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

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

Activity: Issuance of license to Neptune LNG by MARAD to construct, own, and operate an LNG deepwater port
F/NER/2006/04000

Conducted by: National Marine Fisheries Service
Northeast Regional Office

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Approved by: Peter A Kurkul

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 Neptune LNG LLC (Neptune) 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 Opinion also considers the effects of permits issued by the Army Corps of Engineers (ACOE) for the construction of the port and portions of the associated 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 Neptune LNG Deepwater Port License biological assessment (BA), correspondence with MARAD, and other sources of information. A complete administrative record of this consultation will be kept at the NMFS Northeast Regional Office. Formal consultation was initiated on June 29, 2006.

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1.0 CONSULTATION HISTORY

On February 15, 2005, Neptune LNG LLC (Neptune) 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 Neptune'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 March 14, 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 included a request for additional information to assist NMFS in evaluating potential impacts to listed species, and suggested that consultation under 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 March 14, 2005, the USCG informed Neptune that the application had been deemed incomplete, and additional information would be necessary before review under the DWPA and the National Environmental Policy Act (NEPA) could begin.

In a letter dated April 26, 2005, environmental consultants for Neptune submitted a request to NMFS for information on the presence of species protected under the ESA and the Marine Mammal Protection Act (MMPA) in the vicinity of the proposed deepwater port. NMFS responded in a letter dated May 25, 2005 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 potential impacts identified in the March 14 letter to the USCG, as well as the recommendation that section 7 consultation would be necessary for this project. Through several meetings and email exchanges from May through September 2005, NMFS staff provided technical assistance to Neptune's consultants in preparing environmental analyses for Neptune's revised DWPA application.

On October 7, 2005, the USCG acknowledged receipt of Neptune's revised application, and determined that the application contained the required information. On October 20, 2005 the USCG issued a notice of intent to prepare an environmental impact statement (EIS) pursuant to NEPA for the Neptune project. Concurrent with the NEPA process, the USCG pursued discussions with NMFS pursuant to section 7 of the ESA. In a letter dated December 22, 2005, the USCG requested information from NMFS on the presence of endangered or threatened species in the vicinity of the Neptune project area, and requested initiation of informal consultation. NMFS responded in a letter dated January 27, 2006, indicating the presence of listed sea turtles and whales in the project area, reiterating the impacts identified in previous comments provided through the NEPA process, and stating that consultation could continue once the USCG submitted a biological assessment (BA) for the proposed project. On May 26, 2006, the USCG issued the DEIS for the Neptune 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 Neptune 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 Neptune project. NMFS staff met with the USCG and Neptune on July 13, 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.

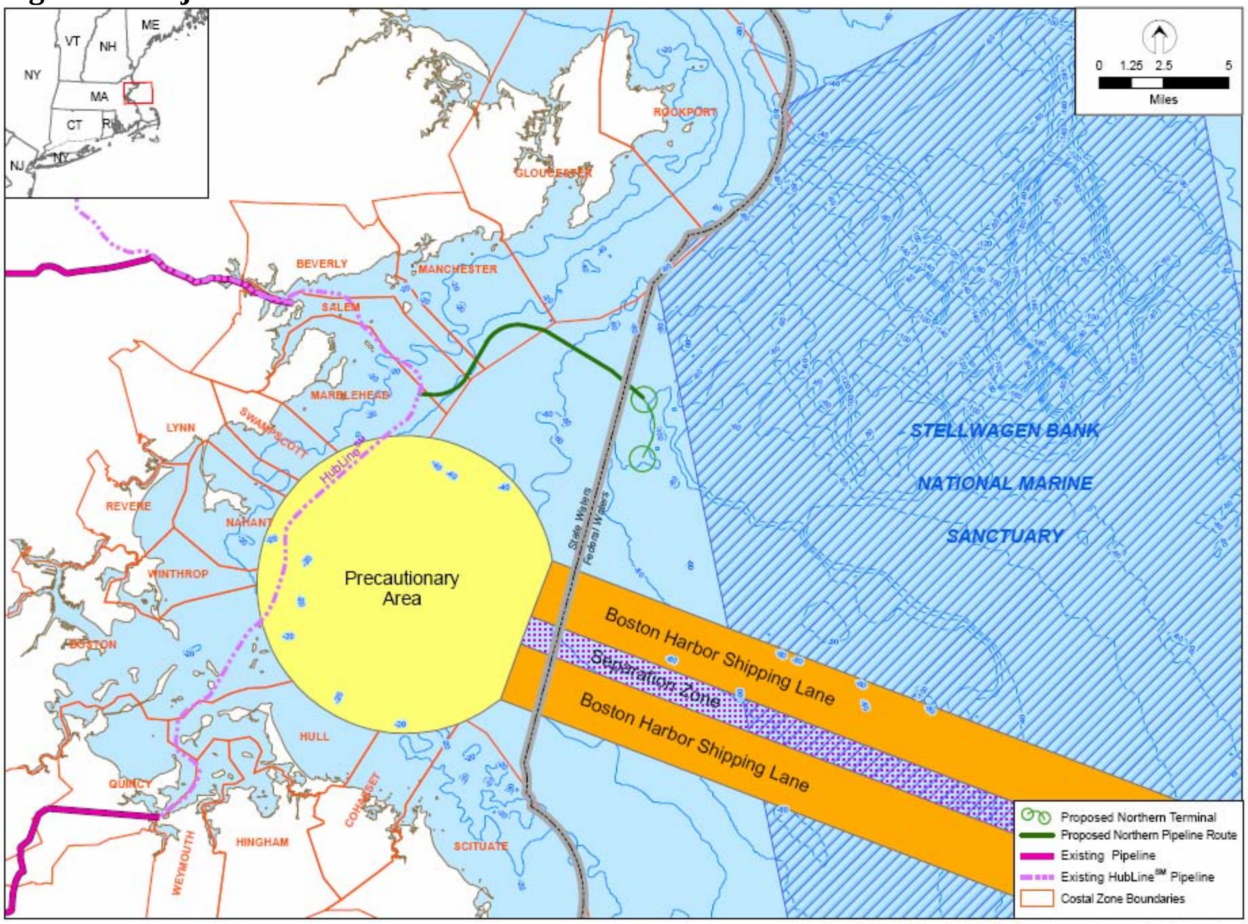
Neptune and the USCG provided the necessary information to NMFS by July 28, 2006. In a letter dated August 22, 2006, NMFS confirmed June 29, 2006 as the date of initiation of formal consultation. On October 25, 2006, the USCG submitted a letter to NOAA's National Marine Sanctuary Program (NMSP)/Stellwagen Bank National Marine Sanctuary (SBNMS) in response to recommendations made by SBNMS through concurrent formal consultation under the National Marine Sanctuaries Act (NMSA). The USCG's response indicated that several mitigation measures recommended by SBNMS would be included as license conditions should a license be issued to Neptune LNG. As many of these measures were designed to minimize impacts to endangered marine mammals, NMFS requested an extension in order to incorporate this change in project description into the BO. In an email dated November 15, 2006, MARAD confirmed that a 30-day extension was acceptable. In a letter dated November 21, 2006, NMFS confirmed December 10, 2006 as the new due date for the BO.

2.0 DESCRIPTION OF THE PROPOSED ACTION

MARAD proposes to issue a deepwater port (DWP) license pursuant to the Deepwater Port Act (DWPA) to Neptune LNG LLC (Neptune) to construct, own, and operate a liquefied natural gas (LNG) deepwater port in the Federal waters of the Outer Continental Shelf (OCS), approximately 22 miles (35 km) northeast of Boston, Massachusetts (Figure 1). The port would consist of two submerged unloading buoys in a water depth of approximately 76.2 m (250 ft) separated by a distance of approximately 2.3 mi (3.7 km), each capable of mooring a LNG shuttle and regasification vessel (SRV) custom designed to store, transport, and vaporize LNG and odorize and meter natural gas to be sent out through conventional subsea pipelines. Each buoy would be anchored to the sea floor by eight suction piles connected to wire rope and chain mooring lines (Figure 2). When not connected to an SRV, the unloading buoys would be submerged approximately 100 ft (30.5 m) below the sea surface. When an SRV arrives at the port, the unloading buoy would be hoisted into a receiving cone in the forward part of the vessel 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. Neptune's application for a deepwater port license also includes the construction and operation of the 24-inch gas transmission pipeline that will connect the port to the existing

HubLine natural gas pipeline approximately 10.9 miles west of the port in Massachusetts Bay. Another 2.3 mi pipeline would connect the northern buoy with the southern buoy.

