizroch et al. 1984). It is unclear whether blue whales in these areas represent a distinct population with year-round residency as do the humpback whales there (see Clapham et al. 1999). Prior to whaling blue whales were found all around the Antarctic during the austral summer (Mackintosh 1966). Based on early whaling data and the recovery of tags blue whales in the Southern Hemisphere are assigned to six stock areas designated by the IWC (Donovan 1991a). Based on evidence showing discrete feeding stocks the IWC designations follow this feeding distribution, although current distributional information on blue whales is still scarce and the overall population structure in the Southern hemisphere is unclear (Sears 2002).

DRAFT

North Atlantic. In the North Atlantic blue whales are found from the Arctic to at least the mid-latitude waters with occasional occurrences in the United States EEZ (Waring et al. 2002). Blue whales are most commonly sighted from Nova Scotia north to Davis Strait, Baffin Bay, Greenland, Iceland, Spitsbergen, and the Barents Sea (NMFS 1998c; Sigurjónsson and Gunnlaugson 1990; Yochem and Leatherwood 1985). Sightings are infrequent in the Gulf of Maine and southward (CETAP 1982; Wenzel et al. 1988). An intensively studied group resides from spring through fall in the Gulf of St. Lawrence (Sears and Larsen 2002; Sears et al. 1987). Historically, blue whales were relatively abundant in the extreme northern Atlantic, but they were severely depleted by commercial whaling (NMFS 1998c). Sparse stranding and sighting data suggest that the range extended south to Florida, the Gulf of Mexico, the Cape Verdes, and the Caribbean (Leatherwood et al. 1976a; Yochem and Leatherwood 1985).

Acoustic surveys by the United States Navy have detected blue whales in winter out to the mid-Atlantic ridge, south of Bermuda, and west and south of the British Isles (COSEWIC 2002). Researchers using Navy Integrated Undersea Surveillance System (IUSS) assets have been able to detect blue whales throughout the open Atlantic south to at least the Bahamas (Clark 1995), suggesting that North Atlantic blue whales may comprise a single stock which ranges throughout the basin (NMFS 1998c).

Life History

The age of sexual maturity for blue whales ranges from about 5-15 years although 8-10 years is more common for both males and females. Length at sexual maturity for Northern Hemisphere females is 21-23 m while females in the Southern Hemisphere attain maturity at 23-24 m. Blue whale reproductive activities start in late fall and continue through the winter. Females are believed to reproduce at 2-3 year intervals. Gestation takes 10-12 months and calves are born in the winter with a nursing period that continues for about 6-8 months. (Sears 2002)

No specific breeding grounds have been identified although male/female pairings have been observed in the Gulf of St. Lawrence, Canada. Mother/calf pairs are regularly sighted in the Gulf of California, Mexico and the Chiloé-Corcovado region off southern Chile (Hucke-Gaete et al. 2004; Sears and Larsen 2002). Little is known of the mating behavior of blue whales. Blue whales are believed to live for at least 80-90 years (Sears 2002).

Blue whale distribution for most of the year is likely dictated by food availability (Burtenshaw et al. 2004, Clapham et al. 1999, Sears and Larsen 2002). Large aggregations of blue whales have been observed feeding in areas with high primary productivity including upwelling areas, the edges of continental shelves and ice edges in the polar regions (Yochem and Leatherwood 1985, Reilly and Thayer 1990, COSEWIC 2002). These regions are usually characterized by complex bathymetry, the presence of sharp oceanographic fronts, eddies and upwelling that support high phytoplankton and zooplankton biomass (Reilly and Thayer 1990; Tynan 1998). Blue whales were once believed to fast during the winter months. There is increasing evidence, however, of at least some populations of blue whales selecting and exploiting predictable productive areas in both summer and winter instead of undertaking seasonal migrations (Hucke-Gaete et al. 2004).

DRAFT

Blue whales have the largest prey requirements of any animal on earth. This requirement is met by feeding almost exclusively on euphausiids (krill) (Burtenshaw et al. 2004; Croll et al. 2000, Sears 2002). Feeding commences when suitably dense concentrations of prey are located (Acevedo-Gutierrez et al. 2002) and is accomplished by lunging and gulping large mouthfuls of water and prey. Blue whales preferentially feed on adult krill which may differ in species and size structure between patches (Burtenshaw et al. 2004, Croll et al. 2000).

In the North Atlantic blue whales feed on the krill species *Meganyctiphanes norvegica*, *Thysanoessa raschii, T. inermis, and T. longicaudat* (Sears 2002). In the North Pacific the blue whale diet consists of the following krill species*: Euphausia pacifica, Thysanoessa. inermis, T. longipes, T. spinifera,* and *Nyctiphanes symplex* (Sears 2002, Yochem and Leatherwood 1985). *Nyctiphanes symplex is regarded* as the principal prey of blue whales in the region, as confirmed from recent fecal analyses. However, this phenomenon appears to be strongly influenced by the occurrence of El Niño Southern Oscillation (ENSO) events (see COSEWIC 2002). In Antarctic waters blue whale prey on the following krill species: *E. superba, E. crystallorophias*, and *E. vallentini* (Sears 2002).

Population Status and Trends

Global pre-whaling blue whale populations are thought to have numbered around 200,000 animals. Current global estimates range from 5,000-12,000, however reliable estimates do not exist (COSEWIC 2002). The data needed to determine status and trends of blue whale populations remain limited because of their wide-ranging distribution, extensive migrations and the inaccessibility of most populations. In the Southern hemisphere, status and trends are further confused by the possibility of two subspecies with no reliable method for distinguishing between the two.

Barlow (1994) estimated the North Pacific population of blue whales at between 1,400 and 1,900. Wade and Gerrodette (1993) and Barlow et al. (1997) estimated there were a minimum of 3,300 blue whales in the North Pacific Ocean in the 1990s. From ship line-transect surveys, Wade and Gerrodette (1993) estimated 1,400 blue whales for the eastern tropical Pacific. No data are available to estimate population size for the putative central stock that apparently summered along the Aleutians and wintered north of Hawaii (Carretta et al. 2004).

There have been a number of abundance estimates for blue whales feeding off California (the eastern North Pacific stock), however these estimates may only reflect a shift in distribution of some whales into more productive waters. The best estimate of the abundance of the blue whales off California, Oregon and Washington is 1,744 (CV=0.28). However, there is considerable uncertainty surrounding recent trends of blue whale abundance in California waters. While there is some indication that abundance increased in California coastal waters between 1979/80 and 1991 (Barlow 1994) and between 1991 and 1996 (Barlow 1997, Larkman and Veit 1998 in Caretta et al. 2004) did not detect any increase in the Southern California Bight from 1987 to 1995. Additional estimates by Calambokidis et al. (2003) and Barlow (2003) indicated declines in 2000-2002 compared to previous years, but sample sizes were small and may not be indicative of a true decline. Although the population in the North Pacific is expected to have grown since being given protected status in 1966, the possibility of continued unauthorized takes

DRAFT

by Soviet whaling vessels after blue whales were protected in 1966 (Yablokov 1994) and the existence of incidental ship strikes and gillnet mortality makes this uncertain.

Gambell (1976) estimated there were between 1,100 and 1,500 blue whales in the North Atlantic before whaling began, although the IWC has determined that this estimate is statistically unreliable (Perry et al. 1999). The current abundance of north Atlantic blue whales is largely unknown except for the Gulf of St. Lawrence area. Three hundred and fifty individuals have been catalogued (Sears 2002), but the data cannot be used for estimating abundance. Population trends for north Atlantic blue whales cannot be estimated at this time, although an increasing trend of 4.9% a year was reported for the period 1969-1988 off western and southwestern Iceland although it is considered somewhat unreliable (Sigurjónsson and Gunnlaugsson 1990 *in* Waring et al 2005). Braham (1991) estimated there were between 100 and 555 blue whales in the North Atlantic during the late 1980s and early 1990s. Sears (2002) notes that North Atlantic blue whale abundance probably ranges from 600 to 1500, although more reliable estimates are needed.

Historically blue whales in the Southern Hemisphere were estimated at about 300,000 animals prior to whaling (COSEWIC 2002). Blue whales are reported to be rare in the Southern Hemisphere. Yochem and Leatherwood (1985) estimated between 5,000 and 6,000 with an average rate of increase of 4 to 5 percent per year. More recent estimates range from 710-1255 although this number is based on poor sighting data (Sears 2002). Given the lack of a reliable method to distinguish between the two subspecies at sea this number includes both true blue and pygmy blue whales. More recently, Stern (2001) estimated the blue whale population in the Southern Ocean at between 400 and 1,400 animals (CV=0.4). The IWC Scientific Committee (IWC SC), however, has concluded that on average the Antarctic blue whale population is increasing at a mean rate of 7.3% per year (95% CI: 1.4-11.6%), had a 1996 estimated circumpolar population size of 1,700 (CI: 860-2,900) and remains severely depleted with the 1996 population estimate at 0.7% of pre-exploitation levels (IWC 2005c).

Threats to Blue Whale Recovery

From 1889 to 1965 approximately 5,761 blue whales were taken from the North Pacific Ocean (Perry et al. 1999). Evidence of a population decline can be seen in the catch data from Japan. In 1912, 236 blue whales were caught, 58 whales in 1913, 123 whales in 1914, and from 1915 to 1965, the catch numbers declined continuously (Mizroch et al. 1984). In the eastern North Pacific, 239 blue whales were taken off the California coast in 1926 and, in the late 1950s and early 1960s, Japan caught 70 blue whales per year off the Aleutian Islands (Mizroch et al. 1984). The IWC banned commercial whaling in the North Pacific in 1966, since that time there have been no reported blue whale takes although Soviet whaling continued after the ban. Soviet catch reports under-represent the number of blue whales killed by whalers (Clapham and Baker 2002). Gregr et al. (2000) reviewed the data collected from 24,862 whales killed off British Columbia from 1908-1967, 1,398 of which were blue whales. Early catches of blue whales numbered 205 but by 1915 dropped significantly due to depletion (Gregr et al. 2000). Further analyses of the data from 1948-1967 indicated that the proportion of pregnant blue whales in the catch declined to low levels which implies that the number of mature females was significantly reduced.

DRAFT

Whaling took place in the North Atlantic starting in 1898 and was halted in 1955 by the IWC although Iceland did not cease whaling until 1960. From the late 19th century to until 1960 at least 11,000 blue whales were killed (COSEWIC 2002). Sigurjónsson and Gunnlaugsson (1990 *in* Waring 2005) note that North Atlantic blue whales appear to have been depleted by commercial whaling to such an extent that they remain rare in some formerly important habitats, notably in the northern and northeastern North Atlantic.

Blue whales were the mainstay of the Southern Ocean whaling once the explosive harpoon was developed in the late-19th century (Shirihai 2002). During the early 1900s, the blue whale became a principal target of the whaling industry throughout the world although the majority of blue whales were killed in the Southern Hemisphere. Approximately 330,000 - 360,000 blue whales were killed from 1904-1967 in the Antarctic alone and their populations were severely depleted to less than 3% or their original numbers. Blue whales were protected in portions of the Southern Hemisphere beginning in 1939, but blue whales were not fully protected in Antarctic until 1966.

There are no reports of fisheries-related mortality or serious injury of blue whales. Blue whale interactions with fisheries may go undetected because the whales are not observed after they swim away with a portion of the net. However, fishers report that large blue and fin whales usually swim through their nets without entangling and with very little damage to the net (Barlow et al. 1997). Gillnets appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle whales (Perrin et al. 1994 *in* Carretta et al. 2005). Large whales have been entangled in longline gear off the Hawaiian Islands (Forney 2004, Nitta and Henderson 1993), but no interactions with blue whales were observed in the Hawaii-based longline fishery between 1994 and 2002 (Forney 2004). There are no confirmed records of mortality or injury to blue whales in the US Atlantic EEZ although in March 1998 a dead 20 m (66ft) male blue whale was brought into Rhode Island waters on the bow of a tanker. The cause of death was determined to be ship strike, but the whale also suffered other injuries that could not be explained (Waring et al. 2005).

In 1980, 1986, 1987, and 1993, ship strikes have been implicated in the deaths of blue whales off California (Barlow et al. 1997). In addition, several photo-identified blue whales from California waters were observed with large scars on their dorsal areas that may have been caused by ship strikes. Within the St. Lawrence Estuary, blue whales are believed to be affected by large amounts of recreational and commercial vessel traffic. The number of blue whales struck and killed by ships is unknown because the whales do not always strand or examinations of blue whales that have stranded did not identify the traumas that could have been caused by ship collisions. In the California/Mexico stock, annual incidental mortality due to ship strikes averaged 0.2 whales during 1991-1995 (Barlow et al. 1997), but we cannot determine if this reflects the actual number of blue whales struck and killed by ships.

As noted by Clapham et al. (1999), the blue whale's nearly exclusive dependence upon euphausiids could make them vulnerable to large-scale changes in ocean productivity caused, for example, by climate change. If blue whales become limited by their forage base, long-term reproductive success could become affected and recovery may be further delayed.

DRAFT

3.7 Loggerhead sea turtle

Loggerhead sea turtles are a cosmopolitan species, found in temperate and subtropical waters and inhabiting pelagic waters, continental shelves, bays, estuaries and lagoons. Loggerhead sea turtles are the most abundant species of sea turtle in U.S. waters.

Pacific Ocean. In the Pacific Ocean, major loggerhead nesting grounds are generally located in temperate and subtropical regions with scattered nesting in the tropics. The abundance of loggerhead turtles on nesting colonies throughout the Pacific basin have declined dramatically over the past 10-20 years. Loggerhead sea turtles in the Pacific are represented by a northwestern Pacific nesting aggregation (located in Japan) and a smaller southwestern nesting aggregation that occurs in Australia (Great Barrier Reef and Queensland), New Caledonia, New Zealand, Indonesia, and Papua New Guinea. Data from 1995 estimated the Japanese nesting aggregation at 1,000 female loggerhead turtles (Bolten *et al.* 1996). More recent estimates are unavailable. However, qualitative reports suggest that the Japanese nesting aggregation has declined since 1995 and continues to decline (Tillman 2000). In addition, genetic analyses of female loggerheads nesting in Japan indicates the presence of genetically distinct nesting colonies (Hatase *et al.* 2002). As a result, Hatase *et al.* (2002) suggest that the loss of one of these colonies would decrease the genetic diversity of loggerheads that nest in Japan, and recolonization of the site would not be expected on an ecological time scale. In Australia, long-term census data has been collected at some rookeries since the late 1960's and early 1970's, and nearly all the data show marked declines in nesting populations since the mid-1980's (Limpus and Limpus 2003). The nesting aggregation in Queensland, Australia, was as low as 300 females in 1997.

Pacific loggerhead turtles are captured, injured, or killed in numerous Pacific fisheries including Japanese longline fisheries in the western Pacific Ocean and South China Seas; direct harvest and commercial fisheries off Baja California, Mexico, commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru; purse seine fisheries for tuna in the eastern tropical Pacific Ocean, and California/Oregon drift gillnet fisheries.

Indian Ocean. Loggerhead sea turtles are distributed throughout the Indian Ocean, along most mainland coasts and island groups (Baldwin *et al.* 2003). In the southwestern Indian Ocean, loggerhead nesting has shown signs of recovery in South Africa where protection measures have been in place for decades. However, in other southwestern areas (*e.g.*, Madagascar and Mozambique) loggerhead nesting aggregations are still affected by subsistence hunting of adults and eggs (Baldwin *et al*. 2003). The largest known nesting aggregation of loggerheads in the world occurs in Oman in the northern Indian Ocean. An estimated 20,000-40,000 females nest at Masirah, the largest nesting site within Oman, each year (Baldwin *et al*. 2003). All known nesting sites within the eastern Indian Ocean are found in Western Australia (Dodd 1988). As has been found in other areas, nesting numbers are disproportionate within the area with the majority of nesting occurring at a single location. This may, however, be the result of fox predation on eggs at other Western Australia nesting sites (Baldwin *et al*. 2003). Throughout the Indian Ocean, loggerhead sea turtles face many of the same threats as in other parts of the world

DRAFT

including loss of nesting beach habitat, fishery interactions, and turtle meat and/or egg harvesting.

Mediterranean Sea. Nesting in the Mediterranean is confined almost exclusively to the eastern basin (Margaritoulis *et al*. 2003). The greatest number of nests in the Mediterranean are found in Greece with an average of 3,050 nests per year (Margaritoulis *et al*. 2003). There is a long history of exploitation for loggerheads in the Mediterranean (Margaritoulis *et al*. 2003). Although much of this is now prohibited, some directed take still occurs (Margaritoulis *et al*. 2003). Loggerheads in the Mediterranean also face the threat of habitat degradation, incidental fishery interactions, vessel strikes, and marine pollution (Margaritoulis *et al*. 2003).

Atlantic Ocean. Loggerheads commonly occur throughout the inner continental shelf from Florida through Cape Cod, Massachusetts although their presence varies with the seasons due to changes in water temperature (Braun and Epperly 1996; Epperly *et al.* 1995a, Epperly *et al.* 1995b; Shoop and Kenney 1992). Aerial surveys of loggerhead turtles north of Cape Hatteras indicate that they are most common in waters from 22 to 49 meters deep although they range from the beach to waters beyond the continental shelf (Shoop and Kenney 1992). The presence of loggerhead turtles in an area is also influenced by water temperature. Loggerheads have been observed in waters with surface temperatures of 7-30EC but water temperatures of ∃11EC are favorable to sea turtles (Epperly *et al.* 1995b; Shoop and Kenney 1992). Within the action area of this consultation, loggerhead sea turtles occur year round in offshore waters off of North Carolina where water temperature is influenced by the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to migrate to North Carolina inshore waters (*e.g.*, Pamlico and Core Sounds) and also move up the coast (Braun-McNeill and Epperly 2004; Epperly *et al.* 1995a; Epperly *et al.* 1995b; Epperly *et al.* 1995c), occurring in Virginia foraging areas as early as April and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some may remain in Mid-Atlantic and Northeast areas until late Fall. By December loggerheads have migrated from inshore North Carolina waters and more northern coastal waters to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Epperly *et al.* 1995b; Shoop and Kenney 1992).

In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. There are at least five western Atlantic subpopulations, divided geographically as follows: (1) a northern nesting subpopulation, occurring from North Carolina to northeast Florida at about 29E N; (2) a south Florida nesting subpopulation, occurring from 29E N on the east coast to Sarasota on the west coast; (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez 1990; TEWG 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (NMFS SEFSC 2001). The fidelity of nesting females to their nesting beach is the reason these subpopulations can be differentiated from one another. Genetic analyses conducted at these nesting sites indicate that they are distinct subpopulations (TEWG 2000). Cohorts from three of these, the south Florida, Yucatán, and northern

DRAFT

subpopulations, are known to occur within the action area of this consultation (Bass *et al.* 2004; Rankin-Baransky *et al.* 2001) and there is genetics evidence that cohorts from the other two also likely occur within the action area (Bass *et al*. 2004).

Loggerheads mate in late March-early June, and eggs are laid throughout the summer, with a mean clutch size of 100-126 eggs in the southeastern United States. Individual females nest multiple times during a nesting season, with a mean of 4.1 nests/individual (Murphy and Hopkins 1984). Nesting migrations for an individual female loggerhead are usually on an interval of 2-3 years, but can vary from 1-7 years (Dodd 1988).

A number of stock assessments (Heppell *et al.* 2003; NMFS SEFSC 2001; TEWG 2000; 1998) have examined the stock status of loggerheads in the waters of the United States, but have been unable to develop any reliable estimates of absolute population size. Due to the difficulty of conducting comprehensive population surveys away from nesting beaches, nesting beach survey data are used to index the status and trends of loggerheads (USFWS and NMFS 2003). Nesting beach surveys count the number of nests. As alluded to above, the number of nests laid are a function of the number of reproductively mature females in the population and the number of times that they nest per season. Between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,014 to 92,182, annually with a mean of 73,751 (TEWG 2000). The south Florida nesting group is the largest known loggerhead nesting assemblage in the Atlantic and one of only two loggerhead nesting assemblages worldwide that has greater than 10,000 females nesting per year (USFWS and NMFS 2003; USFWS Fact Sheet). South Florida nests make up the majority (90.7%) of all loggerhead nests counted along the U.S. Atlantic and Gulf coasts during the period 1989-1998. Annual total nests for the south Florida nesting group have ranged from 48,531 - 83,442 over the past decade (USFWS and NMFS 2003). The northern subpopulation is the second largest loggerhead nesting assemblage within the United States but much smaller than the south Florida nesting group with approximately 1,524 nesting females per year (USWFS and NMFS 2003). Of the total number of nests counted along the U.S. Atlantic and Gulf coasts during the period 1989-1998, 8.5% were attributed to the northern subpopulation. The total nests for this subpopulation have ranged from 4,370 - 7,887, annually, for the period 1989-1998 (USWFS and NMFS 2003). The remaining three subpopulations (the Dry Tortugas, Florida Panhandle, and Yucatán) are much smaller subpopulations. Annual total nests for the Florida Panhandle subpopulation ranged from 113-1,285 nests for the period 1989-2002 (USFWS and NMFS 2003). The Yucatán nesting group was reported to have had 1,052 nests in 1998 (TEWG 2000). Nest counts for the Dry Tortugas subpopulation ranged from 168-270 during the 9-year period from 1995-2003.

While nesting beach data can be a useful tool for assessing sea turtle populations, the detection of nesting trends requires consistent data collection methods over long periods of time (USFWS and NMFS 2003). In 1989, a statewide sea turtle Index Nesting Beach Survey (INBS) program was developed and implemented in Florida, and similar standardized daily survey programs have been implemented in Georgia, South Carolina, and North Carolina (USFWS and NMFS 2003). Currently available nesting trend data for these subpopulations from the INBS program is still too limited to indicate statistically reliable trends (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide and Index Nesting Beach Survey

DRAFT

Programs; USFWS and NMFS 2003). Similarly, nesting surveys for the Dry Tortugas subpopulation have been conducted as part of Florida's statewide survey program since 1995 (although the 2002 year was missed), but no conclusion on the nesting trend for the subpopulation can be made at this time given the relatively short period of survey effort (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data). Nesting survey effort overall has been inconsistent among the Yucatán nesting beaches and no trend can be determined for this subpopulation given the currently available data (Zurita *et al*. 2003).

More reliable nesting trend information is available from some south Florida and northern subpopulation nesting beaches that have been surveyed for longer periods of time. Using the information gathered from these select south Florida and northern subpopulation nesting beaches, the Turtle Expert Working Group (TEWG) previously concluded that the south Florida subpopulation was increasing based on nesting data over the last couple of decades, and that the northern subpopulation was stable or declining (TEWG 2000). Trend data for these nesting beaches are expected to be reviewed and the information provided in a revised Loggerhead Sea Turtle Recovery Plan. However, preliminary review of nesting trend data from several sources for the northern and south Florida nesting beaches now suggest: (1) a declining trend in nesting for 11 beaches in North Carolina, South Carolina and Georgia of 2% annually over a 23 year period (1982-2005) (Barbara Schroeder, NMFS, pers. comm.), (2) a declining trend of 3.3% annually for South Carolina beaches since 1980 (Barbara Schroeder, NMFS, pers. comm.), and (3) an overall decline in nesting of 29% for the south Florida subpopulation during the period 1989-2005 (A. Meylan, presentation at the 26th Annual Symposium on Sea Turtle Biology and Conservation, April 2006).

Nesting trend data must be interpreted cautiously when using it to assess population trends for sea turtles. In general, census of nesting females only reflects the number of reproductively active females (Zurita *et al*. 2003). Females and males that are not reproductively active may not reflect the same tendencies (Ross 1996). Without knowing the proportion of males to females and the age structure of the population, it is impossible to extrapolate the data from nesting beaches to the entire population (Zurita *et al*. 2003; Meylan 1982). In the case of loggerheads, there is currently insufficient information to determine whether the current impacts to mature females are experienced to the same degree amongst all age classes regardless of sex, and/or that the impacts that led to the current abundance of nesting females are affecting the current immature females to the same extent. Adding to the difficulties associated with using loggerhead nesting trend data as an indicator of subpopulation status is the late age to maturity for loggerhead sea turtles. Past literature gave an estimated age at maturity for loggerhead sea turtles of 21-35 years (Frazer and Ehrhart 1985; Frazer *et al.* 1994) with the benthic immature stage lasting at least 10-25 years. New data from tag returns, strandings, and nesting surveys suggested estimated ages of maturity ranging from 20-38 years and the benthic immature stage lasting from 14-32 years (NMFS SEFSC 2001). Given the late age to maturity, there is a greater risk that the factors affecting the number of currently nesting females are not the same as the factors affecting the number of loggerhead sea turtles in the other age classes. Multiple management actions have been implemented in the United States over the last 20 years or less that either directly or indirectly address the known sources of mortality for loggerhead sea turtles

DRAFT

(*e.g.*, fishery interactions, power plant entrainment, destruction of nesting beaches, etc.). These management actions are discussed more fully in section 4.1 of this BO and may have changed the impacts to the different loggerhead age classes.

In 2001, NMFS (SEFSC) reviewed and updated the stock assessment for loggerhead sea turtles of the western Atlantic (NMFS SEFSC 2001). The assessment reviewed and updated information on nesting abundance and trends, estimation of vital rates (including age to maturity), evaluation of genetic relationships between populations, and evaluation of available data on other anthropogenic effects on these populations since the TEWG reports (2000; 1998). In addition, the assessment also looked at the impact of the U.S. pelagic longline fishery on loggerheads with and without the proposed changes in the Turtle Excluder Device (TED) regulations for the shrimp fishery using a modified population model from Heppell *et al*. (2003)[3]. NMFS SEFSC (2001) modified the model developed by Heppell *et al*. (2003) to include updated vital rate information (*e.g.*, new estimates of the duration of life stages and time to maturity) and, unlike Heppell *et al*. (2003), also considered sex ratios other than 1:1 (NMFS SEFSC 2001).

NMFS SEFSC (2001) constructed four different models that differed based on the duration of life stages. Each model was run using three different inputs for population growth, and three different sex ratios (35%, 50%, and 80% female) for a total of 36 model runs. The models also included a 30% decrease in small benthic juvenile mortality based on research findings of (existing) TED effectiveness (Heppell *et al*. 2003; NMFS SEFSC 2001; Crowder *et al*. 1995). The results of the modeling indicated that the proposed change in the TED regulations that would allow larger benthic immature loggerheads and sexually mature loggerheads to escape from shrimp trawl gear would have a positive or at least stabilizing influence on the subpopulation (depending on the estimated growth rate of the subpopulation and proportion of females) in nearly all scenarios. Coupling the anticipated effect of the proposed TED changes with changes in the survival rate of pelagic immature loggerheads revealed that subpopulation status would be positive or at least stable when pelagic immature survival was changed by 0 to +10% in all but the most conservative model scenarios. Given the late age at maturity for loggerhead sea turtles and the normal fluctuations in nesting, changes in populations size as a result of the larger TED requirements and measures to address pelagic immature survival in the U.S. Atlantic longline fishery for swordfish are unlikely to be evident in nesting beach censuses for many years to come.

The diversity of a sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. Hurricanes are particularly destructive to sea turtle nests. Sand accretion and rainfall that result from these storms as well as wave action can appreciably reduce hatchling success. For example, in 1992, all of the eggs over a 90-mile length of coastal Florida were

[3] Although Heppell *et al*. is a later publication, NMFS SEFSC 2001 is actually a more up-to-date version of the modeling approach. Due to differences in publication times, Heppell *et al*. (2003) was actually published after NMFS SEFSC 2001.

DRAFT

destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton *et al.* 1994). Other sources of natural mortality include cold stunning and biotoxin exposure.

Anthropogenic factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion, beach armoring and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; beach driving; coastal construction and fishing piers; exotic dune and beach vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs and an increased presence of native species (*e.g.*, raccoons, armadillos, and opossums) which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (in areas like Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection. Sea turtle nesting and hatching success on unprotected high density east Florida nesting beaches from Indian River to Broward County are affected by all of the above threats.

Sea turtles, including loggerhead sea turtles, are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal development, and transportation; marine pollution; underwater explosions; hopper dredging; offshore artificial lighting; power plant entrainment and/or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; poaching, and fishery interactions.

In the pelagic environment loggerheads are exposed to a series of longline fisheries that include the U.S. Atlantic tuna and swordfish longline fisheries, a Japanese longline fleet, Chinese longline fleet, an Azorean longline fleet, a Spanish longline fleet, and various fleets in the Mediterranean Sea (Aguilar *et al.* 1995; Bolten *et al.* 1994; Crouse 1999). Globally, the number of loggerhead sea turtles captured in pelagic longline fisheries is significant (Lewison *et al.* 2004). The effects of the U.S. tuna and swordfish longline fisheries on loggerhead sea turtles have been assessed through section 7 consultation on the Highly Migratory Species Fishery Management Plan (HMS FMP). Further information on the effects of these fisheries on loggerhead sea turtles is provided in section 4.1.1 of this document. In short, NMFS estimates that 1,869 loggerheads will be captured in the pelagic longline fishery (no more than 438 mortalities) for the 3-year period from 2004-2006. For each subsequent 3-year period, 1,905 loggerheads are expected to be taken with no more than 339 mortalities (NMFS 2004c).

In the benthic environment in waters off the coastal U.S., loggerheads 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. Perhaps the most well documented U.S. fishery with respect to interactions with sea turtles, including loggerheads, is the U.S. shrimp fishery. Turtle Excluder Devices (TEDs) have proven to be effective at excluding Kemp's ridley sea turtles and some age classes of loggerhead and green sea turtles from shrimp trawls. However, it was apparent that TEDs were not effective at excluding large benthic immature and sexually mature loggerheads (as well as large greens) from shrimp trawls (Epperly and Teas 2002). Therefore, on February 21, 2003, NMFS issued a final rule that required increasing the size of TED escape openings to

DRAFT

allow larger loggerheads (and green sea turtles) to escape from shrimp trawl gear. As a result of the new rules, annual loggerhead mortality from capture in shrimp trawls is expected to decline from an estimated 62,294 to 3,947 turtles assuming that all TEDs are installed properly and that compliance will be 100% (Epperly *et al.* 2002). Additional information is provided in section 4.1.1 of this BO regarding loggerhead turtle interactions with U.S. fisheries within the action area.

Power plants can also pose a danger of injury and mortality for benthic loggerheads. In Florida, thousands of sea turtles have been entrained in the St. Lucie Nuclear Power Plant's intake canal over the past couple of decades (Bresette *et al*. 2003). From May 1976 - November 2001, 7,795 sea turtles were captured in the intake canal (Bresette *et al*. 2003). Approximately 57% of these were loggerheads (Bresette *et al*. 2003). Procedures are in place to capture the entrained turtles and release them. This has helped to keep mortality below 1% since 1990 (Bresette *et al*. 2003). The Oyster Creek Nuclear Generating Station in New Jersey is also known to capture sea turtles although the numbers are far less than those observed at St. Lucie, FL. As is the case at St. Lucie, procedures are in place for checking for the presence of sea turtles and rescuing sea turtles that are found within the intake canals. Based on past levels of impingement, the distribution of the species, and the operation of the facility, NMFS anticipates that no more than two loggerheads will be taken each year as a result of the operation of the Oyster Creek Nuclear Generating Station (NMFS 2005a).

Summary of Status for Loggerhead Sea Turtles

In the Pacific Ocean, loggerhead turtles are represented by a northwestern Pacific nesting aggregation (located in Japan) and a smaller southwestern nesting aggregation that occurs in Australia (Great Barrier Reef and Queensland), New Caledonia, New Zealand, Indonesia, and Papua New Guinea. The abundance of loggerhead turtles on nesting colonies throughout the Pacific basin have declined dramatically over the past 10 to 20 years by the combined effects of human activities that have reduced the number of nesting females and reduced the reproductive success of females that manage to nest (*e.g.*, due to egg poaching).

Loggerhead sea turtles also occur in the Indian Ocean and Mediterranean Sea. Nesting beaches in the southwestern Indian Ocean at Tongaland, South Africa have been protected for decades and sea turtle nesting shows signs of increasing (Baldwin *et al*. 2003). However, other southwestern Indian Ocean beaches are unprotected and both poaching of eggs and adults continues in some areas. The largest nesting aggregation of loggerhead sea turtles in the world occurs in Oman, principally on the island of Masirah. Oman does not have beach protection measures for loggerheads (Baldwin *et al*. 2003). Sea turtles in the area are affected by fishery interactions, development of coastal areas, and egg harvesting. In the eastern Indian Ocean, nesting is known to occur in western Australia. All known nesting sites within the eastern Indian Ocean are found in Western Australia (Dodd 1988). As has been found in other areas, nesting numbers are disproportionate within the area with the majority of nesting occurring at a single location. This may, however, be the result of fox predation on eggs at other Western Australia nesting sites (Baldwin *et al*. 2003).

DRAFT

There are at least five western Atlantic loggerhead subpopulations (NMFS SEFSC 2001; TEWG 2000; Márquez 1990). Cohorts from all of these, are expected to occur within the action area of this consultation (Bass *et al*. 2004). The south Florida nesting group is the largest known loggerhead nesting assemblage in the Atlantic and one of only two loggerhead nesting assemblages worldwide that have greater than 10,000 females nesting per year (USFWS and NMFS 2003; USFWS Fact Sheet). The northern subpopulation is the second largest loggerhead nesting assemblage within the United States. The remaining three subpopulations (the Dry Tortugas, Florida Panhandle, and Yucatán) are much smaller subpopulations with nest counts ranging from roughly 100 - 1,000 nests per year.

Loggerheads are a long-lived species and reach sexual maturity relatively late; 20-38 years (NMFS SEFSC 2001). The INBS program helps to track loggerhead status through nesting beach surveys. However, given the cyclical nature of loggerhead nesting, and natural events that sometimes cause destruction of many nests in a nesting season, multiple years of nesting data are needed to detect relevant nesting trends in the population. The INBS program has not been in place long enough to provide statistically reliable information on the subpopulation trends for western Atlantic loggerheads. In addition, given the late age to maturity for loggerhead sea turtles, nesting data represents effects to female loggerheads that have occurred through the various life stages over the past couple of decades. Therefore, caution must be used when interpreting nesting trend data since they may not be reflective of the current subpopulation trend if effects to the various life stages have changed.

NMFS SEFSC (2001) took an alternative approach for looking at trends in loggerhead subpopulations. Using multiple model scenarios that varied based on differences in starting growth rates, sex ratios, and age to maturity, the model looked at the relative change in the subpopulation trend when mortality of pelagic immature, benthic immature, and mature loggerhead sea turtles was reduced as a result of changes to the U.S. shrimp trawl fishery and the U.S. Atlantic pelagic longline fishery for swordfish. The modeling work suggests that western Atlantic loggerhead subpopulations should increase as a result of implementation of the new TED regulations that substantially reduce mortality of large, benthic immature and sexually mature loggerheads combined with a reduction in mortality of pelagic immature loggerheads resulting from implementation of new measures for the pelagic longline fishery. Even in the absence of a reduction in pelagic immature mortality from changes to the pelagic longline fishery, the model work supports the conclusion that the trend for western Atlantic loggerhead subpopulations will move from declining to stable (with an initial growth rate of 0.97, average age to maturity of 39 years, and a sex ratio of 35% females) or from declining to increasing (with an initial growth rate of 0.97, average age to maturity of 39 years, and female sex ratio of 50%) (NMFS SEFSC 2001) given the reduction in mortality of large benthic immature and mature loggerheads as a result of changes to the TED requirements for the shrimp trawl fishery.

3.8 Leatherback sea turtle

DRAFT

Leatherback sea turtles are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic and Pacific Oceans, the Caribbean Sea, and the Gulf of Mexico (Ernst and Barbour 1972). Leatherback sea turtles are the largest living turtles and range farther than any other sea turtle species. Their large size and tolerance of relatively low temperatures allows them to occur in northern waters such as off Labrador and in the Barents Sea (NMFS and USFWS 1995). In 1980, the global population of adult female leatherbacks was estimated at approximately 115,000 (Pritchard 1982). By 1995, the global population of adult females was estimated to number 34,500 turtles (Spotila *et al.* 1996).

Pacific Ocean. Based on published estimates of nesting female abundance, leatherback populations have collapsed or have been declining at all major Pacific basin nesting beaches for the last two decades (Sarti *et al.* 2000; Spotila *et al*. 2000; NMFS and USFWS 1998a; Spotila *et al*. 1996). Leatherback turtles disappeared from India before 1930, have been virtually extinct in Sri Lanka since 1994, and appear to be approaching extinction in Malaysia (Spotila *et al*. 2000). For example, the nesting assemblage on Terengganu (Malaysia) - which was one of the most significant nesting sites in the western Pacific Ocean - has declined severely from an estimated 3,103 females in 1968 to 2 nesting females in 1994 (Chan and Liew 1996). Nesting assemblages of leatherback turtles along the coasts of the Solomon Islands, which historically supported important nesting assemblages, are also reported to be declining (D. Broderick, pers. comm., *in* Dutton *et al*. 1999). In Fiji, Thailand, Australia, and Papua-New Guinea (East Papua), leatherback turtles have only been known to nest in low densities and scattered colonies.

Only an Indonesian nesting assemblage has remained relatively abundant in the Pacific basin. The largest, extant leatherback nesting assemblage in the Indo-Pacific lies on the north Vogelkop coast of Irian Jaya (West Papua), Indonesia, with over 3,000 nests recorded annually (Putrawidjaja 2000; Suárez *et al*. 2000). During the early-to-mid 1980s, the number of female leatherback turtles nesting on the two primary beaches of Irian Jaya appeared to be stable. More recently, however, this population has come under increasing threats that could cause this population to experience a collapse that is similar to what occurred at Terengganu, Malaysia. In 1999, for example, local Indonesian villagers started reporting dramatic declines in sea turtle populations near their villages (Suárez 1999); unless hatchling and adult turtles on nesting beaches receive more protection, this population will continue to decline. Declines in nesting assemblages of leatherback turtles have been reported throughout the western Pacific region where observers report that nesting assemblages are well below abundance levels that were observed several decades ago (*e.g.*, Suárez 1999).

In the western Pacific Ocean and South China Seas, leatherback turtles are captured, injured, or killed in numerous fisheries including Japanese longline fisheries. Leatherback turtles in the western Pacific are also threatened by poaching of eggs, killing of nesting females, human encroachment on nesting beaches, incidental capture in fishing gear, beach erosion, and egg predation by animals.

In the eastern Pacific Ocean, nesting populations of leatherback turtles are declining along the Pacific coast of Mexico and Costa Rica. According to reports from the late 1970s and early 1980s, three beaches located on the Pacific coast of Mexico support as many as half of all

DRAFT

leatherback turtle nests. Since the early 1980s, the eastern Pacific Mexican population of adult female leatherback turtles has declined to slightly more than 200 during 1998-99 and 1999-2000 (Sarti *et al*. 2000). Spotila *et al*. (2000) reported the decline of the leatherback turtle population at Playa Grande, Costa Rica, which had been the fourth largest nesting colony in the world. Between 1988 and 1999, the nesting colony declined from 1,367 to 117 female leatherback turtles. Based on their models, Spotila *et al*. (2000) estimated that the colony could fall to less than 50 females by 2003-2004. Commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru, purse seine fisheries for tuna in the eastern tropical Pacific Ocean, and California/Oregon drift gillnet fisheries are known to capture, injure or kill leatherback turtles in the eastern Pacific Ocean. Although all causes of the declines in Pacific leatherback turtle colonies have not been documented, the Pacific population has continued to decline leading some researchers to conclude that the leatherback is on the verge of extinction in the Pacific Ocean (*e.g.,* Spotila *et al*. 2000; Spotila *et al*. 1996).

Indian Ocean. Leatherbacks nest in several areas around the Indian Ocean. These sites include Tongaland, South Africa (Pritchard 2002), and the Andaman and Nicobar Islands (Andrews *et al*. 2002). Intensive survey and tagging work in 2001 provided new information on the level of nesting in the Andaman and Nicobar Islands (Andrews *et al*. 2002). Based on the survey and tagging work, it was estimated that 400-500 leatherbacks nest annually on Great Nicobar Island alone (Andrews *et al*. 2002). The number of nesting females using the Andaman and Nicobar Islands combined was estimated around 1000 (Andrews and Shanker 2002). Some nesting also occurs along the coast of Sri Lanka although in much smaller numbers than in the past (Pritchard 2002).

Atlantic Ocean. Evidence from tag returns and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between boreal, temperate and tropical waters (NMFS and USFWS 1992). A 1979 aerial survey of the outer Continental Shelf from Cape Hatteras, North Carolina to Cape Sable, Nova Scotia showed leatherbacks to be present throughout the area with the most numerous sightings made from the Gulf of Maine south to Long Island. Leatherbacks were sighted in water depths ranging from 1-4151 m but 84.4% of sightings were in waters less than 180 m (Shoop and Kenney 1992). Leatherbacks were sighted in waters within a sea surface temperature range similar to that observed for loggerheads; from 7-27.2EC (Shoop and Kenney 1992). However, leatherbacks appear to have a greater tolerance for colder waters in comparison to loggerhead sea turtles since more leatherbacks were found at the lower temperatures as compared to loggerheads (Shoop and Kenney 1992). This aerial survey estimated the leatherback population for the northeastern U.S. at approximately 300-600 animals (from near Nova Scotia, Canada to Cape Hatteras, North Carolina). However, the estimate was based on turtles visible at the surface and does not include those that were below the surface out of view. Therefore, it likely underestimates the leatherback population for the northeastern U.S. Estimates of leatherback abundance of 1,052 turtles (C.V.= 0.38) and 1,174 turtles (C.V.= 0.52) were obtained from surveys conducted from Virginia to the Gulf of St. Lawrence in 1995 and 1998, respectively (Palka 2000). However, since these estimates were also based on sightings of leatherbacks at the surface, the author considered the estimates to be negatively biased (Palka 2000). Studies of satellite tagged leatherbacks suggest that they spend a 10% - 41% of their time at the surface, depending on the phase of their migratory cycle (James *et*

DRAFT

al. 2005a). The greatest amount of surface time (up to 41%) was recorded when leatherbacks occurred in continental shelf and slope waters north of 38° N (James *et al*. 2005a).

Leatherbacks are a long lived species (> 30 years). The estimated age at sexual maturity is about 13-14 years for females with 9 years reported as a likely minimum (Zug and Parham 1996) and 19 years as a likely maximum (NMFS SEFSC 2001). In the U.S. and Caribbean, female leatherbacks nest from March through July. They nest frequently (up to 7 nests per year) during a nesting season and nest about every 2-3 years. During each nesting, they produce 100 eggs or more in each clutch and thus, can produce 700 eggs or more per nesting season (Schultz 1975). However, a significant portion (up to approximately 30%) of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. As is the case with other sea turtle species, leatherback hatchlings enter the water soon after hatching. Based on a review of all sightings of leatherback sea turtles of <145 cm curved carapace length (CCL), Eckert (1999) found that leatherback juveniles remain in waters warmer than 26EC until they exceed 100 cm CCL.

Leatherbacks are predominantly a pelagic species and feed on jellyfish (*i.e.*, *Stomolophus, Chryaora*, and *Aurelia* (Rebel 1974)), and tunicates (salps, pyrosomas). Leatherbacks may come into shallow waters if there is an abundance of jellyfish nearshore. For example, leatherbacks occur annually in Cape Cod Bay and Vineyard and Nantucket Sounds during the summer and fall months.

Data collected in southeast Florida clearly indicate increasing numbers of nests for the past twenty years (9.1-11.5% increase), although it is critical to note that there was also an increase in the survey area in Florida over time (NMFS SEFSC 2001). The largest leatherback rookery in the western Atlantic remains along the northern coast of South America in French Guiana and Suriname. More than half the present world leatherback population is estimated to be nesting on the beaches in and close to the Marowijne River Estuary in Suriname and French Guiana (Hilterman and Goverse 2004). Nest numbers in Suriname have shown an increase and the long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). Studies by Girondot *et al*. (in press) also suggest that the trend for the Suriname - French Guiana nesting population over the last 36 years is stable or slightly increasing.

Tag return data emphasize the link between these South American nesters and animals found in U.S. waters. For example, a nesting female tagged May 29, 1990, in French Guiana was later recovered and released alive from the York River, VA. Another nester tagged in French Guiana on June 21, 1990, was later found dead in Palm Beach, Florida (STSSN). Many other examples also exist. For example, leatherbacks tagged at nesting beaches in Costa Rica have been found in Texas, Florida, South Carolina, Delaware, and New York (STSSN database). Leatherback turtles tagged in Puerto Rico, Trinidad, and the Virgin Islands have also been subsequently found on U.S. beaches of southern, Mid-Atlantic and northern states (STSSN database).

DRAFT

Leatherbacks are susceptible to entanglement in multiple types of fishing gear, including longlines, gillnets, pot/trap gear, and trawl gear. Sea turtles entangled in fishing gear generally have a reduced ability to feed, dive, surface to breathe or perform any other behavior essential to survival (Balazs 1985). They may be more susceptible to boat strikes if forced to remain at the surface, and entangling lines can constrict blood flow resulting in tissue necrosis.

Leatherbacks are exposed to pelagic longline fisheries in many areas of their range. An estimated 6,363 leatherback sea turtles were caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992-1999, of which 88 were released dead (NMFS SEFSC 2001). Since the U.S. fleet accounts for only 5-8% of the hooks fished in the Atlantic Ocean, adding up the under-represented observed takes of the other 23 countries actively fishing in the area would likely result in annual take estimates of thousands of leatherbacks over different life stages (NMFS SEFSC 2001).

Leatherbacks are susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer *et al.* 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer *et al.* 2002). A review of leatherback mortality documented by the STSSN in Massachusetts suggests that vessel strikes and entanglement in fixed gear (primarily lobster pots and whelk pots) are the principal sources of this mortality (Dwyer *et al.* 2002). Fixed gear fisheries in the Mid-Atlantic have also contributed to leatherback entanglements. For example, in North Carolina, two leatherback sea turtles were reported entangled in a crab pot buoy inside Hatteras Inlet (D. Fletcher, pers. comm. to Sheryan Epperly, NMFS SEFSC 2001). A third leatherback was reported entangled in a crab pot buoy in Pamlico Sound off of Ocracoke. This turtle was disentangled and released alive; however, lacerations on the front flippers from the lines were evident (D. Fletcher, pers. comm. to Sheryan Epperly, NMFS SEFSC 2001). In the Southeast, leatherbacks are vulnerable to entanglement in Florida's lobster pot and stone crab fisheries as documented on stranding forms. In the U.S. Virgin Islands, where one of five leatherback strandings from 1982 to 1997 were due to entanglement (Boulon 2000), leatherbacks have been observed with their flippers wrapped in the line of West Indian fish traps (R. Boulon, pers. comm. to Joanne Braun-McNeill, NMFS SEFSC 2001). Since many entanglements of this typically pelagic species likely go unnoticed, entanglements in fishing gear may be much higher.

Leatherback interactions with the southeast shrimp trawl fishery, which operates from North Carolina through southeast Florida (NMFS 2002a), are also common. Leatherbacks are likely to encounter shrimp trawls working in the coastal waters off the Atlantic coast (from Cape Canaveral, Florida through North Carolina) as they make their annual spring migration north. For many years, TEDs that were required for use in the southeast shrimp fishery were less effective for leatherbacks as compared to the smaller, hard-shelled turtle species, because the TED openings were too small to allow leatherbacks to escape (USFWS and NMFS 1992). To address this problem, on February 21, 2003, NMFS issued a final rule to amend the TED regulations. Modifications to the design of TEDs are now required in order to exclude leatherbacks as well as large benthic immature and sexually mature loggerhead and green turtles.

DRAFT

Other trawl fisheries are also known to interact with leatherback sea turtles although on a much smaller scale. In October 2001, for example, a fisheries observer documented the take of a leatherback in a bottom otter trawl fishing for *Loligo* squid off of Delaware. TEDs are not required in this fishery.

Gillnet fisheries operating in the nearshore waters of the Mid-Atlantic states are also suspected of capturing, injuring and/or killing leatherbacks when these fisheries and leatherbacks co-occur. Data collected by the NEFSC Fisheries Observer Program from 1994 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54% to 92%. In North Carolina, a leatherback was reported captured in a gillnet set in Pamlico Sound in the spring of 1990 (D. Fletcher, pers.comm. to Sheryan Epperly, NMFS SEFSC 2001). Five other leatherbacks were released alive from nets set in North Carolina during the spring months: one was from a net (unknown gear) set in the nearshore waters near the North Carolina/Virginia border (1985); two others had been caught in gillnets set off of Beaufort Inlet (1990); a fourth was caught in a gillnet set off of Hatteras Island (1993), and a fifth was caught in a sink net set in New River Inlet (1993). In addition to these, in September 1995 two dead leatherbacks were removed from a large (11-inch) monofilament shark gillnet set in the nearshore waters off of Cape Hatteras, North Carolina (STSSN unpublished data reported in NMFS SEFSC 2001).

Poaching is not known to be a problem for nesting populations in the continental U.S. However, the NMFS SEFSC (2001) noted that poaching of juveniles and adults was still occurring in the U.S. Virgin Islands. In all, four of the five strandings in St. Croix were the result of poaching (Boulon 2000). A few cases of fishermen poaching leatherbacks have been reported from Puerto Rico, but most of the poaching is on eggs.

Leatherback sea turtles may be more susceptible to marine debris ingestion than other species due to their pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding areas and migratory routes (Lutcavage *et al.* 1997; Shoop and Kenney 1992). Investigations of the stomach contents of leatherback sea turtles revealed that a substantial percentage (44% of the 16 cases examined) contained plastic (Mrosovsky 1981). Along the coast of Peru, intestinal contents of 19 of 140 (13%) leatherback carcasses were found to contain plastic bags and film (Fritts 1982). The presence of plastic debris in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and plastic debris (Mrosovsky 1981). Balazs (1985) speculated that the object may resemble a food item by its shape, color, size or even movement as it drifts about, and induce a feeding response in leatherbacks.

It is important to note that, like marine debris, fishing gear interactions and poaching are problems for leatherbacks throughout their range. Entanglements are common in Canadian waters where Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland/Labrador were entangled in fishing gear including salmon net, herring net, gillnet, trawl line and crab pot line. Leatherbacks are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (Graff 1995; Castroviejo *et al.* 1994). Gillnets are one of the

DRAFT

suspected causes for the decline in the leatherback sea turtle population in French Guiana (Chevalier *et al.* 1999), and gillnets targeting green and hawksbill turtles in the waters of coastal Nicaragua also incidentally catch leatherback turtles (Lagueux *et al.* 1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six leatherbacks from 13,600 trawls (Marcano and Alio 2000). An estimated 1,000 mature female leatherback sea turtles are caught annually in fishing nets off of Trinidad and Tobago with mortality estimated to be between 50-95% (Eckert and Lien 1999). However, many of the turtles do not die as a result of drowning, but rather because the fishermen butcher them in order to get them out of their nets (NMFS SEFSC 2001).

Summary of Status for Leatherback Sea Turtles
In the Pacific Ocean, the abundance of leatherback turtles on nesting colonies has declined dramatically. At current rates of decline, leatherback turtles in the Pacific basin are a critically endangered species with a low probability of surviving and recovering in the wild.

Leatherbacks nest in several areas around the Indian Ocean, including Tongaland, South Africa (Pritchard 2002), and the Andaman and Nicobar Islands (Andrews *et al*. 2002). Intensive survey and tagging work in 2001 provided new information on the level of nesting in the Andaman and Nicobar Islands (Andrews *et al*. 2002) and the number of nesting females using the Andaman and Nicobar Islands combined was estimated around 1000 (Andrews and Shanker 2002). Some nesting also occurs along the coast of Sri Lanka although in much smaller numbers than in the past (Pritchard 2002).

The largest leatherback rookery in the western Atlantic remains along the northern coast of South America in French Guiana and Suriname. More than half the present world leatherback population is estimated to be nesting on the beaches in and close to the Marowijne River Estuary in Suriname and French Guiana (Hilterman and Goverse 2004). Nest numbers in Suriname have shown an increase and the long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). Studies by Girondot *et al*. (in press) also suggest that the trend for the Suriname - French Guiana nesting population over the last 36 years is stable or slightly increasing.

Some of the same factors that led to precipitous declines of leatherbacks in the Pacific also affect leatherbacks in the Atlantic. Leatherbacks are captured and killed in many kinds of fishing gear and interact with fisheries in U.S. state and federal waters as well as in international waters. Poaching is a problem and affects leatherbacks that occur in U.S. waters. Leatherbacks also appear to be more susceptible to death or injury from ingesting marine debris than other turtle species.

3.9 Kemp's ridley sea turtle

DRAFT

The Kemp's ridley is one of the least abundant of the world's sea turtle species. In contrast to loggerhead, leatherback and green sea turtles which are found in multiple oceans of the world, Kemp's ridleys typically occur in the Gulf of Mexico and the northern half of the Atlantic Ocean (USFWS and NMFS 1992) The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). Estimates of the adult female nesting population reached a low of 300 in 1985 (TEWG 2000). Conservation efforts by Mexican and U.S. agencies have aided this species by eliminating egg harvest, protecting eggs and hatchlings, and reducing at-sea mortality through fishing regulations (TEWG 2000). From 1985 to 1999, the number of nests observed at Rancho Nuevo, and nearby beaches increased at a mean rate of 11.3% (95% C.I. slope = 0.096-0.130) per year (TEWG 2000). Current totals exceed 3000 nests per year, allowing cautious optimism that the population is on its way to recovery (TEWG 2000). Nevertheless, the estimated 2,000 nesting females in the current population is still far below historical numbers (Stephens and Alvarado-Bremer 2003).

Kemp's ridley nesting occurs from April through July each year. Little is known about mating but it is believed to occur at or before the nesting season in the vicinity of the nesting beach. Hatchlings emerge after 45-58 days. Once they leave the beach, neonates presumably enter the Gulf of Mexico where they feed on available sargassum and associated infauna or other epipelagic species (USFWS and NMFS 1992). The presence of juvenile turtles along both the Atlantic and Gulf of Mexico coasts of the U.S., where they are recruited to the coastal benthic environment, indicates that post-hatchlings are distributed in both the Gulf of Mexico and Atlantic Ocean (TEWG 2000). The location and size classes of dead turtles recovered by the STSSN suggests that benthic immature developmental areas occur in many areas along the U.S. coast and that these areas may change given resource quality and quantity (TEWG 2000).

Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in Virginia and Maryland state waters, arriving in these areas during May and June (Keinath *et al.* 1987; Musick and Limpus 1997). In the Chesapeake Bay, where the juvenile population of Kemp's ridley sea turtles is estimated to be 211 to 1,083 turtles (Musick and Limpus 1997), ridleys frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Kemp's ridleys consume a variety of crab species, including *Callinectes* sp., *Ovalipes* sp., *Libinia* sp., and *Cancer* sp. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). Upon leaving Chesapeake Bay in autumn, juvenile ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined there by juveniles of the same size from North Carolina sounds and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Musick and Limpus 1997; Epperly *et al.* 1995a; Epperly *et al.* 1995b).

Kemp's ridleys face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, natural predators at sea, and oceanic events such as cold-stunning. Although cold-stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. For example, in the winter of 1999/2000, there was a major cold-stunning event where 218 Kemp's ridleys, 54 loggerheads, and 5 green turtles were found on Cape Cod beaches (R. Prescott, pers. comm.). Annual cold stun events do not always occur at this magnitude; the

DRAFT

extent of episodic major cold stun events may be associated with numbers of turtles utilizing Northeast waters in a given year, oceanographic conditions and the occurrence of storm events in the late fall. Although many cold-stun turtles can survive if found early enough, cold-stunning events can represent a significant cause of natural mortality.

Like other turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. From the 1940s through the early 1960s, nests from Ranch Nuevo were heavily exploited (USFWS and NMFS 1992), but beach protection in 1966 helped to curtail this activity (USFWS and NMFS 1992). Following World War II, there was a substantial increase in the number of trawl vessels, particularly shrimp trawlers, in the Gulf of Mexico where the adult Kemp's ridley turtles occur. Information from fishers helped to demonstrate the high number of turtles taken in these shrimp trawls (USFWS and NMFS 1992). Subsequently, NMFS has worked with the industry to reduce turtle takes in shrimp trawls and other trawl fisheries, including the development and use of TEDs.

Although changes in the use of shrimp trawls and other trawl gear has helped to reduce mortality of Kemp's ridleys, this species is also affected by other sources of anthropogenic impacts similar to those discussed above. For example, in the spring of 2000, a total of five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. Cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected to have been from a large-mesh gillnet fishery operating offshore in the preceding weeks. The five ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction since it is unlikely that all of the carcasses washed ashore.

Summary of Status for Kemp's ridley Sea Turtles

The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). From 1985 to 1999, the number of nests observed at Rancho Nuevo, and nearby beaches increased at a mean rate of 11.3% per year. Current totals exceed 3000 nests per year (TEWG 2000). Kemp's ridleys mature at an earlier age (7 - 15 years) than other chelonids, thus 'lag effects' as a result of unknown impacts to the non breeding life stages would likely have been seen in the increasing nest trend beginning in 1985 (USFWS and NMFS 1992). While there is cautious optimism that the Kemp's ridley sea turtle population is increasing, the estimated 2,000 nesting females in the current population is still far below historical numbers (Stephens and Alvarado-Bremer 2003). Anthropogenic impacts to the Kemp's ridley population are similar to those discussed above for loggerhead sea turtles.

3.10 Green sea turtle

Green turtles are distributed circumglobally in tropical and subtropical waters (NMFS and USFWS 1998b). Juveniles are also known to occur seasonally in temperate waters (Musick and Limpus 1997; Morreale and Standora 1998). Juvenile green sea turtles occupy pelagic habitats after leaving the nesting beach. At approximately 20 to 25 cm carapace length, juveniles leave

DRAFT

pelagic habitats and enter benthic foraging areas, shifting to a chiefly herbivorous diet but may also consume jellyfish, salps, and sponges (Bjorndal 1997).

Green sea turtle populations have declined in many areas. A review of 32 Index Sites4 distributed globally revealed a 48% to 67% decline in the number of mature females nesting annually over the last 3-generations5 (Seminoff 2004).

Pacific Ocean. Green turtles occur in the eastern, central, and western Pacific. Nesting is known to occur in the Hawaiian archipelago, American Samoa, Guam, and various other sites in the Pacific but none of these are considered large breeding sites (with 2,000 or more nesting females per year)(NMFS and USFWS 1998b). Foraging areas are also found throughout the Pacific and along the southwestern U.S. coast (NMFS and USFWS 1998b).

Historically, green turtles were used in many areas of the Pacific for food. They were also commercially exploited and this, coupled with habitat degradation led to their decline in the Pacific (NMFS and USFWS 1998b). Green turtles in the Pacific continue to be affected by poaching, habitat loss or degradation, fishing gear interactions, and fibropappiloma (NMFS 2004d; NMFS and USFWS 1998b).

Indian Ocean. There are numerous nesting sites for green sea turtles in the Indian Ocean. One of the largest nesting sites for green sea turtles worldwide occurs on the beaches of Oman where an estimated 20,000 green sea turtles nest annually (Ferreira *et al*. 2003; Hirth 1997). Based on a review of the 32 Index Sites used to monitor green sea turtle nesting worldwide, Seminoff (2004) concluded that declines in green turtle nesting were evident for many of the Indian Ocean Index Sites. While several of these had not demonstrated further declines in the more recent past, only the Comoros Island Index Site in the Western Indian Ocean showed evidence of increased nesting (Seminoff 2004).

Atlantic Ocean. In the western Atlantic green sea turtles range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean (Wynne and Schwartz 1999). Green turtles were traditionally highly prized for their flesh, fat, eggs, and shell, and directed fisheries in the United States and throughout the Caribbean are largely to blame for the decline of the species. In the Gulf of Mexico, green turtles were once abundant enough in the shallow bays and lagoons to support a commercial fishery. In 1890, over one million pounds of green turtles were taken in the Gulf of Mexico green sea turtle fishery (Doughty 1984). However, declines in the turtle fishery throughout the Gulf of Mexico were evident by 1902 (Doughty 1984).

In the continental United States, green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). Occasional nesting has been documented along the Gulf coast of Florida, at southwest Florida beaches, as well as the beaches on the Florida Panhandle (Meylan *et al.* 1995). More recently, green turtle nesting occurred on Bald Head Island, North Carolina just east of the

4 The 32 Index Sites include all of the major known nesting areas as well as many of the lesser nesting areas for which quantitative data are available.

5 Generation times ranged from 35.5 years to 49.5 years for the assessment depending on the Index Beach site

DRAFT

mouth of the Cape Fear River, on Onslow Island, and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic Coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Certain Florida nesting beaches have been designated index beaches. Index beaches were established to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the ten years of regular monitoring since establishment of the index beaches in 1989, perhaps due to increased protective legislation throughout the Caribbean (Meylan *et al.* 1995). Seminoff (2004) reviewed the population estimates for green sea turtles at five western Atlantic nesting sites. All of these showed increased nesting compared to prior estimates with the exception of nesting at Aves Island, Venezuela (Seminoff 2004).

Some of the principal green sea turtle foraging areas in the western Atlantic Ocean include the upper west coast of Florida and the northwestern coast of the Yucatán Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Ft. Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971). In North Carolina, green turtles are known to occur in estuarine and oceanic waters and to nest in low numbers along the entire coast. The summer developmental habitat for green turtles also encompasses estuarine and coastal waters of Chesapeake Bay and as far north as Long Island Sound (Musick and Limpus 1997).

Green turtles face many of the same natural threats as loggerhead and Kemp's ridley sea turtles. In addition, green turtles appear to be susceptible to fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtles body. Juveniles are most commonly affected. The occurrence of fibropapilloma tumors may result in impaired foraging, breathing, or swimming ability, leading potentially to death. Stranding reports indicate that between 200-400 green turtles strand annually along the Eastern U.S. coast from a variety of causes most of which are unknown (STSSN database).

As with the other sea turtle 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, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles.

Summary of Status for Green Sea Turtles

Green sea turtle populations have declined in many areas; as much as a 48% to 67% decline in the number of mature females nesting annually over the last 3-generations (Seminoff 2004). Seminoff (2004) concluded that declines in green turtle nesting were evident for many of the Indian Ocean Index Sites. While several of these had not demonstrated further declines in the more recent past, only the Comoros Island Index Site in the Western Indian Ocean showed evidence of increased nesting (Seminoff 2004).

DRAFT

In the Pacific, green turtles continue to be affected by poaching, fishing gear interactions, habitat degradation, and disease (notably fibropappillomatosis) (NMFS 2004d; NMFS and USFWS 1998b). Green turtles face many of the same threats in the Atlantic. In the western Atlantic, green turtles range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean (Wynne and Schwartz 1999) and are exposed to many of the same anthropogenic threats as loggerhead and Kemp's ridley sea turtles. In addition, Atlantic green turtles are also susceptible to fibropapillomatosis which can result in death. In the continental United States, green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). The pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the ten years of regular monitoring since establishment of index beaches in 1989. However, age at sexual maturity is estimated to be between 20 to 50 years (Frazer and Ehrhart 1985; Balazs 1982). Thus, caution is warranted about over interpreting nesting trend data collected for less than 15 years.

4.0 ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this BO includes the effects of several activities that may affect the survival and recovery of threatened and endangered species in the action area. The activities that shape the environmental baseline in the action area of this consultation include vessel operations, fisheries, discharges, dredging, ocean dumping, sonic activities, and recovery activities associated with reducing those impacts. However, all of the listed species that occur in the action area are highly migratory and can thus be affected by activities anywhere in a wide range that encompasses areas throughout the North Atlantic Ocean, Gulf of Mexico, and the Caribbean Sea.

Due to logistical difficulties associated with most marine activities and the significant amount of resources necessary to design effective monitoring programs, monitoring the effects of the various federal actions on threatened and endangered species has not been consistent for all species groups and all projects. For example, the most reliable method for monitoring fishery interactions is the sea sampling program, which provides random sampling of commercial fishing activities. However, due to the size, power, and mobility of whales, sea sampling is only effective for sea turtles. Although takes of whales are occasionally observed by the sea sampling program, levels of interaction between whales and fishing vessels and their gear is derived from data collected opportunistically. It is often impossible to assign gear found on stranded or free-swimming animals to a specific fishery. Consequently, the total level of interaction between fisheries and whales is unknown.

4.1 Fishery Operations

DRAFT

NMFS has undertaken several ESA section 7 consultations to address the effects of vessel operations and gear associated with federally-permitted fisheries on threatened and endangered species in the action area. Each of those consultations sought to develop ways of reducing the probability of adverse impacts of the action on listed species. Similarly, recovery actions NMFS has undertaken under both the Marine Mammal Protection Act (MMPA) and the ESA are addressing the problem of take of whales in the fishing and shipping industries.

Federal Fishery Operations

Several commercial fisheries operating in the action area use gear that is known to capture, injure, and kill listed species. Efforts to reduce the adverse effects of commercial fisheries are addressed through both the MMPA take reduction planning process and the ESA section 7 process. Federally regulated gillnet, longline, trawl, seine, dredge, and pot fisheries have all been documented as interacting with either whales or sea turtles or both. Other gear types may impact whales and sea turtles as well. For all fisheries for which there is a federal fishery management plan (FMP) or for which any federal action is taken to manage that fishery, impacts have been evaluated through the section 7 process.

The management areas for the following fisheries that may adversely affect threatened and endangered species overlap with the action area for the proposed action: American Lobster, Multispecies, Monkfish, Atlantic Mackerel/Squid/Butterfish, Atlantic Herring, Scallop, Red Crab, and Highly Migratory Species. For many of these fisheries, the overlap of the action area with actual fishing activity is likely to be relatively small given that the portion of the action area over the continental shelf where fishing activity primarily occurs is limited to the shipping lanes. Nonetheless, given the migratory nature of the listed species in the action area, the animals affected by the fisheries listed above will be the same animals affected by the proposed action, so we will consider these fisheries as part of the environmental baseline. A summary of each consultation is provided, but more detailed information can be found in the respective BOs.

The *American lobster trap fishery* has been identified as a source of gear causing serious injuries and mortality of endangered whales and leatherback sea turtles. Previous BOs for this fishery have concluded that operation of the lobster trap fishery is likely to jeopardize the continued existence of right whales and may adversely affect leatherback sea turtles. A Reasonable and Prudent Alternative (RPA) to avoid the likelihood that the lobster fishery would jeopardize the continued existence of right whales was implemented. However, these measures were not expected to reduce the number or severity of leatherback sea turtle interactions with the fishery. Subsequently, the death of a right whale was determined to be entanglement related and NMFS concluded that the death provided evidence that the RPA was not effective at removing the likelihood of jeopardy for right whales from the lobster trap fishery. Consultation was reinitiated and is in progress.

American lobster occur within U.S. waters from Maine to Virginia. They are most abundant from Maine to New Jersey with abundance declining from north to south (ASMFC 1997). An Interstate Fishery Management Plan (ISFMP) developed through the ASMFC provides management measures for the fishery that are implemented by the states. NMFS has issued regulations for the Federal waters portion of the fishery based on recommendations from the

DRAFT

ASMFC. Of the seven lobster management areas (LMAs), only LMA 3 occurs entirely within Federal waters. LMAs 1, 2, 4, 5, and the Outer Cape include both state and Federal waters (NMFS 1999; 2002b). Therefore, management of the Federal waters portion of LMAs 1, 2, 4, 5, and the Outer Cape must be consistent with management in the state waters portion of those areas to meet the objectives of the Lobster ISFMP. Management measures include a limited access permit system, gear restrictions, and other prohibitions on possession (*e.g.*, of berried or scrubbed lobsters), landing limits for lobsters caught by non-trap gear, a trap tag requirement, and trap limits. These measures include reduction of effort and capping of effort. The commercial lobster fishery is frequently described as an inshore fishery (typically defined as within state waters; 0-3 nautical miles from shore) and an offshore fishery (typically defined as nearshore Federal waters and the deepwater offshore fishery) (NMFS 1999).

Most lobster trap effort occurs in the Gulf of Maine. Maine and Massachusetts produced 93% of the 2004 total U.S. landings of American lobster, with Maine accounting for 78% of these landings (NMFS 2002b). Lobster landings in the other New England states as well as New York and New Jersey account for most of the remainder of U.S. American lobster landings. However, declines in lobster abundance and landings have occurred from Rhode Island through New Jersey in recent years. The Mid-Atlantic states from Delaware through North Carolina have been granted *de minimus* status under the Lobster ISFMP. Low landings of lobster in these *de minimus* states suggest that there is not a directed fishery for lobster in these territorial waters.

The *Northeast Multispecies fishery* operates throughout the year with peaks in spring, and from October through February. Multiple gear types are used in the fishery. However, the gear type of greatest concern is sink gillnet gear that can entangle whales and sea turtles (*i.e.*, in buoy lines and/or net panels). Data indicate that sink gillnet gear has seriously injured or killed northern right whales, humpback whales, fin whales, loggerhead and leatherback sea turtles. The most recent reinitiation of the Northeast Multispecies consultation was completed on June 14, 2001, and concluded that continued implementation of the Multispecies FMP may adversely affect loggerhead, Kemp's ridley and green sea turtles and is not likely to jeopardize the continued existence of the northern right whale. A new RPA was issued to avoid the likelihood that the operation of the gillnet sector of the multispecies fishery would result in jeopardy to right whales. The ITS exempted the lethal or non-lethal take of one loggerhead sea turtle, and one green, leatherback, or Kemp's ridley turtle annually. The northeast multispecies sink gillnet fishery has historically occurred from the periphery of the Gulf of Maine to Rhode Island in water to 60 fathoms. In recent years, more of the effort in the fishery has occurred in offshore waters and into the Mid-Atlantic. However, participation in this fishery has declined since extensive groundfish conservation measures have been implemented, particularly since implementation of Amendment 13 to the Multispecies FMP in April 2004. Additional management measures (*i.e.* Framework Adjustment 42) are expected to further reduce and control effort in the multispecies fishery.

The Federal *Monkfish fishery* occurs in all waters under federal jurisdiction from Maine to the North Carolina/South Carolina border. The current commercial fishery operates primarily in the deeper waters of the Gulf of Maine, Georges Bank, and southern New England, and in the Mid-Atlantic. Monkfish have been found in depths ranging from the tide line to 840 meters with

DRAFT

concentrations between 70 and 100 meters and at 190 meters. The monkfish fishery uses several gear types that may capture ESA-listed species, including gillnet and trawl gear. A consultation conducted on the continued operation of the fishery concluded in 2001 that the fishery was likely to jeopardize the continued existence of right whales as a result of entanglement in gillnet gear used in the fishery. An RPA was provided and implemented to remove the likelihood of jeopardy. The BO also concluded that sea turtles may be adversely affected by operation of the monkfish fishery as a result of entanglement in gear used in the fishery. Consultation was reinitiated in February 2003 to consider the effects of Framework Adjustment 2 measures on listed species. This consultation concluded that the proposed action was not likely to result in jeopardy to any listed species, although takes of sea turtles were still likely to occur. The ITS anticipated the take of 3 loggerheads and 1 non-loggerhead species (green, leatherback, or Kemp's ridley) in gillnet gear, and 1 sea turtle of any species in trawl gear.

The monkfish fishery is managed in the EEZ through a joint NEFMC and MAFMC Monkfish FMP (NEFSC 2005b). The FMP defines two management areas for monkfish (northern and southern) divided roughly by a line bisecting Georges Bank (NEFSC 2005b). Effort in the fishery is limited through a limited access permit program as well as DAS and trip allocations that were implemented as initial management measures of the FMP in 1999. Trip allocations differ between the two management areas.

Trawl, scallop dredge, and gillnet gear are the primary gear types that land monkfish (NEFSC 2005b). During the period of 1998-2000, trawls accounted for 54% of the total landings, scallop dredges about 17%, and gillnets 29% (NEFSC 2005b). More recently, for the period from 2001-2003, trawl, gillnet, and scallop dredge gear accounted for 55%, 36%, and 8% of landings, respectively (NEFSC 2005b).

The *Atlantic Mackerel/Squid/Butterfish fisheries* are managed under a single FMP. The FMP covers management of four species given that both short-finned squid (*Illex illecebrosus*) and long-finned squid (*Loligo pealei*) are managed under the FMP. Information on each of the fisheries managed under the FMP has been updated in the draft supplemental environmental impact statement for Amendment 9 to the FMP, currently being prepared by the Mid-Atlantic Fishery Management Council (MAFMC). A brief summary of the information is presented below.

Trawl gear is the primary fishing gear for the fisheries. In 2003, bottom trawl gear accounted for 97%, and 99.4% of *Loligo*, and *Illex* landings, respectively (MAFMC, in prep). Mid-water trawl gear accounted for the majority (82%) of mackerel landings with an additional 17% of landings attributed to bottom trawls (MAFMC, in prep). Seasonal differences in landings are evident amongst the fisheries with the majority of mackerel landed January through April, the majority of *Loligo* landed September through March, and the majority of *Illex* landed June through October based on the 2003 fishing year (MAFMC, in prep). While the New England states of Massachusetts and Rhode Island are amongst the leading states in terms of landings for two or more of the FMP species, most fishing occurs in the Mid-Atlantic. Statistical areas 616, 612, 615, and 613 accounted for 90.4% of mackerel landed in 2003 (MAFMC, in prep). By comparison, statistical areas 632, 626 and 622 accounted for 91% of the 2003 *Illex* landings, and

DRAFT

statistical areas 525, 537, 616, and 622 accounted for 68% of the 2003 *Loligo* landings (MAFMC, in prep).

Given the gear types used in these fisheries, the time of year when fishing occurs, and the areas where the fishery operates, interactions between sea turtles and gear used in one or more of the fisheries is likely to occur. An ITS for sea turtles was provided with the April 28, 1999 BO on the continued authorization of the FMP.

The FMP for the *Atlantic Herring fishery* was implemented on December 11, 2000. The BO that considered the effects to ESA-listed species from the implementation of the Herring FMP concluded that sea turtle takes in fishing gear used in the herring fishery were reasonably likely to occur even though none had been observed. An ITS was provided based on the observed capture of sea turtles in other fisheries using comparable gear.

Three management areas, which may have different management measures, were established under the Herring FMP. Management Area 1 includes Gulf of Maine waters and is subdivided into inshore and offshore sub-areas. Management Area 2 is referred to as the South Coastal Area and includes state and Federal waters adjacent to the States of Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina. Management Area 3 includes waters over Georges Bank (NEFMC 1999). The ASMFC's Atlantic Herring ISFMP provides measures for the management of the herring fishery in state waters that are complementary to the Federal FMP.

Operation of the herring fishery was reviewed in a report by the NEFMC Herring Plan Development Team (PDT) and Technical Committee (NEFMC 2004b). The primary gear types used in the fishery are midwater pair trawl, single vessel midwater trawl, purse seine, bottom trawl, and weirs (fixed gear). Of these, midwater pair trawl contributed 65% of the landings for 2003 (NEFMC 2004b). Most of the herring sold in 2003 was from Area 1A (59%) (NEFMC 2004b). Landings from Areas 1B, 2, and 3 contributed 4.9%, 16%, and 20% of the 2003 herring landings, respectively (NEFMC 2004b). Thirty-four vessels landed nearly all of the 2003 landings for herring (NEFMC 2004b). At present, the herring fishery is not a limited access fishery. However, limiting access to the fishery is one of the measures under consideration for Amendment 1 to the Atlantic Herring FMP that is currently being developed. Formal section 7 consultation has been reinitiated on the herring fishery to consider the effect of the fishery on the Gulf of Maine Distinct Population Segment of Atlantic salmon.

The *Atlantic Sea Scallop fishery* is also known to take sea turtles as a result of capture in scallop dredge and trawl gear. The U.S. Atlantic sea scallop fishery occurs in three areas: the Gulf of Maine, Georges Bank, and the Mid-Atlantic. Dredge gear is the primary gear type used in the scallop fishery (NEFMC 2003).

NMFS initiated section 7 consultation on the Atlantic sea scallop fishery following new information on the capture of sea turtles in dredge gear fished in the Mid-Atlantic. The BO for that consultation concluded on February 24, 2003, that the fishery may adversely affect loggerhead, Kemp's ridley, green, and leatherback sea turtles. Additional consultation and BOs

DRAFT

have followed (dated February 23, 2004, December 15, 2004, and September 18, 2006) as a result of new information on the capture of sea turtles in scallop fishing gear and changes to how the fishery is managed. Based on data from observer reports for the scallop fishery, and the distribution and abundance of turtles in the action area, NMFS concluded in the September 18, 2006 BO that the continued implementation of the Scallop FMP, may result in the annual taking of up to 760 sea turtles with the majority of these (749) being loggerheads taken in scallop dredge gear used in the fishery. Up to 489 of the total takes may result in mortality.

The *Red crab fishery* is a pot/trap fishery that occurs in deep waters along the continental slope. The primary fishing zone for red crab, as reported by the fishing industry, is at a depth of 400-800 meters along the continental shelf in the Northeast region, and is limited to waters north of 35° 15.3' N (Cape Hatteras, NC) and south of the Hague Line.

There has been a small, directed fishery for red crab off the coast of New England and the Mid-Atlantic since the 1970s. The fishery was fairly consistent through the 1980's but landings steadily increased from the mid-1990s (NEFMC 2002). Following concerns that red crab could be overfished, an FMP was developed and became effective on October 21, 2002. The FMP includes management measures to control effort in the fishery (*e.g.*, a limited access permit program, trap limits, a fleet DAS allocation) (NEFMC 2005b). Five vessels initially received limited access permits for the red crab fishery but one vessel opted out of the fishery in 2004.

There have been no recorded takes of ESA-listed species in the red crab fishery. However, given the type of gear used in the fishery, takes may be possible where gear overlaps with the distribution of loggerhead and leatherback sea turtles. Section 7 consultation was completed on the proposed implementation of the Red Crab FMP, and concluded that the action was not likely to result in jeopardy to any ESA-listed species under NMFS jurisdiction. An ITS was provided that addresses takes of loggerhead and leatherback sea turtles.

Components of the *Highly Migratory Species (HMS)* Atlantic pelagic fishery for swordfish/tuna/shark in the EEZ occur within the action area for this consultation. Use of pelagic longline, pelagic driftnet, bottom longline, hand line (including bait nets), and/or purse seine gear in this fishery has resulted in the take of sea turtles and whales. The Northeast swordfish driftnet portion of the fishery was prohibited during an emergency closure that began in December 1996, and was subsequently extended. A permanent prohibition on the use of driftnet gear in the swordfish fishery was published in 1999. In June 2001, NMFS completed consultation on the HMS pelagic longline fishery and concluded that the Atlantic HMS fisheries, particularly the pelagic longline fisheries, were likely to jeopardize the continued existence of loggerhead and leatherback sea turtles. An RPA was provided to avoid jeopardy to leatherback and loggerhead sea turtles as a result of operation of the HMS fisheries. Consultation was subsequently reinitiated on the HMS fishery following new information on the number of loggerhead and leatherback sea turtles captured in the fishery. Consultation was completed on June 1, 2004, and NMFS concluded that the continued prosecution of the HMS pelagic longline fishery was likely to jeopardize the continued existence of leatherback sea turtles. A new RPA was developed and implemented. On December 22, 2006, NMFS received a request for reinitiation of consultation on the HMS pelagic longline fishery because the number of turtles

DRAFT

taken in the fishery had exceeded the ITS. NMFS is currently reviewing the request to determine whether the ITS needs to be re-evaluated and consultation reinitiated.

Non-Federally Regulated Fishery Operations

Very little is known about the level of take in fisheries that operate strictly in state waters. However, depending on the fishery in question, many state permit holders also hold federal licenses; therefore, section 7 consultations on federal actions in those fisheries address some state-water activity. Impacts on sea turtles from state fisheries may be greater than the impacts from federal activities in certain areas due to the distribution of these species. Impacts of state fisheries on endangered whales are addressed as appropriate through the MMPA take reduction planning process. NMFS is actively participating in a cooperative effort with the Atlantic States Marine Fisheries Commission (ASMFC) and member states to standardize and/or implement programs to collect information on level of effort and bycatch of protected species in state fisheries. When this information becomes available, it can be used to refine take reduction plan measures in state waters.

With regard to whale entanglements, vessel identification is occasionally recovered from gear removed from entangled animals. With this information, it is possible to determine whether the gear was deployed by a federal or state permit holder and whether the vessel was fishing in federal or state waters. In 1998, three entanglements of humpback whales in state-water fisheries were documented. Nearshore entanglements of turtles have been documented; however, information is not available on whether the vessels involved were permitted by the state or by NMFS.

Leatherbacks are susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer et al. 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer et al. 2002). A review of leatherback mortality documented by the Sea Turtle Stranding and Salvage Network (STSSN) in Massachusetts suggests that vessel strikes and entanglement in fixed gear (primarily lobster pots and whelk pots) are the principal sources of this mortality (Dwyer et al. 2002). Leatherbacks have been found entangled in whelk pot lines that are associated with a *whelk fishery* in New England waters. This fishery operates when sea turtles may be in the area. Sea turtles (loggerheads and Kemp's ridleys in particular) are believed to become entangled in the top bridle line of the whelk pot, given a few documented entanglements of loggerheads in whelk pots, the configuration of the gear, and the turtles' preference for the pot contents. Research is underway to determine the magnitude of these interactions and to develop gear modifications to reduce these potential entanglements. Since many entanglements of this typically pelagic species likely go unnoticed, entanglements in fishing gear may be much higher.

Various *crab fisheries* using pot/trap gear also occur in federal and state waters such as horseshoe crab, green crab, blue crab, and Jonah crab. Effort in the latter is currently limited by trap limits set for the lobster fishery since many Jonah crab fishers are also lobster fishers and Jonah crabs are collected using lobster gear. However, there is interest in developing a separate fishery. If the Jonah crab fishery were to develop apart from the lobster fishery, there is a

DRAFT

potential for a significant amount of trap/pot gear to be added to the environment. Other gear types occurring in waters within the action area which are known to be an entanglement risk for protected species include a slime eel pot/trap fishery in Northeast waters (*e.g.*, Massachusetts and Connecticut), finfish trap fisheries (*i.e.*, for tautog), and weirs off Cape Cod. Residents in some states (*e.g.*, Connecticut and Massachusetts) may also obtain a personal use lobster license that allows individuals to set traps to obtain lobster for personal use.