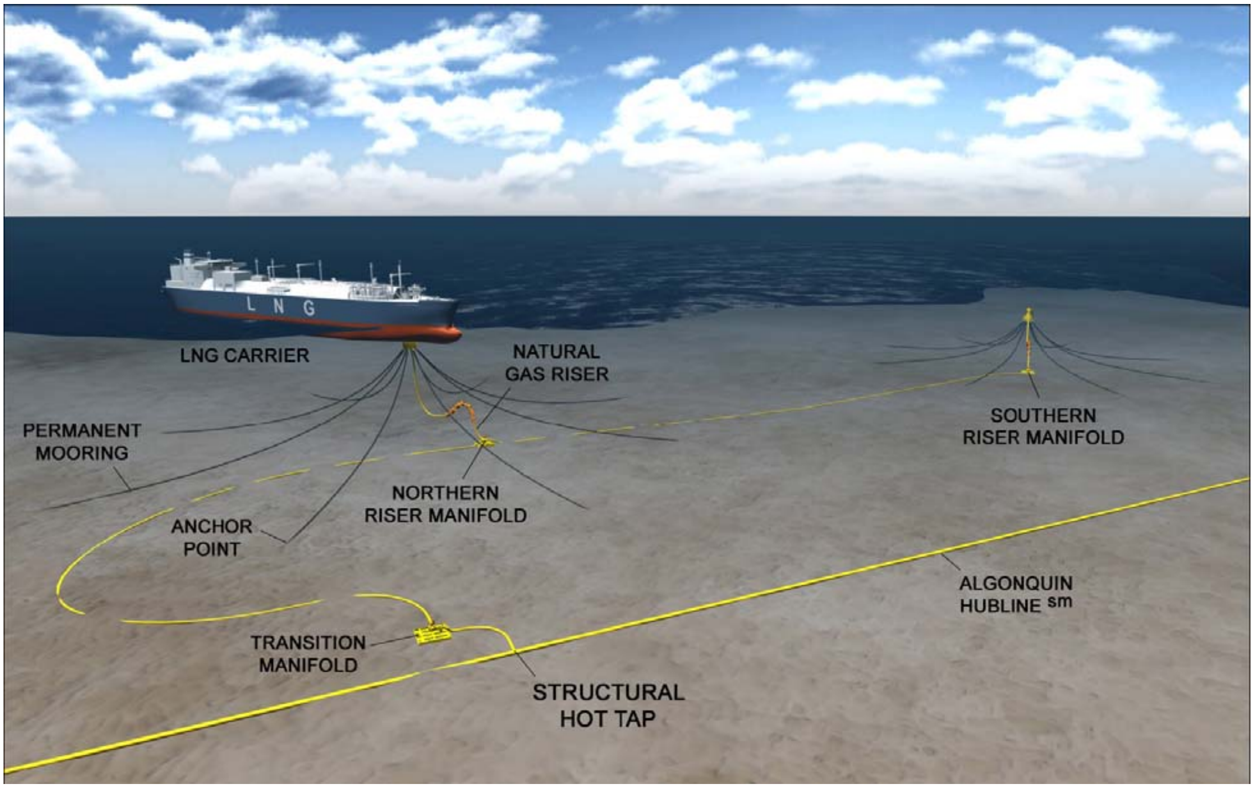
Figure 1. Project location



Sourece: NOAA ENC (Electronic Nautical Chart) 2004

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 SRVs. At the average throughput capacity of 500 million standard cubic feet per day (MMscfd), 50 SRV roundtrips per year would be required to supply the Port with a continuous flow of LNG. An SRV would typically moor at the deepwater port for between 4 and 8 days. As the SRV is concluding the unloading process, a second SRV would arrive at the unoccupied buoy, attach to the buoy, and begin unloading as the first SRV detaches from the buoy and departs.

Figure 2. Neptune port schematic



2.1 Port Operations

Vessel Activity

Three SRVs will be built to accommodate operations at the Neptune port. Each SRV will be double-hulled, approximately 280 m (918 ft) in length and 43 m (141 ft) breadth, with a draft of 11.3 m (37 ft). Two bow thrusters and two stern thrusters will provide improved maneuvering when approaching the buoys. The SRVs will run on four dual fuel diesel engines. Propulsion will be provided by a single-screw driven by twin electric motors. Storage tanks will have a total capacity of approximately 140,000 m^3.

As stated previously, 50 roundtrip SRV transits will take place each year to supply a continuous flow of natural gas into the pipeline (one transit every 3.65 days). The vessels would be traveling to and from LNG supply locations such as Trinidad, Africa, and the Middle East. The SRVs would approach the port using the Boston Traffic Separation Scheme (TSS), entering the TSS within the Great South Channel and remaining in the TSS until they reach the Boston Harbor Precautionary Area. At the Boston Lighted Horn Buoy B (at the center of the Boston Harbor Precautionary Area), the SRV would be met by a pilot vessel and a support vessel. A pilot would board the SRV, and the support vessel would accompany the SRV to the port. The table below provides coordinates for entry into the US Exclusive Economic Zone (EEZ) from

LNG supply locations, and Figure 3 illustrates the cone of approximation for entry into the Boston TSS.

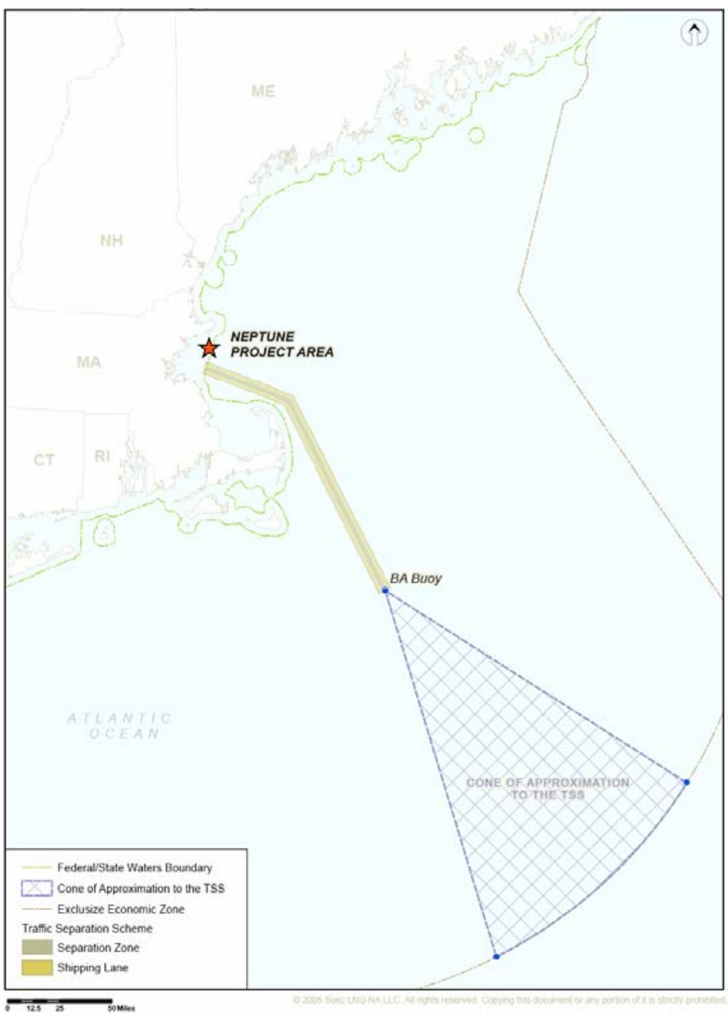
Table 1. SRV point of entry coordinates

U.S. EEZ Point of Entry Coordinates

Port of Origin	Latitude	Longitude
Trinidad	38 deg 16.4 min N	38 deg 16.4 min N
Nigeria	39 degrees 27.3 min	066 degrees 18.0 min W

SRVs carrying LNG typically travel at speeds up to 19.5 knots. However, Neptune SRVs would reduce speed to 10 knots within the TSS year-round in the Off Race Point Seasonal Management Area (SMA) as defined in section 2.4 below, and to a maximum of 10 knots when traveling to and from the buoys once exiting the shipping lanes at the Boston Harbor Precautionary Area. In addition, Neptune has committed to reducing speed to 10 knots from April 1-July 31 in the Great South Channel (GSC) SMA as described in section 2.4 below.

Figure 3. SRV cone of approach into US EEZ



Regasification System
Each SRV will be equipped with three vaporization units, each with the capacity to vaporize 250 MMscfd. Under normal operation, two units would be in service, for a combined send out capacity of 500 MMscfd. The third vaporization unit would be on standby mode, though all three units could operate simultaneously for a maximum send out capacity of 750 MMscfd. The vaporization system would have the capacity to empty a 140,000 m^3 vessel in approximately four to eight days.

Once an SRV is connected to a buoy, the vaporization of LNG and send-out of natural gas can begin. The LNG would be pressurized using pumps and would be heated from –261 degrees Fahrenheit (°F) to a minimum of 32°F. LNG from the storage tanks in an SRV would be withdrawn by means of low-pressure in-tank pumps. The LNG would be boosted to a working pressure of up to 1,740 pounds per square inch (psi) using a high-pressure cryogenic pump.

The LNG would be heated in a two-step closed-loop system. In the first step, a water-glycol solution would be heated in a compact printed circuit heat exchanger (PCHE) by steam produced in two marine auxiliary boilers. In the second step, the warmer water-glycol solution would heat the LNG from –261°F to a minimum of 32°F in a shell and tube heat exchanger. Fiscal metering would be accomplished with an LNG tank gauging system typically installed on SRVs.

Natural gas from the vaporizers would be metered and odorized, then discharged via a trunk in the forward part of the SRV that would house a turret buoy mating cone and swivel system. The swivel system is designed to operate with natural gas at the system send-out working pressure. The SRV is designed for operation in harsh environments and can connect to the unloading buoy in up to 11.5 feet significant wave heights and remain operational in up to 36 feet significant wave heights providing high operational availability.

The main on-vessel components of the unloading buoy system would include a pull-in winch, control system, natural gas piping, a gas swivel, buoy locking mechanism, and receiving cone. All but the pull-in winch would be located in the unloading buoy trunk within the hull of the SRV. The trunk would be fitted with a protective hatch and provided with a ventilation system.

Water withdrawal and discharge
Because the Neptune regasification system will operate on a closed-loop system, no seawater withdrawal will be necessary for warming and vaporizing the LNG. However, seawater intake will be necessary for ballasting purposes as the SRV cargo is offloaded, and for cooling water for the engines powering the regasification process.

The SRVs would use approximately 2.25 million gallons per day (mmgpd) of seawater for supplying ballast tank needs. The ballast water would also be recirculated through a freshwater heat exchanger to supply cooling water needs for the vessel. Seawater will be taken in through two screened sea chests, each measuring 1.6 m by 1.6 m (5.25 ft by 5.25 ft). The seawater intake flow would normally vary from a maximum of 1100 m^3/hr (when initiating cargo discharge) to 0

m^3/hr (as the cargo discharge operation progresses). Water velocity through the lattice screens at the hull side shell would not exceed 0.15 feet per second at the average flow rate of 360 cubic meters per hour (2.25 mmgpd). However, at peak intake flow (1,100 cubic meters per hour) the maximum water velocity through the lattice screens would not exceed 0.47 fps. No seawater would be discharged while SRVs are moored and regasifying cargo. All cooling water would be used to ballast the SRV, and discharges of ballast water will be made when the SRV takes on its next cargo of LNG. International and local requirements for ballast water discharge would apply. As such, the only production discharges while at the buoy will be stack gases from the two auxiliary boilers and the dual fuel engines, and discharges of stormwater from exposed deck areas.

2.2 Project Construction

Schedule
Construction of the deepwater port components (including SRVs, buoy system fabrication and installation, and offshore pipeline construction) is expected to take 36 months. Project components would be manufactured at seaside or upland areas and shipped to the project site for installation. On-site construction/installation activities in Massachusetts Bay would be initiated in mid-May 2009 and completed in mid-September 2009, assuming no delays. However, a construction period of May-November 2009 has been identified to allow for possible downtime or delays.