4.2 Vessel Activity

Fishing Vessels

Other than entanglement in fishing gear, effects of *fishing vessels* on listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. Listed species or critical habitat may also be affected by fuel oil spills resulting from fishing vessel accidents. No collisions between commercial fishing vessels and listed species or adverse effects resulting from disturbance have been documented. However, the commercial fishing fleet represents a significant portion of marine vessel activity. For example, more than 280 commercial fishing vessels fish on Stellwagen Bank in the Gulf of Maine. In addition, commercial fishing vessels may be the only vessels active in some areas, particularly in cooler seasons. Therefore, the potential for collisions exists. Due to differences in vessel speed, collisions during fishing activities are less likely than collisions during transit to and from fishing grounds. Because most fishing vessels are smaller than large commercial tankers and container ships, collisions are less likely to result in mortality. Although entanglement in fishing vessel anchor lines has been documented historically, no information is available on the prevalence of such events.

Fuel oil spills could affect animals directly or indirectly through the food chain. Fuel spills involving fishing vessels are common events. However, these spills typically involve small amounts of material that are unlikely to adversely affect listed species. Larger spills may result from accidents, although these events would be rare and involve small areas. No direct adverse effects on listed species or critical habitat resulting from fishing vessel fuel spills have been documented. Given the current lack of information on prevalence or impacts of interactions, there is no basis to conclude that the level of interaction represented by any of the various fishing vessel activities discussed in this section would be detrimental to the recovery of listed species.

Federal Vessel Operations

Potential adverse effects from federal vessel operations in the action area of this consultation include operations of the U.S. Navy (USN) and the U.S. Coast Guard (USCG), which maintain the largest federal vessel fleets, the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), and the ACOE. NMFS has conducted formal consultations with the USCG, the USN, and is currently in early phases of consultation with the other federal agencies on their vessel operations (e.g., NOAA research vessels). In addition to operation of ACOE vessels, NMFS has consulted with the ACOE to provide recommended permit restrictions for operations of contract or private vessels around whales. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid adverse effects to listed species. At the present time, however, they represent some level of potential interaction. Refer

DRAFT

to the BOs for the USCG (NMFS 1995a; July 22, 1996; and NMFS 1998c) and the USN (NMFS 1997b) for details on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures.

Private and Commercial Vessel Operations

Private and commercial vessels operate in the action area of this consultation and also have the potential to interact with whales and sea turtles. Ship strikes have been identified as a significant source of mortality to the northern right whale population (Kraus 1990) and are also known to impact all other endangered whales. A whale watch enterprise focusing on humpback whales, comprised of approximately 35 vessels (NMFS 2006), has developed in Massachusetts waters. Peak whale watch season is July-August, but operations begin in spring and continue into the fall. Due to whale distribution, a high proportion of whale watching activity is concentrated in or near SBNMS. The Port of Boston has experienced rapid growth over the past 25 years, and is expected to continue expanding its capacity for large cargo ships and large passenger vessels such as cruise liners. USCG vessel arrival data indicates that 483 vessels arrived in the Port of Boston in 2004, plus an additional 94 large passenger vessels and 100 cruise vessels (NMFS 2006). Including vessel arrivals at the ports of Salem, Plymouth, and Gloucester, and the Cape Cod Canal, an estimated 6,710 large commercial vessel transits occur annually in the action area (ACOE 2003 in Neptune 2005). There are also 37 ferry vessels in operation in Massachusetts. In addition, a large number of private recreational boaters frequent coastal waters, some of which are engaged in whale watching or sportfishing activities. NMFS Marine Recreational Fisheries Statistics survey indicates that 154,785 charter fishing trips occurred in Massachusetts in 2004 (NMFS 2006), although not all of these vessel transits occur through Massachusetts Bay and the action area for this consultation. Including small and medium commercial, recreational, cruise, and ferry vessel traffic, an estimated total of 59,475 vessel transits occur in Massachusetts Bay annually (AcuTech 2006).

These activities have the potential to result in lethal (through vessel strike) or non-lethal (through harassment) takes of listed species that could prevent or slow a species' recovery. Effects of harassment or disturbance which may be caused by whale watch operations are currently unknown. The presence of the Massachusetts Bay Disposal Site (MBDS), which is located approximately 17 nmi east of Boston Harbor, also accounts for approximately 100 transits per year between dredge sites along the Massachusetts coast and the disposal site (NMFS 1999b). The advent of new technology resulting in high-speed catamarans for ferry services and whale watch vessels operating in congested coastal areas contributes to the potential for impacts from privately operated vessels in the environmental baseline. Recent federal efforts regarding mitigating impacts of the whale watch and shipping industries on endangered whales are discussed in Section 4.4.1 below.

Other than injuries and mortalities resulting from collisions, the effects of disturbance (primarily acoustic) caused by vessel activity on listed species is largely unknown. Although the difficulty in interpreting animal behavior makes studying the effects of vessel activities problematic, attempts have been made to evaluate the impacts of vessel activities such as whale watch operations on whales in the Gulf of Maine. Some avoidance behavior and minor changes in feeding, diving, vocalizing, and respiratory behavior have been noted (see Section 5.5 for further

DRAFT

discussion of acoustic impacts on whale behavior). However, no conclusive detrimental effects have been demonstrated.

4.3 Other Activities

A number of anthropogenic activities have likely directly or indirectly affect listed species in the action area of this consultation. These sources of potential impacts include dredging projects, discharge sites and pollution, water quality, and sonic activities. However, the impacts from these activities are difficult to measure. Where possible, conservation actions are being implemented to monitor or study impacts from these elusive sources.

Pollution and Marine Debris

Within the action area, sea turtles and optimal sea turtle habitat most likely have been impacted by pollution. In feeding areas of the northeast such as the Massachusetts Bay area, the dominant circulation patterns make it probable that pollutant inputs into Massachusetts Bay will affect Cape Cod Bay's right whale critical habitat. Sources of pollutants in the Gulf of Maine and other coastal regions include atmospheric loading of pollutants such as PCB's, storm water runoff from coastal cities and towns, runoff into rivers emptying into bays, groundwater discharges and sewage treatment effluent, and oil spills.

Marine debris (e.g., discarded fishing line or lines from boats) can entangle turtles in the water and drown them. Turtles commonly ingest plastic or mistake debris for food, as observed with the leatherback sea turtle. The leatherback's preferred diet includes jellyfish, but similar looking plastic bags are often found in the turtle's stomach contents (Magnuson et al. 1990).

Chemical contaminants may also have an effect on sea turtle reproduction and survival, although the effects of contaminants on turtles are relatively unclear. Pollution has been suggested as a possible contributing factor to the fibropapilloma virus that kills many turtles each year (Aguirre et al. 1994). However, the disease has not yet been linked to any particular contaminant. If pollution is not the causal agent, it may make sea turtles more susceptible to disease by weakening their immune systems.

Excessive turbidity due to coastal development and/or construction sites could influence sea turtle foraging ability. Turtles are not very easily affected by changes in water quality or increased suspended sediments, but if these alterations make habitat less suitable for turtles and hinder their capability to forage, eventually they would tend to leave or avoid these less desirable areas (Ruben and Morreale 1999).

Massachusetts Water Resources Authority (MWRA) Outfall Tunnel

A present concern, not yet completely defined, is the possibility of habitat degradation in Massachusetts and Cape Cod Bays due to the MWRA outfall pipe located 9.5 miles east of Deer Island. The MWRA began discharging secondary sewage effluent into Massachusetts Bay in 2000, about 16 miles from designated right whale critical habitat. NMFS concluded in a 1993 BO that the discharge of sewage at the MWRA may affect, but is not likely to jeopardize the

DRAFT

continued existence of any listed or proposed species or destroy or adversely modify critical habitat under NMFS jurisdiction (NMFS 1993). However, scientific uncertainties remain about the potential unforeseen impacts to the marine ecosystem, the food chain, and endangered species. Therefore, post-discharge monitoring is being conducted by the MWRA. A report produced in October 2006 summarizes five years of outfall monitoring, and concludes that no changes in baseline conditions in Massachusetts Bay have been detected. In 2002-2004, summer concentrations of nuisance algal species *Phaeocystis pouchetii* exceeded the caution level, but the wide geographical extent of the blooms suggest that regional processes, rather than the outfall, have been responsible for the increasing frequency of *Phaeocystis* blooms (Werme and Hunt 2006). In May and June 2005, the largest large bloom of toxic dinoflagellates in the genus *Alexandrium* since 1972 occurred, triggering an exceedance of the caution threshold. *Alexandrium* species produce a toxin which can lead to paralytic shellfish poisoning at high concentrations. Investigation into the cause of the 2005 bloom suggests that a high abundance of newly deposited cysts in the western Gulf of Maine triggered the event. A spring bloom occurred in coastal Maine, and was spread into areas south of Martha's Vineyard by two strong northeast storms in May. Concentrations of cells were orders of magnitude higher than in previous years. The MWRA outfall is not suspected to be a factor in the size or extent of this bloom. The results of five years of monitoring have shown that a reduced monitoring program may be justified, but monitoring should not be eliminated.

In addition, monitoring of Boston Harbor water quality has shown improvements due to the relocation of the outfall into Massachusetts Bay, where dilution and mixing occur more rapidly, and more stringent regulations on effluent treatment. Concentrations of nutrients responsible for eutrophic conditions in the water column, chlorophyll levels, and pathogen-indicator bacteria level have decreased, while dissolved oxygen concentrations have increased. Concentrations of many PAHs, PCBs, pesticides, and some metals in the surface sediments have declined by 20 to 75%, and improvements in the benthic communities have been observed at some stations (Werme and Hunt 2006).

Massachusetts Bay Disposal Site (MBDS)

The EPA Region 1 designated the MBDS as an ocean dredged material disposal site in 1993. The site is a two nm diameter area centered at 42°25.1N, 70°35.0W, which is approximately 17 nm east of the entrance to Boston Harbor and adjacent to the boundary of the Stellwagen Bank National Marine Sanctuary. NMFS conducted section 7 consultation on the designation of the site for ocean disposal in 1991 (NMFS 1991c), and on the EPA/ACOE NAE issued Site Management Plan (SMP) for the MBDS in 1996 (NMFS 1996). BOs for both of these consultations concluded that the activities may affect, but would not jeopardize the continued existence of any endangered or threatened species under NMFS' jurisdiction. The most recent consultation on the MBDS was reinitiated in 1999 due to new conservation recommendations for large whales, new species information since the original 1993 determination, revised ocean dumping criteria, and updated monitoring programs (NMFS 1999b). NMFS concluded that the conclusions from previous consultations remained valid based on the continued unknown potential for contaminants to affect protected species. In the SMP, EPA/NAE identified bioaccumulation and biomagnification of contaminants into the food chain as the most important monitoring concern at the MBDS (EPA/NAE 1996). Although no adverse impacts have been

DRAFT

discovered thus far, the EPA and ACOE continue to monitor the impacts of the disposal site through the Disposal Area Monitoring System (DAMOS) tiered monitoring approach, which uses benthic recolonization and sediment quality as indicators that disposal operations are meeting the prescribed regulations.

Neptune LNG Deepwater Port

Although there are several LNG terminals proposed along the US east coast, the only other currently proposed terminal within the action area for this consultation is the Neptune LNG deepwater port. Nonetheless, NMFS acknowledges that other offshore oil, gas, and alternative energy projects may impact the species being considered in this consultation, as they are all highly migratory and can be affected by activities anywhere in a wide range that encompasses areas throughout the North Atlantic Ocean, Gulf of Mexico, and the Caribbean Sea.

Formal section 7 consultation was recently completed for the Neptune LNG deepwater port. The proposed Neptune terminal is nearly identical in technology and operation to the NEG proposal, and would be located approximately 3 miles north of the proposed NEG terminal. The BO for the Neptune port concluded that construction and operation of the port may adversely affect, but is not likely to jeopardize the continued existence of right, humpback, and fin whales, and that loggerhead, Kemp's ridley, leatherback, and green sea turtles and sei, sperm, and blue whales are not likely to be adversely affected by the proposed activities. Take by harassment due to acoustic output of construction and operation activities was anticipated, but an ITS was not issued because an Incidental Harassment Authorization (IHA) has not yet been obtained under the MMPA. Since the Neptune port has not yet been licensed or built, its contribution to the environmental baseline cannot be precisely determined. Nonetheless, there is a reasonable likelihood that the Neptune port will be constructed in fall 2009 and will begin operations in winter 2009. As such, operational impacts associated with the NEG port may overlap in space and time with both construction and operation-related impacts of the proposed Neptune port. The Neptune port would contribute an additional 50 roundtrip LNG carrier transits per year through the Boston TSS. Similar to the NEG port, the Neptune vessels will use thrusters to maneuver at the buoys for approximately 10-30 minutes per vessel arrival. In the environmental impact statement (EIS) for the NEG project, the USCG reports that the two ports are located far enough away from each other such that the sound fields will not overlap. Nonetheless, the existence of two ports would increase the total ensonified area within the action area, thus potentially increasing the number of animals exposed to acoustic disturbance.

Anthropogenic Noise

There has been growing concern among the scientific community about the effects of increasing levels of ocean noise on marine organisms, particularly marine mammals. Marine animals rely on hearing to communicate with conspecifics and derive information about their environment. Acoustic impacts from anthropogenic noise can include auditory trauma, temporary or permanent loss of hearing sensitivity, habitat exclusion, habituation, and disruption of other normal behavior patterns such as feeding, migration, and communication.

Although there is no current measure of ambient noise level at the immediate project site, ambient noise levels were estimated to range from 103-117 dB re 1μPa depending on wind

DRAFT

speeds and turbulence conditions. In addition, ambient noise levels have been measured in the nearby SBNMS and Cape Cod Bay. Ambient noise levels in the SBNMS are highly variable, and range from 50-140 dB re 1μPa (Neptune 2005). Measurements taken in Cape Cod Bay from January-May (periods of low shipping volume) indicate ambient noise levels around or above 110 dB re 1μPa (Neptune 2005). Daily fluctuations in ambient noise are most likely attributable to shipping traffic, although some types of offshore construction noise can propagate over long distances underwater.

NMFS and the Navy have been working to better understand and establish a policy for monitoring and managing acoustic impacts on marine mammals from anthropogenic sound sources in the marine environment. It is expected that the policy on managing anthropogenic sound in the oceans will provide guidance for programs such as the use of acoustic deterrent devices in reducing marine mammal-fishery interactions and review of federal activities and permits for research involving acoustic activities.

4.4 Conservation and Recovery Actions Reducing Threats to Listed Species

A number of activities are in progress that may ameliorate some of the threat that activities summarized in the *Environmental Baseline* pose to threatened and endangered species in the action area of this consultation. These include education/outreach activities, specific measures to reduce the adverse effects of entanglement in fishing gear, including gear modifications, fishing gear time-area closures, and whale disentanglement, and measures to reduce ship and other vessel impacts to protected species. Many of these measures have been implemented to reduce risk to critically endangered right whales. Despite the focus on right whales, other cetaceans and some sea turtles will likely benefit from the measures as well.

Reducing threats of vessel collision on listed whales

In addition to the ESA measures for federal activities mentioned in the previous section, numerous recovery activities are being implemented to decrease the adverse effects of private and commercial vessel operations on the species in the action area and during the time period of this consultation. These include implementation of NOAA's Right Whale Ship Strike Reduction Strategy, extensive education and outreach activities, the Sighting Advisory System (SAS), other activities recommended by the Northeast Implementation Team for the recovery of the North Atlantic right whale (NEIT) and Southeast Implementation Team for the Right Whale Recovery Plan (SEIT), and NMFS regulations.

Northeast Implementation Team (NEIT)

The Northeast Large Whale Recovery Plan Implementation Team (NEIT) was founded in 1994 to help implement the right and humpback whale recovery plans developed under the ESA. The NEIT provided advice and expertise on the issues affecting right and humpback whale recovery, and was comprised of representatives from federal and state regulatory agencies and private organizations, and was advised by a panel of scientists with expertise in right and humpback whale biology. The Ship Strike Committee (SSC) was one of the most active committees of the

DRAFT

NEIT, and NMFS came to recognize that vessel collisions with right whales was the recovery issue needing the most attention. As such, the NEIT was restructured in May 2004 to focus exclusively on right whale ship strike reduction research and issues and providing support to the NMFS Right Whale Ship Strike Working Group.

The Ship Strike Committee (SSC) of the former NEIT undertook multiple projects to reduce ship collisions with North Atlantic right whales. These included production of a video entitled: *Right Whales and the Prudent Mariner*, which provides information to mariners on the distribution and behavior of right whales in relation to vessel traffic. The video raises the awareness of mariners as to the plight of the right whale in the North Atlantic. NMFS and the NEIT also funded a project to develop recommended measures to reduce right whale ship strikes. The recommended measures project included looking at all possible options such as routing, seasonal and dynamic management areas, and vessel speed. It became evident in the process of meeting with the industry that a comprehensive strategy would have to be developed for the entire East coast. Development of NOAA's Ship Strike Reduction Strategy has been ongoing over the last number of years. The strategy is currently focused on protecting the North Atlantic right whale, but the operational measures are expected to reduce the incidence of ship strike on other large whales to some degree. The strategy consists of five basic elements and includes both regulatory and non-regulatory components: 1) operational measures for the shipping industry, including speed restrictions and routing measures, 2) section 7 consultations with Federal agencies that maintain vessel fleets, 3) education and outreach programs, 4) a bilateral conservation agreement with Canada, and 5) continuation of ongoing measures to reduce ship strikes of right whales (e.g., SAS, MSR, ongoing research into the factors that contribute to ship strikes, and research to identify new technologies that can help mariners and whales avoid each other). Progress made under these elements will be discussed further below.

Regulatory Actions to Reduce Vessel Strikes

In one recovery action aimed at reducing vessel-related impacts, including disturbance, NMFS published a proposed rule in August 1996 restricting vessel approach to right whales (61 FR 41116) to a distance of 500 yards. The Recovery Plan for the Northern Right Whale identified anthropogenic disturbance as one of many factors which had some potential to impede right whale recovery (NMFS 1991b). Following public comment, NMFS published an interim final rule in February 1997 codifying the regulations. With certain exceptions, the rule prohibits both boats and aircraft from approaching any right whale closer than 500 yds. Exceptions for closer approach are provided for the following situations, when: (a) compliance would create an imminent and serious threat to a person, vessel, or aircraft; (b) a vessel is restricted in its ability to maneuver around the 500-yard perimeter of a whale; (c) a vessel is investigating or involved in the rescue of an entangled or injured right whale; or (d) the vessel is participating in a permitted activity, such as a research project. If a vessel operator finds that he or she has unknowingly approached closer than 500 yds, the rule requires that a course be steered away from the whale at slow, safe speed. In addition, all aircraft, except those involved in whale watching activities, are excepted from these approach regulations. This rule is expected to reduce the potential for vessel collisions and other adverse vessel-related effects in the environmental baseline.

DRAFT

In April 1998, the USCG submitted, on behalf of the US, a proposal to the International Maritime Organization (IMO) requesting approval of a mandatory ship reporting system (MSR) in two areas off the east coast of the US, one which includes the right whale feeding grounds in the northeast, and one which includes the right whale calving grounds in the southeast. The USCG worked closely with NMFS and other agencies on technical aspects of the proposal. The package was submitted to the IMO's Subcommittee on Safety and Navigation for consideration and submission to the Marine Safety Committee at IMO and approved in December 1998. The USCG and NOAA play important roles in helping to operate the MSR system, which was implemented on July 1, 1999. Ships entering the northeast and southeast MSR boundaries are required to report the vessel identity, date, time, course, speed, destination, and other relevant information. In return, the vessel receives an automated reply with the most recent right whale sightings in the area and information on precautionary measures to take while in the vicinity of right whales.

A key component of NOAA's right whale ship strike reduction strategy is the proposed implementation of speed restrictions for vessels transiting the US Atlantic in areas and seasons where right whales predictably occur in high concentrations. The NEIT-funded "Recommended Measures to Reduce Ship Strikes of North Atlantic Right Whales" found that seasonal speed and routing measures could be an effective means of reducing the risk of ship strike along the US east coast. Based on these recommendations, NMFS published an Advance Notice of Proposed Rulemaking (ANPR) in June 2004 (69 FR 30857), and subsequently published a proposed rule on June 26, 2006 (71 FR 36299). The rulemaking process is ongoing, but NMFS intends to publish final regulations in the near future.

Vessel Routing Measures to Reduce the Co-occurrence of Ships and Whales
Another critical, non-regulatory component of NOAA's right whale ship strike reduction strategy involves the development and implementation of routing measures that reduce the co-occurrence of vessels and right whales, thus reducing the risk of vessel collisions. Recommended routes were developed for the Cape Cod Bay and Southeast critical habitat areas by overlaying right whale sightings data on existing vessel tracks, and plotting alternative routes where vessels could expect to encounter fewer right whales. Full implementation of these routes was completed at the end of November 2006. The routes are now charted on all NOAA electronic and printed charts, published in US Coast Pilots, and mariners have been notified through USCG Notices to Mariners.

Through a joint effort between NOAA and the USCG, the US also submitted a proposal to the IMO to shift the northern leg of the existing Boston Traffic Separation Scheme (TSS) 12 degrees to the north. Overlaying sightings of right whales and all baleen whales on the existing TSS revealed that the existing TSS directly overlaps with areas of high whale densities, while an area slightly to the north showed a considerable decrease in sightings. Separate analyses by the SBNMS and the NEFSC both indicated that the proposed TSS would overlap with 58% fewer right whale sightings and 81% fewer sightings of all large whales, thus considerably reducing the risk of collisions between ships and whales. The proposal was submitted to the IMO in April 2006, and was adopted by the Maritime Safety Committee in December 2006. The shift took effect on July 1, 2007.

DRAFT

Right Whale Sighting Advisory System
The right whale Sighting Advisory System (SAS) was initiated in early 1997 as a partnership among several federal and state agencies and other organizations to conduct aerial and ship board surveys to locate right whales and to alert mariners to right whale sighting locations in a near real time manner. The SAS surveys and opportunistic sightings reports document the presence of right whales and are provided to mariners via fax, email, NAVTEX, Broadcast Notice to Mariners, NOAA Weather Radio, several web sites, and the Traffic Controllers at the Cape Cod Canal. Fishermen and other vessel operators can obtain SAS sighting reports, and make necessary adjustments in operations to decrease the potential for interactions with right whales. The SAS has also served as the only form of active entanglement monitoring in the Cape Cod Bay and Great South Channel critical habitats. Some of these sighting efforts have resulted in successful disentanglement of right whales. SAS flights have also contributed sightings of dead floating animals that can occasionally be retrieved to increase our knowledge of the biology of the species and effects of human impacts. The USCG has also played a vital role in this effort, providing air and sea support as well as a commitment of resources to NMFS operations. The Commonwealth of Massachusetts has been a key collaborator to the SAS effort and has continued the partnership. Other sources of opportunistic right whale sightings include whale watch vessels, commercial and recreational mariners, fishermen, the U.S. Navy, NMFS research vessels, and NEFSC cetacean abundance aerial survey data.

Education and Outreach Activities
NMFS, primarily through the NEIT and SEIT, is engaged in a number of education and outreach activities aimed specifically at increasing mariner awareness of the threat of ship strike to right whales. The NEIT and SEIT have developed a comprehensive matrix of mariner education and outreach tasks ranked by priority for all segments of the maritime industry, including both commercial and recreational vessels, and are in the process of implementing high priority tasks as funding allows. In anticipation of the 2006/2007 calving season, the SEIT is nearing completion of two new outreach tools—a multimedia CD to educate commercial mariners about right whale ship strike issues, and a public service announcement (PSA) targeted towards private recreational vessel operators to be distributed to media outlets in the southeast.

NMFS also distributes informational packets on right whale ship strike avoidance to vessels entering ports in the northeast. The informational packets contain various outreach materials developed by NMFS, including the video "Right Whales and the Prudent Mariner," a placard on the MSR system, extracts from the US Coast Pilots about whale avoidance measures and seasonal right whale distribution, and a placard on applicable right whale protective regulations and recommended vessel operating measures.

NMFS has also worked with the International Fund for Animal Welfare (IFAW) to develop educational placards for recreational vessels. These placards provide vessel operators with information on right whale identification, behavior, and distribution, as well as information about the threat of ship strike and ways to avoid collisions with whales.

DRAFT

The NEIT has contracted the development of a comprehensive merchant mariner education module for use and distribution to maritime academies along the east coast. The purpose of this program is to inform both new captains and those being re-certified about right whales and operational guidelines for minimizing the risk of collision. Development of the module is now complete and is in the process of being distributed and implemented in various maritime academies.

Miscellaneous Activities
Through deliberations of the NEIT and its Ship Strike Committee, NMFS and the National Ocean Service (NOS) recently revised the whale watch guidelines for the Northeast, including the Studds-Stellwagen Bank National Marine Sanctuary (SBNMS). The whale watch guidelines provide operating measures to reduce repeated harassment of whales from close approaches of whale watch vessels. These measures include vessel speed guidelines at specific approach distances, and are therefore expected to reduce the risk of ship strike as well as harassment.

NMFS has established memoranda of agreements (MOA) with several Federal agencies, including the USCG, the Navy, and the ACOE, to provide funding and support for NOAA's aerial surveys conducted for the SAS and the Early Warning System in the southeast. Through these MOAs, the USCG also broadcasts right whale sighting information over USCG outlets such as Notices to Mariners, NAVTEX, and the MSR system, provides enforcement support for regulations that protect right whales, and assists NMFS with distribution of outreach materials aimed at commercial mariners.

In addition, NMFS continues to research technological solutions that have the potential to minimize the threat of vessel collisions with right whales, including technologies that improve our ability to detect the presence and location of right whales and transmit that information to mariners on a real-time basis.

Although many of the above-mentioned activities are focused specifically on right whales, other cetaceans and some sea turtles will likely benefit from the measures as well.

Reducing the Threat of Entanglement on Whales
Several efforts are ongoing to reduce the risk and impact of entanglement on listed whales, including both regulatory and non-regulatory measures. Most of these activities are captured under the Atlantic Large Whale Take Reduction Plan (ALWTRP). The ALWTRP is a multi-faceted plan that includes both regulatory and non-regulatory actions. Regulatory actions are directed at reducing serious entanglement injuries and mortality of right, humpback and fin whales from fixed gear fisheries (*i.e.*, trap and gillnet fisheries). The measures identified in the ALWTRP will also benefit minke whales (a non ESA-listed species). The non-regulatory component of the ALWTRP is composed of four principal parts: (1) gear research and development, (2) disentanglement, (3) the Sighting Advisory System (SAS), and (4) education/outreach**.** These components will be discussed in more detail below.

Regulatory Measures to Reduce the Threat of Entanglement on Whales

DRAFT

The regulatory component of the ALWTRP includes a combination of broad fishing gear modifications and time-area restrictions supplemented by progressive gear research to reduce the chance that entanglements will occur, or that whales will be seriously injured or die as a result of an entanglement. The long-term goal, established by the 1994 Amendments to the MMPA, was to reduce entanglement related serious injuries and mortality of right, humpback and fin whales to insignificant levels approaching zero within five years of its implementation. The ALWTRP is a "work-in-progress", and revisions are made to the regulations as new information and technology becomes available. Because gear entanglements of right, humpback and fin whales have continued to occur, including serious injuries and mortality, new and revised regulatory measures are anticipated. These changes are made with the input of the Atlantic Large Whale Take Reduction Team (ALWTRT), which is comprised of representatives from federal and state government, the fishing industry, scientists and conservation organizations.

Lobster and gillnet gear are known to entangle endangered large whales. Regulations introduced in Massachusetts waters requiring modifications to lobster and gillnet fishing came into effect January 1, 2003. The purpose of the new requirements is to reduce the risk of right whale entanglements in an area that has a known congregation of right whales each year. From January 1 through April 30, single lobster pots are banned, and ground lines must be either sinking or neutrally buoyant. Buoy lines must also be mostly sinking line and must include a weak link. From May 1 through December 31, lobstermen must use at least two of the following gear configurations: buoy lines 7/16-inch diameter or less, a weak link at the buoy of 600 pounds breaking strength, sinking buoy lines, and sinking or neutrally buoyant ground lines.

Gear Modification and Research

Gear research and development is a critical component of the ALWTRP, with the aim of finding new ways of reducing the number and severity of protected species-gear interactions while still allowing for fishing activities. At the outset, the gear research and development program followed two approaches: (a) reducing the number of lines in the water without shutting down fishery operations, and (b) devising lines that are weak enough to allow whales to break free and at the same time strong enough to allow continued fishing. Development of gear modifications are ongoing and are primarily used to minimize risk of large whale entanglement. This regulatory development has now moved into the next phase and reducing the profile of groundlines in the water column is the focus and priority, while reducing risk associated with vertical lines is being discussed and assessed and ongoing research is continuing to develop and alleviate future risk. This aspect of the ALWTRP is important, in that it incorporates the knowledge and encourages the participation of industry in the development and testing of modified and experimental gear.

Large Whale Disentanglement Network

In recent years, NMFS has greatly increased funding for the Whale Disentanglement Network, purchasing equipment caches to be located at strategic spots along the Atlantic coastline, supporting training for fishers and biologists, purchasing telemetry equipment, etc. This has resulted in an expanded capacity for disentanglement along the Atlantic seaboard including offshore areas. The Center for Coastal Studies (CCS), under NMFS authorization, has responded to numerous calls since 1984 to disentangle whales entrapped in gear, and has

DRAFT

developed considerable expertise in whale disentanglement. NMFS has supported this effort financially since 1995. Memorandum of Understandings developed with the USCG ensure their participation and assistance in the disentanglement effort. Hundreds of Coast Guard and Marine Patrol workers have received training to assist in disentanglements. As a result of the success of the disentanglement network, NMFS believes that many whales that may otherwise have succumbed to complications from entangling gear have been freed and survived the ordeal. Humpback and right whales are two species that commonly become entangled due to fishing gear. Over the past five years the disentanglement network has been involved in many successes and has assisted many whales shed gear or freed them by disentangling gear from 35 humpback and 11 right whales (CCS web site).

Sighting Advisory System
Although the Sighting Advisory System (SAS) was developed primarily as a method of locating right whales and alerting mariners to right whale sighting locations in a real time manner, the SAS also addresses entanglement threats. Fishermen can obtain SAS sighting reports and make necessary adjustments in operations to decrease the potential for interactions with right whales. The SAS has also served as the only form of active entanglement monitoring in the Cape Cod Bay and Great South Channel critical habitats. Some of these sighting efforts have resulted in successful disentanglement of right whales.

Education and Outreach
Education and outreach activities are considered one of the primary tools to reduce the threats to all protected species from human activities, including fishing activities. Outreach efforts for fishermen under the ALWTRP are fostering a more cooperative relationship between all parties interested in the conservation of threatened and endangered species. NMFS has also been active in public outreach to educate fishermen regarding sea turtle handling and resuscitation techniques. NMFS has conducted workshops with longline fishermen to discuss bycatch issues including protected species, and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts in an attempt to increase the survival of protected species through education on proper release techniques.

DRAFT

Reducing Threats to Listed Sea Turtles

Education and Outreach Activities
Education and outreach activities are considered one of the primary tools to reduce the threats to all protected species. NMFS has been active in public outreach to educate fishermen regarding sea turtle handling and resuscitation techniques. For example, NMFS has conducted workshops with longline fishermen to discuss bycatch issues including protected species, and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts in an attempt to increase the survival of protected species through education on proper release techniques.

Sea Turtle Stranding and Salvage Network (STSSN)
There is an extensive network of STSSN participants along the Atlantic and Gulf of Mexico coasts which not only collects data on dead sea turtles, but also rescues and rehabilitates live

stranded turtles. Data collected by the STSSN are used to monitor stranding levels and identify areas where unusual or elevated mortality is occurring. These data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN tag live turtles when encountered (either via the stranding network through incidental takes or in-water studies). Tagging studies help provide an understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for the species.

Sea Turtle Disentanglement Network
NMFS Northeast Region established the Northeast Atlantic Coast Sea Turtle Disentanglement Network (STDN) in 2002. This program was established in response to the high number of leatherback sea turtles found entangled in pot gear along the U.S. Northeast Atlantic coast. The STDN is considered a component of the larger STSSN program. The NMFS Northeast Regional Office oversees the STDN program. In Massachusetts, NOAA Fisheries has partnered with the Provincetown Center for Coastal Studies (PCCS) for response to entangled sea turtles in MA. Since the programs inception in 2002, MA responders have received over 50 sea turtle entanglement reports, which resulted in over 20 live turtle disentanglements in MA waters.

HMS Sea Turtle Protection Measures
As described in *Section 4.1.1* above, NMFS completed the most recent BO on the FMP for the Atlantic HMS fisheries for swordfish, tuna, and shark on June 1, 2004, and concluded that the Atlantic HMS fisheries, particularly the pelagic longline fisheries, were likely to jeopardize the continued existence of leatherback sea turtles. An RPA was provided to avoid jeopardy to leatherback sea turtles as a result of operation of the HMS fisheries. Although the BO did not conclude jeopardy for loggerhead sea turtles, the RPA is also expected to benefit this species by reducing mortalities resulting from interactions with the gear. Regulatory components of the RPA have been implemented through rulemaking.

Sea Turtle Handling and Resuscitation Techniques
NMFS also developed and published as a final rule in the *Federal Register* (66 FR 67495, December 31, 2001) sea turtle handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Persons participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the final rule. These measures help to prevent mortality of hard-shelled turtles caught in fishing or scientific research gear.

Sea Turtle Entanglements and Rehabilitation
A final rule (70 FR 42508) published on July 25, 2005, allows any agent or employee of NMFS, the FWS, the U.S. Coast Guard, or any other Federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for

DRAFT

scientific or educational purposes. NMFS already affords the same protection to sea turtles listed as threatened under the ESA (50 CFR 223.206(b)).

4.5 Summary and Synthesis of the Status of the Species and Environmental Baseline

The purpose of the Environmental Baseline is to analyze the status of the species in the action area. Generally speaking, the status of sea turtle and whale species overall is the same as the status of these species in the action area given their migratory nature. In summary, endangered and threatened whales and sea turtles in the vicinity of the proposed NEG LNG terminal may be affected by several ongoing activities in the action area for this consultation, including vessel operations, military activities, commercial and state fisheries, and pollution. However, recovery actions have been undertaken as described and continue to evolve. Although these recovery actions have not been in place long enough to manifest detectable changes in most endangered or threatened populations, they are expected to benefit listed species in the foreseeable future. The recovery actions should not only improve conditions for listed whales and sea turtles, they are expected to reduce sources of human-induced mortality as well.

Summary of status of whale species

Based on recent estimates, NMFS considers the best approximation for the number of *Northern right whales* to be 300 +/- 10%. Losses of adult whales due to ship strikes and entanglements in fishing gear continue to depress the recovery of this species and the right whale population continues to be declining.

The best available population estimate for *humpback whales* in the North Atlantic Ocean is 10,600 animals. Anthropogenic mortality associated with ship strikes and fishing gear entanglements is significant. Modeling using data obtained from photographic mark-recapture studies estimates the growth rate of the Gulf of Maine feeding population at 6.5% (Barlow and Clapham 1997). With respect to the species as a whole, there are also indications of increasing abundance for the eastern and central North Pacific stocks. However, trend and abundance data is lacking for the western North Pacific stock, the Southern Hemisphere humpback whales, and the Southern Indian Ocean humpbacks.

The minimum population estimate for the western North Atlantic *fin whale* is 2,362 which is believed to be an underestimate. Information on the abundance and population structure of fin whales worldwide is limited. NMFS recognizes three fin whale stocks in the Pacific for the purposes of managing this species under the MMPA. Reliable estimates of current abundance for the entire Northeast Pacific fin whale stock are not available (Angliss *et al.* 2001). Stock structure for fin whales in the southern hemisphere is unknown and there are no current estimates of abundance for southern hemisphere fin whales. As this species continues to be subject to natural and anthropogenic mortality, this population is at best stable and at worst declining.

The best available abundance estimate for *sperm whales* in the U.S. North Atlantic, 4,804, is the sum of two estimates from 1998 U.S. Atlantic surveys, where the estimate from the northern U.S. Atlantic is 2,607 and from the southern U.S. Atlantic is 2,197 sperm whales. There are

DRAFT

currently insufficient data to determine population trends. As this species continues to be subject to natural and anthropogenic mortality, this population is at best stable and at worst declining.

Little is known of the population structure, status and trends of *sei whales* world wide. Sei whales were heavily exploited in all areas once the stocks of blue and fin whales in the Northern Hemisphere and after humpback whales in the Southern Hemisphere had been reduced. There is good evidence that the stocks of sei whales were depleted before gaining full protection from commercial whaling in the 1970s and 1980s. The extent to which stocks have recovered since then is uncertain.

Despite almost 40 years since whaling ceased for *blue whales*, their populations remain at fractions of their estimated historic abundances. Massive over-exploitation in the early to mid-twentieth century, may be wholly responsible for the lack of recovery, reducing populations to such small numbers that density dependent factors may partly explain their lack of recovery (see Clapham et al. 1999). Although increasing trends have been reported for the populations off Iceland in the western north Atlantic, off California in the Eastern North Pacific and in Antarctica there is no evidence that any other populations in the Northern or Southern Hemispheres are increasing. If, as in the North Pacific off British Columbia, the number of mature females elsewhere in the world were significantly reduced through whaling, the reproductive fitness of blue whales would have declined and could explain the slow recovery.

Summary of status of sea turtle species

Loggerhead sea turtles in the action area are likely to be from the northern or South Florida nesting subpopulations or the Yucatan subpopulation. The south Florida nesting subpopulation is the largest known loggerhead nesting assemblage in the Atlantic. The northern nesting subpopulation is the second largest loggerhead nesting assemblage in the Atlantic. Nesting data previously led the TEWG to conclude that the northern subpopulation was likely declining and was at best stable, and that the south Florida population was increasing. However, preliminary review of nesting trend data for the northern and south Florida nesting beaches now suggests a declining trend in nesting on beaches in North Carolina, South Carolina, and Georgia. The most recent modeling data suggests that the change in TED regulations to increase survival of large, benthic immature and sexually mature loggerheads would have a positive or at least a stabilizing effect on subpopulation growth (NMFS SEFSC 2001). No reliable estimate of the total number of loggerheads in any of the subpopulations or the species as a whole exists.

Based on the available information it is difficult to determine the current status of the Atlantic *leatherback* population. For example, the number of female leatherbacks reported at some nesting sites in the Atlantic has increased while at other sites the number has decreased. Leatherbacks continue to be captured and killed in many kinds of fisheries and it is likely that the population is declining and at best is stable. No reliable estimate of the total number of leatherbacks in the Atlantic exists.

The *Kemp's ridley* is the most endangered sea turtle species with only one major nesting site remaining. While recent population estimates for this species are not available, patterns of Kemp's ridley nesting data suggests that this population is increasing or is at least stable.

DRAFT

Recent population estimates of the number of *green sea turtles* in the western Atlantic are unavailable. The pattern of nesting abundance for this species has shown a generally positive trend since monitoring began in 1989 suggesting that this population may be increasing or is at least stable.

5.0 EFFECTS OF THE ACTION

This section of a biological opinion assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

Various aspects of the proposed construction and operation of the NEG LNG terminal will impact the water column or the seafloor, and thus may affect listed sea turtles, whales, or both. NMFS identified several potential avenues of impact, and requested that the applicant and MARAD/USCG evaluate each of the following potential impacts on listed species:

- Vessel collisions
- Physical harassment
- Changes to the physical environment (habitat impacts)
- Acoustic disturbance and harassment
- Alteration of prey species distribution and abundance (including plankton)
- Entanglement
- Ingestion of marine debris
- Fuel spills
- Impingement and entrainment during ballast water intake (including prey resources)
- Exposure to contaminants

After reviewing the project description, BA, and mitigation measures proposed by the applicant and MARAD/USCG, NMFS has found that several of these impacts will be discountable or insignificant, and therefore may affect, but are not likely to adversely affect listed sea turtles or whales. NMFS rationale for these determinations is provided in the following sections. Of the impacts listed above, NMFS identified vessel collisions and acoustic disturbance and harassment as the potential impacts of greatest concern. As such, these effects will be considered separately in Sections 5.5 and 5.6.

5.1 Species Presence in the Action Area

Several listed species are likely to be present in the action area at various times of the year and may therefore be affected either directly or indirectly by the construction and operation portions

DRAFT

of the proposed LNG terminal. The primary concern for sea turtles is interaction with pipelaying equipment and removal of prey resources due to construction activities that destroy benthic habitat, while the main concern for endangered whales involves interactions with project vessels and acoustic harassment due to both construction and operational noise.

Sea turtles forage in shallow harbors and embayments in northeast waters during the warmer months, generally from June through October in Massachusetts waters. Kemp's ridley, leatherback, and loggerhead sea turtles are the most common turtle species in Massachusetts waters. Although green turtles are not as common in Massachusetts waters as Kemp's ridley, loggerhead, or leatherback sea turtles, they have been documented occasionally in Massachusetts waters and as such, NMFS considers them to be present in the action area.

To some extent, the number of sea turtles occurring in a particular area is dictated by water depth. Water depth at the terminal site is approximately 250 ft deep. Satellite tracking studies of sea turtles in the Northeast found that turtles mainly occurred in areas where the water depth was between approximately 16 and 49 ft (Ruben and Morreale 1999). This depth was interpreted not to be as much an upper physiological depth limit for turtles, as a natural limiting depth where light and food are most suitable for foraging turtles (Standora et al. 1990). Sea turtles are capable of dives to substantial depths (300-1000 m; Eckert et al. 1986 in Stabenau et al. 1991), and chelonid turtles have been found to make use of deeper, less productive channels as resting areas that afford protection from predators because of the low energy, deep water conditions. Leatherbacks have been shown to dive to great depths, often spending a considerable amount of time on the bottom (NMFS 1995). Therefore, although the depth at the terminal site may not be optimal for foraging, sea turtles may still transit the action area while moving into or out of more suitable foraging environments, or may be resting on or near the bottom.

There has been little directed survey effort to assess sea turtle abundance in the vicinity of the terminal site. Observer data collected during 17 days of water quality surveys near the MWRA outfall pipe in 1997 reported no sea turtle sightings; however, sea turtles are difficult to spot from surface vessels, and these data cannot be interpreted to mean that sea turtles were not present (Wennemer et al. 1998). Sea turtles have stranded along the coast throughout Massachusetts and Cape Cod Bays, and therefore it is reasonable to conclude that sea turtles are present in the action area.

Endangered whales could also migrate through the action area at various times of the year. North Atlantic right, humpback and fin whales have all been sighted in Massachusetts Bay waters, although sightings in the immediate vicinity of the port are less common than in the neighboring waters of Stellwagen Bank and Cape Cod Bay. In general, right whales can be anticipated to be in Massachusetts and Cape Cod Bays from December through July, humpback whales can be found in Massachusetts waters year-round, with peaks between May and August, and fin whales may be in Massachusetts waters year-round, with peaks during the summer months. Neither of the right whale critical habitat designations in Massachusetts waters coincides with the NEG DWP site; however, the port is 17 nautical miles northwest of the Cape Cod Bay critical habitat. Although right whale sightings are concentrated in the critical habitat

DRAFT

areas, the Gulf of Maine serves as an important spring and summer nursery/feeding area. Therefore, right whales may be transiting near the DWP.

Blue, sei, and sperm whales are known to occur in northeast waters, but these species tend to remain further offshore in deep water near shelf edges. Sightings of these species near the proposed pipeline and port sites are rare. However, they may occur in the portion of the action area that encompasses the transit path of the EBRVs from the EEZ to the port site.

5.2 Effects of Construction

The proposed action involves several stages of construction activity in various locations (i.e., pipeline route vs. port site). However, the types of impacts associated with these activities and our knowledge about the presence of listed species at the specific time and activity location are often very similar. As such, this section will be organized by the type of potential effect, with a brief summary of the various activities that may contribute to that effect.

Potential effects of pipeline and port construction on listed sea turtles and whales include:

- Interactions with construction equipment
- Water quality degradation (turbidity, contaminants, discharges, marine debris)
- Destruction of prey resources/loss of foraging habitat
- Light pollution
- Increased risk of vessel strike due to construction-related vessel traffic (see section 5.5)
- Exposure to disturbing or injurious noise levels (see section 5.6)

Interactions with Construction Equipment

Because sea turtles forage and rest in benthic environments, activities that interact with the sea floor have the potential to impact sea turtles. Due to the offshore location of this project in deeper waters, large-scale dredging to deepen or widen channels to accommodate LNG vessels is not required for this project. Therefore, the only type of construction equipment being used for the proposed action that may interact with listed species includes the trenching and plowing equipment used during pipelaying activities.

Post-lay plows use plow blades to remove bottom material from beneath the pipeline resting on the sea floor. Sea turtles in the path of the plow could theoretically collide with the plow or the vessel towing the plow. However, water depth along the proposed pipeline routes (135-290 ft) is deeper than optimal foraging depth (16-49 ft). Although sea turtles may occur in these areas and are capable of deep dives, they are more likely to be sub-surface transiting than foraging along the bottom. In waters deeper than 50 ft, Kemp's ridleys typically dive to depths of 6-10 m, and spend most of their time in the upper portion of the water column. Aerial surveys of loggerhead turtles north of Cape Hatteras indicate that they are most common in waters from 22 to 49 m deep. Leatherbacks are primarily pelagic, feeding on jellyfish and tunicates, and are not likely to be foraging at the bottom. In addition, pipelaying and plowing operations proceed at speeds of <1 knot. At these speeds, any sea turtle that is encountered on the bottom is expected to be able to avoid collision or interaction with the plow blades or pipelaying barges. Similarly, any whales foraging near the bottom would be able to avoid collision or interaction with pipelaying

DRAFT

and trenching equipment. Although any sea turtles or whales present in the vicinity of the plow path may be displaced from the area, displacement would be temporary for the duration of the plow pass. There is no evidence to suggest that sea turtles or whales are more attracted to the resources along the pipeline route than to those in surrounding waters, so temporary displacement to neighboring areas is not likely to have a significant impact on foraging success. Based on this information, the likelihood of listed species colliding or directly interacting with pipelaying and trenching equipment is discountable, and the effect of any associated displacement would be insignificant.

Water Quality Degradation and Increased Marine Debris

Construction activities can impact water quality in various ways, including increased turbidity, resuspension of contaminated sediments due to seafloor disturbance, discharge of biocide during hydrostatic testing of the pipeline and flowlines, and discharges associated with the presence of a construction crew and hotelling needs.

Increased Turbidity and Exposure to Contaminated Sediments

Turbidity can interfere with the ability of sea turtles and whales to forage effectively by obscuring visual detection of or dispersing potential prey. Disturbance of the sea floor through trenching, jetting, and other construction activities can also release contaminated sediments back into the water column, thus exposing marine organisms to contaminants that were previously attached to sediment particles.

Increased turbidity and resuspension of sediments can be expected from the following pipeline and port-related construction activities:

- Pipeline installation
- Anchor pile installation
- Placement of mats for manifolds and risers
- Laybarge anchoring

Of these activities, pipeline installation, including plowing, jetting, and backfill, is expected to generate the most turbidity and disturbance of bottom sediments. During typical marine pipeline installation, an estimated 5,000 m^3 (176,573 ft^3) of sediment are suspended for each 1 km (0.6 mi) of pipeline buried (MMS 2001). This means that installation of the 1.1 km flowline and 25.9 km pipeline route could potentially disturb approximately 5,500 m^3 and 129,500 m^3 of sediment, respectively. Turbidity due to installation of the NEG pipeline and flowline is expected to be similar to that measured during HubLine plowing events (TRC 2004). Turbidity measurements taken at varying intervals within 820 feet (250 m) of the disturbance did not exceed 10.1 NTU, and average values generally did not exceed average reference site readings (0.5-2.56 NTU). Average turbidity readings for backfilling (7.65 to 8.11 NTU) and jetting (0.27-28.9 NTU) were generally higher than reference values. Coastal states that have numeric criteria for turbidity generally recommend that turbidity not exceed 5-50 NTU over background turbidity when background turbidity is 50 NTU or less (EPA 2003). Of the trenching activities proposed for the NEG project, jetting is expected to result in the most turbidity. Sediment transport modeling conducted by NEG for jetting activity indicates that initial turbidity could reach 5,000-20,000 mg/L in the upper water column immediately above the jetting apparatus while jetting was

DRAFT

ongoing in areas where the sediment is composed of fine sand. However, sediment concentrations would decrease to 500 mg/L in two hours, and 200 mg/L in three hours. Near-background concentrations would be seen after 12 hours. The aerial extent of impact was 1 x 0.35 miles exceeding 20 mg/L in the water column. In areas with clay sediment, the model indicates that the sediment concentration in the water column would be lower than for sand (500-1000 mg/L), but the aerial extent of increased suspended sediment would be larger (1 x 1.4 nm) and of longer duration (30 hours). Although increased turbidity may cause displacement of sea turtles and whales or their prey, displacement will be temporary (turbidity will persist for 12-30 hours), and sea turtles and whales are likely to find suitable prey in surrounding areas.

Sediment samples collected along the proposed pipeline route found that concentrations of metals and PCBs were below NOAA probable effects levels (PELs – the concentration above which adverse effects are frequently expected) with the exception of cadmium at one sample site and nickel at two sample sites. PAHs were reported above NOAA threshold effects levels (TEL – the concentration below which adverse effects are expected to be observed only rarely) at every sample location, but no levels were reported above the NOAA PEL. However, the laboratory method detection limits (MDLs – the minimum concentration that can be reliably detected in a sample) for many PAHs were above the NOAA TELs and PELs. Therefore, some uncertainty exists regarding the concentration of PAHs along the pipeline route. Four pesticides were reported above NOAA TELs at four of the five sample locations, but none exceeded NOAA PELs. Most of the sediments along the pipeline route are silty clay, meaning that adsorption and colloid formation characteristic of these sediments would likely result in minimal dissolution of contaminants into the water column and thus minimal exposure to marine organisms. Water quality monitoring in the vicinity of nearby dredging and disposal operations showed no evidence of an increase in the concentrations of dissolved contaminants over background levels (FERC 2001), indicating that contaminants remain attached to sediment particles during typical dredging operations. Since plowing/trenching results in less resuspension than conventional dredging, pipeline installation is expected to have a very low potential to cause contaminant dissolution. Based on this information, pipeline installation is not likely to result in an increase of contaminant levels in the water column, and is therefore not likely to increase the exposure of listed species to potentially harmful contaminants. Since other sources of turbidity and seafloor disturbance will be minimal compared to that caused by pipeline installation, the overall effect of project construction on listed species due to turbidity and exposure to contaminants is discountable.

Hydrostatic Pipeline Integrity Testing Discharges

Because a biocide will be used to treat seawater used for hydrostatic testing, NEG has applied for a National Pollutant Discharge Elimination System (NPDES) permit from EPA for the construction portion of the proposed project. The biocide used will be a Tetrakis hydroxymethyl phosphonium sulfate (THPS) based biocide, at an initial concentration of 290 mg/L. THPS biocides can be easily broken down into very low concentrations through introduction of hydrogen peroxide. Effluent from the dewatered pipelines will be stored on board a vessel and treated with hydrogen peroxide until it reaches a target THPS concentration of 4.4 mg/L. The byproduct of the hydrogen peroxide treated biocide is trishydroxymethyl phosphine oxide (THPO). THPO has been shown to have very low toxicity to aquatic organisms except at very

DRAFT

high concentrations. Of species evaluated for discharges into Massachusetts coastal waters, mysid shrimp, sheepshead minnow, *menidia beryllina*, and *mysidopsis bahia* are used as toxicity indicators organisms. Of these, the lowest threshold observed was the No Observed Adverse Effect Concentration (NOAEC) for *mysidopsis bahia* of 12.5 mg/l. The target threshold of 4.4 mg/L is below the NOAEC. In addition, an aerating device will be used to increased dissolved oxygen (DO) concentrations to a minimum of 6.0 mg/L, which meets Massachusetts Surface Water Quality Standards. Based on this information, the discharge associated with hydrostatic integrity testing of the pipeline and flowlines is not likely to have an adverse impact on water quality at the port site, and is not likely to adversely affect sea turtles or whales.

Increased Marine Debris

Personnel will be present onboard the barges throughout construction activities, thus presenting some potential for accidental releases of debris overboard. As noted in the Environmental Baseline section, sea turtles may be adversely affected if they become entangled in or ingest marine debris, particularly plastics that are mistaken for prey items. The discharge and disposal of garbage and other solid debris from vessels by lessees is prohibited by the MMS (30 CFR 250.300) and the USCG (MARPOL Annex V, Public Law 100-220 [Statute 1458]). The discharge of plastics is strictly prohibited. During construction, individual crew members will be responsible for ensuring that debris is not discharged into the marine environment. Additionally, training of construction crews will include a requirement explaining that the discharge of trash and debris overboard is harmful to the environment, and is illegal under the Act to Prevent Pollution from Ships and the Ocean Dumping. Discharge of debris will be prohibited, and violations will be subject to enforcement actions. Therefore, construction activities are not likely to result in increased marine debris.

Destruction of Prey Resources/Loss of Foraging Habitat

Activities that disturb the sea floor will also destroy benthic communities, and can cause indirect effects to sea turtles by reducing the numbers or altering the composition of the species upon which sea turtles prey. Water withdrawal can remove ichthyoplankton and zooplankton from the water column, thus removing potential humpback, fin, and right whale prey resources. Construction activities that may result in loss of foraging resources for listed species include:

- Pipeline installation
- Anchor pile installation
- Placement of mats for manifolds and risers
- Laybarge anchoring
- Hydrostatic pipeline integrity testing

Loss of Benthic Resources/Habitat

The loss of foraging habitat could be especially detrimental to sea turtles because these species primarily enter Northeast shallow harbors and bays to forage (NMFS and USFWS 1995). However, there is no information to indicate that unique concentrations of preferred prey or better foraging habitat exist along the pipeline route or port site as opposed to neighboring areas. As stated previously, water depth along the pipeline route and at the port site is much deeper than optimal foraging habitat for turtles. Therefore, although the possibility that the areas

DRAFT

affected may provide foraging habitat for sea turtles cannot be excluded, it can be assumed that sea turtles are not likely to be more attracted to these areas than to other foraging areas and should be able to find sufficient prey in alternate areas. Some of the prey species targeted by turtles are mobile and are likely to avoid the plow or quickly repopulate the area from surrounding areas once the backfill is complete. Thus, while available foraging habitat may be reduced temporarily, long-term effects to listed species' benthic prey are expected to be minimal. The pipeline route will also be subject to periodic monitoring to confirm that benthic communities are recovering.

Loss of Plankton Resources

Following laying, trenching, and burial, the combined pipeline system (transmission line and flowline) would be hydrotested once. Hydrostatic testing of the pipeline involves withdrawal of 1.9 million gallons of seawater injected with a biocide to inhibit corrosion. The flowlines would require one-time use of 47,300 gallons (179 m^3) of seawater for the flowline to Buoy A, and 34,400 gallons (130 m^3) for the shorter flowline to Buoy B, also treated with a biocide. Although zooplankton species that provide forage for right whales can be entrained and killed by seawater intake systems, a one-time removal of 1.58 million gallons of seawater would have a negligible impact on the overall availability of plankton resources. In addition, right whales rely on dense plankton patches in order to meet their energy requirements, and it is primarily the distribution of these dense plankton patches that is thought to dictate seasonal concentrations of right whales in Massachusetts waters. Hydrostatic testing will take place during the summer or early fall when right whales are rare in the vicinity of the pipeline, so although plankton species may still be present in the area during hydrostatic testing, right whales are not likely to be relying on these resources for foraging. Other construction activities do not involve seawater intake, and therefore will not impact plankton resources.

Based on the above information, NMFS anticipates that the construction activities associated with the proposed project are not likely to disrupt normal sea turtle or whale feeding behaviors and are not likely to remove critical amounts of prey resources from the Massachusetts Bay.

Light Pollution

Construction activities would take place 24 hours per day, 7 days per week during project installation. Construction and support vessels would be required to display lights when operating at night, and deck lights would be required to illuminate work areas. However, lights would be downshielded to illuminate the deck, and would not intentionally illuminate surrounding waters. If sea turtles, whales, or their prey are attracted to the lights, it could increase the potential for interaction with equipment or associated turbidity. However, due to the nature of project activities as described above, listed species and their prey are more likely to be displaced by seafloor disturbance, turbidity, and noise than attracted by lighting. If attraction to the site were to occur, any interactions are not likely to result in injury or death, as equipment and vessels will be moving slowly, and all other construction-related impacts (turbidity, destruction of benthic habitat) are indirect.

5.3 Effects of Operation

DRAFT

Potential effects of port operation on listed sea turtles and whales include:

- Loss of prey resources/foraging habitat
- Water quality degradation and increased marine debris
- Entanglement directly in project components or indirectly through displaced fishing effort
- Exposure to fuel/LNG spills
- Light pollution
- Increased risk of vessel collisions (see section 5.5)
- Acoustic disturbance and harassment (see section 5.6)

Loss of Prey Resources/Destruction of Foraging Habitat

Although the majority of benthic impacts will occur during construction and will be temporary for the duration of construction activity, some components of the pipeline and port will have a long-term impact on the seafloor. Permanent impacts include conversion of soft sediment areas to hard substrate (0.44 acres), and long-term sediment disturbance associated with chain sweep (43 acres) attributed to the following:

- The permanent footprint of the 16 buoy anchors (0.18 acres), flowlines (0.18 acres) and PLEMs (0.08 acres)
- Cable sweep associated with weathervaning of buoyed EBRV (43 acres)
- Anchor chain sweep when EBRV is not on buoy (4 acres)

The combined total area of seafloor permanently disturbed by all of these activities would be 43.44 acres. The areas that are converted from soft sediment to hard substrate may experience a permanent shift in benthic faunal communities, while benthic communities in areas of continuous chain sweep are not likely to be re-established. In addition, the physical presence of anchor chains and other project components in the 43 acres occupied by the footprint of the two buoys may exclude whales from foraging at or near the bottom in the vicinity of the port site. Although these impacts would result in permanent loss of 43.44 acres of potential foraging habitat for sea turtles and whales, loss of this habitat is not likely to have a measurable adverse impact on normal sea turtle or whale foraging activity. The total impacted area represents only 0.2 percent of the 21,000 acres of similar bottom habitat surrounding the project area. In addition, as mentioned previously in relation to construction activities, the depth of the water at the pipeline and port sites is deeper than optimal foraging depth for sea turtles, and there is no evidence to suggest that the pipeline or port sites offer more favorable foraging habitat for whales than surrounding areas. Whales and sea turtles are likely to find suitable foraging habitat in alternate areas nearby, and would not be adversely affected by the permanent loss of habitat resulting from the proposed project.

Ballast and cooling water withdrawal at the port as the EBRV unloads cargo could potentially impinge and entrain marine organisms. Screening of the ballast intake chests and low intake velocity would prevent direct impingement or entrainment of sea turtles or whales. However, zooplankton and ichthyoplankton, which serve as prey for whale species, could be removed by ballast and cooling water intake. While at the port, EBRVs would withdraw approximately 4.97 million gallons per day (mgd) of seawater. The estimated zooplankton abundance in the vicinity of the seawater intake ranges from 19,880 to 57,180 individuals per m^3, or 76 to 216 individuals

DRAFT

per gallon. This means that the daily intake would remove approximately 377.7 to 1,073 million individual zooplankton in a day. At an estimated weight of 6.3 x 10^{-6} g per organism (Ara 2004 in USCG 2006a), this is the equivalent of approximately 2380 to 6760 g (5.25-14.9 lb) per day, or 1916-5439 lbs per year. On average, a right whale eats 1,000 to 2,500 kg (2200 to 5500 lbs) of zooplankton per day. Therefore, the daily seawater intake would remove a maximum of approximately 0.68% of a single right whale's daily diet. These amounts would be indistinguishable from natural variability. As discussed in the Status of the Species, since *Calanus* sp. are the most common zooplankton in the North Atlantic and current right whale abundance is greatly below historical levels, the proposal that food limitation was a major factor in right whale recovery seems questionable (IWC 2001). There is no evidence that copepod abundance or distribution has decreased dramatically since the right whale population was reduced. Therefore, it is highly unlikely that the population is near carrying capacity, or that natural fluctuations in copepod numbers on the order stated above would severely limit right whale foraging success. The Seabrook Power Generating Station in New Hampshire withdraws 600 MGD, and 13 years of monitoring has not indicated shifts in zooplankton distinguishable from natural variability (NAI 2004). In addition, concentrations of feeding right whales have not been observed in the immediate project location where water withdrawal would take place, suggesting that removal of plankton from this area would not remove critical prey resources. As such, impingement and entrainment of zooplankton due to ballast and cooling water withdrawal at the port site is not likely to adversely affect listed whales or sea turtles.

Water Quality Degradation and Increased Marine Debris

Water quality in the vicinity of the proposed project can be affected by increased turbidity associated with long-term anchor chain sweep as described above, routine discharges generated by EBRVs while buoyed, and accidental releases of marine debris.

Increased Turbidity

According to modeling by the applicant, maximum turbidity expected under a worst-case scenario (100-year storm event) would be 686 mg/L, with silt transport limited to 7,527 feet. This degree of turbidity would only be expected during extreme storm events in December and March. However, some increase in suspended sediment would be expected at all times due to the movement of anchor chains under normal sea conditions. NEG did not model anchor chain sweep turbidity under normal sea conditions; however, modeling from the nearby Neptune terminal indicated a total area of elevated turbidity of 1.88 square miles (Neptune 2005). Although sediment characteristics may be different at the two sites, the total impacted area is likely to be similar in scale. Due to the loss of benthic resources in the area, sea turtles are not likely to be foraging in the areas of highest turbidity near the project site. Although slightly elevated levels of total suspended solids may be present over a greater area than the extent of lost foraging habitat, the total area affected represents a highly localized impact. Both sea turtles and whales would be able to easily avoid turbid areas by swimming above the height of the turbidity plume. Based on this information, increased turbidity due to anchor chain sweep is not likely to adversely affect sea turtles or whales in the action area.

Routine Discharges

DRAFT

Routine discharges associated with project operation include LNG warming water during the first and last days of regasification cycles, auxiliary cooling water, hotelling and sanitary wastes (treated wastewater, graywater, and food waste), brine water discharged from the freshwater generator, untreated seawater from the water safety curtain (fire safety system), and intermittent storm water runoff. All food waste, graywater, and blackwater would be treated at an onboard sewage treatment facility. An average of 0.005 mgd of treated wastewater would be discharged per day at the port location. All other wastes would be retained onboard and properly discharged at sea according to MARPOL standards while EBRVs are in transit outside US waters.

To minimize the potential for an accidental discharge of oil, blackwater, graywater, or bilge water, each EBRV is equipped with an oil monitoring system, which detects oil in excess of allowed percentages, and a Marine Sanitation Device, which is required to be inspected annually by a qualified engineer. Such procedures are part of the required Spill Control and Countermeasures (SPCC) plan, which includes a spill contingency plan and maintenance of Material Safety Data Sheets for all hazardous materials stored on board. The plan also requires materials to be kept on board that would be necessary to contain and clean up small spills.

Routine discharges would also include cooling water discharges. Water used to warm LNG during regasification would be recirculated to the cool the main condenser. The net result of this loop would be a final discharge at the end of the 8-day regasification process of water that is a maximum of 0.61°C warmer than ambient conditions. The Cornell Mixing (CORMIX) hydrodynamic model was used to evaluate the initial mixing, transport, and dilution of the potential thermal plume. The maximum increase in surface temperature would be 0.61°C during summer conditions, which would be reduced to 0.10°C above ambient at a distance of 1640 ft (500 m) downdrift from the discharge port. Sea turtles are cold-blooded animals whose departure from northeast waters is triggered by decreasing water temperature. Failure of a sea turtle to depart Massachusetts waters because of increased water temperatures around the port site could increase the chances of cold-stunning. However, the CORMIX model results indicate that the discharge would be small compared with the available mixing volume and would mix quickly to near ambient temperatures. Therefore, the impact of cooling water discharge on water temperature surrounding the port would be insignificant, and is not likely to alter the migratory behavior of sea turtles in the vicinity of the port.

Based on the information above, routine discharges due to NEG port operations are not likely to adversely affect listed species in the action area.

Increased Marine Debris

Personnel will be living onboard the EBRVs while docked and unloading LNG, thus presenting some potential for accidental releases of debris overboard. As noted in the Environmental Baseline section, sea turtles may be adversely affected if they become entangled in or ingest marine debris, particularly plastics that are mistaken for prey items. However, the discharge and disposal of garbage and other solid debris from vessels by lessees is prohibited by the MMS (30 CFR 250.300) and the USCG (MARPOL Annex V, Public Law 100-220 [Statute 1458]). The

DRAFT

discharge of plastics is strictly prohibited. All plastics must be returned to shore and are tracked. These prohibitions will be incorporated as enforceable conditions into the DWPA license, if issued. As such, although occasional releases of marine debris associated with the proposed project are possible, the amount of debris released is expected to be minimal, and would not lead to adverse effects on sea turtles.

Entanglement

The proposed buoy structure would involve 16 anchor chains radiating out from the buoys and attached to suction anchors in the seafloor. The anchor chains and cables are not likely to pose an entanglement risk, as the anchor chain is 18 inches in diameter and the wire anchor cable is six inches in diameter. Chains and wire cables of this size are likely to be too stiff to wrap around and entangle a whale or sea turtle. Although it is possible that a whale or sea turtle might swim into one of the chains, it is not likely that the interaction would result in an entanglement. Four-inch diameter recovery lines would also be present in the water column. Rope recovered from entangled whales is typically one inch or less in diameter. Although there is not enough information about the logistics of entanglements to rule out the possibility that a four-inch diameter rope could potentially entangle a whale or sea turtle, NMFS is not aware of any entanglement case involving rope of this size. In addition, the number of these lines in the water would be minimal—one vertical line and one surface line per buoy. Based on this information, the likelihood of a whale or sea turtle becoming entangled in project components is minimal.

The safety zone required around the EBRVs could permanently exclude fishing activities from the port site. This could displace fishing gear that would have been present in the project location to other areas surrounding the port. It is difficult to quantify how much fishing activity would be displaced and where it would be displaced to. NOAA landings data indicate that the gear types used most in the vicinity of the port are otter trawls and lobster pots (USCG 2006b). Displacement of otter trawls into areas with higher whale densities than the port site is not likely to increase impacts to whales because otter trawls are not known to interact with whales. Otter trawls can interact with sea turtles, but there is no evidence to suggest that sea turtle concentration would be higher in any area to which otter trawl gear would be displaced. Displacement of lobster traps into areas where whales are more heavily concentrated than at the port site could result in a higher risk of entanglement; however, the total amount of gear in the water would not increase as a result of the proposed action.

Exposure to Fuel/LNG Spills

LNG is commonly composed of 95-97% methane, with the remainder a combination of ethane, propane, and other heavier gases. It is considered a flammable liquid, and the vapor is odorless, colorless, and non-toxic. When mixed with air, natural gas is only flammable when concentrations are in the range of 5-15%. Unconfined natural gas vapor clouds do not explode, but as the level of confinement increases, the potential to explode also increases. In all cases, an ignition source is required for a fire or explosion to occur. LNG does not dissolve in water, and is rapidly converted to vapor as it is warmed. Although the vapor is initially heavier than air due to its cold temperature, once warmed it is quickly dispersed into the atmosphere by the wind.

The primary hazard conditions associated with LNG include:

DRAFT

- Thermal radiation (flux) hazards – Thermal radiation hazards can result from ignition of an LNG pool or ignition of a flammable LNG vapor cloud. Thermal radiation is the heat felt from the source, and can result in burns.
- Cryogenic hazards – LNG is a cryogenic liquid that quickly cools the materials it comes in contact with, and can cause extreme thermal stress. Potential hazards for marine organisms would include exposure to extremely cold temperatures resulting in frostbite or death, or asphyxiation by concentrated natural gas vapors above the surface of the water. LNG vapors are non-toxic, but can displace enough air to make the atmosphere temporarily unsafe for air-breathing mammals.
- Rapid phase transition (RPT) – RPT occurs when LNG comes in direct contact with warmer water. In some cases, the rapid, uncontrolled expansion of LNG as it changes phase from a liquid to a gas could result in an explosion caused by the physical energy released during the rapid expansion of the liquid to a gas. However, the hazard zones from an RPT would be much smaller than those from vapor cloud or pool fire hazards, and are considered the lowest concern of the potential LNG hazards.

Although these hazards represent a possible avenue of impact to endangered sea turtles and whales in the project area should a spill or other LNG release occur, the likelihood of an LNG spill or accident is considered extremely rare. During the past 40 years, more than 80,000 LNG carrier voyages have taken place, covering more than 100 million miles, without major accidents or safety problems, either in port or on the high seas (Pitblado 2004 in Hightower et al. 2004). Over the life of the industry, eight marine incidents worldwide have resulted in LNG spills, with some damage, but no cargo fires have occurred. Seven incidents have been reported with ship structural damage, two from groundings; but no spills were recorded.

Spills are most likely to occur due to intentional events, collisions with other vessels, or accidental groundings. During the independent risk assessment conducted for the evaluation of the NEG project, groundings were eliminated as a plausible scenario due to the offshore nature of the port. Similarly, incidents due to sea-state, weather, mooring, and connection operating conditions were also excluded from the range of credible scenarios. Intentional events and accidental collision were carried forward for analysis, but due to the safety and exclusion zones surrounding LNG carriers, intentional events and collisions are still considered unlikely scenarios. The analysis concluded that the likelihood of a powered collision was once every 1,484 years for the NEG port, and the likelihood of a drifting collision was once in 9,091 years (AcuTech 2006). In addition, should an incident occur, the impacts would be limited to the immediate vicinity of the spill within approximately one hour of the spill, due to the properties of LNG described above. As such, the potential for listed sea turtles or whales to come into contact with harmful LNG spills is considered discountable.

Similarly, fuel oil releases are possible; however, since the vessels associated with the port would not be carrying oil as cargo, the only oil available for release would be oil carried in fuel tanks. Small releases of fuel oil due to fishing and other small vessel operations do occur; however, small amounts of fuel accidentally released in the course of normal operations are not expected to adversely affect whales or sea turtles. A large scale oil spill could have major adverse impacts on listed species or their prey. However, a large scale oil spill would only occur

DRAFT

in the event of a collision or grounding, which for reasons stated above, would be highly unlikely for the proposed action.

Light Pollution

Northeast Gateway will be required to maintain adequate vessel lighting while the vessel is moored at the Port and in regasification mode. While moored, deck floodlights shall be operating in sufficient quantities to provide a safe working environment for vessel crew engaged in the regasification efforts. The EBRV is to be sufficiently lighted while moored to the Port to allow other vessels traversing the area to see and avoid the vessel and avoid. Lighting is downward shielded for full illumination on the deck of the vessel, and would not be directed at the surrounding waters. This should reduce attraction of marine organisms to the EBRV, but even if prey species were attracted to the vessel, thus attracting whales, the vessel would be stationary and therefore pose no risk of strike or other adverse impacts. Sea turtle hatchlings are known to be attracted to lights and adversely affected by artificial beach lighting, which disrupts proper orientation towards the sea. However, nesting does not occur in Massachusetts, and hatchlings are not known to be present in Massachusetts waters.

5.4 Effects of Decommissioning

At the conclusion of the economic life of the NEG deepwater port, port components would be retrieved and removed from the site, with the exception of the pipelines, which would most likely be abandoned in place. All port components in the water column would be retrieved, including the STL buoys, flexible risers, and wire rope mooring segments. Suction pile anchors would be recovered by reverse pumping. The portion of each flowline that was not buried would be recovered by mechanically severing each flowline where it began burial, and retrieving the unburied reach. Diver jetting operations would lower the end of each flowline to at least 18 inches below the mud line, and any depressions would be restored with sand or equivalent. Spoolpieces connecting the flowlines to the Pipeline Lateral would remain buried.

At the end of the pipeline's useful life, Algonquin would be required to obtain the necessary permission to abandon its facilities. The pipeline would be purged and flooded with seawater. Blind flanges would be installed on each end and the pipe would be abandoned in place.

These types of activities are expected to have impacts similar to those discussed above in relation to construction activities, including temporary seafloor disturbance, turbidity, and water withdrawal and discharge associated with flushing of the pipeline. However, all impacts would be of less magnitude than those resulting from construction activities. As such, decommissioning activities are not likely to adversely affect listed species in the action area.

5.5 Increased Risk of Vessel Strike

As discussed in the Environmental Baseline, collision with vessels remains a source of anthropogenic mortality for both sea turtles and whales. The proposed NEG project will lead to increased vessel traffic during construction and long-term operation that would not exist but for the proposed action. This increase in vessel traffic will result in some increased risk of vessel

DRAFT

strike of listed species. However, due to the limited information available regarding the incidence of ship strike and the factors contributing to ship strike events, it is difficult to determine how a particular number of vessel transits or a percentage increase in vessel traffic will translate into a number of likely ship strike events or percentage increase in collision risk. In spite of being one of the primary known sources of direct anthropogenic mortality to whales, and to a lesser degree, sea turtles, ship strikes remain relatively rare, stochastic events, and a 1.5% increase in ship traffic would not necessarily translate into a 1.5% increase in ship strike events. Since 1970, the Everett LNG terminal in Massachusetts has received 619 vessel calls, with annual transits increasing since 1999 to approximately 50 shipments per year (Neptune 2005). No vessel strike events have been reported for these vessels, which transit the same waters as the EBRVs associated with the NEG project. Nonetheless, the risk of ship/whale collisions is a cumulative risk. It also remains possible that an interaction could have occurred between a whale and a tanker calling at the Everett terminal without being detected. As such, MARAD/USCG and NEG have proposed to implement the following mitigation measures to further reduce the likelihood of an NEG vessel (EBRV, construction, or support) interacting with a whale:

- All construction and support vessels will report their activities to the mandatory ship reporting system (MSR) of the U.S. Coast Guard to remain apprised of North Atlantic right whale movements within the area. All vessels entering and exiting the MSR will report their activities to WHALESNORTH. Vessel operators will contact the USCG either by email (RightWhale.MSR@noaa.gov) or Telex (236737831). If they are unable to use satellite communications equipment, they will contact the USCG Communication Area Master Station Chesapeake VA via SITOR/NBDP on 8426.3 kHz, 12590.8 kHz, or 16817.8 kHz 24 hours per day, or 6314.3 kHz from 2300 GMT until 1100 GMT and 22387.8 kHz from 1100 GMT until 2300 GMT.

- While under way, all construction vessels will remain 500 yards away from right whales, and 100 yards away from all other whales to the extent physically feasible given navigational constraints as required by NMFS.

- All construction vessels greater than 300 gross tons will maintain a speed of 10 knots or less. Crew and supply boats, which move at up to 15 knots, when smaller than 300 gross tons will not be restricted to 10 knots; however, the crew members will be required to monitor the area for marine mammals and report any sightings to the other construction vessels operating in the area.

- Vessels transiting through the Cape Cod Canal and Cape Cod Bay between January 1-May 15 will reduce speed to ten knots or less, follow the recommended routes charted by NOAA to reduce interactions between right whales and shipping traffic, and avoid identified aggregations of right whales in the eastern portion of Cape Cod Bay. To the extent practicable, pipe deliveries will be avoided during the January to May timeframe. In the unlikely event the Canal is closed during construction, the pipe haul barges would transit around Cape Cod following the TSS and all measures agreed to below for the EBRVs when transiting to the Port.

DRAFT

- Vessels will remain 500 yards away from North Atlantic right whales and 100 yards away from all other marine mammals and sea turtles to the extent possible.

- An array of passive acoustic detection buoys will be installed in the Boston TSS that meets the criteria specified in the recommendations developed by NOAA through consultation with the USCG under the National Marine Sanctuaries Act (see Appendix A). The system will provide near real-time information on the presence of vocalizing whales in the shipping lanes.

- All EBRVs approaching or departing the port will comply with the MSR system to keep apprised of right whale sightings in the vicinity. Vessel operators will also receive active detections from the passive acoustic array prior to and during transit through the northern leg of the Boston TSS where the buoys are installed.

- In response to active right whale sightings (detected acoustically or reported through other means such as the MSR or SAS), and taking into account safety and weather conditions, EBRVs will take appropriate actions to minimize the risk of striking whales, including reducing speed to 10 knots or less and alerting personnel responsible for navigation and lookout duties to concentrate their efforts.

- All individuals onboard the EBRVs responsible for the navigation and lookout duties will receive training, a component of which will be training on marine mammal sighting/reporting and vessel strike avoidance measures (see Appendix B for recommended vessel strike avoidance procedures). Crew training of EBRV personnel will stress individual responsibility for marine mammal awareness and reporting.

- If a marine mammal or sea turtle is sighted by a crew member, an immediate notification will be made to the Person-in-Charge on board the EBRV and the NEG Port Manager, who would ensure that the required reporting procedures were followed.

- EBRVs transiting to the NEG port from cargo sources generally south of Gibraltar or coming north from areas such as Trinidad would most likely be traversing the Great South Channel right whale critical habitat area and would try to enter the Boston TSS near the entry point of the TSS as soon as practicable. EBRVs transiting to the NEG port from cargo sources in northern Europe or the Middle Eastern region will generally follow the Great Circle approach to North America. The most practical point at which the EBRVs might enter the Boston TSS will be in the Off Race Point area generally north of the point before the TSS angles to the southeast. EBRVs will maintain speeds of 12 knots or less while in the TSS until reaching the vicinity of the buoys (except during the seasons and areas defined below, when speed will be limited to 10 knots or less). At 1.86 miles from the NEG port, speed will be reduced to 3 knots, and to less than 1 knot at 1640 feet from the buoy.

DRAFT

- EBRVs will reduce transit speed to 10 knots or less (unless hydrographic, meteorological, or traffic conditions dictate an alternative speed to maintain the safety or maneuverability of the vessel) from March 1-April 30 in the Off Race Point SMA as described in section 2.4 of this BO.

- EBRVs will reduce transit speed to 10 knots or less (unless hydrographic, meteorological, or traffic conditions dictate an alternative speed to maintain the safety or maneuverability of the vessel) from April 1-July 31 in the Great South Channel SMA as described in section 2.4 of this BO.

- EBRVs are not expected to transit Cape Cod Bay. However, in the event transit through Cape Cod Bay is required, EBRVs will reduce transit speed to 10 knots or less (unless hydrographic, meteorological, or traffic conditions dictate an alternative speed to maintain the safety or maneuverability of the vessel) from January 1-May 15 in all waters in Cape Cod Bay, extending to all shorelines of Cape Cod Bay, with a northern boundary of 42° 12' N latitude.

- In such cases where speeds in excess of the ten knot speed maximums as described above are required, the reasons for the deviation, the speed at which the vessel is operated, the area, and the time and duration of such deviation will be documented in the logbook of the vessel and reported to the NMFS NER Ship Strike Coordinator.

Additional Vessel Operating Measures for Construction in December

- A ½ day training course will be provided by the current MMO provider to designated crew members assigned to the transit barges and other support vessels. These designated crew members will be required to keep watch on the bridge and immediately notify the navigator of any whale sightings. All watch crew will sign into a bridge log book upon start and end of watch. Transit route, destination, sea conditions and any protected species sightings/mitigation actions during watch will be recorded in the log book. Any whale sightings within 1,000 m of the vessel will result in a high alert and slow speed of 4 knots or less and a sighting within 750 m will result in idle speed and/or ceasing all movement.

- Prior to leaving the Quincy dock to begin transit, the barge will contact one of the MMOs on watch to receive an update of sightings within the visual observation area. If the MMO has observed a North Atlantic right whale within 30 minutes of the transit start, the vessel will hold for 30 minutes and again get a clearance to leave from the MMOs on board. MMOs will assess whale activity and visual observation ability at the time of the transit request to clear the barge for release.

- The material barges and tugs used to transport the sand to the dive support vessels along the route shall transit from the operations dock to the work sites during daylight hours when possible provided the safety of the vessels is not compromised. Should transit at night be required, the maximum speed of the tug will be 5 knots.

DRAFT

- Consistent with navigation safety, all construction vessels must maintain a speed of 10 knots or less during daylight hours. All vessels will operate at 5 knots or less at all times within 5 km of the construction area.

Effects of Vessel Collisions on Whales

Large whales, particularly right whales, are vulnerable to injury and mortality from ship strikes. Due to the overlap of heavy shipping traffic and high whale density, Massachusetts waters are a high risk area for ship strike events. Jensen and Silber (2003) report 36 documented ship strikes in Massachusetts waters from 1975-2002 (6 right whales, 10 humpbacks, 7 fin, 7 minke, 1 sei, and 5 of unknown species). Since 2002, there have been five additional confirmed or suspected ship strikes reported in Massachusetts waters (1 minke, 1 right, 1 humpback, 1 fin, 1 unknown; NMFS unpublished data). However, some of these reported locations represent where carcasses were found, and not necessarily where the whales were actually struck. It should also be noted that these numbers represent a minimum number of whales struck by vessels, as many ship strikes go undetected or unreported, and many whale carcasses are never recovered. Although fin whales are the species most often reported struck, the low abundance of right whales suggests that right whales are struck proportionally more often than any other species of large whale (Jensen and Silber 2003). There have been no documented ship strikes of sperm or blue whales in Massachusetts waters.

Ship strike injuries to whales take two forms: (1) propeller wounds characterized by external gashes or severed tail stocks; and (2) blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae, and massive bruises that sometimes lack external expression (Laist et al. 2001). Collisions with smaller vessels may result in propeller wounds or no apparent injury, depending on the severity of the incident. Laist et al. (2001) reports that of 41 ship strike accounts that reported vessel speed, no lethal or severe injuries occurred at speeds below ten knots, and no collisions have been reported for vessels traveling less than six knots. A majority of whale ship strikes seem to occur over or near the continental shelf, probably reflecting the concentration of vessel traffic and whales in these areas (Laist et al. 2001). As discussed in the Status of the Species section, all whales are potentially subject to collisions with ships. However, due to their critical population status, slow speed, and behavioral characteristics that cause them to remain at the surface, vessel collisions pose the greatest threat to right whales. In the past two years, at least four female right whales have been killed by ship collisions, two of which were carrying near-term fetuses. Because females are more critical to a population's ability to replace its numbers and grow, the premature loss of even one reproductively mature female could hinder the species' likelihood of recovering.

As discussed in the Environmental Baseline, to address the occurrence of ship strikes of endangered right whales along the US east coast, NMFS has proposed measures to regulate speed in the approaches to major port entrances, including the approaches to Boston (71 FR 36299, June 26, 2006). However, the rulemaking process is still ongoing, and there are no regulations currently in place to restrict vessel activity in the vicinity of right whales. As such, NEG agreed to reduce transit speed to 12 knots year-round upon entering the Boston TSS. In addition, NEG committed to a further reduction in speed to 10 knots or less from March 1-April

DRAFT

30 in the Off Race Point SMA as described in section 2.4 of this BO, and in the Great South Channel SMA from April 1-July 31 of every year. Because right whales have been sighted year-round in Massachusetts waters, NEG also agreed to consult recent right whale sighting information prior to entering areas where right whales are known to occur, and slow to 10 knots or less and alert crew members responsible for navigation and lookout duties to increase vigilance in the vicinity of active sighting locations.