The anticipated offshore construction sequence is as follows:

- Mobilize anchored lay barge, pipelaying vessel, and workboats to site
- Install anchor piles and lower portion of mooring lines
- Install two riser manifolds and transition manifold
- Install the flowline between the riser manifolds
- Install the new gas transmission pipeline from the northern riser manifold to the transition manifold and the hot tap to the HubLine.
- Conduct hydrostatic testing
- Connect the mooring lines to the unloading buoys and properly tension the mooring lines
- Connect the two risers and control umbilicals between the unloading buoys and the riser manifolds.
- Demobilize the offshore construction equipment.

Port Installation
The components of the port include the buoy unloading systems, the new gas transmission pipeline, and manifolds to connect the new pipeline to the buoys and the existing pipeline. Each buoy system consists of the following components:

- Buoyancy cone
- Eight mooring lines connecting each unloading buoy to anchors on the ocean floor
- Eight anchor points consisting of suction piles
- Turret structure that would allow the SRV to weathervane about the unloading buoy as the wind, waves, and current change directions

- Marker buoys and navigation aids for the submerged buoy
- Buoy retrieval bridle
- One 16-inch ID flexible pipe riser; and
- One electrohydraulic control umbilical from the unloading buoy to the riser manifold.

The prefabricated anchor piles would be installed in an array within a radius of 1600-3600 ft of the center of each unloading buoy. Each pile would be approximately 6 ft in diameter and 24-39 ft long. Installation via suction pile method is the preferred method; however, should soil conditions prohibit suction piles from being used, Neptune proposes to use embedment anchors, gravity anchors, or driven piles as alternatives to suction piles. Installing the 16 piles would take approximately 5 days.

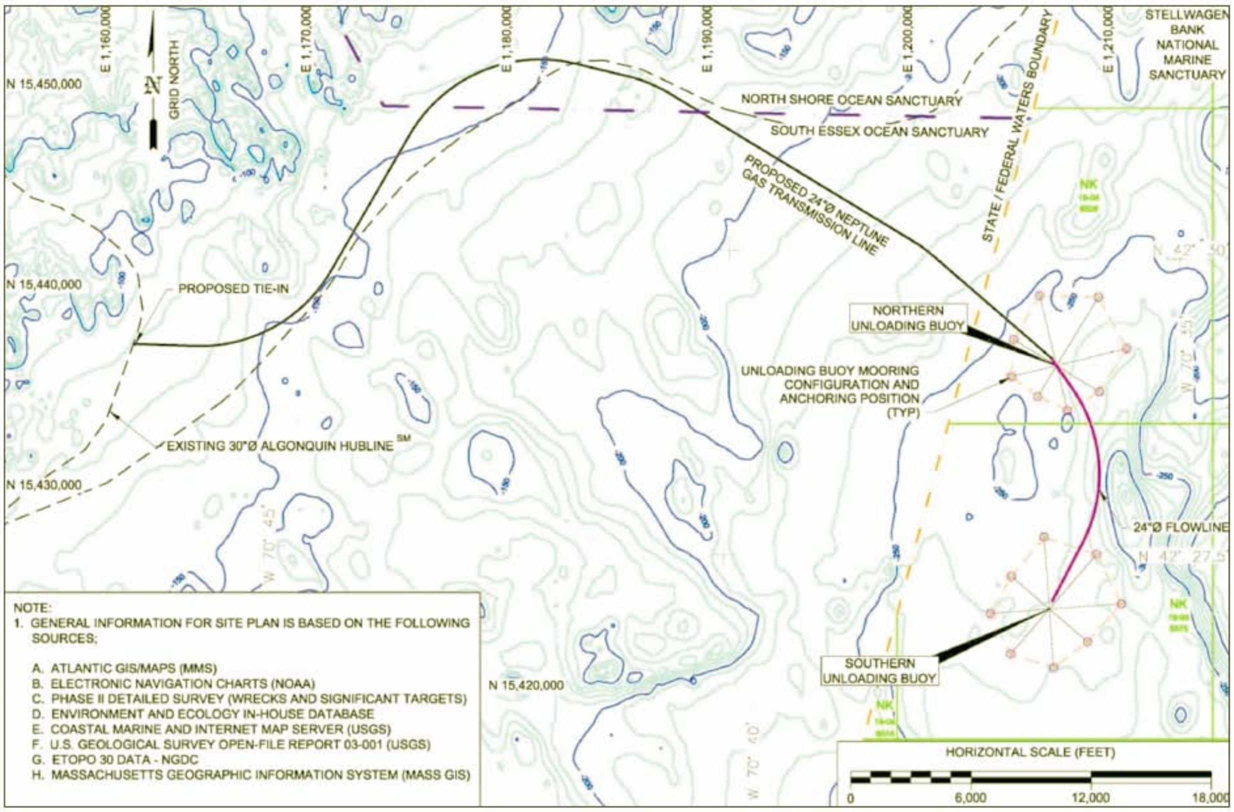
Pipeline Installation

The Neptune natural gas pipeline/flowline would consist of one 24-inch flowline with a length of approximately 2.5 miles to connect the unloading buoys and a 24-inch gas transmission line approximately 10.9 miles long that would carry the gas from the unloading buoys to the existing 30-inch HubLine. The pipeline/flowline would be constructed of carbon steel (0.562-inch nominal wall thickness), covered by a fusion-bonded epoxy coating and a high-density concrete coating (3 inches thick). The pipeline would be rated for a MAOP of 1,740 psi gauge. Elements integral to the Neptune pipeline system would be:

- Two riser manifolds below the unloading buoys that would connect the flexible risers to the flowline; and
- A transition manifold and hot tap that would connect the new gas transmission pipeline to the existing HubLine Pipeline.

A Northern route was selected as preferred for the natural gas transmission pipeline based on results of geophysical, geotechnical, cultural resources, biological, and sediment survey results, and consideration of engineering factors. 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 (Figure 4).

Figure 4. Pipeline and flowline routes



Each mooring location would include a riser manifold and would be located within a 500-foot offset from the proposed unloading buoy locations. The purpose of the riser manifold would be to provide an interface between the pipeline system and the flexible riser, isolation of the riser between gas unloading operations, and for the future attachment of a temporary subsea pig launcher or receiver.

The gas transmission pipeline would be buried and would have at least 3 feet of cover. The flowline would be buried to the top of the pipeline and covered with sediment. The manifolds, tie-in spools, and hot tap would be covered with concrete mattresses or grout bags for protection. These design considerations would minimize the potential for external damage to the pipeline system.

The flowlines will be installed using an anchored lay barge and burial plow. Transition sections would use suction pumps, jetting machines, airlifts, or submersible pumps as required.

Hydrostatic Pipeline Integrity Testing
Following laying, trenching, and burial of the transmission line and flowline, one-time hydrostatic pipeline integrity testing will take place. Testing would require withdrawal of

approximately 3.0 million gallons of unfiltered seawater, including complete flushing of the system, and 676 gallons of environmentally safe fluorescein liquid dye. Fluorescein dyes are part of the environmentally benign xanthene dye class. They are relatively inactive chemically (they do not interact with the surrounding system) and biodegradable. No biocides or corrosion inhibitors would be added to the flooding and test water, as the water would remain in the lines for less than ten days.

Construction Vessels
All construction vessels will likely come from the Gulf of Mexico, although exact point of origin is not yet known. The derrick/lay barge, anchor-handling vessels, and dive support vessel would each make two trips (one roundtrip) to and from the area, and would stay on station for the majority of the construction period. The supply vessel and crew/survey vessel would make regular trips between the construction sites and the ports of Boston or Gloucester. During project installation, the supply vessel would make approximately 102 trips (51 roundtrips) and the crew/survey vessel would make approximately 720 trips (360 roundtrips), for a combined total of 822 (411 roundtrips) construction/support-related transits.

All of the construction and support vessels will be transiting Massachusetts Bay en route to the port. While transiting to and from the construction sites, the supply vessel and crew/survey vessel would travel at approximately 10 knots. While transiting to and from the Gulf of Mexico, the derrick/lay barge and anchor handling vessels would travel up to 12 and 14 knots respectively, but would either operate in place or at very slow speeds during construction. The dive support vessel would travel to and from the construction area and between dive sites at speeds up to 10 knots.

2.3 Decommissioning

The Neptune deepwater port would have an expected operating life of 20 years. At the conclusion of the economic life of the port, the port components would be removed and the pipeline would likely be decommissioned in place. Decommissioning would consist of the mobilization of vessels and barges, the removal of the deepwater port components (other than pipelines), the transportation of the components for disposal or recycling, and the demobilization of the vessels and barges. The subsea valves would be closed. The risers and control umbilicals would be disconnected from the riser manifolds then reeled up and disconnected from the buoys. The mooring lines would be disconnected from the unloading buoys and the buoys would be removed. The mooring lines would be disconnected from the anchor points and reeled up. The risers, control umbilicals, mooring lines, unloading buoys and anchor piles would be loaded onto barges and removed from the deepwater port site. In the event the anchor piles could not be removed, they would be cut 15 feet below the mudline and the top section removed.

Decommissioning of the pipeline is expected to include closing and plugging the hot tap connection to the Algonquin HubLine, pigging and flushing both the flowline and gas transmission line with seawater, removing all manifolds and tie-in spools, cutting (if required) and sealing each end of the flowline and gas transmission line. Decommissioning would take approximately nine weeks to complete.

2.4 Mitigation Measures

MARAD/USCG and Neptune 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 Neptune DWP, MARAD/USCG, as the lead Federal action agency for this consultation, has agreed to ensure that the following mitigation measures proposed by Neptune or MARAD/USCG are implemented either through the DWP license, the Neptune 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.

Construction Mitigation Measures

General

- An environmental coordinator with experience coordinating projects to monitor and minimize impacts to marine mammals and sea turtles will be onsite to coordinate all issues concerning marine protected species, following all of the latest real time marine mammal and sea turtle movements. The coordinator will also communicate with NOAA/NERO personnel, as appropriate.

- During all phases of construction, NMFS-approved endangered species observers (marine mammal observers (MMOs)) will be required to scan for and report all marine mammal or sea turtle sightings to the vessel captain. The captain will then alert the environmental coordinator that a marine protected species was near the construction area.