Limited data are available on whale behavior in the vicinity of an approaching vessel and the hydrodynamics of whale/vessel interactions. However, the measures proposed by NEG above are in accordance with measures outlined in NMFS Ship Strike Reduction Strategy as the best available means of reducing ship strikes of right whales. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist et al. 2001). An analysis by Vanderlaan and Taggart (2006) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%. The seasonal management time periods developed through the right whale ship strike reduction strategy were designed to capture the majority of predictable right whale concentrations (Merrick 2005). According to NEFSC data, there have been only six right whale sightings since 1970 within the Boston TSS in the Great South Channel SMA outside of the proposed April-July season. Protection in the Off Race Point SMA will be further augmented by the real-time passive acoustic detection system included as a license condition by the USCG. This system will provide additional information to vessel operators about the presence of whales in the shipping lanes during periods outside of the proposed SMA, when sighting data is lacking due to weather limitations on aerial survey flights. Although these measures have been developed specifically with right whales in mind, the speed reduction is likely to provide protection for other large whales as well, as these species are generally faster swimmers and are more likely to be able to avoid oncoming vessels. In addition, all vessels operators and lookouts will receive training on prudent vessel operating procedures to avoid vessel strikes with all protected species.

DRAFT

Construction-related Vessel Traffic

Approximately 209 roundtrip vessel transits will occur as the result of construction activities over the 8-month construction period. Table 2 summarizes the types of construction support vessels and the number of anticipated trips for each vessel type:

Table 2: Number of Construction Vessel Trips and Time on Station

Vessel Type	Roundtrip transits to NEG port	Roundtrip transits to pipeline sites	Days on station (NEG port)	Days on station (Pipeline Lateral)
Anchor handling	8	14	15	105
Diving support	5	10	105	150
Crew boat	12	100	N/A	N/A

Restoration vessel	4	NA	15	N/A
Lay barge	N/A	1	N/A	50
Plow vessel	N/A	2	N/A	55
Tremie vessel	N/A	1	N/A	30
Survey vessel	N/A	8	N/A	105
Pipehaul barge tug	N/A	4	N/A	50
Supply vessel	N/A	40	N/A	N/A
Total Roundtrips	**29**	**180**	**135**	**545**

Vessels will only travel between 0-4 knots while actually engaged in construction activities, or 1-2 miles in a 24-hour period. At these speeds, vessel movements during construction are not likely to pose a vessel strike risk to marine mammals or sea turtles. Vessels installing buoys and mooring anchors would travel at speeds of less than 10 knots. Ancillary pipeline construction vessels, including anchor handling tugs, pipe haul barges and tugs, dive support vessels and crew/supply boats are maneuverable, and would be able to respond to collision avoidance requirements as necessary. All construction vessels greater than 300 gross tons would maintain a speed of 10 knots or less. Crew and supply boats less than 300 gross tons would move at speeds up to 15 knots, and would follow the vessel strike avoidance procedures discussed above.

According to US Army Corps of Engineers (ACOE) data, 4,561 large vessels entered and departed Massachusetts Bay harbors in 2003 (USCG 2006a). An independent risk assessment conducted for the USCG in relation to the Neptune and Northeast Gateway LNG projects also accounted for an additional 54,914 transits from medium-sized cruise ships, roll-on/roll-off ferries, whale watch vessels, commercial fishing vessels, and dredging vessels. Overall, an estimated 59,475 vessel trips occur annually in Massachusetts Bay. The 418 additional transits contributed by the construction portion of the proposed project would constitute a one-time 0.76% increase in vessel traffic in the area. It is important to note that this total does not include vessel traffic contributed by private recreational vessels. In addition, the majority of these transits will be occurring between Boston and the pipeline and port sites. Sightings of large baleen whales in the Boston Inner and Outer Harbor areas are rare. Sightings increase closer to the port site, but the presence of a real-time passive acoustic array around the construction site will allow detection and localization of whales as the vessels approach the site. The on-site endangered species observers will be able to provide information to approaching vessels about the locations of whales nearby, observers will be posted on vessels, and vessels can reduce speed, increase vigilance, or alter course accordingly. As such, at the typical operating speeds of the construction support vessels and with the proposed mitigation measures in place, NMFS concludes that the likelihood of the construction-related vessel traffic resulting in collision with a whale is discountable.

EBRV and Support Vessel Transits

The 1st and 2nd generation EBRVs that will be carrying cargo to and from the NEG terminal may pose greater risk to whales due to their deep draft, which increases the zone of potential impact with whales that are sub-surface. In addition, the greater mass of larger vessels increases the likelihood that serious injury or death to the whale will result from any collision. However, the

DRAFT

mitigation measures discussed above are expected to be effective for EBRV transits as well as construction vessel transits. In addition, the 65 roundtrip vessel transits per year contributed by the NEG project will constitute a minor increase (1.4%) in total traffic in the action area compared to the 4,561 estimated annual large vessel transits currently taking place. Combined with the implementation of the ship strike reduction measures described in section 2.4, this level of increased vessel traffic presents a discountable increase in the risk of a vessel strike, and there is not a reasonable likelihood that an LNG tanker associated with the NEG terminal will collide with a whale.

Effects of vessel collisions on sea turtles

Interactions between vessels and sea turtles occur and can take many forms, from the most severe (death or bisection of an animal or penetration to the viscera), to severed limbs or cracks to the carapace which can also lead to mortality directly or indirectly. Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about 9% of living and dead stranded sea turtles had propeller or other boat strike injuries (Lutcavage et al. 1997). According to 2001 STSSN stranding data, at least 33 sea turtles (loggerhead, green, Kemp's ridley and leatherbacks) that stranded on beaches within the northeast (Maine through North Carolina) were struck by a boat. From 2001-2006, an additional 14 sea turtles (12 leatherbacks, 1 Kemp's ridley, 1 loggerhead) have been documented with injuries consistent with propeller wounds (NMFS unpublished data) in the northeast. This number underestimates the actual number of boat strikes that occur since not every boat struck turtle will strand, every stranded turtle will not be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a boat. It should be noted, however, that it is not known whether all boat strikes were the cause of death or whether they occurred post-mortem (NMFS SEFSC 2001).

Information is lacking on the type or speed of vessels involved in sea turtle vessel strikes. However, there does appear to be a correlation between the number of vessel struck turtles and the level of recreational boat traffic (NRC 1990). Sea turtles have been reported with injuries consistent with propeller wounds, which are likely from interactions with small, fast moving vessels, such as recreational boats. Based on the best available information, sea turtles are thought to be able to avoid large LNG vessels or to be pushed out of the impact zone by prop wash or bow wake and the likelihood of an interaction between a sea turtle and an LNG vessel is discountable.

Although little is known about a sea turtle's reaction to vessel traffic, sea turtles are thought to be able to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. As such, the 10 knot speed of the support and construction vessels is likely to reduce the chance for collision. In addition, lookouts will be posted on all construction vessel transits. The presence of an experienced endangered species observer at the construction site who can advise the vessel operator to slow the vessel or maneuver safely when sea turtles are spotted will further reduce to a discountable level the potential for interaction with vessels.

Synthesis of the effects of vessel collisions on listed species

DRAFT

Although the threat of vessel collision exists anywhere listed species and vessel activity overlap, ship strike is more likely to occur in areas where high vessel traffic coincides with high species density. In addition, ship strikes are more likely to occur and more likely to result in serious injury or mortality when vessels are traveling at speeds greater than ten knots. Although most construction vessel transits will occur at speeds of ten knots or less, some vessels may travel at speeds up to 15 knots. However, NEG has agreed to limit EBRV and construction vessel transit speeds to ten knots or less during the areas and seasons where right whales are most likely to occur. Outside of those seasonal time periods, NEG has agreed to reduce vessel speed in response to dynamic sighting information provided through NMFS SAS and supplemented by the passive acoustic detection array in the northern leg of the Boston TSS, providing protection for animals that may occur unexpectedly. All vessel operators and lookouts will receive training on protected species identification and prudent vessel operating procedures in the presence of marine mammals and sea turtles. With these vessel strike avoidance measures in place, NMFS has determined that the vessel activity associated with the proposed action is not likely to adversely affect right, humpback, fin, sperm, blue, or sei whales or loggerhead, Kemp's ridley, green or leatherback sea turtles in the action area.

5.6 Acoustic Effects

When anthropogenic disturbances elicit responses from sea turtles and marine mammals, it is not always clear whether they are responding to visual stimuli, the physical presence of humans or manmade structures, or acoustic stimuli. However, because sound travels well underwater, it is reasonable to assume that, in many conditions, marine organisms would be able to detect sounds from anthropogenic activities before receiving visual stimuli. As such, exploring the acoustic effects of the proposed NEG terminal provides a reasonable and conservative estimate of the magnitude of disturbance caused by the general presence of a manmade, industrial structure in the marine environment, as well as the specific effects of sound on marine mammal and sea turtle behavior.

Marine organisms rely on sound to communicate with conspecifics and derive information about their environment. There is growing concern about the effect of increasing ocean noise levels due to anthropogenic sources on marine organisms, particularly marine mammals. Effects of noise exposure on marine organisms can be characterized by the following range of physical and behavioral responses (Richardson et al. 1995):

1. Behavioral reactions – Range from brief startle responses, to changes or interruptions in feeding, diving, or respiratory patterns, to cessation of vocalizations, to temporary or permanent displacement from habitat.
2. Masking – Reduction in ability to detect communication or other relevant sound signals due to elevated levels of background noise.
3. Temporary threshold shift (TTS) – Temporary, fully recoverable reduction in hearing sensitivity caused by exposure to sound.
4. Permanent threshold shift (PTS) – Permanent, irreversible reduction in hearing sensitivity due to damage or injury to ear structures caused by prolonged exposure to sound or temporary exposure to very intense sound.

DRAFT

5. Non-auditory physiological effects – Effects of sound exposure on tissues in non-auditory systems either through direct exposure or as a consequence of changes in behavior, e.g., resonance of respiratory cavities or growth of gas bubbles in body fluids.

Several components of project construction and operation will produce sound that may affect listed sea turtles and whales. NMFS is in the process of developing a comprehensive acoustic policy that will provide guidance on managing sources of anthropogenic sound based on each species' sensitivity to different frequency ranges and intensities of sound. The available information on the hearing capabilities of cetaceans and the mechanisms they use for receiving and interpreting sounds remains limited due to the difficulties associated with conducting field studies on these animals. However, current thresholds for determining impacts to marine mammals typically center around root-mean-square (RMS) received levels of 180 dB re 1μPa for potential injury, 160 dB re 1μPa for behavioral disturbance/harassment from a non-continuous noise source, and 120 dB re 1μPa for behavioral disturbance/harassment from a continuous noise source. These thresholds are based on a limited number of experimental studies on captive odontocetes, a limited number of controlled field studies on wild marine mammals, observations of marine mammal behavior in the wild, and inferences from studies of hearing in terrestrial mammals. In addition, marine mammal responses to sound can be highly variable, depending on the individual hearing sensitivity of the animal, the behavioral or motivational state at the time of exposure, past exposure to the noise which may have caused habituation or sensitization, demographic factors, habitat characteristics, environmental factors that affect sound transmission, and non-acoustic characteristics of the sound source, such as whether it is stationary or moving (NRC 2003). Nonetheless, the threshold levels referred to above are considered conservative based on the best available scientific information at this time and will be used in the analysis of effects for this BO.

The acoustic effects analysis will:

- characterize the various sources of noise attributed to the NEG terminal
- determine which species are likely to be exposed to each type of noise
- characterize the range of expected or possible responses of sea turtles and marine mammals exposed to the noise
- determine the significance of those effects to individuals and populations.

Characterization of Construction Noise Sources

NEG does not propose to use blasting, pile driving with an impact hammer, or any other activity that involves impulse sounds. All noise sources associated with construction will be non-impulse sounds continuous for the duration of the activity. Sources of construction noise associated with the NEG LNG project include the following:

- Anchor pile installation (suction piles)
- Pipelaying and associated activities
- Dynamically positioned vessels for installation of PLEMs and anchor lines
- Construction vessel transits

Suction Pile Installation

DRAFT

Suction anchors involve long pipes that are closed off at one end and open at the other. A pump is fitted to the open end of the pipe, the pipe is dropped vertically to the seabed, and water is evacuated, sucking the pile into the bottom soil. Suction piles work on the principle of differential pressures between the surface and water depth of the pile. The only acoustic impact associated with the installation of piles via suction method is the underwater noise generated by the pump. No measured data are available for the sound generated by suction piling. However, the sound profile of a typical pump that would be used for suction pile installation has been modeled. Modeling results indicate that noise levels from a 30 HP pump with a broadband source level of 138 dB re 1μPa would be below 90 dB re 1μPa within 0.3 km of the source (Neptune 2005). Although the actual pump used for the NEG project installation and the sound propagation at the NEG site as opposed to the Neptune site may vary, the sound levels produced by suction piling are likely to be on the same scale as the modeled scenario.

Pipeline Installation

Noise associated with pipeline installation comes primarily from the vessels performing the operations. A typical pipelaying scenario involves five vessels operating simultaneously on site. Noise output from these vessels varies slightly depending on individual vessel specifications. Exact vessels to be used during pipelaying operations have not been specified at this time; however, vessel noises generally fall in the frequency range of 5-2000 Hz, with peak intensities below 100 Hz. Broadband source levels for NEG port construction vessels are expected to range from approximately 160-180 dB re 1μPa at 1 meter, with thrusters adding another 5 to 10 dB for dynamically positioned vessels. Post-lay jetting operations have been recorded in the past to create broadband sounds up to 500 Hz, with peak intensities below 10 Hz (Richardson et al. 1995).

In a pipelaying scenario involving five vessels on site at the same time, including thrusters used intermittently for dynamic positioning, sound levels at or above the 120 dB criteria for continuous sound are estimated to extend in an area 40-42 km^2, or a radius of approximately 3.66 km from the activity (USCG 2006a). However, modeling of several different vessels and construction scenarios by Neptune indicated 120 dB impact zones of up to 11 km from construction activity. Therefore, to provide a conservative analysis, NMFS will consider that noise in excess of 120 dB generated by pipeline installation is expected to extend at least 3.6 km from the site, but may extend as far as 11 km from the construction site.

Construction Vessel Traffic

In addition to vessels engaged in pipelaying activities, support vessel transits will occur regularly throughout the construction period. These vessels will be shuttling personnel and supplies between Boston and the construction site, and will represent an additional transient source of noise along the transit path. An estimated total of 418 supply vessel transits (209 roundtrips) will take place. Although NEG did not model general construction support vessel transit scenarios, the broadband source level of a typical support vessel was reported at 183.6 dB re 1μPa at cruising speed (Neptune 2005).

Table 3. Summary of Construction Noise Sources and Impact Zones

	Type of	Source level	Dominant	180 dB	160 dB	120 dB

DRAFT

	noise	(dB re 1μPa RMS)	Frequencies	zone	zone	zone
Suction pile	Non-pulse; continuous	138	>1000 Hz	N/A	N/A	<300 m
Pipe laying/ plowing	Non-pulse; continuous	Variable; ~160-200	Variable; generally <250 Hz	N/A	N/A	3.6-11 km
Vessel traffic	Non-pulse; continuous	Variable; ~160-200	Variable; generally <250 Hz	Not modeled	Not modeled	Not modeled

Exposure Analysis – Construction Noise

The endangered whale species most likely to be present near the construction activities during the majority of the proposed construction timeframe (May-December) are humpback and fin whales. Sightings of right whales in this area are rare from May-November, but transient right whales have been seen in the vicinity of the proposed terminal during the summer months (Weinrich and Sardi 2005; NEFSC unpublished data). In addition, right whales are more commonly sighted in the area during the last month of construction activity in December, so we will consider them to be present for the purposes of this analysis. Sperm, blue, and sei whales are generally found further offshore, and are not likely to be encountered in the immediate vicinity of the construction activities. Although construction noise may be audible for several kilometers from the source, sperm, blue, and sei whales are primarily found over shelf edges and slopes, beyond the distances over which the 120-160 dB contours are likely to extend. As such, sperm, blue, and sei whales are not likely to be adversely affected by construction-related noise and will not be considered further in this portion of the analysis.

Sea turtles are present in Massachusetts waters during the summer months, and therefore may be exposed to construction-related noise. In Massachusetts waters, loggerhead, Kemp's ridley, and green sea turtles are usually foraging in shallow harbors and bays, while leatherback sea turtles are more pelagic. As such, loggerhead, Kemp's ridley, and green sea turtles are more likely to be exposed to pipeline-related activities, while leatherbacks are more likely to be exposed to noise associated with port installation activities, including installation of the pipeline connecting the north and south buoys.

Right, Humpback, and Fin Whale Hearing

In order for right, humpback, and fin whales to be adversely affected by construction noise, they must be able to perceive the noises produced by the activities. If a species cannot hear a sound, or hears it poorly, then the sound is unlikely to have a significant effect (Ketten 1998). Baleen whale hearing has not been studied directly, and there are no specific data on sensitivity, frequency or intensity discrimination, or localization (Richardson et al. 1995) for these whales. Thus, predictions about probable impact on baleen whales are based on assumptions about their hearing rather than actual studies of their hearing (Richardson et al. 1995; Ketten 1998).

DRAFT

Ketten (1998) summarized that the vocalizations of most animals are tightly linked to their peak hearing sensitivity. Hence, it is generally assumed that baleen whales hear in the same range as their typical vocalizations, even though there are no direct data from hearing tests on any baleen whale. Most baleen whale sounds are concentrated at frequencies less than 1 kHz (Richardson et al. 1995), although humpback whales can produce songs up to 8 kHz (Payne and Payne 1985). Based on indirect evidence, at least some baleen whales are quite sensitive to frequencies below 1 kHz but can hear sounds up to a considerably higher but unknown frequency. Most of the manmade sounds that elicited reactions by baleen whales were at frequencies below 1 kHz (Richardson et al. 1995). Some or all baleen whales may hear infrasounds, sounds at frequencies well below those detectable by humans. Functional models indicate that the functional hearing of baleen whales extends to 20 Hz, with an upper range of 30 Hz. Even if the range of sensitive hearing does not extend below 20-50 Hz, whales may hear strong infrasounds at considerably lower frequencies. Based on work with other marine mammals, if hearing sensitivity is good at 50 Hz, strong infrasounds at 5 Hz might be detected (Richardson et al. 1995). Fin whales are predicted to hear at frequencies as low as 10-15 Hz. The right whale uses tonal signals in the frequency range from roughly 20 to 1000 Hz, with broadband source levels ranging from 137 to 162 dB (RMS) re 1 μPa at 1 m (Parks & Tyack 2005). One of the more common sounds made by right whales is the "up call," a frequency-modulated upsweep in the 50–200 Hz range (Mellinger 2004). The following table summarizes the range of sounds produced by right, humpback, and fin whales (from Au et al. 2000):

Table 4. Summary of known right, humpback, and fin whale vocalizations

Species	Signal type	Frequency Limits (Hz)	Dominant Frequencies (Hz)	Source Level (dB re 1μPa RMS)	References
Northern right	Moans	< 400	--	--	Watkins and Schevill (1972)
	Tonal	20-1000	100-2500	137-162	Parks and Tyack (2005)
	Gunshots		50-2000	174-192	Parks et al. (2005)
Humpback	Grunts	25-1900	25-1900	--	Thompson, Cummings, and Ha (1986)
	Pulses	25-89	25-80	176	Thompson, Cummings, and Ha (1986)
	Songs	30-8000	120-4000	144-174	Payne and Payne (1985)
Fin	FM moans	14-118	20	160-186	Watkins (1981), Edds (1988), Cummings and Thompson (1994)
	Tonal	34-150	34-150		Edds (1988)
	Songs	17-25	17-25	186	Watkins (1981)

Most species also have the ability to hear beyond their region of best sensitivity. This broader range of hearing probably is related to their need to detect other important environmental phenomena, such as the locations of predators or prey. Considerable variation exists among marine mammals in hearing sensitivity and absolute hearing range (Richardson et al. 1995; Ketten 1998); however, from what is known of right, humpback, and fin whale hearing and the source levels and dominant frequencies of the construction noise sources summarized in Table 3, it is evident that right, humpback, and fin whales are capable of perceiving construction noises,

DRAFT

and have hearing ranges that are likely to have peak sensitivities in low frequency ranges that overlap the dominant frequencies of pile driving and vessel noise.

Sea Turtle Hearing

The hearing capabilities of sea turtles are poorly known. Few experimental data exist, and since sea turtles do not vocalize, inferences cannot be made from their vocalizations as is the case with baleen whales. Direct hearing measurements have been made in only a few species. An early experiment measured cochlear potential in three Pacific green turtles and suggested a best hearing sensitivity in air of 300–500 Hz and an effective hearing range of 60–1,000 Hz (Ridgway et al. 1969). Sea turtle underwater hearing is believed to be about 10 dB less sensitive than their in-air hearing (Lenhardt 1994). Lenhardt et al. (1996) used a behavioral "acoustic startle response" to measure the underwater hearing sensitivity of a juvenile Kemp's ridley and a juvenile loggerhead turtle to a 430-Hz tone. Their results suggest that those species have a hearing sensitivity at a frequency similar to those of the green turtles studied by Ridgway et al. (1969). Lenhardt (1994) was also able to induce startle responses in loggerhead turtles to low frequency (20–80 Hz) sounds projected into their tank. He suggested that sea turtles have a range of best hearing from 100–800 Hz, an upper limit of about 2,000 Hz, and serviceable hearing abilities below 80 Hz. More recently, the hearing abilities of loggerhead sea turtles were measured using auditory evoked potentials in 35 juvenile animals caught in tributaries of Chesapeake Bay (Bartol et al. 1999). Those experiments suggest that the effective hearing range of the loggerhead sea turtle is 250–750 Hz and that its most sensitive hearing is at 250 Hz. In general, however, these experiments indicate that sea turtles generally hear best at low frequencies and that the upper frequency limit of their hearing is likely about 1 kHz. As such, sea turtles are capable of hearing in low frequency ranges that overlap with the dominant frequencies of pile driving and vessel noise, and are therefore likely to be exposed to construction-related noise.

Exposure to Injurious Levels of Sound

Suction piling activity will not generate source levels in excess of 180 dB re 1 μPa, and thus is not likely to cause injury to whales or sea turtles. The predominant noise source associated with pipelaying and trenching activity is caused by the noise generated by the actual vessels involved in the process. Noise generated by pipelaying vessels will only exceed the 180 dB threshold for potential injury within very close distances to the vessels, i.e. tens of meters or less. As such, it is not likely that a whale or sea turtle will approach the vessel within a distance to be exposed to potentially injurious sound levels. In addition, pipelaying vessels will be moving at very slow speeds, minimizing the likelihood that a sea turtle or whale will be unable to move away from an approaching vessel before the received level reaches a potentially injurious threshold. Thus, sea turtles and whales are not likely to be exposed to levels of construction-related noise that will result in injury.

Exposure to disturbing levels of sound

Although the potential for construction-related sounds to cause injury to whales and sea turtles is extremely low, there is greater potential for whales to be exposed to disturbing levels of sound produced by these activities. Potentially disturbing levels of construction-related noise (120-160 dB) are expected to propagate over distances ranging from 0.3-11.0 km from the sources. Since

DRAFT

humpback and fin whales are abundant in Massachusetts waters during the summer months, they are likely to be exposed to construction-related noise during the 8-month construction window. Right whales may also be exposed to disturbing levels of construction-related noise, but will be present in the action area to a lesser degree than humpback or fin whales, and primarily during the last month of construction activity (December) when a limited amount of work will be taking place (diver-facilitated supplemental backfill).

There is very little information about sea turtle behavioral reactions to levels of sound below the thresholds suspected to cause injury or TTS. However, some studies have demonstrated that sea turtles have fairly limited capacity to detect sound, although all results are based on a limited number of individuals and must be interpreted cautiously. Ridgway et al. (1969) found that one green turtle with a region of best sensitivity around 400 Hz had a hearing threshold of about 126 dB in water. Streeter (in press) found similar results in a captive green sea turtle, which demonstrated a hearing threshold of approximately 125 dB at 400 Hz, but better sensitivity at 200 Hz (110-115 dB threshold). McCauley (2000) noted that dB levels of 166 dB re 1μPa were required before any behavioral reaction was observed. As such, the mitigation measures proposed for pile driving are likely to prevent exposure of sea turtles to levels of sound that may be disturbing to them. Other sources of construction noise are not likely to reach levels that may be disturbing to sea turtles. As such, NMFS concludes that construction noise is not likely to adversely affect sea turtles, and the remainder of the acoustics portion of the analysis will focus on potential behavioral harassment of whales.

Effects of Construction Noise on Whales

Characterizing the effect of noise on whales involves assessing the species' sensitivity to the particular frequency range of the sound, the intensity, duration, and frequency of the exposure, potential physiological effects, and potential behavioral responses that could lead to impairment of feeding, breeding, nursing, breathing, sheltering, migration, or other biologically important functions. Much of any analysis involving the effects of anthropogenic sounds on listed species relate to how an animal may change behavior upon exposure. In some cases, the change in behavior would constitute harassment, one type of take under the ESA. "Take" is defined in Section 3 of the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by NMFS to include "any act, which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering" (50 CFR 222.102). The ESA does not define harassment, nor has NMFS defined this term pursuant to the ESA through regulation; however, it is commonly understood to mean to annoy or bother. However, legislative history helps elucidate Congress' intent: "[take] includes harassment, whether intentional or not. This would allow, for example, the Secretary to regulate or prohibit the activities of birdwatchers where the effect of those activities might disturb the birds and make it difficult for them to hatch or raise their young" (HR Rep. 93-412, 1973).

However, the Marine Mammal Protection Act of 1972, as amended, defines harassment as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or

DRAFT

marine mammal stock in the wild or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [16 U.S.C. 1362(18)(A)]. For this BO, we will use the MMPA definition of harassment as the standard for defining take by harassment. We are particularly concerned about effects that may manifest as a failure of an animal to feed successfully, breed successfully (which can result from feeding failure), or complete its life history because of changes in its behavioral patterns.

In previous sections, we concluded that listed species in the action area are not likely to be exposed to injurious levels of sound. As such, this analysis of construction-related acoustic effects will focus on behavioral harassment that may result from the construction portions of the proposed action.

Continuous non-pulses (general construction noise)
The noise sources associated with construction are categorized as continuous non-pulses. While non-impulse noise is generally less likely to cause injury, continuous noise has been observed to elicit behavioral reactions at lower received levels. As noted previously, the species most likely to be present in the vicinity of the construction activities during the summer months are humpback and fin whales.

The 120 dB contour around the pipelaying activity is estimated to extend 3.6-11 km from the source. Vessel noise is dominated by low frequencies, which propagate further underwater and are within the range of best hearing sensitivity of large baleen whales.

The most commonly observed marine mammal behavioral responses to vessel activity include increased swim speed (Watkins 1981), horizontal and vertical (diving) avoidance (Baker et al 1983; Richardson et al 1985), changes in respiration or dive rate (Baker et al 1982; Bauer and Herman 1985; Richardson et al 1985; Baker and Herman 1989; Jahoda et al 2003), and interruptions or changes in feeding or social behaviors (Richardson et al 1985; Baker et al 1982; Jahoda et al 2003). Watkins et al. (1981) noted that passage of a tanker within 800 m did not disrupt feeding humpback whales. Although these studies have shown a high degree of variability in the intensity of responses, perhaps due to the demographic characteristics of the individual whale, the type of vessel approach, and the social and motivational state of the animal at the time of the interaction, in all cases the changes were observed to be short-term (e.g., minutes to hours), with animals often returning to their original behavioral state even if the stimulus remained (Wartzok et al. 1989).

Baker et al. (1982) found that abrupt changes in engine speed and aggressive maneuvers such as circling the whale or crossing directly behind or in front of the whale or its projected path elicited much stronger responses than unobtrusive maneuvering (tracking in parallel to the whale and changing vessel speed only when necessary to maintain a safe distance from the whale). Reactions were even less intense during a simple straight line passby, which most closely represents the type of vessel transit that will take place as a result of the construction activities (i.e., not targeted toward viewing whales).

DRAFT

Richardson et al (1985) observed strong reactions in bowhead whales to approaching boats and subtler reactions to drillship playbacks, but also found that bowhead whales often occurred in areas where low frequency underwater noise from drillships, dredges, or seismic vessels was readily detectable, suggesting that bowheads may react to transient or recently begun industrial activities, but may tolerate noise from operations that continue with little change for extended periods of time (hours or days).

Watkins (1986) compiled and summarized whale responses to human activities in Cape Cod Bay over 25 years, and found that the types of reactions had shifted over the course of time, generally from predominantly negative responses to an increasing number of uninterested or positive responses, although trends varied by species and only emerged over relatively long spans of time (i.e., individual variability from one experience to the next remains high). Watkins also noted that whales generally appeared to habituate rapidly to stimuli that were relatively non-disturbing.

Jahoda *et al*. (2003) studied the response of 25 fin whales in feeding areas in the Ligurian Sea to close approaches by inflatable vessels and to biopsy samples. They concluded that close vessel approaches caused these whales to stop feeding and swim away from the approaching vessel. The whales also tended to reduce the time they spent at surface and increase their blow rates, suggesting an increase in metabolic rates that might indicate a stress response to the approach. In their study, whales that had been disturbed while feeding remained disturbed for hours after the exposure ended. Beale and Monaghan (2004) concluded that the significance of disturbance was a function of the distance of humans to the animals, the number of humans making the close approach, and the frequency of the approaches. These results would suggest that the cumulative effects of the various human activities in the action area would be greater than the effects of the individual activity. None of the existing studies examined the potential effects of numerous close approaches on whales or gathered information of levels of stress-related hormones in blood samples that are more definitive indicators of stress (or its absence) in animals.

One playback experiment on right whales recorded behavioral reactions to different stimuli, including an alert signal, vessel noise, other whale social sounds, and a silent control (Nowacek et al. 2004). No significant response was observed in any case except the alert signal broadcast ranging from 500-4500 Hz. In response to the alert signal, whales abandoned current foraging dives, began a high power ascent, remained at or near the surface for the duration of the exposure, and spent more time at subsurface depths (1–10 m) (Nowacek et al. 2004). The only whale that did not respond to this signal was the sixth and final whale tested, which had potentially already been exposed to the sound five times. The lack of response to a vessel noise stimulus from a container ship and from passing vessels indicated that whales are unlikely to respond to the sounds of approaching vessels even when they can hear them (Nowacek et al. 2004). This nonavoidance behavior could be an indication that right whales have become habituated to the vessel noise in the ocean and therefore do not feel the need to respond to the noise or may not perceive it as a threat. In another study, scientists played a recording of a tanker using an underwater sound source and observed no response from a tagged whale 600 meters away (Johnson and Tyack 2003). These studies may suggest that if right whales are startled or disturbed by novel construction sounds, they may temporarily abandon feeding

DRAFT

activities, but may habituate to those sounds over time, particularly if the sounds are not associated with any aversive conditions.

From these various studies, it is possible to reach a broad conclusion that vessel activity often elicits some behavioral response in whales, although the response is usually minor. The behavioral responses observed indicate that vessel activity is probably stressful to the whales exposed to it, but the consequences of this stress on the individual whales or populations as a whole remains unknown.

We expect the right, humpback, and fin whales exposed to pipelaying activity and construction-related vessel traffic to respond similarly to those observed during the studies discussed above. As discussed previously, those responses are likely to be highly variable, depending on the distance of a whale from a vessel, vessel speed, vessel direction, vessel noise, and the number of vessels involved. Particular whales might not respond to the vessels at all, while in other circumstances, whales are likely to change their vocalizations, surface time, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions. However, the changes are expected to be minor and short-term, and are therefore not likely to have population-level effects.

Synthesis of effects – Construction noise

Aside from the case of mass strandings of beaked whales in response to acoustic activities, no scientific studies have conclusively demonstrated a link between exposure to sound and adverse effects on a marine mammal population (NRC 2005). Any animals that are exposed to construction noises may display behavioral reactions to the sounds by temporarily ceasing resting, migration, and foraging activities and moving away from the sound source. Behavioral responses are typically more extreme when a novel source is initiated. Since the construction-related noise would continue steadily and predictably for several days, we expect the alterations in behavior to diminish or cease over time. The action area currently experiences a high volume of commercial, fishing, whale watching, and other recreational vessel traffic, increasing the likelihood that the animals present are already habituated to a degree to the presence of industrial noise in their environment. As discussed in the Environmental Baseline section of this BO, the ambient noise level in the action area is likely to range from 103-117 dB re 1μPa, but can range from 50-140 dB re 1μPa in nearby areas, which suggests the animals in the area are accustomed to fluctuations in background noise. Animals would likely exhibit some startle responses and temporary avoidance behavior at the initiation of activities, but would habituate relatively quickly and resume their initial behaviors once the activity was no longer perceived as a potential threat. In addition, after the construction activity has ceased, any animal temporarily displaced for the duration of construction activity would likely return to the area without impairment of migrating, feeding, resting, or other behaviors. Major shifts in habitat use or distribution or foraging success are not expected. Based on what we know about their responses upon exposure to such sound sources in other instances, we expect that long-term adverse effects on individuals are unlikely, and as such would be unlikely to reduce the overall reproductive success, feeding, or migration of any individual animal. Therefore, the proposed construction activities may result in temporary harassment of right, humpback, and fin whales, but are not likely to result in death or injury of any individuals.

DRAFT

Characterization of Operational Noise Sources
In addition to construction-related noise, there is some noise associated with the long-term operation of the proposed LNG facility. Operational noise can be attributed to the following:

- Cargo unloading and LNG regasification process
- Bow thrusters used for dynamic positioning of LNG carriers at the buoys
- LNG carrier and support vessel transits

LNG Unloading and Regasification
Due to the technology being employed, there is minimal noise associated with the regasification process itself. Acoustic output of an existing offshore LNG facility in the Gulf of Mexico utilizing the same STL buoy system technology proposed by NEG was measured over a 5-day period in 2005 to provide an estimate of the acoustic impact of the NEG port. However, the facility in the Gulf of Mexico operates in open-loop mode as opposed to the closed-loop mode proposed for the NEG port. The measured sound levels were adjusted for extraneous noise sources contributed by other nearby industrial facilities and numerous vessels passing the facility, which result in generally higher ambient noise levels in the Gulf compared to ambient conditions in Massachusetts Bay. When corrected for these inputs, the noise level of an EBRV operating in open loop mode was calculated at 115-119 dB re 1μPa (highest noise output off the bow of the vessel). Closed-loop mode eliminates the noise attributed to the discharge of heating water, so NEG adjusted the measured sound levels an additional 7 dB to reflect the properties of a closed-loop system. The 7 dB adjustment is considered a minimum reduction, suggesting that the final estimated noise level is a conservative estimate. With the 7 dB adjustment, the estimated noise output of regasification activities is 108-112 dB re μPa. However, these estimates do not take into account the site-specific conditions such as water temperature, depth, and bottom contours which are likely to be much different in the Gulf of Mexico as opposed to Massachusetts Bay, and which all affect the propagation of sound underwater. An array of passive acoustic buoys will be installed around the port to verify the actual acoustic output of port operations. However, based on the best available information regarding noise generated by the EBRV regasification process, normal regasification operations are not expected to produce noise levels that disturb marine mammals or sea turtles, and will not be considered further in this discussion.

Bow Thrusters
Bow thrusters may be used for dynamic positioning of the EBRV during docking procedures. The maximum source level of normal thruster operations while the EBRV is maneuvering at the port were calculated at 160-170 dB re 1μPa, assuming all three thrusters operating at full load. Thruster noise is similar to the noise of large vessel transits, with peak intensities in the lower frequency ranges (10-100 Hz). Thruster operation is expected to take place in bouts of 10-30 minutes at a time, at alternate buoys every 4-8 days. Assuming a worst-case scenario maximum of 30 minutes per vessel arrival, this would constitute a total of approximately 32.5 hours per year (65 annual arrivals).

Thruster operations were modeled based on recent field surveys, and it was estimated that sounds associated with two EBRVs at 100 m distance would fall below 120 dB re 1μPa. Due to

DRAFT

the proximity of the buoys to each other, NEG would prohibit two vessels from simultaneously maneuvering on or off a buoy. At 500 m and 1 km, NEG estimates that all sound energy will be within the existing ambient range and below the 120 dB threshold for behavioral harassment of marine mammals due to continuous noise, even considering the unloading of two EBRVs. However, modeling conducted by Neptune for a similar project 3 miles from the NEG port indicates that thruster noise will persist at levels up to 120 dB for 5-6 km from the source (JASCO 2006). Although Neptune project vessels differ considerably in that they operate four thrusters simultaneously, producing broadband source levels of 187.9 dB re 1μPa, Neptune also modeled use of two thrusters at a broadband source level of 183.2 dB re 1μPa, and estimated that the 120 dB contour would extend less than 1 km (0.92-0.96 km) at the surface, and between 3-4 km at 50 m depth and at the bottom. Uncertainty exists regarding which model is a more accurate depiction of actual sound output of the thrusters. However, after reviewing NEG's application for an incidental harassment authorization, NMFS modeled the propagation of thruster noise based on a 180 dB re 1μPa source level and predicted the 120 dB zone of impact to extend approximately 2 miles from the source. This is generally consistent with Neptune's model of two thrusters in operation, so for the purposes of this analysis, we will consider that thruster use attributed to the NEG port may result in sound levels sufficient to disturb marine mammals at distances of 2 miles from the buoy sites.

Vessel Transits (LNG carriers and support vessels)
Source level data specific to the EBRVs proposed to be used for this project are not available. However, data exist for other tankers of similar size and power. Large commercial vessels and supertankers have powerful engines and large, slow-turning propellers. These vessels produce high sound levels, mainly at low frequencies. At these frequencies the noise is dominated by propeller cavitation noise combined with dominant tones arising from the propeller blade rate (Neptune 2005). A large bulk cargo ship called the Overseas Harriette has been used previously as a model for an LNG carrier in transit (Neptune 2005). The Harriette is 173 m long and is powered by a direct-drive low-speed diesel engine and a single 4 blade propeller 4.9 m in diameter. It has a power output of 11,200 hp and a maximum speed of 15.6 knots. The Overseas Harriette is less powerful and possibly less loud than an EBRV, but the sound level spectrum should be of similar shape with much louder noise at low frequency. The vessel modeled has a peak sound level at 50 Hz. The Overseas Harriette was modeled at its maximum speed (16.5 knots) to demonstrate a possible worst case scenario. At this transit speed, the broadband source level is 192 dB re 1μPa, and the 120 dB contour was modeled to extend up to 9.3 km. At a transit speed of 10 knots, the broadband source level is 174.7 dB re 1μPa, and the 120 dB contour was modeled to extend 0.54-1.72 km from the vessel. At a speed of 14 knots, the 120 dB contour was modeled to extend 0.75-2.39 km (Neptune 2005).

Table 5. Summary of operational noise source characteristics

	Source level (dB re 1μPa RMS)	Dominant Frequencies	120 dB zone (surface)	120 dB zone (50 m-bottom)
Bow thrusters – dynamic	160-187.9	10-100 Hz	1.0 km	5-6 km

DRAFT

positioning				
Bow thrusters – maintaining position	160-183.2	10-100 Hz	0.92-0.96 km	3-4 km
EBRV transit (10 knots)	174.7	50 Hz	0.54-0.58 km	1.58-1.72 km

Exposure Analysis

Because operational acoustic effects will occur year-round and involve vessel transits from the EBRV's entry point into the US EEZ to the port site, all whale and sea turtle species being considered in this consultation have the potential to be affected to some degree by the proposed operational activities. Vessel transits are expected to be distributed fairly evenly throughout the seasons, and since there will be a vessel on buoy at all times, impacts at the port site will be consistent throughout the year. However, it is important to consider that sounds tend to propagate slightly further in colder water, meaning that operational noise during the winter has the potential to expose animals in a somewhat wider area, although there may be fewer animals overall in the area during the winter. Species that are present only seasonally in the area, such as sea turtles, will be exposed to operational noise less often than other species that are present year-round. In addition, species that occur further offshore such as sei, blue, and sperm whales are only likely to be exposed to the noise from EBRV vessel transits.

As established previously in relation to construction noise, right, humpback, and fin whales are all known to be sensitive to sounds within the frequency ranges of vessel noise and thrusters. Blue whales are also low frequency specialists. Blue whales vocalize at frequencies between 12.5-200 Hz (Au et al. 2000). Very little is known about sei whale vocalizations and hearing, although vocalizations have been recorded 1500-3500 Hz (Knowlton, Clark, and Kraus 1991 in Au et al. 2000). However, since sei whales are mysticetes, it is assumed that their hearing is similar to that of other mysticetes such as right, humpback, fin, and blue whales. Sperm whales are odontocetes, and are considered mid-frequency specialists rather than low frequency specialists, although sperm whales are also known to produce loud broad-band clicks from about 100 Hz to 20 kHz (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate (Carder and Ridgway 1990). These data suggest that neonatal sperm whales respond to sounds from 2.5-60 kHz. Although vessel noise may not be within the most sensitive hearing frequency of sperm whales, sperm whales are likely to be able to perceive some degree of vessel noise, and so we will consider that they may be exposed to operational noise from the proposed NEG project.

As noted previously in relation to construction noise, sea turtles are thought to be far less sensitive to sound than marine mammals. Although vessel and thruster noise are within the limited range of frequencies they can detect, evidence suggests that sound levels of 110-126 dB re 1μPa are required before sea turtles can detect a sound (Ridgway 1969; Streeter, in press). McCauley (2000) noted that dB levels of 166 dB re 1μPa were required before any behavioral reaction was observed. All operational noise sources are expected to diminish to below this threshold within very short distances, and as such, sea turtles are not likely to be adversely affected by operational noise and will not be considered further in this discussion.

DRAFT

Effects of Operational Noise on Right, Humpback, and Fin Whales
None of the noise sources associated with day-to-day operation of the facility are expected to reach levels that would potentially cause injury to marine mammals. All operation-related noise sources, however, are continuous and long-term in nature, and thus have the potential to result in some type of behavioral disturbance or harassment. As discussed previously, we will use the MMPA definition of harassment for the purposes of this BO.

Short-term behavioral reactions of marine mammals to noise were discussed previously in relation to construction noise. Although the noise sources associated with operation are different, the behavioral reactions to operational noise sources are expected to be very similar to the reactions discussed previously. The primary difference between construction-related noise and operational noise is the long-term, chronic nature of the operational noise. As such, this section of the analysis will focus on the potential long-term effects of chronic exposures to levels of sound sufficient to trigger behavioral responses in baleen whales.

Displacement and Behavioral Disruption
Although the noise associated with operation is generally present at lower intensities and is expected to propagate over shorter distances than that associated with construction, sounds to which animals are exposed repeatedly over extended periods of time have greater potential to result in population-level effects. When a chronic disturbance is introduced into an animal's environment, the animal can either abandon the site or remain in the area and tolerate the disturbance. Both types of responses have been observed in relation to industrial activities, although it is often difficult to isolate noise disturbance as the environmental factor leading to changes in marine mammal abundance in a particular area. Gray whales apparently abandoned the Guerrero Negro Lagoon in Baja California for a few years when an evaporative salt works operation increased shipping and other industrial disturbance and noise. The whales returned once the activity ceased (Gard 1974; Reeves 1977; Bryant et al.1984). Although no direct causal link could be made, Norris and Reeves (1978) reported decreased abundance of humpback whales along the coast of Oahu since the 1940s and 1950s, coincident with drastic increases in human activity, including shipping. However, in most cases where potential noise-induced abandonment has occurred, other environmental factors such as prey availability have not been sufficiently measured to eliminate other interpretations of the observed abandonment. On the other hand, whales are known to return year after year to feeding areas even in the presence of heavily trafficked shipping lanes and high volumes of fishing and whale watching activity, as occurs in the action area near Cape Cod Bay, the Great South Channel, and SBNMS. Gray whales continue to migrate annually along the west coast of North America despite intermittent seismic exploration in that area for decades (Malme et al. 1984). Bowhead whales continue to travel to the eastern Beaufort Sea each summer despite previous long-term seismic exploration in their summer and autumn range. However, tolerance of noise does not necessarily mean that noise is not causing stress or other negative effects.

Due to the variability in baleen whale responses to disturbing levels of noise, it is difficult to predict the reaction to the long-term operation of the proposed LNG terminal. However, since the primary operational noise source will be the occasional use of thrusters, the response would

DRAFT

likely be similar to the response to vessel activity. Although continuous for the duration of thruster use, the noise associated with the thrusters would be transient in nature, occurring for only 10-30 minutes at a time. Whales may temporarily exhibit avoidance behavior upon start up of thruster use, but return quickly once the noise is no longer perceived as a threat, or thruster use ceases. Feeding behavior is not likely to be significantly impacted, as whales appear to be less likely to exhibit behavioral reactions or avoidance responses while engaged in feeding activities (Richardson et al. 1995). In addition, even if temporary displacement from the ensonified area occurs, there is no evidence to suggest that the terminal site provides more abundant foraging opportunities for whales than surrounding waters. Whale prey species are mobile, and are broadly distributed throughout Stellwagen Bank and surrounding areas. Humpback and fin whales temporarily displaced due to start-up of thrusters are likely to easily find alternate foraging locations nearby. Given their population status and because they rely on very specific conditions for feeding (dense plankton patches) and do not feed year-round, temporary, frequent interruptions in feeding behavior may be most significant to right whales. Right whales are occasionally observed feeding near Stellwagen Bank; however, right whales continue to feed in Cape Cod Bay and the Great South Channel in spite of frequent disturbance from passing vessels. Based on this information and the high level of vessel traffic disturbance already present in the action area, it is likely that whales will habituate to or tolerate the occasional disturbance of the thrusters, and would return to the area even if some initial displacement occurred.

Masking

Since abandonment is not likely to occur, we must evaluate the potential for long-term masking effects and increased stress to have deleterious effects on individuals or the population. Again, since the sound produced by the thrusters would be intermittent in nature, masking would not be a continuous phenomenon, but would occur in 10-30 minute bouts approximately once a week due to thruster use. Masking is a natural phenomenon which marine mammals must cope with even in the absence of man-made noise (Richardson et al. 1995). Marine mammals demonstrate strategies for reducing the effects of masking, including changing the source level of calls, increasing the frequency or duration of calls, and changing the timing of calls (NRC 2003). Although these strategies are not necessarily without energetic costs, the consequences of temporary and localized increases in background noise level are impossible to determine from the available data (Richardson et al. 1995; NRC 2005). However, one relevant factor in attempting to consider the effect of elevated noise levels on marine mammal populations is the size of the area affected versus the habitat available. The endangered whale species likely to be affected by the noise of the port operations (right, humpback, and fin whales) are widely dispersed. As such, only a small percentage of the population is likely to be within the radius of masking at any given time. Richardson et al. (1995) concludes broadly that, although further data are needed, localized or temporary increases in masking probably cause few problems for marine mammals, with the possible exception of populations highly concentrated in an ensonified area. Although a high proportion of the known right whale population can be concentrated in Cape Cod Bay or the Great South Channel at one time, these areas are beyond the predicted zone of ensonification from thruster use. Noise levels are expected to diminish to 100 dB or less before reaching Cape Cod Bay, the closest habitat area where a significant portion of the population may be at any one time. These levels approach existing ambient noise levels,

DRAFT

and from the perspective of a right whale in Cape Cod Bay, the thruster noise itself is likely to be masked by local vessel traffic in Cape Cod Bay. As such, although some number of right, humpback, and fin whales are likely to be subject to occasional masking as a result of port operations, temporary shifts in calling behavior to reduce the effects of masking, on the scale of 10-30 minutes once a week, are not likely to result in failure of an animal to feed successfully, breed successfully, or complete its life history.

Acoustically Induced Stress

Stress can be defined in different ways, but in general, a stress response demonstrates a perturbation to homeostasis (NRC 2003), or a physiological change that increases an animal's ability to cope with challenges. Typical manifestations of stress include changes in heart rate, blood pressure, or gastrointestinal activity. Stress can also involve activation of the pituitary-adrenal axis, which stimulates the release of more adrenal corticoid hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg 1987, Rivest and Rivier 1995) and altered metabolism (Elasser *et al*. 2000), immune competence (Blecha 2000) and behavior.

Generally, stress is a normal, adaptive response, and the body returns to homeostasis with minimal biotic cost to the animal. However, stress can turn to "distress" or become pathological if the perturbation is frequent, outside of the normal physiological response range, or persistent (NRC 2003). In addition, an animal that is already in a compromised state may not have sufficient reserves to satisfy the biotic cost of a stress response, and then must divert resources away from other functions. In these cases, stress can inhibit critical functions such as growth (in a young animal), reproduction, or immune responses.

There are very few studies on the effects of stress on marine mammals, and even fewer on noise-induced stress in particular. One controlled laboratory experiment on captive bottlenose dolphins showed cardiac responses to acoustic playbacks, but no changes in the blood chemistry parameters measured (Miksis et al. 2001 in NRC 2003). Beluga whales exposed to playbacks of drillrig noise (30 minutes at 134-153 dB re 1μPa) exhibited no short term behavioral responses and no changes in catecholamine levels or other blood parameters (Thomas et al. 1990 in NRC 2003). However, techniques to identify the most reliable indicators of stress in natural marine mammal populations have not yet been fully developed, and as such it is difficult to draw conclusions about potential noise-induced stress from the limited number of studies conducted.

There have been some studies on terrestrial mammals, including humans, that may provide additional insight on the potential for noise exposure to cause stress. Marine mammals are likely to exhibit some of the same stress symptoms as terrestrial mammals. For example, the stress caused by pursuit and capture activates similar physiological responses in terrestrial mammals (Harlow et al. 1992 in NRC 2003) and cetaceans (St. Aubin and Geraci 1992 in NRC 2003). Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (for example, elevated respiration and increased heart rates). Jones and Broadbent (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al*. (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while

DRAFT

Krausman *et al*. (2004) reported on the auditory and physiological stress responses of endangered Sonoran pronghorn to military overflights.

These studies on stress in terrestrial mammals lead us to believe that the whales exposed to repeated thruster use associated with the long term operation of the proposed terminal may experience some degree of stress due to chronic acoustic exposure. However, the stress response, and thus the biological costs associated with the stress response, may diminish over time as habituation to the disturbance occurs. Although responses have been variable, most studies examining habituation to disturbance have found that habituation occurs rapidly (Richardson et al. 1995). Richardson et al. (1995) provides a summary of studies on habituation to noise disturbance, which will not be duplicated here. For example, however, the heart rate response of elk, antelope, and bighorn sheep in pens habituated to high-altitude aircraft overflights after only four passes (Bunch and Workman 1993 in Richardson et al. 1995). Heart rate responses in captive red deer calves diminished to near zero after <10 exposures (Espmark and Langvatn 1985 in Richardson et al. 1995). Cox et al. (2001) found that porpoise avoidance of a 10 kHz, 135 dB re 1μPa pinger diminished by 50% within 4 days, and sightings within 125 m equaled control levels within 10-11 days. Although data from these studies do not allow us to determine the reactions of whales to the specific type and duration of noise associated with the proposed LNG terminal, these studies do suggest that physiological stress responses, if they are initially triggered by thruster noise, may indeed diminish over time through habituation, thus minimizing the likelihood of long-term adverse effects.

Effects of Operational Noise on Sperm, Sei, and Blue Whales

Sperm, sei, and blue whales are not likely to be present within the range of ensonification from activities at the port site (thruster use, regasification). The transit of an EBRV from its point of entry into the US EEZ to the port site may expose any whale along its path to potentially disturbing levels of noise. However, sperm, blue, and sei whales are only likely to be exposed to noise during a very limited portion of the EBRV transit through the action area due to their offshore distribution. In addition, because the vessel will be moving through the area, an individual sperm, blue, or sei whale within the ensonified field around the vessel would not be exposed to disturbing levels of sound throughout the entire transit of the vessel through this portion of the action area. Although studies on sperm, blue, and sei whale responses to anthropogenic noise and vessel activity are very limited, responses similar to those witnessed in other whales as discussed above have been documented (Gaskin 1964, Reeves 1992, Gordon et al. 1992, Lockyer 1981, in Richardson et al. 1995), e.g., minor, short-term displacement and avoidance, alteration of diving or breathing patterns, and less responsiveness when feeding. Due to the limited potential for exposure, the moderate sound levels, and the limited duration of exposure, sperm, blue, and sei whales are not likely to be adversely affected by vessel noise associated with the NEG EBRV transits.

Synthesis of Effects – Operational Noise

The evidence presented above indicates that animals do respond and modify behavioral patterns in the presence of industrial noise, although adequate data do not yet exist to quantitatively assess or predict the significance of minor alterations in behavior and shifts in energy budgets or accumulation of stress responses to the health and viability of marine mammal populations. In

DRAFT

many cases, it can be difficult to assess the energetic costs of a behavioral change, let alone the effect of that energetic cost on the likelihood that an individual will survive and reproduce. For example, studies have been able to show that the distribution of feeding baleen whales correlates with prey rather than with loud sonar or industrial activities, but were unable to test for potentially more subtle effects on feeding, such as reduced prey capture per unit effort and reduced time engaged in feeding due to the presence of noise in the environment (NRC 2005). Further, in order to move from energetic cost to potential deleterious effects on survival and reproduction, data regarding whether a change in feeding rate is within the range of normal variation would be needed (NRC 2005). A full predictive model for the effects of noise on marine mammal populations is at least a decade away from fruition due to lack of necessary data (NRC 2005).

The uncertainties in the available data make it difficult to predict the response and long term significance of masking and stress on right, humpback, and fin whales affected by the proposed NEG LNG port. However, based on observations of marine mammals exposed to other types of industrial activity, the moderate intensity and duration of sound generated by project components, and the levels of vessel noise and disturbance already present in the project area, NMFS anticipates that the noise associated with the long term operation of the NEG facility is not likely to have a measurable adverse impact on the capacity of the animals to feed successfully, breed successfully, or complete their life histories. Nonetheless, NMFS remains concerned about the potential for unknown or unanticipated long-term effects on the individuals present in the project area. As such, NMFS believes that long-term monitoring of port operations is necessary to verify that large scale abandonment of the habitat is not occurring, and that acoustic output from the port is within the ranges predicted by modeling exercises.

Long-term monitoring through a passive acoustic archival array will be implemented as a condition of MARAD's license of the facility, which will assist NMFS in detecting large-scale shifts in marine mammal use of or distribution within the project area, which may indicate greater population level impacts than anticipated. In addition, the passive acoustic monitoring array will collect information about the actual sound output of the port operations, and may provide some additional information about the percentage of time that calls are being masked and any changes in calling behavior that may be a response to masking effects. Monitoring of stress and the overall health of these populations would provide better information on the potential long-term effects of the port; however, techniques for assessing stress in free-ranging marine mammals are not developed to the point where such monitoring studies would be considered feasible, nor does baseline data exist for the populations in the project area. As such, NMFS does not consider it appropriate to include such studies as license conditions. However, research and investigation into the development and improvement of such techniques are critical to our understanding of minor, cumulative impacts on endangered whale populations, which is reflected in NMFS' Conservation Recommendations for this consultation.

6.0 CUMULATIVE EFFECTS

DRAFT

Cumulative effects, as defined in the ESA, are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Sources of human-induced mortality or harassment of cetaceans or turtles in the action area include incidental takes in state-regulated fishing activities, vessel collisions, ingestion of plastic debris, and pollution. The combination of these activities may affect populations of ESA-listed species, preventing or slowing a species' recovery.

Future commercial fishing activities in state waters may take several protected species. However, it is not clear to what extent these future activities would affect listed species differently than the current state fishery activities described in the Environmental Baseline section. The Atlantic Coastal Cooperative Statistics Program (ACCSP) and the NMFS sea turtle/fishery strategy, when implemented, are expected to provide information on takes of protected species in state fisheries and systematically collected fishing effort data which will be useful in monitoring impacts of the fisheries. NMFS expects these state water fisheries to continue in the future, and as such, the potential for interactions with listed species will also continue.

As noted in the Environmental Baseline section, private and commercial vessel activities in the action area may adversely affect listed species in a number of ways, including entanglement, boat strike, or harassment. Boston, Massachusetts is one of the Atlantic seaboard's busiest ports. In 2003, 3,849 commercial ships used the port of Boston (USCG 2006a). The major shipping lane to Boston traverses the SBNMS, a major feeding and nursery area for several species of baleen whales. Vessels using the Cape Cod Canal, a major conduit for shipping along the New England Coast pass through Massachusetts and Cape Cod Bays. In a 1994 survey, 4093 commercial ships (> 20 meters in length) passed through the Cape Cod Canal, with an average of 11 commercial vessels crossing per day (Wiley *et al.* 1995).

In addition to commercial boat traffic, recreational boat traffic is likely to persist at the current level or increase in the Massachusetts and Cape Cod Bays. Recent whale strikes resulting from interaction with whale watch boats and recreational vessels have been recorded (Pat Gerrior, pers. comm.). In New England, there are approximately 36 whale watching companies, operating 55-70 boats (NMFS 2006), with the majority of effort during May through September. Annual transits are estimated at 3,328 (NOS 2004 in USCG 2006a). The average whale watching boat is 85 feet, but size ranges from 50 to 150 feet. In addition, over 500 fishing vessels and over 11,000 pleasure craft frequent Massachusetts and Cape Cod Bays (Wiley *et al.* 1995). Various initiatives have also been planned or undertaken to expand or establish high-speed watercraft service in the northwest Atlantic. In the action area for this project, a high-speed ferry (40 mph) operates between Boston and Provincetown, Massachusetts, cutting across Stellwagen Bank. It appears likely that these types of private activities will continue to affect listed species if actions are not taken to minimize the impacts, although it is not possible to predict to what degree these activities will be detrimental to the species.

DRAFT

Increasing vessel traffic in the action area also raises concerns about the potential effects of noise pollution on marine mammals and sea turtles. The effects of increased noise levels are not yet completely understood, and can range widely depending on the context of the disturbance. Acoustic impacts can include auditory trauma, temporary or permanent loss of hearing sensitivity, habitat exclusion, habituation, and disruption of other normal behavior patterns such as feeding, migration, and communication. NMFS is working to develop policy guidelines for monitoring and managing acoustic impacts on marine mammals from anthropogenic sound sources in the marine environment.

Marine debris (e.g., discarded fishing line, lines from boats, plastics) can entangle turtles in the water and drown them. Turtles commonly ingest plastic or mistake debris for food, as observed with the leatherback sea turtle. The leatherback's preferred diet includes jellyfish, but similar looking plastic bags are often found in the turtle's stomach contents (Magnuson et al. 1990). It is anticipated that marine debris will continue to impact listed species in the action area.

Nutrient loading from land-based sources such as coastal community discharges is known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effect to larger embayments is unknown. Pollutant loads are usually lower in baleen whales than in toothed whales and dolphins. However, a number of organochlorine pesticides were found in the blubber of North Atlantic right whales with PCB's and DDT found in the highest concentrations (Woodley et al. 1991). Contaminants could indirectly degrade habitat if pollution and other factors reduce the food available to marine animals. Turtles are relatively hardy species and are not easily affected by changes in water quality or increased suspension of sediments in the water column. However, if these changes persist, they can cause habitat degradation or destruction, eventually leading to foraging difficulties, which may in turn lead to long term avoidance or complete abandonment of the polluted area by the affected species (Ruben and Morreale 1999).

DRAFT

7.0 INTEGRATION AND SYNTHESIS OF EFFECTS

Kemp's ridley, loggerhead, green and leatherback sea turtles

As noted in sections above, the physical disturbance of sediments and associated benthic resources from the port and pipeline sites could reduce the availability of sea turtle prey in the affected areas, but these reductions will be localized and temporary, and foraging turtles are not likely to be limited by the reductions. Interactions with sea turtles, while possible, are unlikely to occur during the transit of EBRVs to and from the NEG terminal. Interactions between sea turtles and construction vessels are also unlikely because construction vessels will be traveling at speeds at or below ten knots and observers will be present. Sea turtles are unlikely to be exposed to injurious or disturbing levels of sound from construction and operation noises. As such, this action is not likely to adversely affect listed sea turtles in the action area.

Right, humpback, fin, sperm, sei, and blue whales

As noted in sections above, interactions with whales, while possible, are unlikely to occur during the transit of EBRVs or construction vessels to and from the NEG terminal. The applicant has proposed several mitigation measures that will reduce the likelihood of interactions between whales and LNG vessels, including seasonal 10 knot speed restrictions, presence of observers, and dynamic speed reductions based on increased awareness of real-time whale locations provided by passive acoustic detection arrays. All of these measures have been incorporated into the project design.

Large baleen whales are known to be injured and harassed by anthropogenic noise sources associated with construction and operation of offshore oil and gas structures. There are no sound levels associated with construction and operation of the NEG port that are likely to cause injury to listed whales. However, right, humpback, and fin whales may be exposed to potentially disturbing levels of sound during both construction and operation of the proposed facility, and sperm, sei, and blue whales may be exposed to potentially disturbing levels of sound during port operations, specifically during EBRV transits through offshore portions of the vessel transit path. Temporary, short-term behavioral effects during construction-related activities such as cessation of feeding, resting, or other activities or temporary alterations in breathing, vocalizing, or diving rates are likely, although these effects are not likely to appreciably reduce an individual's likelihood of survival or reproduction, and therefore not likely to result in population-level effects. Long-term exposure to operational noise sources is not likely to result in abandonment of the area, but is likely to result in some degree of increased stress and periodic masking. The significance of minor, long-term stressors and periodic increases in energy expenditure to the overall health, survival, and reproductive success of individual whales is not well understood. While whales may be present in the action area year-round, a single individual's exposure to operation-related noise is likely to be transient, as all of the whales in the action area are highly migratory, and a single individual is not likely to be within the zone of impact year-round. In addition, sperm, blue, and sei whales have only limited potential for exposure, since they are only likely to be present in a limited portion of the action area where the only project-related activity is the weekly transit of an EBRV. As such, NMFS anticipates that the effects of periodic masking, temporary behavioral changes, and acoustically-induced stress from the moderate noise output associated with operation of the NEG deepwater port is not likely to adversely affect sperm, sei, and blue whales, and may adversely affect but is not likely to appreciably reduce the likelihood of survival and recovery of right, humpback, and fin whale populations.

8.0 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under NMFS jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects in the action area, it is NMFS' biological opinion that the construction and operation of the NEG LNG deepwater port is likely to adversely affect, but is not likely to jeopardize the continued existence of the Northern right, humpback, and fin whale. Further, NMFS has determined that the sperm, sei, and blue whale and loggerhead, Kemp's ridley, leatherback, and green sea turtle are not likely to be adversely affected by the proposed action. Because the proposed construction and operation of the terminal are not likely to affect

DRAFT

copepod abundance or distribution, designated critical habitat in the action area will not be affected by the project.

9.0 INCIDENTAL TAKE STATEMENT

Section 9 of the Endangered Species Act of 1973 (ESA), as amended, and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NOAA's National Marine Fisheries Service (NMFS) to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited provided that such taking is in compliance with the terms and conditions of an Incidental Take Statement (ITS).

A marine mammal species or population stock which is listed as threatened or endangered under the ESA is, by definition, also considered depleted under the Marine Mammal Protection Act (MMPA). The ESA allows takings of threatened and endangered marine mammals only if authorized by section 101(a)(5) of the MMPA. NMFS authorized the taking of listed marine mammals associated with the construction and operation of the Northeast Gateway (NEG) LNG deepwater port under section 101(a)(5)(D) on May 7, 2007, and amended the authorization on November 30, 2007 to include the December construction window and prescribe additional mitigation measures for work in December. Therefore, the incidental taking of marine mammals described in this ITS is also exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

The measures described below are nondiscretionary, and must be undertaken by the Maritime Administration (MARAD) so that they become binding conditions of any grant, permit, or other authorization issued to NEG LNG, as appropriate, for the exemption in section 7(o)(2) to apply. MARAD has a continuing duty to regulate the activity covered by this ITS. If MARAD (1) fails to assume and implement the terms and conditions, or (2) fails to require NEG to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, MARAD must monitor the progress of the action and its impact on the species as specified in the ITS [50 CFR §402.14(i)(3)].

Amount or Extent of Take

NMFS has concluded that the construction and operation of the NEG LNG deepwater port is likely to result in take of Northern right (*Eubalaena glacialis*), humpback (*Megaptera novaeaengliae*), and fin (*Balaenoptera physalus*) whales in the form of harassment, where

DRAFT

habitat conditions (i.e., received sound levels above the 120 dB threshold for continuous noise used to determine harassment under the MMPA) will temporarily impair normal behavior patterns. This harassment will occur in the form of avoidance or displacement from preferred habitat and behavioral and/or metabolic compensations to deal with short-term masking or stress. While whales may experience temporary impairment of behavior patterns, no significant impairment resulting in injury (i.e., "harm") is likely due to: the moderate sound output of project components (i.e., sound levels below the thresholds for injury), the ability of whales to easily move to areas beyond the impact zone that also provide suitable prey, and the limited exposure time to disturbing levels of sound (10-30 minutes per week during operations).

NMFS does not expect any whales to be injured or killed by these activities. However, planned monitoring and mitigation measures are designed to avoid sudden onsets of potentially disturbing noise, to detect marine mammals occurring near the activities, and to avoid exposing them to sound sources that may cause hearing impairment.

In the process of amending NEG's IHA, NMFS revised its estimates of the maximum number of potential marine mammal takes by harassment, as NEG's marine mammal monitoring reports indicated that the previous estimates had likely been exceeded. A preliminary count of whales sighted within the 120 dB impact zone indicates that up to 150 takes (humpback and fin whales) have potentially occurred during construction activities between May through October 2007. However, some sightings may have counted the same marine mammal more than once, as marine mammal monitoring was conducted by several MMOs simultaneously on different construction vessels within the same area. As a result, more rigorous analyses are needed to better estimate the numbers of each species that were actually taken by harassment. Nonetheless, NMFS believes this preliminary count indicates that the previously anticipated take levels have likely been exceeded. Therefore, for the purposes of this revised ITS, the estimates were revised to account for the extension of the construction window into December, when there is a greater likelihood of right whales entering the project area, as well as new information on the numbers of sightings occurring in the vicinity of the port site. The maximum number of takes by acoustic harassment for the remainder of construction in December 2007 is estimated to be 15 right, 60 fin, and 120 humpback whales. This was calculated based on an estimated 15 days of construction in the month of December, a 77.3 mi^2 area of impact, and right, fin, and humpback whale density estimates for the region. In addition, for the port operations phase projected to begin in January 2008 and continuing through May 2008 (when the current IHA expires), the maximum number of exposures is estimated to be 32 right, 140 fin, and 256 humpback whales. This estimate is based on 65 annual vessel arrivals, during which whales could be exposed to sound levels above 120 dB re: 1μPa while thrusters are in use for docking at the port (approximately 10-30 minutes for each vessel arrival). Each of these exposures would be considered a take by harassment; however, not all whales would be expected to react at the same level, and some may not react at all. In addition, these numbers represent anticipated exposure events and not necessarily the number of individual animals harassed.

The amount of take will have been exceeded if any right, humpback, or fin whales are harmed, injured, or killed as a result of the construction and operation of the NEG port and associated Pipeline Lateral, or if the number of takes by acoustic harassment as defined above exceeds the

DRAFT

estimate of 47 right, 200 fin, and 376 humpback whale takes from December 1, 2007 through May 7, 2008. This ITS is only valid through May 7, 2008.

Effect of the Take

In the process of amending the IHA issued to NEG for this project, NMFS determined that the limited extension of the construction activities into December, in conjunction with the additional mitigation and monitoring measures, does not alter the original activity or mitigation measures in a manner that materially affects the basis for the original findings of negligible impact as defined in 50 CFR 216.103, and that the observed take levels do not invalidate the small numbers determination. In the accompanying BO, NMFS concluded that the construction and operation of the NEG LNG deepwater port were not likely to result in jeopardy to the right, humpback, or fin whale or the destruction or adverse modification of critical habitat. Exposure to construction noise and other sound sources associated with this work has the potential to harass right, humpback, and fin whales, although such takes are expected to be temporary and not to affect the reproduction, survival, or recovery of this species.

Reasonable and Prudent Measures

Reasonable and prudent measures (RPMs) are actions that NMFS considers necessary and appropriate to minimize the impacts of incidental take on listed species. MARAD and NEG have worked with NMFS to develop a comprehensive mitigation program to minimize the impacts of the proposed activities on endangered right, humpback, and fin whales as part of the project description for this action. NMFS believes this mitigation program minimizes incidental take to the extent that is technologically feasible. Therefore, the RPMs included with this ITS are limited to monitoring and reporting activities.

1. NEG must implement a NMFS approved program to monitor the incidental harassment of marine mammals due to the construction and operation of the NEG LNG deepwater port and associated Pipeline Lateral.

2. MARAD and NEG must cooperate with NMFS to facilitate adaptive management of the impacts of NEG project activities on listed species in the action area through proper reporting of project activities, marine mammal observations, and interactions with listed species.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, MARAD must comply with and ensure NEG complies with, the following terms and conditions, which implement the reasonable and prudent measures described above and outline reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To implement RPM #1 and RPM #2, the requirements of the Incidental Harassment Authorization (attached) issued under section 101(a)(5)(D) and 50 CFR 216.107 are incorporated herein.

DRAFT

2. To implement RPM #1, trained NEG personnel must monitor and record marine mammal presence while thrusters are being used during EBRV docking and submit monthly sighting reports to the NMFS Northeast Regional Office. Sighting reports should include, to the best of the observer's ability, the date and time of sighting, number of species sighted, general direction and distance of sighting from the vessel, and the type of species sighted.

3. To implement RPM #2, NEG must suspend any construction activities immediately if a dead or injured marine mammal is found in the vicinity of the project area and the death or injury of the animal could be attributable to the NEG LNG facility construction or operations. NMFS Northeast Regional Office Endangered Species Coordinator must be notified within 24 hours (978-281-9208) of the observation.

4. To implement RPM #2, MARAD or NEG must notify NMFS Northeast Regional Office when the take level of any species reaches 50% of the total authorized for that species in this ITS. At that time, MARAD and NMFS will determine if additional measures are needed to minimize acoustic harassment due to project activities.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the potential for and impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take is exceeded, reinitiation of consultation and review of the reasonable and prudent measures are required. MARAD must immediately provide an explanation of the causes of the taking and review with NMFS the need for possible modification of the reasonable and prudent measures. Reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is *exceeded*, section 7 consultation must be reinitiated immediately.

DRAFT

10.0 CONSERVATION RECOMMENDATIONS

In addition to section 7(a)(2), which requires agencies to ensure that proposed projects will not jeopardize the continued existence of listed species, section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species". Conservation Recommendations are discretionary activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. MARAD/USCG should develop, or require the licensee to develop, a system through which passive acoustic detections of whales can be distributed in real-time to other vessels transiting the Boston TSS, thereby improving mariner awareness of whale presence and providing widespread reduction of whale/vessel interactions.

2. MARAD/USCG and/or the licensee should support research and development of technologies that may reduce the acoustic impact of port operations, or improve the ability of mariners to detect and avoid striking whales. This can include expanding or improving the capabilities of the real-time passive acoustic detection array to provide more reliable whale detection over larger portions of the Boston TSS.

3. MARAD/USCG should conduct, or require the licensee to conduct, research directed specifically toward assessing endangered species use of the proposed deepwater port site, particularly species for which little information currently exists, such as sea turtles. Such research could include aerial surveys or other techniques that maximize detection of sea turtles and whales.

4. MARAD/USCG should conduct, or require the licensee to conduct, additional studies that may enable better detection of effects that may be attributed directly to port operations. This can include studies on prey distribution, water quality, or focal animal studies that provide more specific data on the reactions of whales and sea turtles to the presence of the deepwater port, such as determining whether individual animals are permanently abandoning the site or altering energy budgets (particularly time spent feeding) due to acoustic disturbance. Data gathered during research activities should be reported to NMFS.

5. MARAD/USCG and/or the licensee should support research and development of techniques to assess the effects of stress on free-ranging marine mammals, or other techniques that advance our understanding of long-term, cumulative effects of anthropogenic noise and other stressors on marine mammal populations.

DRAFT

11.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the issuance of a license for the construction and operation of the NEG LNG deepwater port. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) a new species is listed or critical habitat designated that may be affected by the action; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered. If the amount or extent of incidental take is exceeded, MARAD/USCG must immediately request reinitiation of formal consultation.

LITERATURE CITED

Acevedo-Gutierrez A, Croll DA, Tershy BR. 2002. High feeding costs limit dive time in the largest whales. Journal of Experimental Biology 205(12):1747-1753.

AcuTech. 2006. Independent Risk Assessment for Neptune and Northeast Gateway Deepwater Ports. Prepared for US Coast Guard, G-PSO05, Deepwater Ports Standards Division. April 12, 2006.

Agler, B.A., R.L., Schooley, S.E. Frohock, S.K. Katona, and I.E. Seipt. 1993. Reproduction of photographically identified fin whales, *Balaenoptera physalus*, from the Gulf of Maine. J. Mamm. 74:577-587.

Aguilar, A. 1986. A review of old Basque whaling and its effect on the right whales (Eubalaena glacialis) of the North Atlantic. Report of the International Whaling Commission, Special Issue 10:191-199.

Aguilar, R., J. Mas, and X. Pastor. 1995. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle, Caretta caretta, population in the western Mediterranean. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SEFSC-361:1-6.

Aguilar, A. and C. Lockyer. 1987. Growth, physical maturity and mortality of fin whales (*Balaenoptera physalus*) inhabiting the temperate waters of the northeast Atlantic. Can. J. Zool. 65:253-264.

Aguirre, A.A., G.H. Balazs, B. Zimmerman, and F.D. Galey. 1994. Organic contaminants and trace metals in the tissues of green turtles (*Chelonia mydas*) afflicted with fibropapillomas in the Hawaiian Islands. Mar. Poll. Bull., 28, 2: 109-114.

Andrews, H.V., and K. Shanker. 2002. A significant population of leatherback turtles in the Indian Ocean. Kachhapa. 6:19.

Andrews, H.V., S. Krishnan, and P. Biswas. 2002. Leatherback nesting in the Andaman and Nicobar Islands. Kachhapa. 6:15-18.

Angliss, R.P., D.P. DeMaster, and A.L. Lopez. 2001. Alaska marine mammal stock assessments, 2001. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-124, 203 p.

ASMFC. 1997. Amendment 3 to the Interstate Fishery Management Plan for American Lobster. Atlantic States Marine Fisheries Commission. December 1997.

Au, W.W.L., A.N. Popper, R.R. Fay (eds.). 2000. Hearing by Whales and Dolphins. Springer-Verlag, New York, NY.

DRAFT

Baker, C. S. and Herman, L. M. 1989. Behavioral responses of summering humpback whales to vessel traffic: experimental and opportunistic observations. Final Report to the National Park Service, U. S. Department of the Interior, Anchorage, AK.

Baker, C.S. L.M. Herman, B.G. Bays and G.B. Bauer. 1983. The impact of vessel traffic on the behavior of humpback whales in southeast Alaska: 1982 season. Report submitted to the National Marine Mammal Laboratory, Seattle, Washington.

Baker, C.S., L.M. Herman, B.G. Bays and W.F. Stifel. 1982. The impact of vessel traffic on the behavior of humpback whales in southeast Alaska. Report submitted to the National Marine Mammal Laboratory, Seattle, Washington

Balazs, G.H. 1982. Growth rates of immature green turtles in the Hawaiian Archipelago, p. 117-125. *In* K.A. Bjorndal (ed.), Biology and conservation of sea turtles. Smithsonian Institution Press, Washington D.C.

Balazs, G.H. 1985. Impact of ocean debris on marine turtles: entanglement and ingestion. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-54:387-429.

Baldwin, R., G.R. Hughes, and R.T. Prince. 2003. Loggerhead turtles in the Indian Ocean. Pages 218-232. *In*: A.B. Bolten and B.E. Witherington (eds.) Loggerhead Sea Turtles. Smithsonian Books, Washington, D.C. 319 pp.

Bartol, S.M., J. Musick, and M.L. Lenhardt. 1999. Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta*). Copeia 1999(3): 836-840.

Bass, A.L., S.P. Epperly, J.Braun-McNeill. 2004. Multi-year analysis of stock composition of a loggerhead sea turtle (*Caretta caretta*) foraging habitat using maximum likelihood and Bayesian methods. Conserv. Genetics 5:783-796.

Barlow J. 1994. Abundance of large whales in California coastal waters: a comparison of ship surveys in 1979/80 and in 1991. Report of the International Whaling Commission 44:399-406.

Barlow, J. 1997. Preliminary estimates of the abundance of cetaceans along California, Oregon, and Washington based on a 1996 ship survey and comparisons of passing and closing modes. Admin. Rept. LJ-97-11. Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA. 25 pp.

Barlow J. 2003. Preliminary Estimates of the Abundance of Cetaceans Along the U.S. West Coast: 1991-2001. NOAA Fisheries Southwest Fisheries Science Center Administrative Report LJ-03-03. 31 p.

Barlow, J., and P. J. Clapham. 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. Ecology, 78: 535-546.

DRAFT

Barlow J, Forney K, Hill P, Brownell R, Carretta J, DeMaster D, Julian F, Lowry M, Ragen T, Reeves R. 1997. U.S. Pacific Marine Mammal Stock Assessments: 1996. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-248.

Bauer, G.B., and L.M. Herman. 1985. Effects of vessel traffic on the behavior of humpback whales in Hawaii. Report submitted to the National Marine Fisheries Service, Honolulu, Hawaii.

Baumgartner, M.F. and B.R. Mate. 2005. Summer and fall habitat of North Atlantic right whales inferred from satellite telemetry. *Canadian Journal of Fisheries and Aquatic Science* 62:527-543.

Beale, C. M., and P. Monaghan. 2004. Human disturbance: people as predation-free predators? Journal of Applied Ecology 41:335-343.

Best, P. B. 1979. Social organization in sperm whales, *Physeter macrocephalus*. Pages 227-289 *in* H. E. Winn and B. L. Olla (editors), Behavior of marine animals, Vol. 3: Cetaceans. Plenum Press, New York.

Best, P.B., J. L. Bannister, R.L. Brownell, Jr., and G.P. Donovan (eds.). 2001. Right whales: worldwide status. *J. Cetacean Res. Manage.* (Special Issue). 2. 309pp.

Bjorndal, K.A. 1997. Foraging ecology and nutrition of sea turtles. Pages 199-233 *In*: Lutz, P.L. and J.A. Musick, eds., The Biology of Sea Turtles. CRC Press, New York. 432 pp.

Blecha F. 2000. Immune system response to stress. In: Moberg GP, Mench IA, eds. Biology of Animal Stress: Implications for Animal Welfare. Wallingford, Oxon, UK: CAB

Bolten, A.B., K.A. Bjorndal, and H.R. Martins. 1994. Life history model for the loggerhead sea turtle (*Caretta caretta*) populations in the Atlantic: Potential impacts of a longline fishery. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SWFSC-201:48-55.

Bolten, A.B., J.A. Wetherall, G.H. Balazs, and S.G. Pooley (compilers). 1996. Status of marine turtles in the Pacific Ocean relevant to incidental take in the Hawaii-based pelagic longline fishery. U.S. Dept. of Commerce, NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-230.

Boulon, R., Jr., 2000. Trends in sea turtle strandings, U.S. Virgin Islands: 1982 to 1997. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-436:261-263.

Braham, H. W. 1991. Endangered whales: status update. A Report on the 5-year status of stocks review under the 1978 amendments to the U.S. Endangered Species Act. NMFS Unpublished Report.

DRAFT

Braun, J. and S.P. Epperly. 1996. Aerial surveys for sea turtles in southern Georgia waters, June 1991. Gulf of Mexico Science. 1996(1): 39-44.

Braun-McNeill, J. and S.P. Epperly. 2004. Spatial and temporal distribution of sea turtles in the western North Atlantic and the US Gulf of Mexico from Marine Recreational Fishery Statistics Survey (MRFSS). Mar. Fish. Rev. 64(4): 50-56.

Bresette, M.J., R.M. Herren, and D.A. Singewald. 2003. Sea turtle captures at the St. Lucie nuclear power plant: a 25-year synopsis. P. 46. In: J.A. Seminoff (compiler). Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-503, 308 p.

Brown, M.W., O.C. Nichols, M.K. Marx, and J.N. Ciano. 2002. Surveillance, Monitoring, and Management of North Atlantic Right Whales in Cape Cod Bay and Adjacent Waters – 2002. Final report to the Division of Marine Fisheries, Commonwealth of Massachusetts. Center for Coastal Studies.

Brown, S.G. 1986. Twentieth-century records of right whales (*Eubalaena glacialis*) in the northeast Atlantic Ocean. *In*: R.L. Brownell Jr., P.B. Best, and J.H. Prescott (eds.) Right whales: Past and Present Status. IWC Special Issue No. 10. p. 121-128.

Bryant, P.J., Lafferty, C.M. and Lafferty, S.K. 1984. Reoccupation of Laguna Guerrero Negro, Baja California, Mexico, by gray whales. pp. 375-387. *In*: M.L. Jones, S.L. Swartz, S. Leatherwood (eds.). *The Gray Whale Eschrichtius robustus*. Academic Press, San Diego, California. xxiv+600pp.

Burtenshaw J, Oleson E, Hildebrand J, McDonald M, RK A, Bruce Howe M, Mercer J. 2004. Acoustic and satellite remote sensing of blue whale seasonality and habitat in the Northeast Pacific. Deep-Sea Research Part II: Topical Studies in Oceanography 51:967-986.

Calambokidis, J., T. Chandler, L. Schlender, G. H. Steiger, and A. Douglas. 2003. Research on humpback and blue whale off California, Oregon and Washington in 2002. Final Contract Report to Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA 92038. 49 pp.

Carder, D.A. and S.H. Ridgway. 1990. Auditory brainstem response in a neonatal sperm whale Physeter spp. Journal of the Acoustical Society of America Supplement 1:88.

Carr, A.R. 1963. Pan specific reproductive convergence in Lepidochelys kempi. Ergebn. Biol. 26: 298-303.

Carretta, J.V., J. Barlow, K.A. Forney, M.M. Muto, and J. Baker. 2001. U.S. Pacific marine mammal stock assessments, 2001. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-317, 280p.

DRAFT

Carretta, J.V., K.A. Forney, M.M. Muto, J. Barlow, J. Baker, B. Hanson and M. Lowry. 2004. U.S. Pacific Marine Mammal Stock Assessments: 2004. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-375. 316 p.

Castroviejo, J., J.B. Juste, J.P. Del Val, R. Castelo, and R. Gil. 1994. Diversity and status of sea turtle species in the Gulf of Guinea islands. Biodiversity and Conservation 3:828-836.

Caswell, H. 2001. Matrix population models. Sunderland, Massachusetts, Sinauer Publishers, Inc.