- Offshore construction activities will be temporarily suspended if a marine mammal or sea turtle were observed in the construction area within 1 km of the pipelay vessel and the MMO or environmental coordinator determined there was potential for harm to an individual. The MMO will be charged with determining when it is safe to resume activity.

- 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.

Noise

- To demonstrate and document that whales are not being exposed to sound levels that exceed permitted thresholds, an array of passive acoustic detection buoys will be installed and operated around the construction site that meets the requirements described by NOAA (see Appendix A). A NMFS-approved bioacoustic technician will monitor detections (through both listening and a visual spectrogram display) and keep the environmental coordinator apprised of whale presence in the project area.

- Contractors will be encouraged to use equipment and procedures that minimize noise. Possible options include the use of special enclosures and mufflers during construction, and tuned propellers and minimal use of thrusters on vessels.

- Construction operations involving excessively noisy equipment (e.g., pile-driving hammers) will slowly initialize sound sources. This allows marine mammals that are disturbed to move further away before full noise levels are reached.

- Construction equipment will be operated as needed and maintained to manufacturers' specifications in order to minimize noise effects, which include proper operation of any sound-muffling devices or engine covers.

- Construction equipment will be turned off when not in operation to minimize the duration of noise.

- The preferred method for installing anchor piles is via suction piles; however, should impact pile driving be required, NMFS will be notified as soon as practicable and the following additional mitigation measures will be employed:

    < A 500 m safety zone will be established around pile-driving activity. This safety zone will be monitored, both visually by NMFS-approved endangered species observers and acoustically by a NMFS-approved bioacoustic technician, for at least 30 minutes prior to the start of any pile driving activity. Pile driving activity will not commence until the observers and bioacoustic technician have declared the safety zone clear of sea turtles and whales.

    < Each time a pile driving hammer is started, dry-firing and ramping-up of the hammer will be conducted for at least 30 minutes to allow animals the opportunity to leave the area. Dry firing of a pile driving hammer is a method of raising and dropping the hammer with no compression of the pistons, producing a lower-intensity sound than the full power of the hammer. Ramp-up involves slowly increasing the power of the hammer and noise produced over the ramp-up period.

    < Following the initial 30-minute observations for protected species, continuous visual observations will occur during daylight hours to monitor for sea turtles and whales in the area. Passive acoustic devices will also be actively monitored for detections by a NMFS-approved bioacoustic technician. If at any time animals are detected in the safety zone during pile driving, the pile driving activity will cease until the animal has left the area of its own volition. Pile driving can resume (following ramp-up procedures) once the animal has been visually confirmed beyond the impact zone, or 30 minutes have passed without re-detecting the animal.

< If pile driving commenced during daylight hours, pile driving may continue into nighttime hours provided that there has been no interruption in activity. The safety zone will continue to be monitored by a NMFS-approved bioacoustic technician, and shut-down procedures will apply if a whale is detected within the safety zone. However, pile driving will not be initiated or reinitiated during nighttime hours when visual clearance of the zone cannot be conducted.

< Records will be maintained of all visual and acoustic detections of sea turtle and marine mammals, including relevant details such as date and time, weather conditions, species identification, approximate distance from the pile, direction and heading in relation to the pile driving (if known), and behavioral observations. When animals are detected in the safety zone, additional information will be recorded, including corrective actions taken (e.g., shutdown of the pile driver and duration of the shut-down), behavior of the animal, and time the animal spent in the safety zone. A summary report will be submitted to NMFS at the conclusion of pile-driving activity.

< Sound pressure levels will be monitored on the first day of pile driving activity and will continue for a duration and in a manner sufficient to ensure that the predicted 180 dB contour is accurate. The safety zone will be adjusted to accommodate any difference between predicted and measured sound levels.

Vessel strike avoidance

- Prior to construction and operation, designated crew members will undergo NOAA-certified training regarding marine mammal and sea turtle presence and collision avoidance procedures (see Appendix B for recommended vessel strike avoidance procedures). Watches will be maintained while all vessels are underway.

- Construction and support vessels will transit at 10 knots maximum in the following seasons and areas:

  <u>November 15-April 15</u>
  Southeast US Seasonal Management Area (SMA) – The area bounded by: the shoreline, 31°27′N. lat. (i.e., the northern edge of the MSRS boundary) to the north, 29°45′N. lat. to the south, and 80°51.6′W. long. (i.e., the eastern edge of the MSRS boundary)

  <u>November 1-April 30</u>
  Mid-Atlantic SMAs – The waters within a 30 nm area with an epicenter located at the midpoint of the COLREG demarcation line crossing the entry into the following designated ports or bays: (a) Ports of New York/New Jersey; (b) Delaware Bay (Ports of Philadelphia and Wilmington); (c) Entrance to the Chesapeake Bay (Ports of Hampton Roads and Baltimore); (d) Ports of Morehead City and Beaufort, NC; (e) Port of Wilmington, NC; (f) Port of Georgetown, SC; (g) Port of Charleston, SC; and (h) Port of Savannah, GA. At Block Island Sound, the designated area is a box with a 30–nm width

extending south and east of the mouth of the Sound (reference points: Montauk Point and the western end of Martha's Vineyard)

Year-round
Off Race Point SMA – All waters bounded by straight lines connecting the following points in the order stated:

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

January 1-May 15
Cape Cod Bay SMA – All waters in Cape Cod Bay, extending to all shorelines of the Bay, with a northern boundary of 42°12′ N. lat.

April 1-July 31
Great South Channel SMA – All waters bounded by straight lines connecting the following points in the order stated:

42°30′ N 69° 45′ W
42°30′ N 67°27′ W
42°09′ N 67°08.4′ W
41°00′ N 69°05′ W
41°40′ N 69°45′ W
42°30′ N 69°45′ W

- Vessels will remain 1 km away from North Atlantic right whales and all other whales to the extent possible.
- MMOs will direct a moving vessel to slow to idle if a baleen whale is seen within 1 km of the vessel.
- Vessels will report any North Atlantic right whale sightings to the USCG and NMFS.

Entanglement

- Any material that has the potential to entangle marine mammals or sea turtles (e.g., anchor lines, cables, rope, or other construction debris) will be deployed only as long as necessary to perform its task. It will then be immediately removed from the project site
- All possible slack will be taken out of any potentially entangling material.

- In the unlikely event that an entanglement appeared likely to occur, all potentially entangling material will be removed from the water immediately.

- Knotless and nonfloating lines will be used on construction vessels.

- If necessary, temporary mooring buoys will be positioned with heavy steel cables or chains to minimize potential entanglements.

- In the unlikely event that a marine mammal or sea turtle becomes entangled, the endangered species observer will immediately notify NMFS so that a rescue effort may be initiated.

Seafloor disturbance and turbidity

- One-pass backfill techniques will be used to recontour bottom sediments so that benthic communities can reestablish in the shortest time possible.

- In limited areas where jetting techniques will be used, the pipeline trench will be backfilled with sand, concrete mats, or other material. This material will be placed using a tremie tube or by divers to minimize turbidity.

- Post construction monitoring will be conducted to verify benthic community recovery along the transmission line.

Lighting

- Lighting used during construction/decommissioning activities will be limited to the number of lights and wattage necessary to perform such activities.

- Lights used to illuminate vessel decks will be down-shielded to maximize deck illumination and reduce upward illumination.

- Once an activity has been completed, all lights used only for that activity will be extinguished.

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 by NOAA in recommendations to 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.

- Prior to entering areas where right whales are known to occur, including the Great South Channel and SBNMS, SRV operators will consult recent right whale sighting information through NAVTEX, NOAA Weather Radio, NOAA's Right Whale Sighting Advisory

System (SAS) or other means to obtain the latest sighting information. 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 either acoustically or through the SAS), SRVs will take appropriate actions to minimize the risk of striking whales, including reducing speed to 10 knots maximum and posting additional observers.

- Designated crew members will undergo NOAA-certified training regarding marine mammal and sea turtle presence and collision avoidance procedures (see Appendix B for recommended vessel strike avoidance procedures).

- Vessels approaching and departing the port from LNG supply locations will enter the Boston TSS as soon as practicable and remain in the TSS until the Boston Harbor precautionary area.

- SRVs and support vessels will travel at 10 knots maximum when transiting to/from the port outside of the TSS.

- SRVs will reduce transit speed to 10 knots maximum (unless hydrographic, meteorological, or traffic conditions dictate an alternative speed to maintain the safety or maneuverability of the vessel) throughout the year 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

- SRVs will reduce transit speed to 10 knots maximum (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
  41°00′ N 69°05′ W
  41°40′ N 69°45′ W

42°30′ N 69°45′ W

- 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.

- All vessels will comply with the year-round Mandatory Ship Reporting System (MSRS).

- If whales are seen within 1 km of the buoy, then the SRVs will wait until the whale leaves the area before departing.

Noise

- An archival array of passive acoustic detection buoys ("pop-ups") will be installed around the port site that meets the criteria specified in NOAA's recommendations to the USCG under the National Marine Sanctuaries Act. 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.

- The use of dynamic positioning thrusters will be minimized to the extent practical.

Marine debris/pollution

- All SRV and service vessel personnel will attend initial and refresher training on elimination of marine debris.

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 (SRV, 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;

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 cone of approximation from the US EEZ to the TSS illustrated in Figure 3, as well as the route of construction vessel transits from Boston, MA and Gloucester, MA to the pipeline and port sites.

The Northern Terminal port location is within the Boston NK 19-04 Minerals Management Service (MMS) lease area. The southern buoy is within Lease Block NK 19-04 6575 and the northern buoy is within Block NK 19-04 6525. The table below shows the coordinates of the buoy locations.

Table 2. Location of Unloading Buoys

Component	Easting	Northing	Latitude	Longitude	Lease Block
Northern Buoy	1207435.37	15435945.12	42° 29' 06.3"	70° 36' 20.8"	NK 19-04 6525
Southern Buoy	1207077.7	15423798.13	42° 27' 06.2"	70° 36' 22.5"	NK 19-04 6575

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 4)

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.

[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.

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 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.

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. 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 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].

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

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

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 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 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 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 (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.

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 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
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.

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.

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 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

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

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).

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).

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 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.

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.

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 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 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

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 (*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 destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton

[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.

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 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).

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

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 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 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).

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.

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 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

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 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 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 Sites[4]

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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.

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 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

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

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).

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

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 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 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 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 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.

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 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 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 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 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 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.