Caswell, H., M. Fujiwara, and S. Brault. 1999. Declining survival probability threatens the North Atlantic right whale. Proc. Nat. Acad. Sci. 96: 3308-3313.

Caulfield, R.A. 1993. Aboriginal subsistence whaling in Greenland: the case of Qeqertarsuaq municipality in West Greenland. Arctic 46:144-155.

Cetacean and Turtle Assessment Program (CeTAP). 1982. Final report of the cetacean and turtle assessment program, University of Rhode Island, to Bureau of Land Management, U.S. Department of the Interior. Ref. No. AA551-CT8-48. 568 pp.

Chan, E.H., and H.C. Liew. 1996. Decline of the leatherback population in Terengganu, Malaysia, 1956-1995. Chelonian Conservation and Biology 2(2):192-203.

Chevalier, J. and M. Girondot. 1998. Nesting dynamics of marine turtles in French Guiana during the 1997 nesting season. Bull. Soc. Herp. Fr., 85-86: 5-19.

Chevalier, J., X. Desbois, and M. Girondot. 1999. The reason for the decline of leatherback turtles *(Dermochelys coriacea*) in French Guiana: a hypothesis p.79-88. In Miaud, C. and R. Guyétant (eds.), Current Studies in Herpetology, Proceedings of the ninth ordinary general meeting of the Societas Europea Herpetologica, 25-29 August 1998 Le Bourget du Lac, France.

Clapham, P.J. 1992. Age at attainment of sexual maturity in humpback whales, *Megaptera novaengliae*. Can. J. Zool. 70:1470-1472.

Clapham, P.J. (ed.). 2002. Report of the working group on survival estimation for the North Atlantic right whales. Available from the Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543.

Clapham, P.J. and C.A. Mayo. 1990. Reproduction of humpback whales (*Megaptera novaengliae*) observed in the Gulf of Maine. Rep. Int. Whal. Commn. Special Issue 12: 171-175.

DRAFT

Clapham, P.J. and I.E. Seipt. 1991. Resightings of independent fin whales, *Balaenoptera physalus*, on maternal summer ranges. J. Mamm. 72: 788-790.

Clapham, P.J., S.B. Young, and R.L. Brownell. 1999. Baleen whales: Conservation issues and the status of the most endangered populations. Mammal Rev. 29(1):35-60.

Clapham P. and C. Baker. 2002. Whaling, Modern In: Perrin W, Wursig B, Thewissen J, editors. Encyclopedia of Marine Mammals. San Diego, CA: Academic Press. p 1328-1332.

Clark, C.W. 1995. Application of U.S. Navy underwater hydrophone arrays for scientific research on whales. Rep. Int. Whal. Commn. 45: 210-212.

Clarke, M.R. 1962. Stomach contents of sperm whales caught off Madeira in 1959. Norsk Hvalfangstidende. 51:173-191.

Clarke, M.R. 1980. Cephalopoda in the diet of sperm whales of the southern hemisphere and their bearing on sperm whale biology. Disc. Rep. 37:1-324.

Clarke, R. 1954. Open boat whaling in the Azores. The history and present methods of a relic industry. Disc. Rep. 26:281-354.

Cole, T.; Hartley, D; Garron, M. 2006. Mortality and Serious Injury Determinations for Baleen Whale Stocks Along the Eastern Seaboard of the United States, 2000-2004. *U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc.* 06-04; 18 p.

COSEWIC. 2002. COSEWIC assessment and update status report on the blue whale *Balaenoptera musculus* in Canada. Ottawa. 38 p.

Cox, T.M, A.J. Read, A. Solow, and N. Tregenza. 2001. Will harbor porpoises (*Phocoena phocoena*) habituate to pingers? Journal of Cetacean Research Management 3:81-86.

Croll, D.A., B. Marinovic, S. Benson, F.P. Chavez, N. Black, R. Temullo, B.R. Tershy. 2000. From Wind to Whales: Trophic Links in a Coastal Upwelling System. Final Report to the Monterey Bay National Marine Sanctuary, Contract No. 50ABNF500153.

Crouse, D.T. 1999. The consequences of delayed maturity in a human-dominated world. American Fisheries Society Symposium. 23:195-202.

Crowder, L.B., D.T. Crouse, S.S. Heppell. and T.H. Martin. 1994. Predicting the impact of turtle excluder devices on loggerhead sea turtle populations. Ecol. Applic. 4:437-445.

Crowder, L.B., S.R. Hopkins-Murphy, and A. Royle. 1995. Estimated effect of turtle excluder devices (TEDs) on loggerhead sea turtle strandings with implications for conservation. Copeia. 1995:773-779.

DRAFT

Dodd, C.K. 1988. Synopsis of the biological data on the loggerhead sea turtles *Caretta caretta* (Linnaeus 1758). U.S. Fish and Wildlife Service, Biological Report 88 (14).

Donovan, G.P. 1991. A review of IWC stock boundaries. Rep. Int. Whal. Comm., Spec. Iss. 13:39-63.

Doughty, R.W. 1984. Sea turtles in Texas: A forgotten commerce. Southwestern Historical Quarterly. pp. 43-70.

Dutton, P.H., B.W. Bowen, D.W. Owens, A. Barragan, and S.K. Davis. 1999. Global phylogeography of the leatherback turtle (*Dermochelys coriacea*). Journal of Zoology 248:397-409.

Dwyer, K.L., C.E. Ryder, and R. Prescott. 2002. Anthropogenic mortality of leatherback turtles in Massachusetts waters. Poster presented at the 20th Annual Sea Turtle Symposium.

Eckert, S.A. 1999. Global distribution of juvenile leatherback turtles. Hubbs Sea World Research Institute Technical Report 99-294.

Eckert, S.A. and J. Lien. 1999. Recommendations for eliminating incidental capture and mortality of leatherback sea turtles, *Dermochelys coriacea*, by commercial fisheries in Trinidad and Tobago. A report to the Wider Caribbean Sea Turtle Conservation Network (WIDECAST). Hubbs-Sea World Research Institute Technical Report No. 2000-310, 7 pp.

Ehrhart, L.M. 1979. Reproductive characteristics and management potential of the sea turtle rookery at Canaveral National Seashore, Florida. Pp. 397-399 in Proceedings of the First Conference on Scientific Research in the National Parks, New Orleans, Louisiana, November 9-12, 1976. R.M. Linn, ed. Transactions and Proceedings Series-National Park Service, No. 5. Washington, D.C.: National Park Service, U.S. Government Printing Office.

Elasser, T.H., KC Klasing, N Flipov and F Thompson, 2000. The Metabolic consequences of stress: Targets for stress and priorities of nutrient use. In 'The Biology of Animal Stress', G P Moberg and J A Mench, pp77-110. CAB INTERNATIONAL.Wallingford.

EPA Region 1 and ACOE, NAE. 1996. Massachusetts Bay Disposal Site Management Plan. December 31, 1996.

Epperly, S.P. and W.G. Teas. 2002. Turtle Excluder Devices - Are the escape openings large enough? Fish. Bull. 100:466-474.

Epperly, S.P., J. Braun, and A.J. Chester. 1995a. Aerial surveys for sea turtles in North Carolina inshore waters. Fishery Bulletin 93:254-261.

DRAFT

Epperly, S.P, J. Braun, A.J. Chester, F.A. Cross, J.V. Merriner, and P.A. Tester. 1995b. Winter distribution of sea turtles in the vicinity of Cape Hatteras and their interactions with the summer flounder trawl fishery. Bull. Mar. Sci. 56(2):519-540.

Epperly, S.P., J. Braun, and A. Veishlow. 1995c. Sea turtles in North Carolina waters. Cons. Biol. 9(2): 384-394.

Epperly, S., L. Avens, L. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J. Poffenberger, C. Sasso, E. Scott-Denton, and C. Yeung. 2002. Analysis of sea turtle bycatch in the commercial shrimp fisheries if southeast U.S. waters and the Gulf of Mexico. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-SEFSC-490, 88pp.

Ernst, C.H. and R.W. Barbour. 1972. Turtles of the United States. Univ. Press of Kentucky, Lexington. 347 pp.

Federal Energy Regulatory Commission (FERC). 2001. Final Environmental Impact Statement—Volume I on Maritimes and Northeast Pipeline, LLC et al.'s Phase III/HubLine Project. Docket No. CP01-4 et al. November 2001.

Ferreira, M.B., M. Garcia, and A. Al-Kiyumi. 2003. Human and natural threats to the green turtles, *Chelonia mydas*, at Ra's al Hadd turtle reserve, Arabian Sea, Sultanate of Oman. *In*: J.A. Seminoff (compiler). Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-503, 308 p.

Forney K. 2004. Estimates of cetacean mortality and injury in two U.S. Pacific longline fisheries, 1994-2002. Admin. Rep. LJ-04-07. Southwest Fisheries Science Center, National Marine Fisheries Service, 8604 La Jolla Shores Drive, La Jolla, CA 92037. 17 p.

Frazer, N.B., and L.M. Ehrhart. 1985. Preliminary growth models for green, Chelonia mydas, and loggerhead, Caretta caretta, turtles in the wild. Copeia 1985:73-79.

Frazer, N.B., C.J. Limpus, and J.L. Greene. 1994. Growth and age at maturity for Queensland loggerheads. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-SEFSC-351: 42-45.

Fritts, T.H. 1982. Plastic bags in the intestinal tracts of leatherback marine turtles. Herpetological Review 13(3): 72-73.

Fujiwara, M. and H. Caswell. 2001. Demography of the endangered North Atlantic right whale. Nature. 414:537-541.

Gambell, R. 1976. World whale stocks. Mammal Review 6 (1): 41-53.

DRAFT

Gambell, R. 1985. Sei whale *Balaenoptera borealis* (Lesson 1828). In Ridgway SH, Harrison R, editors. Handbook of Marine Mammals. Vol. 3: The Sirenians and Baleen Whales. London, U.K.: Academic Press.

Gambell, R. 1993. International management of whales and whaling: an historical review of the regulation of commercial and aboriginal subsistence whaling. Arctic 46:97-107.

Gard, R. 1974. Aerial census of gray whales in Baja California Lagoons, 1970 and 1973, with notes on behavior, mortality, and conservation. Calif. Fish and Game. 60(3):132-143.

Germano and Associates. 2005. Sediment Profile Imaging Report: Evaluation of Sediment and Benthos Characteristics at the Proposed Northern and Direct Pipeline Routes for the Neptune Deepwater Port Locations in Massachusetts Bay, USA. Appendix A of Module 4 (Marine Resources) of the Neptune Project Deepwater Port License Application Completion Status Report. Prepared for Ecology and Environment. August 2005.

Girondot, M., M.H. Godfrey, and R. Philippe. in review. Historical records and trends of leatherbacks in French Guiana and Suriname.

Goddard, P.C., and D.J. Rugh. 1998. A group of right whales seen in the Bering Sea in July 1996. Mar. Mamm. Sci. 14(2): 344-349.

Goff, G.P. and J.Lien. 1988. Atlantic leatherback turtle, *Dermochelys coriacea*, in cold water off Newfoundland and Labrador. Can. Field Nat.102(1):1-5.

Goold, J.C. and S.E. Jones. 1995. Time and frequency domain characteristics of sperm whale clicks. Journal of the Acoustical Society of America 98: 1279-1291.

Graff, D. 1995. Nesting and hunting survey of the turtles of the island of Svo Tomé. Progress Report July 1995, ECOFAC Componente de Svo Tomé e Príncipe, 33 pp.

Gregr EJ, Nichol L, Ford JKB, Ellis G, Trites AW. 2000. Migration and population structure of northeastern Pacific whales off coastal British Columbia: An analysis of commercial whaling records from 1908-1967. Marine Mammal Science 16(4):29.

Hain, J.H.W., M.J. Ratnaswamy, R.D. Kenney, and H.E. Winn. 1992. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. Rep. Int. Whal. Comm. 42: 653-669.

Hain J, Hyman M, Kenney D, Winn H. 1985. The role of cetaceans in the shelf-edge region of the Northeastern U.S. Marine Fisheries Review 47(1):13-17.

Hamilton, P.K., M.K. Marx, and S.D. Kraus. 1998. Scarification analysis of North Atlantic right whales (*Eubalaena glacialis*) as a method of assessing human impacts. Final report to the Northeast Fisheries Science Center, NMFS, Contract No. 4EANF-6-0004.

DRAFT

Hamilton, P.K., and C.A. Mayo. 1990. Population characteristics of right whales (*Eubalaena glacialis*) observed in Cape Cod and Massachusetts Bays, 1978-1986. Reports of the International Whaling Commission, Special Issue No. 12: 203-208.

Hatase, H., M. Kinoshita, T. Bando, N. Kamezaki, K. Sato, Y. Matsuzawa, K. Goto, K. Omuta, Y. Nakashima, H. Takeshita, and W. Sakamoto. 2002. Population structure of loggerhead turtles, *Caretta caretta*, nesting in Japan: Bottlenecks on the Pacific population. Marine Biology 141:299-305.

Heppell, S.S., L.B. Crowder, D.T Crouse, S.P. Epperly, and N.B. Frazer. 2003. Population models for Atlantic loggerheads: Past, Present, and Future. *In*: Bolten, A.B. and B.E. Witherington (eds.) Loggerhead Sea Turtles. Smithsonian Institution.

Herman, L. M., C. S. Baker, P. H. Forestell, and R. C. Antinoja. 1980. Right whale, *Balaena glacialis,* sightings near Hawaii: a clue to the wintering grounds? Mar. Ecol. Prog. Ser. 2:271-275.

Hightower, M. et al. 2004. Threat and Breach Analysis of an LNG Ship Spill Over Water. U.S. DOE and Sandia National Laboratories, Albuquerque, NM.

Hildebrand, H. 1982. A historical review of the status of sea turtle populations in the western Gulf of Mexico, P. 447-453. In K.A. Bjorndal (ed.), Biology and conservation of sea turtles. Smithsonian Institution Press, Washington, D.C.

Hill, P.S. and D.P. DeMaster. 1998. Alaska marine mammal stock assessments, 1998. U.S. Department of Commerce, Seattle, WA. NOAA Technical Memorandum NMFS-AFSC-97. 166p.

Hilterman, M.L. and E. Goverse. 2004. Annual report of the 2003 leatherback turtle research and monitoring project in Suriname. World Wildlife Fund - Guianas Forests and Environmental Conservation Project (WWF-GFECP) Technical Report of the Netherlands Committee for IUCN (NC-IUCN), Amsterdam, the Netherlands, 21p.

Hirth, H.F. 1971. Synopsis of biological data on the green sea turtle, *Chelonia mydas.* FAO Fisheries Synopsis No. 85: 1-77.

Hirth, H.F. 1997. Synopsis of the biological data of the green turtle, *Chelonia mydas* (Linnaeus 1758). USFWS Biological Report 97(1). 120pp.

Horwood J. 1987. The sei whale: population biology, ecology and management. Kent, UK: Croom Helm, Beckenham.

Horwood, J. 2002. Sei whale *Balaenoptera borealis*. Pp. 1069-1071 in W. F. Perrin, B. Wursig and J. G. M. Thewissen, eds. Encyclopedia of marine mammals. Academic Press.

DRAFT

Hucke-Gaete R, Osman LP, Moreno CA, Findlay KP, Ljungblad DK. 2004. Discovery of a blue whale feeding and nursing ground in southern Chile. Proceedings of the Royal Society Biological Sciences Series B 271, Suppl. 4:S170-S173.

International Whaling Commission (IWC). 1971. Report of the special meeting on sperm whale biology and stock assessments. Rep. Int. Whal. Comm. 21:40–50.

International Whaling Commission (IWC). 1979. Report of the sub-committee on protected species. Annex G., Appendix I. Rep. Int. Whal. Comm. 29: 84-86.

International Whaling Commission (IWC). 1986. Right whales: past and present status. Reports of the International Whaling Commission, Special Issue No. 10; Cambridge, England.

International Whaling Commission (IWC). 1992. Report of the comprehensive assessment special meeting on North Atlantic fin whales. Reports of the International Whaling Commission 42:595-644.

International Whaling Commission (IWC). 1995. Report of the Scientific Committee, Annex E. Rep. Int. Whal. Comm. 45:121-138.

International Whaling Commission (IWC). 2001a. Report of the workshop on the comprehensive assessment of right whales: A worldwide comparison. Reports of the International Whaling Commission. Special Issue 2.

International Whaling Commission (IWC). 2001b. The IWC, Scientific Permits and Japan. Posted at http://www.iwcoffice.org/sciperms.htm.

International Whaling Commission (IWC). 2001. Report of the workshop on the comprehensive assessment of right whales: a worldwide comparison. Reports of the International Whaling Commission. Special Issue 2.

Jahoda, M., C. L. Lafortuna, N. Biassoni, C. Almirante, A. Azzelino, S. Panigada, M. Zanardelli et al. 2003. Mediterranean fin whale's (*Balaenoptera physalus*) response to small vessels and biopsy sampling assessed through passive tracking and timing of respiration. Marine Mammal Science 19:15.

James, M.C., R.A. Myers, and C.A. Ottenmeyer. 2005a. Behaviour of leatherback sea turtles, *Dermochelys coriacea*, during the migratory cycle. Proc. R. Soc. B, 272: 1547-1555.

Jansen, G. 1998. Chapter 25. Physiological effects of noise. Pages 25.21 - 25.19 in C. M. Harris, editor. Handbook of acoustical measurements and noise control. Acoustical Society of America, Woodbury, New York.

DRAFT

JASCO Research Limited (JASCO). 2006. Assessment of the Effects of Underwater Noise From the Proposed Neptune LNG Project: Supplementary Acoustic Modeling Report. Report to Ecology and Environment, Inc. Arlington, VA. August 2006.

Jensen AS and GK Silber. 2003. Large whale ship strike database. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-F/OPR 25, 37 p.

Johnson, J.H.and A.A. Wolman. 1984. The humpback whale,*Megaptera novaengliae*. Mar. Fish. Rev. 46(4): 30-37.

Johnson, M. P. & P.L. Tyack. 2003. A digital acoustic recording tag for measuring the response of wild marine mammals to sound. *IEEE J. Oceanic Engng* **28**, 3–12.

Jones, D. M., and D. E. Broadbent. 1998. Chapter 24. Human peformance and noise. Pages 24.21 - 24.24 in C. M. Harris, editor. Handbook of acoustical measurements and noise control. Acoustical Society of America, Woodbury, New York.

Kawamura A. 1980. A review of food of balaenopterid whales. Sci. Rep. Whales Res. Inst. (Tokyo) 32:155- 197.

Keinath, J.A., J.A. Musick, and R.A. Byles. 1987. Aspects of the biology of Virginia's sea turtles: 1979-1986. Virginia J. Sci. 38(4): 329-336.

Kenney, R.D. 2000. Are right whales starving? Electronic newsletter of the Center for Coastal Studies, posted at www.coastalstudies.org/entanglementupdate/kenney1.html on November 29, 2000. 5pp.

Kenney, R.D. 2002. North Atlantic, North Pacific and Southern right whales, *Eubalaena glacialis, E. japonica and E. australis*. Pp 806-813 in Perrin et al., editors, Encyclopedia of Marine Mammals.

Kenney, R.D., M.A.M. Hyman, R.E. Owen, G.P. Scott, and H.E. Winn. 1986. Estimation of prey densities required by Western North Atlantic right whales. Mar. Mamm. Sci. 2(1): 1-13.

Kenney, R.D., H.E. Winn, and M.C. Macaulay. 1995. Cetaceans in the Great South Channel, 1979-1989: right whale (*Eubalaena glacialis*). Cont. Shelf. Res. 15: 385-414.

Ketten, D.R. 1998. Marine mammal auditory systems: a summary of audiometric and anatomical data and its implications for underwater acoustic impacts. NOAA Technical Memorandum NMFS: NOAA-TM-NMFS-SWFSC-256.

Knowlton, A.R. and S.D. Kraus. 2001. Mortality and serious injury of northern right whales (*Eubalaena glacialis*) in the western North Atlantic Ocean. J. Cetacean Res. Manage.

DRAFT

Knowlton, A. R., J. Sigurjonsson, J.N. Ciano, and S.D. Kraus. 1992. Long-distance movements of North Atlantic right whales (*Eubalaena glacialis*). Mar. Mamm. Sci. 8(4): 397-405.

Knowlton, A.R., S.D. Kraus, and R.D. Kenney. 1994. Reproduction in North Atlantic right whales (*Eubalaena glacialis*). Can. J. Zool. 72: 1297-1305.

Kraus, S.D. 1990. Rates and Potential Causes of Mortality in North Atlantic Right Whales (*Eubaleana glacialis*). Mar. Mamm. Sci. 6(4):278-291.

Kraus, S.D., P.K. Hamilton, R.D. Kenney, A.R. Knowlton, and C.K. Slay. 2001. Reproductive parameters of the North Atlantic right whale. J. Cetacean Res. Manage. 2: 231-236.

Kraus, S.D., M.W. Brown, H. Caswell, C.W. Clark, M. Fujiwara, P.K. Hamilton, R.D. Kenney, A.R. Knowlton, S. Landry, C.A. Mayo, W.A. McLellan, M.J. Moore, D.P. Nowacek, D.A. Pabst, A.J. Read, R.M. Rolland. 2005. North Atlantic Right Whales in Crisis. *Science*, 309:561-562.

Krausman, P. R., L. K. Harris, C. L. Blasch, K. K. G. Koenen, and J. Francine. 2004. Effects of military operations on behavior and hearing of endangered Sonoran pronghorn. Wildlife Monographs:1-41.

Lageux, C.J., C. Campbell, L.H. Herbst, A.R. Knowlton and B. Weigle. 1998. Demography of marine turtles harvested by Miskitu Indians of Atlantic Nicaragua. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-412:90.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17(1):35-75.

Leatherwood S, D. Caldwell, A.H. Winn. 1976. Whales, Dolphins and Porpoises of the Western North Atlantic: A Guide to Their Identification. NOAA Technical Report NMFS Circ 396:1-175.

Leatherwood, S.L. and R.R. Reeves. 1983. The Sierra Club Handbook of Whales and Dolphins. Sierra Club Books, San Francisco.

Leatherwood S, Reeves RR, Perrin WF, Evans WE. 1982. Whales, dolphins, and porpoises of the eastern North Pacific and adjacent arctic waters: a guide to their identification. NOAA Tech. Rep.: National Marine Fisheries Service. Circular 444.

Lenhardt, M.L. 1994. Seismic and very low frequency sound induced behaviors in captive loggerhead marine turtles (*Caretta caretta*). In Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Eliazar (Compilers). 1994. Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351, 323 pp.

DRAFT

Lenhardt, M.L., S. Moein, and J. Musick. 1995. A method for determining hearing thresholds in marine turtles. In Keinath, J.A., D.E. Barnard, J.A. Musick, and B.A. Bell. 1996. Proceedings of the Fifteenth Annual Workshop on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-387, 355 pp.

Lewison, R.L., S.A. Freeman, and L.B. Crowder. 2004. Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on loggerhead and leatherback sea turtles. Ecology Letters. 7: 221-231.

LGL Limited and and JASCO Research Limited (LGL and JASCO). 2005. Assessment of the Effects of Underwater Noise From the Proposed Neptune LNG Project. LGL Report No. TA4200-3. Report to Ecology and Environment, Inc. Arlington, VA. October 2005.

Libby, P.S., W.R. Geyer, A.A. Keller, J.T. Turner, D. Borkman, and C.A. Oviatt. 2004. 2003 Annual Water Column Monitoring Report. Report ENQUAD 2004-07. MWRA: Boston, MA. Available online: http://www.mwra.state.ma.us/harbor/enquad/trlist.html.

Limpus, C.J. and D.J. Limpus. 2003. Loggerhead turtles in the equatorial Pacific and southern Pacific Ocean: A species in decline. *In*: Bolten, A.B., and B.E. Witherington (eds.), Loggerhead Sea Turtles. Smithsonian Institution.

Ljungblad, D.K., B. Wursig, S.L. Swartz, and J.M. Keene. 1988. Observations of the behavioral responses of bowhead whales (Balaena mysticetus) to active geophysical vessels in the Alaskan Beaufort Sea. Arctic. 41:183-194.

Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival, p 387-409. In P.L. Lutz and J.A. Musick, (eds), The Biology of Sea Turtles, CRC Press, Boca Raton, Florida. 432 pp.

Mackintosh NA. 1966. The distribution of southern blue and fin whales. In: Norris KS, editor. Whales, Dolphins and Porpoises. Berkeley and Los Angeles: University of California Press. p 125-144.

Magnuson, J.J., J.A. Bjorndal, W.D. DuPaul, G.L. Graham, D.W. Owens, C.H. Peterson, P.C.H. Prichard, J.I. Richardson, G.E. Saul, and C.W. West. 1990. Decline of Sea Turtles: Causes and Prevention. Committee on Sea Turtle Conservation , Board of Environmental Studies and Toxicology, Board on Biology, Commission of Life Sciences, National Research Council, National Academy Press, Washington, D.C. 259 pp.

Malik, S., M. W. Brown, S.D. Kraus and B. N. White. 2000. Analysis of mitochondrial DNA diversity within and between North and South Atlantic right whales. Mar. Mammal Sci. 16:545-558.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J. E. Bird. 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray

DRAFT

whale behavior/Phase II: January 1984 migration. BBN Rep. 586. Rep. from Bolt, Beranek, & Newman, Inc. Cambridge, Massachusetts, for U.S. Minerals Management Service, Anchorage, Alaska.

Malme, C.I., P.R. Miles, P. Tyack, C.W. Clark, and J.E. Bird. 1985. Investigation of the potential effects of underwater noise from petroleum industry activities on feeding humpback whale behavior. Report No. 5851, Unpublished report prepared by Bolt, Beranek and Newman Inc., Cambridge, USA, for U.S. Minerals Management Service, Alaska OCS Office, Anchorage, Alaska.

Marcano, L.A. and J.J. Alio-M. 2000. Incidental capture of sea turtles by the industrial shrimping fleet off northwestern Venezuela. U.S. department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-436:107.

Margaritoulis, D., R. Argano, I. Baran, F. Bentivegna, M.N. Bradai, J.A. Camiñas, P. Casale, G. De Metrio, A. Demetropoulos, G. Gerosa, B.J. Godley, D.A. Haddoud, J. Houghton, L. Laurent, and B. Lazar. 2003. Loggerhead turtles in the Mediterranean Sea: Present knowledge and conservation perspectives. Pages 175-198. *In*: A.B. Bolten and B.E. Witherington (eds.) Loggerhead Sea Turtles. Smithsonian Books, Washington, D.C. 319 pp.

Márquez, R. 1990. FAO Species Catalogue, Vol. 11. Sea turtles of the world, an annotated and illustrated catalogue of sea turtle species known to date. FAO Fisheries Synopsis, 125. 81pp.

Masaki Y. 1976. Biological studies on the North Pacific sei whale. Bull. Far Seas Fish. Res. Lab. (Shimizu) 14:1-104.

Masaki Y. 1977. The separation of the stock units of sei whales in the North Pacific. Report of the International Whaling Commission Spec. Iss. 1:71-79.

Mate, B.M., S.L. Nieukirk, R. Mescar, and T. Martin. 1992. Application of remote sensing methods for tracking large cetaceans: North Atlantic right whales (*Eubalaena glacialis*). Final Report to the Minerals Management Service, Contract No. 14-12-0001-30411, 167 pp.

Mate, B.M., S.L. Nieukirk, and S.D. Kraus. 1997. Satellite monitored movements of the North Atlantic right whale. J. Wildl. Manage. 61:1393-1405.

Mayo, C.A. and M.K. Marx. 1990. Surface foraging behavior of the North Atlantic right whale, *Eubalaena glacialis*, and associated zooplankton characteristics. Can. J. Zool. 68: 2214-2220.

McCauley, R. D., M-N Jenner, C. Jenner, K. A. McCabe, and J. Murdoch. 1998. The response of humpback whales (*Megaptera navaengliae*) to offshore seismic survey noise:

DRAFT

preliminary results of observations about a working seismic vessel and experimental exposures. APPEA Journal 1998, 692-707.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M-N Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys: analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid. Report R99-15. Centre for Marine Science and Technology, Curtin University of Technology, Western Australia.

McLeod, L.A., L.M. Short, and J.K. Smith. 2003. Summary of marine mammal observations during 2002 surveys. Boston: Massachusetts Water Resources Authority. Report ENQUAD 2003-01. 21 pp.

Mead, JG. 1977. Records of Sei and Bryde's Whales From the Atlantic Coast of the United States, the Gulf of Mexico, and the Caribbean. Report of the International Whaling Commission 1:113-116.

Mellinger, D.K. 2004. A comparison of methods for detecting right whale calls. *Canadian Acoustics*, 32:55-65.

MELLINGER, D.K., K.M. STAFFORD, S.E. MOORE, L. MUNGER, AND C.G. FOX. 2004. Detection of North Pacific right whale (Eubalaena japonica) calls in the Gulf of Alaska. Marine Mammal Science 20(4): 872-879.

Meylan, A., 1982. Estimation of population size in sea turtles. *In:* K.A. Bjorndal (ed.) Biology and Conservation of Sea Turtles. Smithsonian Inst. Press, Wash. D.C. p 135-138.

Meylan, A., B. Schroeder, and A. Mosier. 1995. Sea turtle nesting activity in the state of Florida. Fla. Mar. Res. Publ. 52:1-51.

Minerals Management Service (MMS). 2001. Proposed Use of Floating Production, Storage, and Offloading Systems on the Gulf of Mexico Outer Continental Shelf, Final Environmental Impact Statement. OCS EIS/EA MMS 2000-090. New Orleans, LA: USDOI, MMS, GOM OCS Region.

Milton, S.L., S. Leone-Kabler, A.A. Schulman, and P.L. Lutz. 1994. Effects of Hurricane Andrew on the sea turtle nesting beaches of South Florida. Bulletin of Marine Science, 54-3:974-981.

Mizroch, S.A. and A.E. York. 1984. Have pregnancy rates of Southern Hemisphere fin whales, *Balaenoptera physalus*, increased? Reports of the International Whaling Commission, Special Issue No. 6:401-410.

Mizroch SA, D.W. Rice, J.M. Breiwick. 1984. The blue whale, *Balaenoptera musculus*. Marine Fisheries Review 46(4):15-19.

DRAFT

Moberg, GP. 1987. Influence of the adrenal axis upon the gonads. *Oxford Reviews of Reproductive Biology* **9** 456–496.

Moore M.J., A.R. Knowlton, S.D. Kraus, W.A. McLellan, and R.K. Bonde. 2005. Morphometry, gross morphology and available histopathology in North Atlantic right whale mortalities (1970-2002). *Journal of Cetacean Research and Management*, 6(3):199-214.

Morreale, S.J. and E.A. Standora. 1998. Early life stage ecology of sea turtles in northeastern U.S. waters. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-413, 49 pp.

Mrosovsky, N. 1981. Plastic jellyfish. Marine Turtle Newsletter 17:5-6.

Murphy, T.M. and S.R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the southeast region. United States Final Report to NMFS-SEFSC. 73pp.

Musick, J.A. and C.J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. Pp. 137-164 *In*: Lutz, P.L., and J.A. Musick, eds., The Biology of Sea Turtles. CRC Press, New York. 432 pp.

Nasu, K. 1974. Movement of baleen whales in relation to hydrographic conditions in the northern part of the North Pacific Ocean and the Bering Sea. In: Hood DW, Kelley EJ, editors. Oceanography of the Bering Sea. Institute of Marine Science. Fairbanks: Univ. of Alaska. p 345-361.

National Research Council (NRC). 1990. Decline of the Sea Turtles: Causes and Prevention. Committee on Sea Turtle Conservation. Natl. Academy Press, Washington, D.C. 259 pp.

NMFS. 1991a. Final recovery plan for the humpback whale (*Megaptera novaeangliae*). Prepared by the Humpback Whale Recovery Team for the national Marine Fisheries Service, Silver Spring, Maryland. 105 pp.

NMFS. 1991b. Final recovery plan for the northern right whale (*Eubalaena glacialis*). Prepared by the Right Whale Recovery Team for the National Marine Fisheries Service. 86 pp.

NMFS. 1991c. Endangered Species Act Section 7 Consultation on the Final Designation of the Massachusetts Bay Disposal Site. NMFS Northeast Regional Office, Gloucester, Massachusetts. November 7, 1991.

NMFS. 1993. Endangered Species Act Section 7 Consultation on the Boston Harbor sewer outfall project. NMFS Northeast Regional Office, Gloucester, Massachusetts. September 8, 1993.

NMFS. 1995a. Endangered Species Act Section 7 Consultation on USCG vessel and aircraft operations along the Atlantic coast. NMFS, Silver Spring, Maryland.

DRAFT

NMFS. 1996. Endangered Species Act Section 7 Consultation on the site management plan for the Massachusetts Bay Disposal Site. NMFS Northeast Regional Office, Gloucester, Massachusetts. May 21, 1996.

NMFS. 1997b. Endangered Species Act Section 7 Consultation on Navy activities along the Southeastern United States along the Atlantic coast. NMFS Southeast Regional Office, St. Petersburg, Florida.

NMFS. 1998a. Final recovery plan for the shortnose sturgeon (*Acipenser brevirostrum*). National Marine Fisheries Service, Silver Spring, Maryland. October 1998.

NMFS. 1998b. Draft recovery plans for the fin whale (*Balaenoptera physalus*) and sei whale (*Balaenoptera borealis*). Prepared by R.R. Reeves, G.K. Silber, and P.M. Payne for the National Marine Fisheries Service, Silver Spring, Maryland. July 1998.

NMFS. 1998c. Recovery plan for the blue whale (*Balaenoptera nusculus*). Prepared by R.R. Reeves, P. Clapham, R.L. Brownell, G.K. Silber for the National Marine Fisheries Service, Silver Spring, Maryland.

NMFS 1998c. Endangered Species Act Section 7 Second Reinitiation of Consultation on USCG vessel and aircraft operations along the Atlantic coast. NMFS Northeast Regional Office, Gloucester, Massachusetts.

NMFS. 1999a. Federal Lobster Management in the Exclusive Economic Zone. FINAL Environmental Impact Statement and Regulatory Impact Review. National Marine Fisheries Service Northeast Region. April 28, 1999. 166 pp.

NMFS. 1999b. Endangered Species Act Section 7 Reinitiation of Consultation on the designation of the Massachusetts Bay Disposal Site for ocean disposal. NMFS Northeast Regional Office, Gloucester, Massachusetts. October 4, 1999.

NMFS. 2001a. Endangered Species Act Section 7 Reinitiation of Consultation on the Federal Lobster Management Plan in the Exclusive Economic Zone. NMFS Northeast Regional Office, Gloucester, Massachusetts. June 14, 2001.

NMFS. 2001b. Endangered Species Act Section 7 Consultation on authorization of fisheries under the Northeast multispecies fishery management plan. NMFS Northeast Regional Office, Gloucester, Massachusetts. June 14, 2001.

NMFS. 2001c. Endangered Species Act Section 7 Consultation on authorization of fisheries under the spiny dogfish fishery management plan. NMFS Northeast Regional Office, Gloucester, Massachusetts. June 14, 2001.

DRAFT

NMFS. 2001d. Endangered Species Act Section 7 Consultation on 2002 specifications for summer flounder, scup, and black sea bass. NMFS Northeast Regional Office, Gloucester, Massachusetts. December 16, 2001.

NMFS. 2001e. Endangered Species Act Section 7 reinitiation of consultation on the Atlantic highly migratory species fishery management plan and its associated fisheries. NMFS, Silver Spring, Maryland. June 8, 2001.

NMFS. 2001f. Endangered Species Act Section 7 Consultation on the fishery management plan for tilefish. NMFS Northeast Regional Office, Gloucester, Massachusetts.

NMFS. 2001g. Endangered Species Act Section 7 Consultation on the authorization of fisheries under the Monkfish Fishery Management Plan. NMFS Northeast Regional Office, Gloucester, Massachusetts. June 14, 2001.

NMFS. 2002a. Endangered Species Act Section 7 Consultation on Shrimp Trawling in the Southeastern United States, under the Sea Turtle Conservation Regulations and as Managed by the Fishery Management Plans for Shrimp in the South Atlantic and Gulf of Mexico. December 2.

NMFS. 2002b. Endangered Species Action Section 7 Consultation on Federal Lobster Management in the Exclusive Economic Zone, October 31.

NMFS. 2003a. Endangered Species Act Section 7 Consultation on authorization of fisheries under the Monkfish Fishery Management Plan. NMFS Northeast Regional Office, Gloucester, Massachusetts. April 14, 2003.

NMFS. 2003b. Endangered Species Act Section 7 Consultation on the Atlantic Sea Scallop fishery management plan. NMFS Northeast Regional Office, Gloucester, Massachusetts. February 24, 2003.

NMFS. 2003c. Endangered Species Act Section 7 Consultation on the Northeast skate complex fishery management plan. NMFS Northeast Regional Office, Gloucester, Massachusetts. July 24, 2003.

NMFS. 2004c. Endangered Species Act Section 7 Reinitiated Consultation on the Continued Authorization of the Atlantic Pelagic Longline Fishery under the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks (HMS FMP). Biological Opinion, June 1.

NMFS. 2004d. Endangered Species Act Section 7 Consultation on the Proposed Regulatory Amendments to the Fisheries Management Plan for the Pelagic Fisheries of the Western Pacific. Biological Opinion, February 23.

DRAFT

NMFS. 2005. Recovery Plan for the North Atlantic Right Whale (*Eubalaena glacialis*). National Marine Fisheries Service, Silver Spring, MD.

NMFS. 2005a. Endangered Species Act Section 7 consultation on the Continued operation of the Oyster Creek Nuclear Generating Station on the Forked River and Oyster Creek, Barnegat Bay, New Jersey. Biological Opinion, September 22.

NMFS. 2006. Draft Environmental Impact Statement (DEIS) to Implement the Operational Measures of the North Atlantic Right Whale Ship Strike Reduction Strategy. National Marine Fisheries Service. July 2006.

NMFS Southeast Fisheries Science Center. 2001. Stock assessments of loggerheads and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. U.S. Department of Commerce, National Marine Fisheries Service, Miami, FL, SEFSC Contribution PRD-00/01-08; Parts I-III and Appendices I-IV. NOAA Tech. Memo NMFS-SEFSC-455, 343 pp.

NMFS and U.S. Fish and Wildlife Service (USFWS). 1991a. Recovery plan for U.S. population of Atlantic green turtle. National Marine Fisheries Service, Washington, D.C. 58 pp.

NMFS and U.S. Fish and Wildlife Service (USFWS). 1991b. Recovery plan for U.S. population of loggerhead turtle. National Marine Fisheries Service, Washington, D.C. 64 pp.

NMFS and USFWS. 1992. Recovery plan for leatherback turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. National Marine Fisheries Service, Washington, D.C. 65 pp.

NMFS and USFWS. 1995. Status reviews for sea turtles listed under the Endangered Species Act of 1973. National Marine Fisheries Service, Silver Spring, Maryland. 139 pp.

NMFS and USFWS. 1998a. Recovery Plan for the U.S. Pacific Population of the Leatherback Turtle (*Dermochelys coriacea*). National Marine Fisheries Service, Silver Spring, Maryland.

NMFS and USFWS. 1998b. Recovery Plan for U.S. Pacific Populations of the Green Turtle (*Chelonia mydas*). National Marine Fisheries Service, Silver Spring, Maryland.

National Oceanic and Atmospheric Administration (NOAA). 1999. Screening Quick Reference Tables (SQuiRTS). Updated September 1999. Available online: http://response.restoration.noaa.gov/book_shelf/122_squirt_cards.pdf.

National Research Council (NRC). 2003. Ocean noise and marine mammals. National Academy Press; Washington, D.C.

DRAFT

National Research Council (NRC). 2005. Marine mammal populations and ocean noise : determining when noise causes biologically significant effects. National Academies Press, Washington, D.C.

Neptune. 2005a. Volume I (Deepwater Port Application) of the Deepwater Port License Application, Neptune Project, Massachusetts Bay. Prepared by INTEC Engineering, Ecology and Environment, Inc. and Leif Hoegh. November 2005 – Updated version.

Neptune 2005b. Volume II (Environmental Evaluation) of the Deepwater Port License Application, Neptune Project, Massachusetts Bay. Prepared for Neptune LNG by INTEC Engineering, Ecology and Environment, Inc. and Leif Hoegh. November 2005 – Updated version.

New England Fishery Management Council (NEFMC). 1999. Final Atlantic Herring Fishery Management Plan incorporating the Regulatory Impact Review, and Regulatory Flexibility Analysis. New England Fishery Management Council. March 8, 1999.

NEFMC. 2002. Fishery Management Plan for Deep-Sea Red Crab including an Environmental Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Analysis. New England Fishery Management Council. March 2002.

NEFMC. 2004b. Herring Plan Development Team/Technical Committee Report. May 5, 2004. 39pp.

NEFMC. 2005b. Framework Adjustment 1 to the Atlantic Deep-Sea Red Crab Fishery Management Plan with an Environmental Assessment, Regulatory Impact Review, and Regulatory Flexibility Analysis. New England Fishery Management Council. February 18, 2005 (revised April 6, 2005).

Nitta E, Henderson J. 1993. A review of interactions between Hawaii's fisheries and protected species. Marine Fisheries Review 55(2):83-92.

Norris, K.S. and R.R. Reeves. 1978. Report on a workshop on problems related to humpback whales (*Megaptera novaeangliae*) in Hawaii. Final report to US Marine Mammal Commission. NTIS PB-280794. 90 p.