Northeast Gateway 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 Northeast Gateway (NEG) 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.

The proposed NEG terminal is nearly identical in technology and operation to the Neptune proposal, and would be located approximately 3 miles south of the proposed Neptune terminal. Although a BO has not yet been issued for this project, federal permitting and formal section 7 consultation is also in progress for the NEG terminal. The potential avenues of impact will include destruction of benthic resources due to construction, increased risk of vessel strikes due to construction and operation vessel transits, and chronic noise output. Since the NEG 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 port will be in operation at the time the Neptune port is built. As such, operational impacts associated with the NEG port will overlap in space and time with both construction and operation-related impacts of the proposed Neptune port. The NEG port would contribute an additional 65 roundtrip LNG carrier transits per year through the Boston TSS. The acoustic output during regasification operations is estimated at 108-112 dB re 1μPa. Similar to the Neptune port, the NEG 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 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 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.

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 change may be implemented six months after adoption by the IMO, or in June 2007, after domestic implementation procedures (notice in the Federal Register and public comment).

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.

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

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 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.

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 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 Neptune 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 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.

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 Neptune 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 5.4 and 5.5.

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 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 Neptune 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 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 SRVs 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
- Increased turbidity and resuspension of contaminated sediments
- Destruction of prey resources/loss of foraging habitat
- Light pollution
- Increased risk of vessel strike due to construction-related vessel traffic (see section 5.4)
- Exposure to disturbing or injurious noise levels (see section 5.5)

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. The types of construction equipment being used for the proposed action that may interact with listed species include:

- Dredges and pumps used to remove seafloor material during installation of transition manifolds and HotTap.
- Trenching and plowing equipment used during pipelaying activities

Dredging

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. However, some use of dredging equipment is necessary to facilitate installation of transition manifolds and the HubLine Hot tap. Sea turtle takes have only been documented during dredging activities using hopper dredges. The type of dredge used for the proposed action consists of a pump with an open tube mouth ranging from 3-12 inches in diameter. The suction power is much lower than that of a hydraulic hopper dredge; the flow rate based on a 3-4 inch diameter is only 0.41-0.73 ft/sec, and flow rate would decrease with increased tube diameter. In addition, the equipment is diver-operated, and proceeds at a much slower pace than hopper dredging. As such, a sea turtle would be able to avoid direct interaction with the dredge equipment. Large baleen whales are not known to interact with dredges, and would not be affected by the type of equipment being used for the proposed activity.

Pipeline Installation

The pipeline trenching system associated with the Neptune pipeline would use plow blades to cut an approximate 1.7 m (5.5 ft) deep and 7.5 m (24.5 ft) wide ditch for placement of the gas transmission line along the pipeline route and flowline. 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 (120-257 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, during pipelaying and trenching operations, equipment will be towed at very slow speeds, approximately 1.5 m (5 ft) per minute. 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 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.

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 trenching, 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 4.0 km flowline and 17.5 km pipeline route could potentially disturb approximately 20,000 m^3 and 87,500 m^3 of sediment, respectively. Sediment transport modeling conducted by Neptune indicates that initial turbidity from installation of the pipeline could reach 100 mg/L, and would subside to 20 mg/L after four hours. Turbidity associated with the flowline and Hot-tap would be considerably less, and would also settle within hours. As noted above, although increased turbidity may cause displacement of sea turtles and whales or their prey, displacement will be temporary, and sea turtles and whales are likely to find suitable prey in surrounding areas.

Neptune performed a sediment characterization survey of the project area in July 2005, and found that concentrations of metals, PCBs, pesticides, PAHs, TPH, and VOCs were below state or Federal environmental threshold criteria. The only exception was arsenic, which ranged from 10-20 ppm at one of 22 stations along the pipeline route (Germano & Associates 2005) and 6 of

10 stations at the port site. Although NOAA's toxicity thresholds for arsenic in marine sediment (NOAA 1999) indicates that toxicity may begin to be observed in sensitive species at concentrations of 8.2 ppm, the levels measured along the pipeline route and port site remain below the NOAA Apparent Effect Threshold, the concentration above which adverse impacts would always be expected on a given indicator species (35 ppm for bivalves). In addition, 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.

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 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 involves withdrawal of 3.0 million gallons of filtered seawater and complete flushing of the system, including 676 gallons of environmentally benign fluoroscein dye. No biocides or corrosion inhibitors would be added to the flooding and test water, since the water would remain in the pipes for less than ten days. Although zooplankton species that provide forage for right whales can be entrained and killed by seawater intake systems, a one-time removal of 3.0 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. Right whales are rare in the vicinity of the pipeline during the summer construction period, so although plankton species may still be present in the area during hydrostatic testing, right whales would not be relying on these resources for foraging.

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.

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. In addition, an environmental coordinator will be on site to ensure that environmental standards are adhered to and adverse interactions between project equipment and listed species do not occur. Therefore, construction activities are not likely to result in increased marine debris.

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, use of lights will be limited to areas where work is actually taking place, and all other lights would be extinguished. 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

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 (0.9 acres), and long-term sediment disturbance associated with chain sweep (63.7 acres) attributed to the following:

- The permanent footprint of the 16 buoy anchors (0.1 acres), 2 riser manifolds and 2 flowline transition areas (0.1 acres)
- Pipeline route transition area, manifolds, and hot tap tie-in (0.4 acres)
- Armored areas of the pipeline route (0.3 acres)
- Anchor chain sweep associated with 16 buoy anchor chains (56.9 acres) and 2 flexible risers (6.8 acres)

The combined total area of seafloor permanently disturbed by all of these activities would be 64.6 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 56.9 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 64.6 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 0.3 percent of the 24,000 acres of similar bottom habitat surrounding the project area (the Northeast Sector of Massachusetts Bay). 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 SRV 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, SRVs would withdraw approximately 2.39 million gallons per day (MGD) of seawater. This estimate includes the combined seawater intake while two SRVs are moored at the port (approximately 9 hours every 6 days). The estimated zooplankton abundance in the vicinity of the seawater intake ranges from 6,750 to 27,588 individuals per m^3, or 25.6 to 105 individuals per gallon (Libby et al. 2004). This means that the daily intake would remove approximately 61.2 to 251 million individual zooplankton in a day, the equivalent of approximately 3.47 to 14.2 kg (7.65 to 31.4 pounds). 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 1.42% of a single right whale's daily diet. Since zooplankton are short-lived (most copepods live from one week to several months), 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 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, it has been hypothesized that right whales need to exploit dense prey patches of tens to hundreds of thousands of copepods per cubic meter in order to achieve an energetic benefit from feeding (Kenney et al. 1986). These concentrations of prey have not been observed in the project location where water withdrawal would be taking place. 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 SRVs while buoyed, and accidental releases of marine debris. According to modeling by the applicant, turbidity in the immediate vicinity of the anchor chains would be 100-200 mg/L, and would persist at a level of 20 mg/L for a total area of 500-1200 acres (0.78-1.88 square miles). The height of the turbidity plume above the seafloor would be approximately 16.4-19.7 ft depending on the current. 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 (1.88 square miles) 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 associated with project operation include sanitary wastes, firewater discharges, and intermittent storm water runoff. Uncontaminated precipitation runoff from SRV decks would be routed and discharged through outlets on each side of the vessel, but is not likely to have any effect on water quality. Sanitary wastes would be treated onboard and properly discharged at sea according to MARPOL standards while SRVs are in transit outside US waters. As such, there will be no direct impact to water quality in the action area of this consultation. Firewater systems will be tested approximately four times per year, discharging 79,250 gallons of unfiltered, untreated seawater. Due to the nature of this discharge, there will be no effect on surrounding waters.

Any open deck machinery or other open deck areas where diesel or oil spills could occur would have spill pans or would be fitted with welded steel containment barriers. These would prevent contaminated rainwater from washing over the side. The water would be collected in holding tanks and treated by on-board oil-water separators. The residual oil would be stored and disposed of at shoreside docks. Spill pans would collect approximately 913 gpd of rainwater, machine washdown water, and other fluids, and would divert it to holding tanks. The water would be treated and disposed of properly in compliance with MARPOL standards while SRVs are in transit outside US waters. As such, routine discharges are not likely to affect the water quality at the port site, and are not likely to adversely affect listed species in the action area.

Personnel will be living onboard the SRVs 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 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.

In spite of these prohibitions, however, accidental discharges associated with offshore structures do occur. A condition of the license, if issued, would require all Neptune personnel to attend annual training on marine debris awareness and elimination. Appropriate measures would be taken to ensure proper handling of food, garbage, and other waste, including specific prohibitions on feeding marine animals. 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 anchor piles in the seafloor. These chains are not likely to pose an entanglement risk, as each link in the chain measures approximately 0.8 m by 0.5 m (2.5 ft by 1.5 ft) and weighs 217.7. kg (480 lb). Each chain would be approximately 1,000 m (3,281 ft) long and would be separated by hundreds of feet from the other lines. Although it is possible that a whale or sea turtle might swim into one of the chains, it is not likely that the chain would wrap around and entangle the animal.

The safety zone required around the SRVs 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 at the port site are otter trawls and lobster pots. 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:

- 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 Neptune 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 2,639 years for the Neptune port, and the likelihood of a drifting collision was once in 45,045 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 in the event of a collision or grounding, which for reasons stated above, would be highly unlikely for the proposed action.

Light Pollution

The submerged unloading buoys would be marked by lighted buoys at the water surface to enable SRVs to locate the submerged buoys and moor at the port. However, once the SRV has successfully docked, the lighted buoys would be taken on board and turned off. Moored SRVs would be required to exhibit 2 all-round white lights as appropriate for vessels at anchor, one at the fore of the vessel and one near the stern, approximately 150 ft and 70 ft above the sea surface, respectively. Deck illuminating lights (high pressure sodium lights) would be used to illuminate working decks during regasification activities. However, the overall amount of light used would be low. Lights would be downshielded to illuminate the deck only, and would not intentionally illuminate the surrounding waters. This should reduce attraction of marine organisms to the SRV, 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 20-year life of the Neptune 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. The pipelines would be pigged, flushed, and filled with seawater. The ends of the flowline and transmission line would be exposed, cut, filled, and covered with protective concrete mats. The manifolds and tie-in spools would be removed. Anchor piles would be removed completely, or cut below the mudline and the top portion removed if complete removal was not possible. 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 Neptune 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 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 SRVs associated with the Neptune 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 Neptune have proposed to implement the following mitigation measures to further reduce the likelihood of a Neptune vessel (SRV, construction, or support) interacting with a whale:

- Prior to construction and operation, designated crew members will undergo NOAA-certified training regarding marine mammal and sea turtle presence and collision avoidance procedures (see Appendix B for recommended vessel strike avoidance procedures). Watches will be maintained while all vessels are underway.