Northeast Fisheries Science Center (NEFSC). 2005b. 41st Northeast Regional Stock Assessment Workshop (41st SAW). Northeast Fish. Sci. Cent. Ref. Doc. 05-10. 36 p.

Nowacek, D., M. P. Johnson and P. L. Tyack. 2003. North Atlantic right whales (*Eubalaena glacialis*) ignore ships but respond to alerting stimuli. Proceedings of the Royal Society of London. Series B. Biological Sciences 271, 227-231.

Palka , D. 2000. Abundance and distribution of sea turtles estimated from data collected during cetacean surveys. *In*: Bjorndal, K.A. and A.B. Bolten. Proceedings of a workshop on

DRAFT

assessing abundance and trends for in-water sea turtle populations. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-445, 83pp.

Parks, S.E. and P.L. Tyack. 2005. Sound production by North Atlantic right whales (Eubalaena glacialis) in surface active groups. J. Acoust. Soc. Am. 117(5): 3297-3306.

Parks, S. E., P. K. Hamilton, S. D. Kraus and P. L. Tyack. 2005. The gunshot sound produced by male North Atlantic right whales (Eubalaena glacialis) and its potential function in reproductive advertisement. Marine Mammal Science 21:458-475.

Payne, K. and R.S. Payne. 1985. Large-scale changes over 17 years in songs of humpback whales in Bermuda. Z. Tierpsychol. 68:89-114.

Payne, P.M., D.N. Wiley, S.B. Young, S. Pittman, P.J. Clapham, and J.W.Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fish. Bull. 88 (4): 687-696.

Perry, S.L., D.P. DeMaster, and G.K. Silber. 1999. The Great Whales: History and status of six species listed as endangered under the US Endangered Species Act of 1973. Special issue of the Marine Fisheries Review 61(1), 74 pp.

Pritchard, P.C.H. 1982. Nesting of the leatherback turtle, *Dermochelys coriacea*, in Pacific, Mexico, with a new estimate of the world population status. Copeia 1982:741-747.

Pritchard, P.C.H. 1997. Evolution, phylogeny and current status. Pp. 1-28 *In*: The Biology of Sea Turtles. Lutz, P., and J.A. Musick, eds. CRC Press, New York. 432 pp.

Pritchard, P.C.H. 2002. Global status of sea turtles: An overview. Document INF-001 prepared for the Inter-American Convention for the Protection and Conservation of Sea Turtles, First Conference of the Parties (COP1IAC), First part August 6-8, 2002.

Putrawidaja, M. 2000. Marine turtles in Irian Jaya, Indonesia. Marine Turtle Newsletter. 90:8-10.

Rankin-Baransky, K., C.J. Williams, A.L. Bass, B.W. Bowen, and J.R. Spotila. 2001. Origin of loggerhead turtles stranded in the Northeastern United States as determined by mitochondrial DNA analysis. Journal of Herpetology 35(4):638-646.

Rebel, T.P. 1974. Sea turtles and the turtle industry of the West Indies, Florida and the Gulf of Mexico. Univ. Miami Press, Coral Gables, Florida.

Reeves, R.R. 1977. The problem of gray whale (Eschrichtus robustus) harassment: at the breeding lagoons and during migration. Final report to the US Marine Mammal Commission.

Reilly SB, Thayer VG. 1990. Blue whale (*Balaenoptera musculus*) distribution in the eastern tropical Pacific. Marine Mammal Science 6(4):265-277.

DRAFT

Rice, DW. 1977. Synopsis of biological data on the sei whale and Bryde's whale in the eastern North Pacific. Report of the International Whaling Commission Special Issue 1:92-97.

Rice D. 1998. Marine mammals of the world. The Society for Marine Mammalogy Special Publication No. 4. . Lawrence, KS: Allen Press, Inc.

Richardson, W.J., M.A. Fraker, B. Wursig, and R.S. Wells. 1985. Behavior of bowhead whales *Balaena mysticetus* summering in the Beaufort Sea: Reactions to industrial activities. Biol. Conserv. 32: 195-230.

Richardson, W.J., B. Wursig, and C.R. Greene Jr. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. J. Acoustic. Soc. Am. 79(4):1117-1126.

Richardson W.J., C.R. Greene Jr., C.I. Malme, and D.H. Thomson. 1995. Marine mammals and noise. Academic Press; San Diego, California.

Richardson, W.J., Miller, G.W. and Greene Jr., C.R. 1999. Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. *J. Acoust. Soc. Am.* 106(4, Pt. 2): 2281.

Ridgway, S.H., E.G. Weaver, J.G. McCormick, J. Palin, and J.H. Anderson. 1969. Hearing in the Giant Sea Turtle, *Chelonia mydas*. Proceedings of the National Academy of Sciences 64(3): 884-890.

Rivest S., Rivier C., 1995. The role of corticotropin-releasing factor and interleukin-1 in the regulation of neurons controlling reproductive functions. Endocr. Rev. 16, 177-99.

Robbins, J., and D. Mattila. 1999. Monitoring entanglement scars on the caudal peduncle of Gulf of Maine humpback whales. Report to the National Marine Fisheries Service. Order No. 40EANF800288. 15 pp.

Ross, J.P. 1996. Caution urged in the interpretation of trends at nesting beaches. Marine Turtle Newsletter 74:9-10.

Ruben, H.J, and S.J. Morreale. 1999. Draft Biological Assessment for Sea Turtles in New York and New Jersey Harbor Complex. Unpublished Biological Assessment submitted to National Marine Fisheries Service.

Sarti, L., S. Eckert, P. Dutton, A. Barragán, and N. García. 2000. The current situation of the leatherback population on the Pacific coast of Mexico and central America, abundance and distribution of the nestings: an update. Pp. 85-87 *in* Proceedings of the Nineteenth Annual Symposium on Sea Turtle Conservation and Biology, 2-6 March, 1999, South Padre Island, Texas.

DRAFT

Schaeff, C.M., Kraus, S.D., Brown, M.W., Perkins, J.S., Payne, R., and White, B.N. 1997. Comparison of genetic variability of North and South Atlantic right whales (Eubalaena), using DNA fingerprinting. Can. J. Zool. 75:1073-1080.

Scarff, J.E. 1986. Historic and present distribution of the right whale (*Eubalaena glacialis*) in the eastern North Pacific south of 50°N and east of 180°W. *In*: R.L. Brownell Jr., P.B. Best, and J.H. Prescott (eds.) Right whales: Past and Present Status. IWC Special Issue No. 10. p 43-63.

Schevill, W.E., W.A. Watkins, and K.E. Moore. 1986. Status of *Eubalaena glacialis* off Cape Cod. Reports of the International Whaling Commission, Special Issue No. 10: 79-82.

Schilling, M. R., I. Seipt, M. T. Weinrich, S. E. Frohock, A. E. Kuhlberg and P. J. Clapham. 1993. Behavior of individually identified sei whales, *Balaenoptera borealis*, during an episodic influx into the southern Gulf of Maine in 1986. *Fish. Bull., U.S.* 90(4): 749-755.

Schultz, J.P. 1975. Sea turtles nesting in Surinam. Zoologische Verhandelingen (Leiden), Number 143: 172 pp.

Sears R. 2002. Blue Whale In: Perrin WF, Wursig B, Thewissen JG, editors. Encyclopedia of Marine Mammals. San Diego, CA: Academic Press. p 112-116.

Sears R and F. Larsen. 2002. Long range movements of a blue whale (*Balaenoptera musculus*) between the Gulf of St. Lawrence and West Greenland. Marine Mammal Science 18(1):281-285.

Sears R, JM Williamson, FW Wenzel, M. Bérubé, D. Gendron, and P. Jones. 1987. Photographic identification of the blue whale (*Balaenoptera musculus*) in the Gulf of St. Lawrence, Canada. Report of the International Whaling Commission (Special Issue 12):335-342.

Seipt, I., P.J. Clapham, C.A. Mayo, and M.P. Hawvermale. 1990. Population characteristics of individually identified fin whales, *Balaenoptera physalus*, in Massachusetts Bay. Fish. Bull. 88:271-278.

Seminoff, J.A. 2004. *Chelonia mydas. In*: IUCN 2004. 2004 IUCN Red List of Threatened Species. Downloaded on October 12, 2005 from www.redlist.org.

Shirihai H. 2002. A complete guide to Antarctic wildlife. Knapantie 49, FIN-10160 Degerby, Finland: Alula Press.

Shoop, C.R. and R.D. Kenney. 1992. Seasonal distributions and abundances of loggerhead and leatherback sea turtles in waters of the northeastern United States. Herpetological Monographs 6:43-67.

DRAFT

Sigurjónsson J, Gunnlaugson T. 1990. Recent trends in abundance of blue (*Balaenoptera musculus*) and humpback whales (*Megaptera novaeangliae*) off west and south-west Iceland, with a note on occurrence of other cetacean species. Report of the International Whaling Commission 40:537-551.

Slijper EJ, WL Van Utrecht, and C Naaktgeboren. 1964. Remarks on the Distribution and Migration of Whales, Based on Observations from Netherlands Ships. Bijdragen tot de Dierkunde, vol. 34, pp. 3-93.

Spotila, J.R., A.E. Dunham, A.J. Leslie, A.C. Steyermark, P.T. Plotkin, and F. V. Paladino. 1996. Worldwide Population Decline of *Demochelys coriacea*: Are Leatherback Turtles Going Extinct? Chelonian Conservation and Biology 2(2): 209-222.

Spotila, J.R., R.D. Reina, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 2000. Pacific leatherback turtles face extinction. Nature. 405(6786):529-530.

St. Aubin, D.J. and Geraci, J.R. 1992. Thyroid hormone balance in beluga whales, *Delphinapterus leucas*: dynamics after capture and influence of thyrotropin. Canadian Journal of Veterinary Research 56: 1-5.

Stabenau, E.K., T.A. Heming, and J.F. Mitchell. 1991. Respiratory, acid-base and ionic status of Kemp's ridley sea turtles (*Lepidochelys kempi*) subjected to trawling. Comp. Biochem. Physiol. v. 99a, no.½, 107-111.

Stafford, K.M., S. L. Nieukirk, and G.G. Fox. 2001. Geographic and seasonal variation of blue whale calls in the North Pacific. J. Cetacean Res. Manage. 3(1):65-76.

Stafford KM. 2003. Two types of blue whale calls recorded in the Gulf of Alaska. Marine Mammal Science 19(4):682-693.

Standora, E.A., S.J. Morreale, R.D. Thompson, and V.J. Burke. 1990. Telemetric monitoring of diving behavior and movements of juvenile Kemp's ridleys. In Richardson, T.H., Richardson, J.I. ,Donnelly, M. (Compilers)., Proceedings of the Tenth Annual Workshop on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFC-278.; 1990, p. 133

Stephens, S.H. and J. Alvarado-Bremer. 2003. Preliminary information on the effective population size of the Kemp's ridley (*Lepidochelys kempii*) sea turtle. *In*: Seminoff, J.A., compiler. Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-503, 308p.

Streeter, K. In press. What can sea turtles hear and how can they tell us? Proceedings of the 2005 Reptile and Amphibian Training and Enrichment Workshop. April 2005.

DRAFT

Suárez, A. 1999. Preliminary data on sea turtle harvest in the Kai Archipelago, Indonesia. Abstract appears in the 2 nd ASEAN Symposium and Workshop on Sea Turtle Biology and Conservation, held from July 15-17, 1999, in Sabah, Malaysia.

Suárez, A., P.H. Dutton and J. Bakarbessy. Leatherback (*Dermochelys coriacea*) nesting on the North Vogelkop Coast of Irian Jaya, Indonesia. *In*: Kalb, H.J. and T. Wibbels, compilers. 2000. Proceedings of the Nineteenth Annual Symposium on Sea Turtle Biology and Conservation. U.S. Dept. Commerce. NOAA Tech. Memo. NMFS-SEFSC-443, 291p.

Swingle, W.M., S.G. Barco, T.D. Pitchford, W.A. McLellan, and D.A. Pabst. 1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Mar. Mamm. Sci. 9: 309-315.

Tillman, M. 2000. Internal memorandum, dated July 18, 2000, from M. Tillman (NMFS-Southwest Fisheries Science Center) to R. McInnis (NMFS - Southwest regional office).

Trimper, P. G., N. M. Standen, L. M. Lye, D. Lemon, T. E. Chubbs, and G. W. Humphries. 1998. Effects of low-level jet aircraft noise on the behaviour of nesting osprey. The Journal of Applied Ecology 35:9.

TEWG. 1998. An assessment of the Kemp's ridley (*Lepidochelys kempi*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-409. 96 pp.

Turtle Expert Working Group (TEWG). 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-444, 115 pp.

Tyack, P.L. and C.W. Clark. 1998. Quick-look report: Playback of low-frequency sound to gray whales migrating past the central California coast. Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.

Tynan, C.T. 1998. Ecological importance of the southern boundary of the Antarctic Circumpolar Current. Nature 392(6677):708-710.

US Coast Guard. 2006a. Final Environmental Impact Statement and Environmental Impact Report, Northeast Gateway Deepwater Port.

US Coast Guard. 2006b. Final Environmental Impact Statement and Environmental Impact Report, Neptune LNG Deepwater Port License Application.

U.S. Fish and Wildlife Service (USFWS). 1997. Synopsis of the biological data on the green turtle, *Chelonia mydas* (Linnaeus 1758). Biological Report 97(1). U.S. Fish and Wildlife Service, Washington, D.C. 120 pp.

DRAFT

USFWS and NMFS. 1992. Recovery plan for the Kemp's ridley sea turtle (*Lepidochelys kempii*). NMFS, St. Petersburg, Florida.

USFWS and NMFS. 2003. Notice of Petition Finding (Fed Register) September 15, 2003.

Vanderlaan, A.S.M. and C.T. Taggart. 2006. Vessel collisions with whales: The probability of lethal injury based on vessel speed. Mar. Mam. Sci. 22(3).

Wade, P. R. and T. Gerrodette. 1993. Estimates of cetacean abundance and distribution in the eastern tropical Pacific. Rept. Int. Whal. Commn. 43:477-493.

Waring, G.T., E. Josephson, C.P. Fairfield, and K. Maze-Foley (eds). 2005. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments - 2005. NOAA Technical Memorandum NMFS-NE-194.

Wartzok, D., W.A. Watkins, B. Wursig, and C.I. Malme. 1989. Movements and behaviors of bowhead whales in response to repeated exposures to noise associated with industrial activities in the Beaufort Sea. Report to Amoco Production Company, Denver, CO. 228 pp.

Watkins, W.A. 1981. Activities and underwater sounds of fin whales. Scientific Reports of the International Whaling Commission 33: 83-117.

Watkins, W.A. 1986. Whale reactions to human activities in Cape Cod waters. Marine Mammal Science 2(4): 251-262.

Watkins, W.A., and W.E. Schevill. 1982. Observations of right whales (*Eubalaena glacialis*) in Cape Cod waters. Fish. Bull. 80(4): 875-880.

Watkins, W. A., K. E. Moore, D. Wartzok, and J. H. Johnson. 1981. Radio tracking of finback *(Balaenoptera physalus*) and humpback *(Megaptera novaeangliae*) whales in Prince William Sound, Alaska. Deep-Sea Research 28A(6):577-588.

Watkins, W.A., K.E. Moore, J. Sigurjonsson, D. Wartzok, and G. Notarbartolo di Sciara. 1984. Fin whale (*Balaenoptera physalus*) tracked by radio in the Irminger Sea. Rit Fiskideildar 8(1): 1-14.

Weilgart, L. and H. Whitehead. 1993. Coda vocalizations in sperm whales *Physeter macrocephalus* off the Galapagos Islands. Canadian Journal of Zoology. 71, 744-752.

Weilgart, L. and H. Whitehead. 1997. Group-specific dialects and geographical variation in coda repertoire in South Pacific sperm whales. Behavioural Ecology and Sociobiology 40: 277-285.

DRAFT

Weinrich, M. and K. Sardi. 2005. The Distribution of Baleen Whales in the Waters Surrounding the Northeast Gateway Proposed LNG Buoy Project: 1995-2004. The Whale Center of New England, Gloucester, MA.

Weisbrod, A.V., D. Shea, M.J. Moore, and J.J. Stegeman. 2000. Organochlorine exposure and bioaccumulation in the endangered Northwest Atlantic right whale (*Eubalaena glacialis*) population. Environmental Toxicology and Chemistry, 19(3):654-666.

Wennemer J, Gagnon C, Boye D, Gong G. 1998. Summary of marine mammal and turtle observations during the 1997 nearfield water quality surveys. Boston: Massachusetts Water Resources Authority. Report ENQUAD 98-03. 17 p.

Wenzel F, D.K. Mattila, P.J. Clapham. 1988. *Balaenoptera musculus* in the Gulf of Maine. Marine Mammal Science 4(2):172-175.

Werme C and Hunt CD. 2006. 2005 outfall monitoring overview. Boston: Massachusetts Water Resources Authority. Report ENQUAD 2006-18. 105p.

Wiley, D.N., R.A. Asmutis, T.D. Pitchford, and D.P. Gannon. 1995. Stranding and mortality of humpback whales, Megaptera novaeangliae, in the mid-Atlantic and southeast United States, 1985-1992. Fishery Bulletin 93(1):196-205.

Woodley, T.H., M.W. Brown, S.D. Kraus, and D.E. Gaskin. 1991. Organochlorine levels in North Atlantic right whale *(Eubalaena glacialis)* blubber. *Arch. Environ. Contam. Toxicol*. 21 (1): 141-145.

Wynne, K. and M. Schwartz. 1999. Guide to marine mammals and turtles of the U.S. Atlantic and Gulf of Mexico. Rhode Island Sea Grant, Narragansett, Rhode Island. 114 pp.

Yablokov A. 1994. Validity of whaling data. Nature 367:108.

Yochem PK, Leatherwood S. 1985. Blue whale *Balaenoptera musculus* (Linnaeus, 1758). In: Ridgway SH, Harrison R, editors. Handbook of Marine Mammals, vol. 3: The Sirenians and Baleen Whales. London: Academic Press. p 193-240.

Zemsky, V., A.A. Berzin, Y.A. Mikhaliev, and D.D. Tormosov. 1995. Soviet Antarctic pelagic whaling after WWII: review of actual catch data. Report of the Sub-committee on Southern Hemisphere baleen whales. Rep. Int. Whal. Comm. 45:131-135.

Zug, G.R. and J.F. Parham. 1996. Age and growth in leatherback turtles, Dermochelys coriacea (Testudines: Dermochelyidae): a skeletochronological analysis. Chelonian Conservation and Biology 2(2): 244-249.

Zurita, J.C., R. Herrera, A. Arenas, M.E. Torres, C. Calderon, L. Gomez, J.C. Alvarado, and R. Villavicencio. 2003. Nesting loggerhead and green sea turtles in Quintana Roo, Mexico.

DRAFT

Pp. 125-127. I*n:* J.A. Seminoff (compiler). Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-503, 308 p.

DRAFT

APPENDIX A

Description of Passive Acoustic Buoy Proposals Recommended by Stellwagen Bank National Marine Sanctuary (SBNMS) Under Formal Consultation Pursuant to the National Marine Sanctuaries Act (NMSA)

The following three proposals were included as SBNMS recommendations to the US Coast Guard (USCG) pursuant to the NMSA, which requires the Sanctuary to conduct formal consultation on actions that may affect Sanctuary resources. In response to SBNMS's recommendations, the USCG agreed to require the applicant to implement these proposals as conditions of the Deepwater Port License.

These proposals were developed collaboratively by the Gerry E. Studds Stellwagen Bank National Marine Sanctuary (SBNMS) and NMFS Northeast Regional Office (NERO) and Northeast Fisheries Science Center (NEFSC) to mitigate the risk of vessel collision on endangered marine mammals, and assess acoustic output during construction and operation that may disturb or harass marine mammals. The proposals were included originally as Appendix A, B, and C to SBNMS' recommendations under the NMSA as part of NOAA's comments to the USCG on the Draft Environmental Impact Statement (DEIS) for the NEG LNG Deepwater Port (July 3, 2006), available on the USCG docket at http://dms.dot.gov, docket #22219. Since SBNMS issued their recommendations, details have been further developed and modified through discussions with the USCG and NEG. Each of the proposals is summarized below; please refer to correspondence between USCG and SBNMS pursuant to the NMSA consultation (on the USCG docket) for further details.

DRAFT

Proposal 1: Mitigate increased risk of vessel collision due to operation of the NEG LNG deepwater port

This proposal calls for the installation of ten auto-detection buoys moored at regular intervals in the northern leg of the Boston Traffic Separation Scheme (TSS) within the separation zone between the incoming and outgoing lanes. The purpose of this buoy array would be to detect the presence of vocally active whales within the shipping lane, and transmit this information in real-time to NEG EBRVs approaching the port. Vessel captains could then take appropriate action to avoid a collision with the whale. The existing auto-detection buoy technology was developed and tested in Cape Cod Bay and the SBNMS by the Massachusetts Department of Marine Fisheries, NMFS, the SBNMS, Woods Hole Oceanographic Institution (WHOI), and the Bioacoustics Research Program (BRP) at Cornell University. SBNMS's recommendation was based on knowledge of this particular technology, but the applicant has the option to develop and explore alternative technologies that achieve the same purpose. Any system, however, must be reviewed and approved by NOAA and must meet the following criteria:

1. Be capable of providing near-real-time (i.e., within the time frame necessary for management decision-making and/or less than two hours) passive acoustic monitoring of whales (and associated communications and operating protocols) to mitigate project impacts using the methodology outlined in this proposal

2. Be designed, installed, and operated by those having expertise in designing, building and installing near-real-time (i.e., within time frame necessary for management decision-making and/or less than two hours) recording units, including the necessary moorings, anchorage and data communication systems
3. Include software to automatically detect humpback, fin, minke, and North Atlantic right whales calls, as well as additional odontocete species, in Massachusetts Bay (or an area exhibiting similar depth, temperature, current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species)
4. Have the capacity to transmit acoustic detection logs in near-real-time (i.e., within time frame necessary for management decision-making and/or less than two hours), with estimates of uncertainty based on large sample sizes, utilizing data from populations in Massachusetts Bay (or an area exhibiting similar depth, temperature, current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species)
5. Utilize a web-based browser to disseminate information regarding whale detections in near-real-time (i.e., within time frame necessary for management decision-making and/or less than two hours)
6. Be operated and fully tested in Massachusetts Bay (or an area exhibiting similar depth, temperature, current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species) to a degree that satisfies to the NMSP that the system will meet the goals and objectives of this proposal
7. Include a data management system that is openly accessible to the public and all resource managers, including a commitment to publish results of the analysis of data collected through this acoustic monitoring program in the peer-reviewed literature.

DRAFT

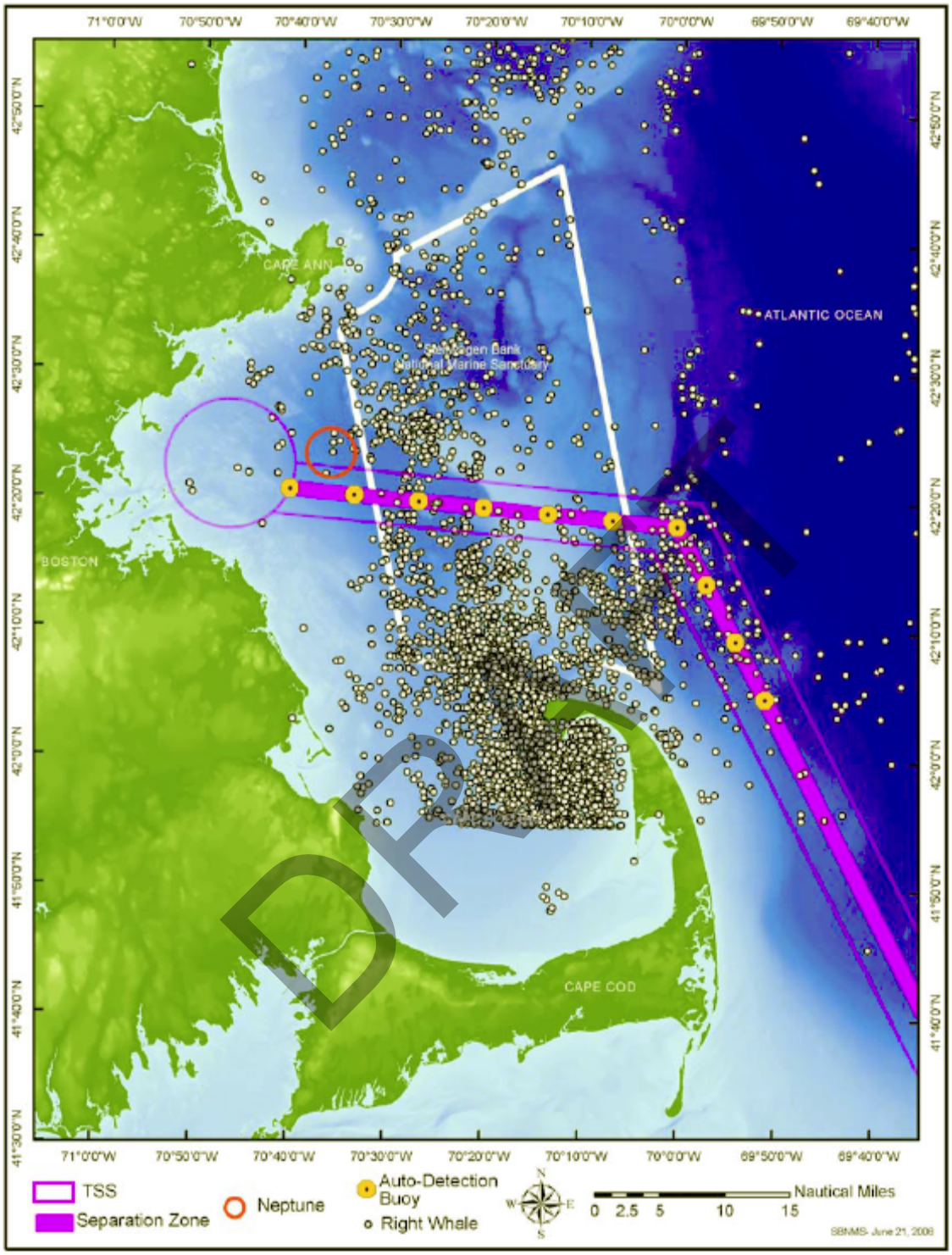


Figure 1. Research design for near-real-time auto detection of endangered whales for vessels in and around the Boston TSS to reduce risk of vessel collisions. Right whale sighting data for areas of interest was taken from the North Atlantic Right Whale Consortium Database.

Proposal 2: Monitor acoustic output during construction of the NEG DWP and monitor and mitigate acoustic harassment of marine mammals

This proposal calls for the installation of an array of auto-detection buoys moored at regular intervals in a circle surrounding the site of terminal and associated pipeline construction (see Figure 2). Buoys would be arranged to maximize auto detection and provide localization capability. With the existing technology, this would require six buoys moored every five nautical miles to provide some overlap in coverage (see Figure 2). The buoys would monitor the noise output from construction activities to ensure predicted levels are not exceeded, and detect the presence of vocally active marine mammals. This would assist monitoring of acoustic take permitted under the Marine Mammal Protection Act and trigger management action if certain thresholds were exceeded. The system must meet the following criteria:

1. Be capable of providing near real-time (i.e., within time frame necessary for management decision-making and/or less than two hours) passive acoustic monitoring (and associated communications and operating protocols) to mitigate project impacts, using the methodology outlined in this proposal
2. Be designed, installed, and operated by those having expertise in designing, building and installing near-real-time (i.e., within time frame necessary for management decision-making and/or less than two hours) recording units, including the necessary moorings, anchorage and data communication systems
3. Include software to automatically detect humpback, fin, minke, and North Atlantic right whales calls, as well as additional odontocete species, in Massachusetts Bay (or an area exhibiting similar depth, temperature, current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species)
4. Have the capacity to transmit acoustic detection logs in near-real-time (i.e., within time frame necessary for management decision-making and/or less than two hours), with estimates of uncertainty based on large sample sizes, utilizing data from populations in Massachusetts Bay (or an area exhibiting similar depth, temperature, current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species)
5. Have the capacity to generate locations and tracks using near-real-time data (i.e., within time frame necessary for management decision-making and/or less than two hours), for calling humpback, fin, minke, and North Atlantic right whales, as well as additional odontocete species, in Massachusetts Bay (or an area exhibiting similar depth, current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species)
6. Utilize a web-based browser to disseminate information regarding whale detections in near-real-time (i.e., within time frame necessary for management decision-making and/or less than two hours)
7. Be operated and fully tested in Massachusetts Bay (or an area exhibiting similar depth, temperature, current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species) to a degree that satisfies the NMSP that the system will meet the goals and objectives of this proposal

DRAFT

8. Include a data management system that is openly accessible to the public and all resource managers, including a commitment to publish results of the analysis of data collected through this acoustic monitoring program in the peer-reviewed literature.

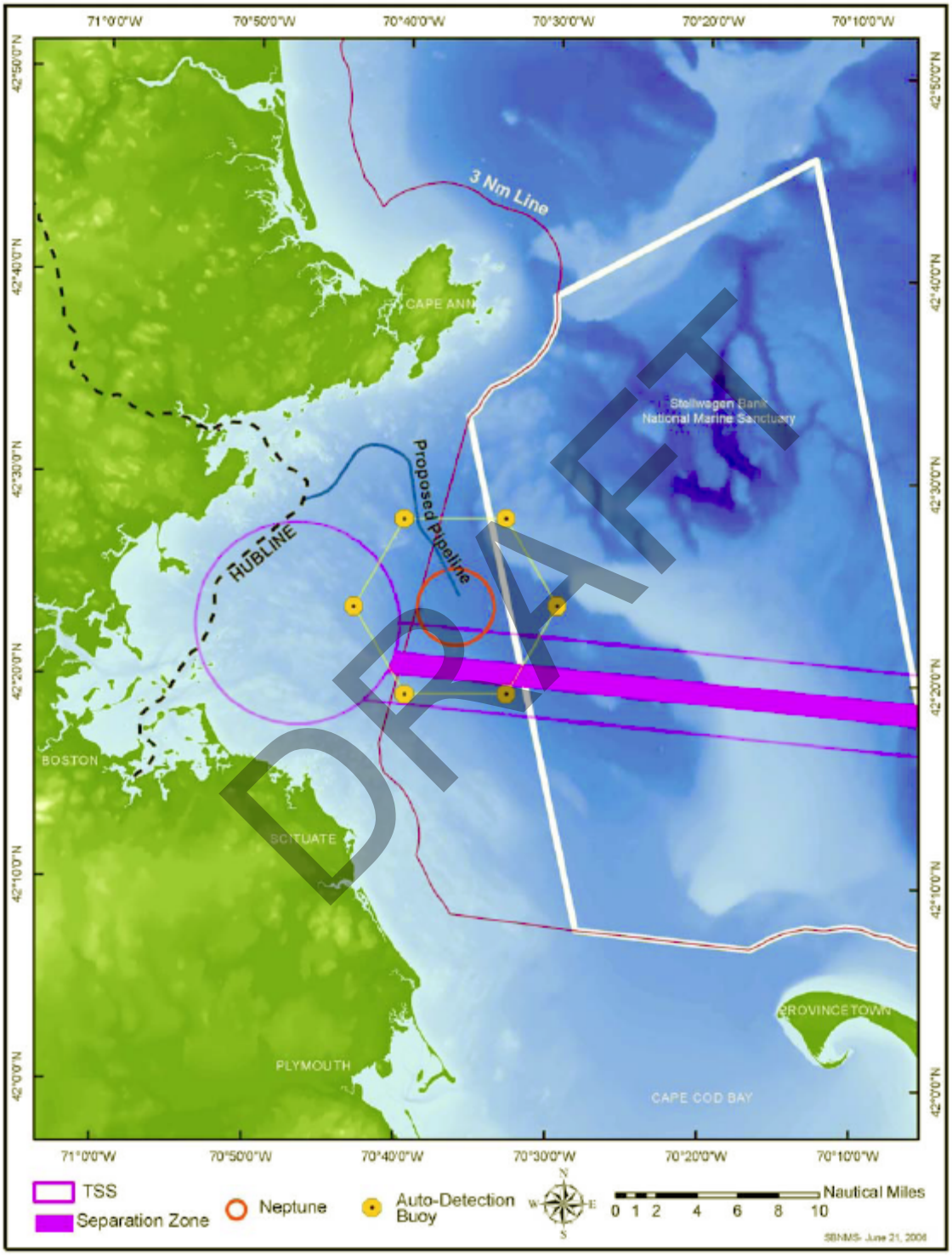


Figure 2. Research design for near-real-time auto detection of endangered whales in the NEG LNG deepwater port and pipeline construction area to minimize acoustic harassment.

Proposal 3: Long-term passive acoustic monitoring of port operations using an archival buoy array

This proposal calls for the installation of an archival buoy (autonomous recording unit (ARU), or "pop-up") array around the port site to collect baseline data on ambient noise and marine mammal vocalizations prior to port construction, and provide continuous, long-term monitoring of the acoustic output of the port and marine mammal vocalizations for five years following initiation of operations. The purpose of the array is to determine whether operational noise output is within the levels predicted, and detect major shifts in marine mammal presence in the area (i.e., abandonment). While there are limitations in the capabilities of these data to demonstrate small-scale shifts in distribution or habitat use and attribute the cause of any detectable shift directly to the port operations, the data may be used to trigger reinitiation of consultation if major, unanticipated effects are observed. The system must meet the following criteria:

1. Be capable of providing passive acoustic monitoring (and associated communications and operating protocols) to mitigate project impacts, using the methodology outlined in this proposal
2. Be designed, installed, and operated by those having expertise in designing, building and installing passive acoustic monitoring recording units, including the necessary anchorage and communication systems
3. Be operated and fully tested in Massachusetts Bay (or an area exhibiting similar depth, temperature, current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species) to a degree that satisfies the NMSP that the system will meet the goals and objectives of this proposal
4. Have the capacity to efficiently browse large acoustic datasets (0.35MB/unit/day =7MB/day for 18 unit array) and automatically generate detection logs with estimates of uncertainty for numbers of calling humpback, fin, minke, and North Atlantic right whales, as well as additional odontocete species, in Massachusetts Bay (or an area exhibiting similar depth, temperature current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species)
5. Have the capacity to efficiently browse large acoustic datasets (0.35MB/unit/day =7MB/day for 18 unit array) and generate locations and tracks with estimates of uncertainty for calling humpback, fin, minke, and North Atlantic right whales, as well as additional odontocete species, in Massachusetts Bay (or an area exhibiting similar depth, current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species)
6. Have the capacity to utilize acoustic data from the full array (18 units) to interpolate and display the ambient sound field for the entire receiving area in Massachusetts Bay (or an area exhibiting similar depth, current, acoustic propagation and ambient noise characteristics, as well as a diversity of vocalizing whale species) dynamically through time (hours, days, months, years)
7. Have the capacity to identify and quantify the contributions of individual source types to the total ambient sound field characterized in #6 over various spatial and temporal scales

DRAFT

8. Include a data management system that is openly accessible to the public and all resource managers, including a commitment to publish results of the analysis of data collected through this acoustic monitoring program in the peer-reviewed literature.

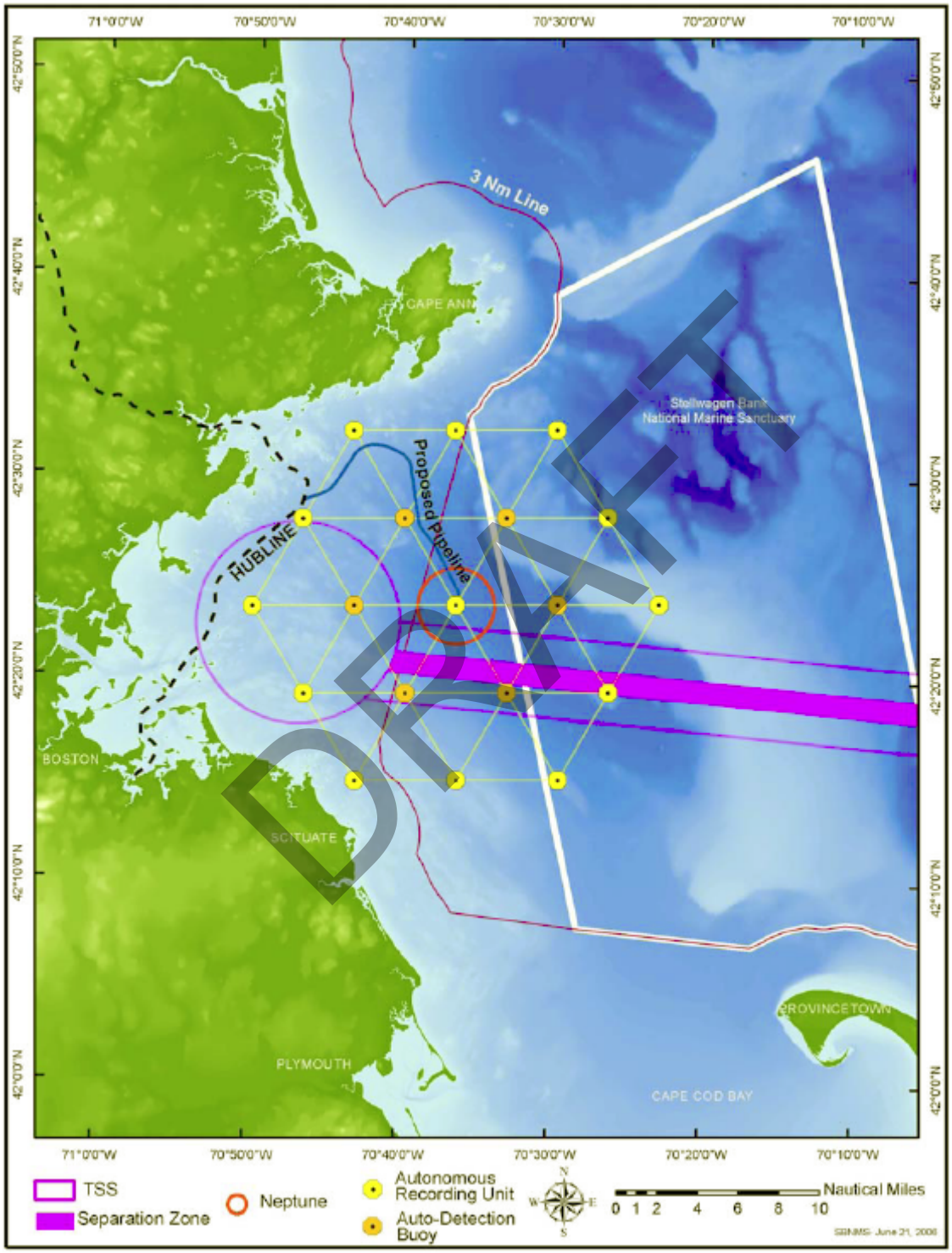


Figure 3. Research design for long-term passive acoustic monitoring program for NEG port operations

APPENDIX B

VESSEL OPERATING PROCEDURES TO REDUCE RISK OF COLLISION WITH PROTECTED SPECIES

The following measures represent general prudent vessel operating procedures that will reduce the risk of vessel strikes or disturbance to marine mammals and sea turtles due to vessel operations. These measures are supplementary to those proposed by USCG and Northeast Gateway (NEG) in the biological opinion on the construction and operation of the NEG LNG Deepwater Port.

Protected Species Identification Training

Vessel crews should be provided with a reference guide that helps identify the species of marine mammals and sea turtles that might be encountered in U.S. waters of the Atlantic Ocean. Additional training should be provided regarding federal laws and regulations for protected species, ship strike information, critical habitat, migratory routes and seasonal abundance, and recent sightings of protected species.

Vessel Strike Avoidance

Vessels should be operated in a manner that minimizes the risk of injury or death to marine mammals and sea turtles, including the following:

1. Vessel operators and crews should maintain a vigilant watch for marine mammals and sea turtles.

2. When whales are sighted, maintain a distance of 100 yards or greater between the whale and the vessel.

3. When sea turtles or small cetaceans are sighted, attempt to maintain a distance of 50 yards or greater between the animal and the vessel whenever possible.

4. When small cetaceans are sighted while a vessel is underway (e.g., bow-riding), attempt to remain parallel to the animal's course. Avoid excessive speed or abrupt changes in direction until the cetacean has left the area.

5. Reduce vessel speed to 10 knots or less when mother/calf pairs, groups, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity; therefore, prudent precautionary measures should always be exercised. The vessel should attempt to route around the animals, maintaining a minimum distance of 100 yards whenever possible.

6. Whales may surface in unpredictable locations or approach slowly moving vessels. When an animal is sighted in the vessel's path or in close proximity to a moving vessel,

DRAFT

reduce speed and shift the engine to neutral. Do not engage the engines until the animals are clear of the area.

Additional Recommendations for the North Atlantic Right Whale

1. Whenever possible, avoid transiting right whale habitat at night or during periods of low visibility. If transit in such conditions is necessary, reduced speed may reduce the risk of collision.

2. Mariners should check with various communication media for general information regarding avoiding ship strikes and specific information regarding North Atlantic right whale sighting locations. These include NOAA weather radio, U.S. Coast Guard NAVTEX broadcasts, Notices to Mariners, and US Coast Pilots.

3. NMFS recommends mariners route around known right whale locations or reduce speeds to 10 knots or less.

4. Any right whale sightings should be reported to the NMFS Sighting Advisory System at 978-585-8473.

DRAFT