- Construction and support vessels will transit at 10 knots maximum year-round in the Off Race Point management area and from April 1-July 31 in the Great South Channel SMA as described in Section 2.4 of this BO.

- Vessels will remain 1 km away from North Atlantic right whales and all other whales to the extent possible.

- MMOs will direct a moving vessel to slow to idle if a baleen whale is seen within 1 km of the vessel.

- An array of passive acoustic detection buoys will be installed in the Boston TSS that meets the criteria specified by NOAA in recommendations to 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.

- Prior to entering areas where right whales are known to occur, including the Great South Channel and SBNMS, SRV operators will consult recent right whale sighting information through NAVTEX, NOAA Weather Radio, NOAA's Right Whale Sighting Advisory System (SAS) or other means to obtain the latest sighting information. 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 either acoustically or through the SAS), SRVs will take appropriate actions to minimize the risk of striking whales, including reducing speed to 10 knots max and posting additional observers.

- Designated crew members will undergo NOAA-certified training regarding marine mammal and sea turtle presence and collision avoidance procedures (see Appendix B for recommended vessel strike avoidance procedures).

- Vessels approaching and departing the port from LNG supply locations will enter the Boston TSS as soon as practicable and remain in the TSS until the Boston Harbor precautionary area.

- SRVs and support vessels will travel at 10 knots maximum when transiting to/from the port outside of the TSS.

- SRVs will transit at 10 knots maximum year-round in the Off Race Point management area and from April 1-July 31 in the Great South Channel SMA as described in Section 2.4 of this BO, unless hydrographic, meteorological, or traffic conditions dictate an alternative speed to maintain the safety or maneuverability of the vessel.

- 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.

- All vessels will comply with the year-round Mandatory Ship Reporting System (MSR).

- If whales are seen within 1 km of the buoy, then the SRVs will wait until the whale leaves the area before departing.

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, Neptune agreed to implement a 10-knot speed restriction year-round in the Off Race Point management area as described in section 2.4 of this BO, and a 10-knot speed restriction in the Great South Channel seasonal management area from April 1-July 31 of every year. Because right whales have been sighted year-round in Massachusetts waters, Neptune also agreed to consult recent right whale sighting information prior to entering areas where right whales are known to occur, and slow to ten knots or less and post additional lookouts 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 Neptune 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. According to NEFSC data, there have been only six right whale sightings since 1970 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.

Construction-related Vessel Traffic

During construction, a 514-ft anchored derrick/lay barge and two 216-ft anchor handling vessels would be used to install various project components. Construction support vessels will also include

- A 190-ft supply vessel providing construction crew with food, equipment, and removing trash or other equipment to shore
- A 166-ft diver support vessel providing a platform for dive operations
- A 122-ft crew/survey vessel shuttling personnel to and from the construction area and performing survey activities

All construction vessels would likely come from the Gulf of Mexico. The derrick/lay barge and anchor handling vessels would each only make two trips (one roundtrip) each. The supply and crew vessels would make regular trips between the construction sites and the port of Boston, totaling approximately 830 total transits (415 roundtrips). While transiting to and from the construction sites, the supply vessel, crew/survey vessel, and dive support vessel would travel at approximately 10 knots. While actually engaged in operations, including surveys and installation of project components, the vessels would move at speeds less than 10 knots. While transiting from the Gulf of Mexico, the derrick/lay barge and anchor handling vessel would travel at speeds of up to 12 and 14 knots, respectively.

Neptune provided data for the number of large commercial vessel transits in Massachusetts Bay in 2003, and estimates 4,561 large vessel trips were made. 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 830 additional transits contributed by the construction portion of the proposed project would constitute a one-time 1.5% 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 environmental coordinator 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.

SRV and Support Vessel Transits
The SRVs that will be carrying cargo to and from the Neptune 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 mitigation measures discussed above are expected to be effective for SRV transits as well as construction vessel transits. In addition, the 50 roundtrip vessel transits per year contributed by the Neptune project will constitute a minor increase (1%) in total traffic in the action area compared to the 4,561 estimated annual 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 Neptune 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

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. Construction vessels will not be traveling at speeds greater than ten knots, except during initial transits from the Gulf of Mexico, at which time they will be traveling at speeds between 12-14 knots. However, Neptune has agreed to limit SRV 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, Neptune 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 Neptune 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.
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 Neptune 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

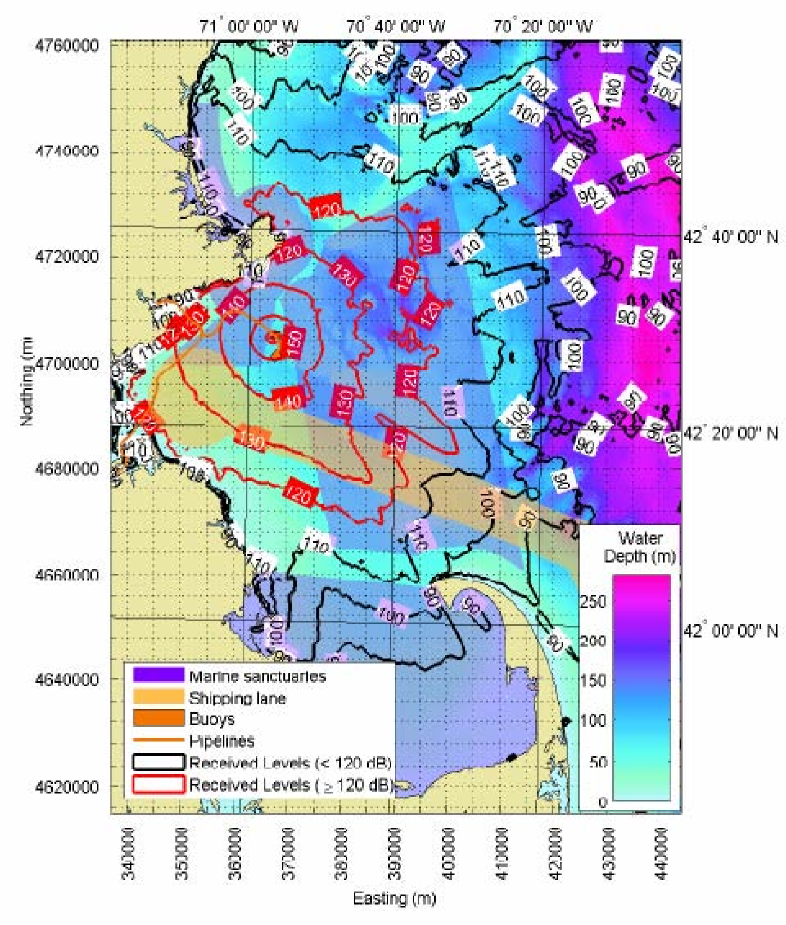
Sources of construction noise associated with the Neptune LNG project include the following:

- Anchor pile installation (suction pile or driven piles)
- Pipelaying and associated activities
- Construction vessel transit

Impact Pile-Driving

Anchor pile installation using a hydraulic impact hammer is the only impulse noise source associated with construction activities at the proposed Neptune terminal. Impulse noise sources are short in duration (less than 1 second) and characterized by a rapid rise time. Pulses can have a greater impact at lower source levels than non-pulse noise sources. Suction pile installation remains the applicant's preferred method of installation; however, if conditions at the site do not allow the pile to reach full penetration depth using suction piling, driven piles are being maintained as a possible alternative. Sixteen steel anchor piles will be required (eight at each buoy), each 72" in diameter and 15-20 m long. Pile-driving will take place for 15 days total during August and September, according to Neptune's construction schedule. Acoustic modeling was conducted by LGL and JASCO for the stated pile-driving scenario (summer noise profile conditions) at the surface, 50 m below the surface, and at the bottom. The source level for the hammer was taken from measurements of pile driving activity using similar sized steel piles for the Sable Offshore Energy project on the Scotian Shelf (broadband source energy level calculated to be 216 dB re 1μPa at 1 m, with peak intensities at frequencies between 160-250 Hz) (Neptune 2005). The model predicts that received sound levels from pile driving will be louder at 50 m below the surface than at the surface or at the bottom. The model predicts that the 180 dB contour would only extend approximately 30-40 m from the source. The 160 dB contour would extend 0.8-1.4 km from the source, and the 120 dB contour would extend 26.3-29.9 km from the source (from Neptune 2005, Appendix H). Figure 5 shows the spatial coverage of these received levels.

Figure 5. Diagram of pile-driving noise propagation at 50 m below the surface



Suction Pile Installation
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. As such, the sound profile was modeled using the source level of a typical pump of similar size to the one being used for the suction pile installation (30 HP; broadband source level of 138 dB re 1μPa). Other parameters modeled were the same for the impact pile-driving scenario (summer noise profile conditions), since suction pile installation is the preferred anchor pile installation method and would occur during the same 15-day period in August or September instead of (not in combination with) impact pile-driving. Modeling results indicate that noise levels would be below 90 dB re 1μPa within 0.3 km of the source.

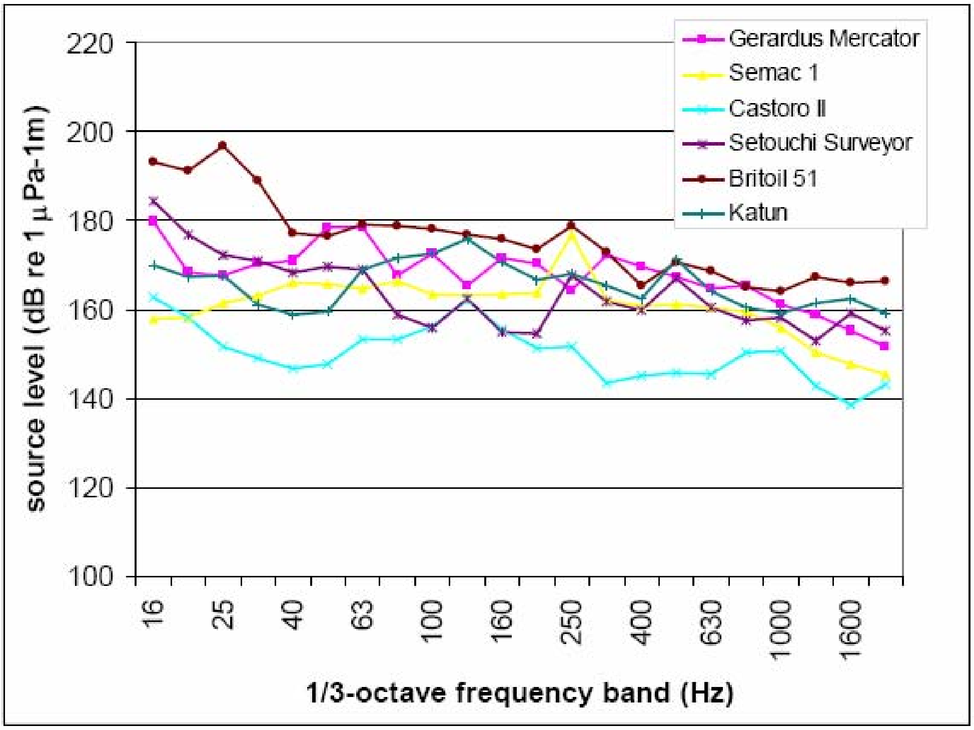
Pipeline Installation
Noise associated with pipeline installation comes primarily from the vessels performing the operations. A typical pipelaying scenario involves a dredger or pipelaying barge, two anchor handling tugs, and a survey vessel. Noise output from these vessels varies slightly depending on

individual vessel specifications. Since the exact vessels to be used during pipelaying operations have not been specified at this time, Neptune modeled several different scenarios involving different combinations of vessels that could be used to conduct the pipelaying work. The vessels modeled and their corresponding broadband source levels are in Table 3 below. The 1/3rd octave band source levels for each vessel are shown graphically in Figure 6.

Table 3. Properties of vessels used during pipelaying operations

Vessel	Type	Length *(m)*	Total engine Power *(hp)*	Broadband Source Level *(dB re 1 μPa-1m)*
Gerardus Mercator	TSHD	152.5	29,000	185.7 *dredging*
Semac 1	Pipelay Barge	148.5	not available	179.2 *pipelaying*
Castoro II	Pipelay Barge	130.0	3,350	168.1 *anchor operations*
Setouchi Surveyor	Survey Vessel	64.6	2,600 + 2,000 (thruster)	186.0 *using thrusters*
Britoil 51	AHTS	45.0	6,600 + 500 (thruster)	199.7 *anchor pulling*
Katun	AHTS	67.6	12,240	181.8 *anchor pulling*

Figure 6. 1/3rd octave band source levels for pipelaying vessels



The pipelaying along the 4.02 km flowline between the northern and southern buoys is scheduled to take 6 days, the trenching 5 days, and the backfilling another 5 days during June and July 2009 (Neptune 2005a). The construction of the 17.45 km northern route pipeline is scheduled to take 22 days to lay pipe, 10 days to trench, and 10 days to backfill (Neptune 2005a).

JASCO's modeling is based on the company's MONM (Marine Operations Noise Model), which has been used in the past to provide estimates of underwater construction-related noise. The model has been demonstrated to be accurate to within 2 dB of actual levels measured in the field. JASCO modeled a total of 4 pipelay scenarios, including the trenching operations at the northern buoy and a point along the northern pipeline route (scenario 1), pipelaying for the flowline between the two buoys (scenario 2 and 3) and pipelaying for the 17.45 km northern route. Of scenarios 2 and 3, scenario 3 resulted in larger 120 dB contours, and thus NMFS will use scenario 3 in order to provide a conservative estimate of potential impacts on endangered species. The results of the modeling are summarized in Table 4 below.

Table 4. Summary of 120-dB contour ranges for pipeline installation operations

Activity	Average 120 dB contour range at surface (km)	Average 120 dB contour range at 50 m depth (km)
Trenching (Northern buoy)	3.9	Not modeled
Trenching (pipeline route)	4.2	Not modeled
Pipelay (flowline - spring)	11.0	10.9
Pipelay (flowline – summer)	10.8	10.6
Pipelay (pipeline route – spring)	6.8	7.6
Pipelay (pipeline route – summer)	6.5	6.9

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 822 supply vessel transits (411 roundtrips) will take place. Although Neptune 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.

Table 5. Summary of Construction Noise Sources and Impact Zones

	Type of noise	Source level (dB re 1μPa)[3]	Dominant Frequencies	180 dB zone	160 dB zone	120 dB zone
Pile-driving (impact)	Pulse; non-continuous	216	160-250 Hz	30-40 m	0.8-1.4 km	26.3-29.9 km
Suction pile	Non-pulse; continuous	138	>1000 Hz	N/A	N/A	<300 m
Pipeline trenching	Non-pulse; continuous	Variable; ~180-200	Variable; generally <250 Hz	N/A	N/A	3.9-4.2 km
Pipe laying	Non-pulse; continuous	Variable; ~180-200	Variable; generally <250 Hz	N/A	N/A	6.5-11 km
Vessel traffic	Non-pulse; continuous	Variable; ~180-200	Variable; generally <250 Hz	Not modeled	Not modeled	Not modeled

Exposure Analysis – Construction Noise

[3] All source levels in Table 5 are reported as RMS sound pressures, except pile-driving, which is reported as peak pressure.

The endangered whale species most likely to be present near the construction activities during the proposed summer timeframe (May-September) are humpback and fin whales. Sightings of right whales in this area and season are rare, but transient right whales have been seen in the vicinity of the proposed terminal during the summer months (Weinrich 2006; NEFSC unpublished data), 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).

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 6. 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 5, it is evident that right, humpback, and fin whales are capable of perceiving construction noises, 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.

Impact pile driving associated with construction of the Neptune LNG terminal will result in sound levels that exceed the 180 dB threshold for potential injury to marine mammals and sea turtles, but only within very short distances from the source. In order to minimize the potential for injury to endangered species due to impact pile driving activity, Neptune LNG has proposed to employ the following mitigation measures if impact pile driving takes place:

1. A 500 m safety zone will be established around pile-driving activity. This safety zone will be monitored, both visually by NMFS-approved endangered species observers and acoustically by a NMFS-approved bioacoustic technician, for at least 30 minutes prior to the start of any pile driving activity. Pile driving activity will not commence until the observers and bioacoustic technician have declared the safety zone clear of sea turtles and whales.

2. Each time a pile driving hammer is started, dry-firing and ramping-up of the hammer will be conducted for at least 30 minutes to allow animals the opportunity to leave the area. Dry firing of a pile driving hammer is a method of raising and dropping the hammer with no compression of the pistons, producing a lower-intensity sound than the full power of the hammer. Ramp-up involves slowly increasing the power of the hammer and noise produced over the ramp-up period.

3. Following the initial 30-minute observations for protected species, continuous visual observations will occur during daylight hours to monitor for sea turtles and whales in the area. Passive acoustic devices will also be actively monitored for detections by a NMFS-

approved bioacoustic technician. If at any time animals are detected in the safety zone during pile driving, the pile driving activity will cease until the animal has left the area of its own volition. Pile driving can resume (following ramp-up procedures) once the animal has been visually confirmed beyond the impact zone, or 30 minutes have passed without re-detecting the animal.

4. If pile driving commenced during daylight hours, pile driving may continue into nighttime hours provided that there has been no interruption in activity. The safety zone will continue to be monitored by a NMFS-approved bioacoustic technician, and shut-down procedures will apply if a whale is detected within the safety zone. However, pile driving will not be initiated or reinitiated during nighttime hours when visual clearance of the zone cannot be conducted.

5. Records will be maintained of all visual and acoustic detections of sea turtle and marine mammals, including relevant details such as date and time, weather conditions, species identification, approximate distance from the pile, direction and heading in relation to the pile driving (if known), and behavioral observations. When animals are detected in the safety zone, additional information will be recorded, including corrective actions taken (e.g., shutdown of the pile driver and duration of the shut-down), behavior of the animal, and time the animal spent in the safety zone. A summary report will be submitted to NMFS at the conclusion of pile-driving activity.

6. Sound pressure levels will be monitored on the first day of pile driving activity and will continue for a duration and in a manner sufficient to ensure that the predicted 180 dB contour is accurate. The safety zone will be adjusted to accommodate any difference between predicted and measured sound levels.

Coverage of the safety zone by both visual and passive acoustic surveillance provides a reasonable likelihood of detecting endangered species in the impact zone. Ramp-up procedures provide further protection for any whale or sea turtle that is undetected by visual or passive acoustic means and enters the 180 dB impact zone prior to the start of pile driving activity. Once pile driving activity has begun, whales and sea turtles are likely to avoid approaching a sound source within a distance that causes pain or injury. Observations of marine mammal avoidance in association with pile driving activity are limited, particularly for large baleen whales. Most pile driving activities take place in shallow, nearshore waters where large baleen whales are rarely observed. However, some data exist for other multiple pulse sound sources, such as seismic airgun activity. There are some significant differences between airgun arrays and pile driving noise, namely that seismic surveys are conducted from a moving vessel while pile driving is a stationary activity, and marine mammals may react differently to noise sources depending on the perceived motion of the source. Watkins (1986) found fin and right whales to be more tolerant of stationary noise sources than an approaching noise source. A sudden onset of loud noise might also elicit a greater startle response at lower received levels than a continuously present noise source (Malme et al. 1985), and may be a response to the novelty of the sound rather than the intensity of the sound source. Nonetheless, seismic pulses remain the best available model for large whale responses to pile driving.

Richardson et al. (1999) observed initiation of avoidance responses to seismic airgun activity at received levels exceeding approximately 120 dB re 1μPa. Ljungblad et al. (1988) observed initiation of avoidance behavior at received levels from as low as 142 dB re 1μPa to 178 dB re 1μPa. Malme et al. (1984) calculated a 90% probability of gray whale avoidance reactions to seismic airgun activity at a received level of 180 dB re 1μPa. Migrating humpback whales near Australia showed general behavioral avoidance to a single airgun at a received level of approximately 168 dB_{p-p} re 1μPa (McCauley et al. 1998).

Data regarding sea turtle avoidance behavior in response to multiple pulse sounds are extremely limited. However, one controlled exposure experiment on caged sea turtles indicated avoidance or alarm responses at received levels of 155-165 dB rms (McCauley et al. 2000). McCauley et al. (2000) reported that green and loggerhead sea turtles will avoid air-gun arrays at 2 km and at 1 km with received levels of 166 dB re 1 μPa and 175 db re 1 μPa, respectively. The sea turtles responded consistently: above a level of approximately 166 dB re 1 μPa $_{rms}$ the turtles noticeably increased their swimming activity compared to non-airgun operation periods. Above 175 dB re 1 μPa mean squared pressure their behavior became more erratic, possibly indicating the turtles were in an agitated state.

Motivational state may influence an individual animal's reaction to noise and threshold for initiation of avoidance behavior, e.g. a feeding right whale might pursue a particularly rich plankton patch in spite of disturbing levels of sound. Nonetheless, passive acoustic detection, visual surveillance, and shut down procedures are in place to protect animals that may approach the area while pile driving is taking place. As such, with the above mitigation measures in place, combined with the limited amount of pile driving necessary for this project (15 days total) and the limited area over which potentially injurious sound levels will propagate (30-40 m), the chance of a sea turtle or whale being exposed to potentially injurious sound levels is discountable.

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 0.8-11.0 km from the sources. Since 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 7-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.

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 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 due to the limited activities producing such sound and the mitigation measures being implemented. 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.

Non-continuous pulses (impact pile-driving)
Observed baleen whale responses to seismic airgun arrays have included rapid swimming away from the seismic vessel (avoidance and displacement) (Ljungblad et al. 1988), unusual or altered respiration, surfacing, and diving behaviors (Richardson et al. 1986), deflection of migration path (Tyack and Clark 1998), and alteration of vocal activity (Watkins 1986; Wartzok et al. 1989). Although these observations are clear indications of a behavioral reaction, very little is known about the type of effect these responses may have on the long-term health and viability of an individual animal or the population as a whole. Displacement from preferred foraging habitat can cause animals to feed in suboptimal conditions, which can affect an individual's overall fitness or reproductive success, particularly for species such as the right whale that do not feed year-round. Of all the potential behavioral responses, displacement from a feeding area is likely to have the most direct, measurable impact on an individual or population. Alterations in the migratory path or an increase in calling intensity, duration, or frequency can lead to increased energy expenditure and thus reduced fitness or increased vulnerability to other stressors in the environment. In general, however, these types of behavioral reactions are likely to have impacts that are cumulative in nature and an individual behavioral response is not likely to have a measurable impact on an animal's capacity to engage in biologically significant behaviors.

Humpback and fin whales in the vicinity of the project area during the summer months are likely to be feeding. Feeding humpback whales off southeastern Alaska showed no clear evidence of avoidance of airgun activity, even at relatively high received levels (172 dB re 1 μPa). This may reflect a reduced sensitivity to noise in the species as a whole (as compared to bowhead whales), habituation by the local population of humpbacks, or increased motivational state to remain in the area because of the available food resource. If the latter is true, the whales present in the area during pile driving activity are not likely to be displaced from a preferred foraging patch. On the other hand, remaining in an area with a potentially disturbing sound source may have other negative impacts such as masking and a general increase in stress. As mentioned previously, whales do adjust their calling behavior to mitigate the effects of masking, although the increased calling rate and/or intensity can result in increased energy expenditure. However, because the behavioral disturbance caused by pile driving will be temporary (15 days of activity), the increased exposure to noise is not likely to result in a level of behavioral disturbance that will significantly affect the health or fitness of an individual whale or the population as a whole. However, take by harassment is unavoidable due to the area of impact (1.4 km) and the abundance of humpback and fin whales in the vicinity of the proposed terminal during the summer months.

Continuous non-pulses (general construction noise)
The remaining noise sources associated with construction, including suction piling, 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 4.2-11 km, depending upon the particular stage of activity (trenching vs. pipelaying). 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).

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 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 can range from 50-140 dB re 1μPa, 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.

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

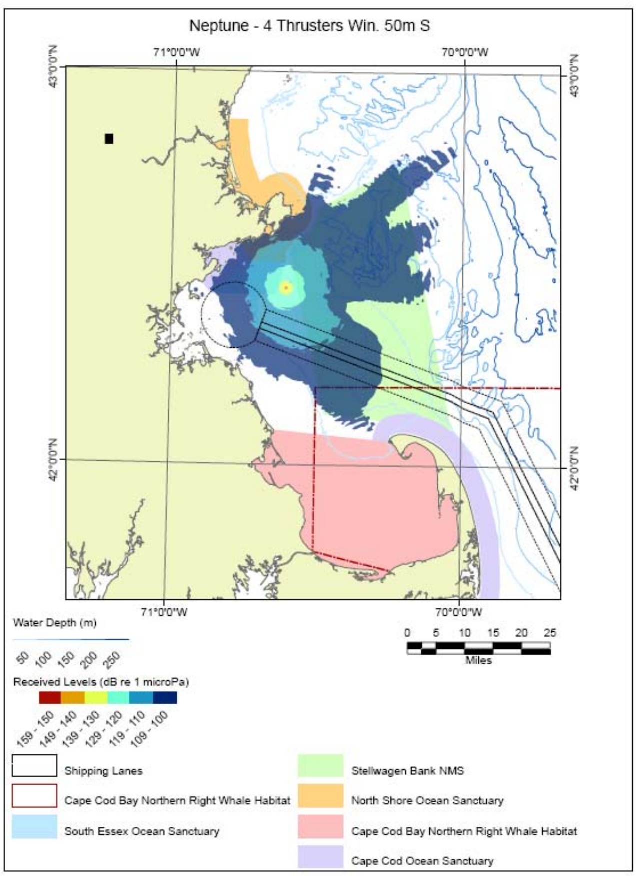
Due to the technology being employed, there is minimal noise associated with the regasification process itself. Noise associated with regasification comes from normal ship operations with the engines turned off, one or two high-pressure, cryogenic LNG pumps, one water-glycol circulation pump, one seawater pump, one cargo pump, and one turbine generator. Although the broadband source level for all of these components together reaches 164.6 dB re 1μPa, peak intensities are in the higher frequencies (1000-2000 Hz). The regasification scenario modeled incorporated the worst-case scenario of two vessels on site (one at each buoy) unloading cargo simultaneously, which is only expected to occur for a brief period of time as one vessel arrives while the other is nearly finished unloading. In this scenario, noise levels did not reach 120 dB re 1μPa within any appreciable distance from the vessel (i.e., within a few meters). In addition, the model did not take into account sound dampening properties of the vessel hull. As such, the noise generated during normal regasification operations is not expected to 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 and to assist the LNG carrier in maintaining position while engaged in the regasification process. Neptune modeled both of these scenarios in all four seasons at both the northern and southern buoys (JASCO 2006).

The dynamic positioning scenario assumes that all four thrusters are operating at full load at the same time (two bow and two stern). This operation is expected to take place for 20 hours annually, in bouts of 10-30 minutes at a time, at alternate buoys every 4-8 days. The broadband source level for all four thrusters operating simultaneously is 187.9 dB re 1μPa, with peak intensities in the lower frequencies (10-100 Hz). Modeling indicates that propagation distances are much shorter at the surface (~1.5 km) than at 50 m or at the bottom, and distances increase slightly as water temperature decreases. However, the estimated distance of the 120 dB contour from the source at both the north and south buoys generally ranges from approximately 5-6 km (see Figure 7).

Figure 7. Ensonified area from use of all four thrusters during winter at the southern buoy, 50 m below the surface.



The thrusters may also be used to maintain the SRV position at the buoy under certain sea state conditions in order to reduce rolling and sloshing of LNG in the cargo tanks. Under this scenario, only the two stern thrusters would be operational, both at 100% load. The thruster noise would be continuous during the periods of use, and it is expected that because of the sea conditions that necessitate use of thrusters, the ambient noise level will already be high due to wind and wave noise. However, since use of thrusters under this scenario are dependent on weather and sea conditions, it is not known how often or for what duration the stern thrusters would be needed to maintain position while the vessel is regasifying at the port. The broadband source level for use of the two stern thrusters at 100% load is 183.2 dB re 1μPa, with peak intensities in the same low frequency range as the previous scenario (10-100 Hz). Modeling of this scenario indicates that the 120 dB contour extends 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.

Vessel Transits (LNG carriers and support vessels)
Source level data specific to the SRVs 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). The Overseas Harriette was used as a model for the SRV in the carrier transit scenarios modeled by Neptune. The Harriette is a large bulk cargo ship 173 m long 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 specifications provided for the LNG carrier are that it is a single propeller 280-m long vessel powered by a geared steam turbine engine with 35,000 hp and a maximum speed of 19.5 knots. The LNG carrier has a 5 blade propeller, 8.6 m in diameter. The Overseas Harriette is therefore less powerful and possibly less loud 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 to demonstrate a possible worst case scenario. At this transit speed, the broadband source level is 192 dB re 1μPa. The carrier would spend about 1.5 hours in the shipping lane through the SBNMS and 0.5 hours traveling from the lane to the buoys.

SRV transits associated with the Neptune terminal will also involve a support vessel accompanying the SRV. The support vessel used in the model was the Neftegaz 22 which is a supply tug 81 m long with 7200 hp and a maximum speed of 15 knots. The support vessel expected to be used is about 40 m long with up to 7000 hp and a maximum speed of 13 knots. The broadband source level of Neftegaz 22 operating at full speed is 186.1 dB re 1 μPa at 1m.

When the transit of the LNG tanker accompanied by the support vessel was modeled at full-speed, results indicate that the 120 dB contour would extend approximately 7.5-9.3 km from the source vessels. When modeled at approximately half speed (8-10 knots), results indicate that the 120 dB contour is greatly reduced, extending approximately 2.4-2.8 km from the source vessels.

In addition to these scenarios, Neptune also modeled the transit of a single LNG carrier in the Boston TSS prior to accompaniment by a support vessel, at a point near the Cape Cod Bay right whale critical habitat. At a transit speed of 10 knots, the 120 dB contour extends 0.54-1.72 km from the vessel, and at a speed of 14 knots, the 120 dB contour extends 0.75-2.39 km (see Figure 8).

Figure 8. Transit of single LNG carrier at 10 knots during winter at 50 m depth.

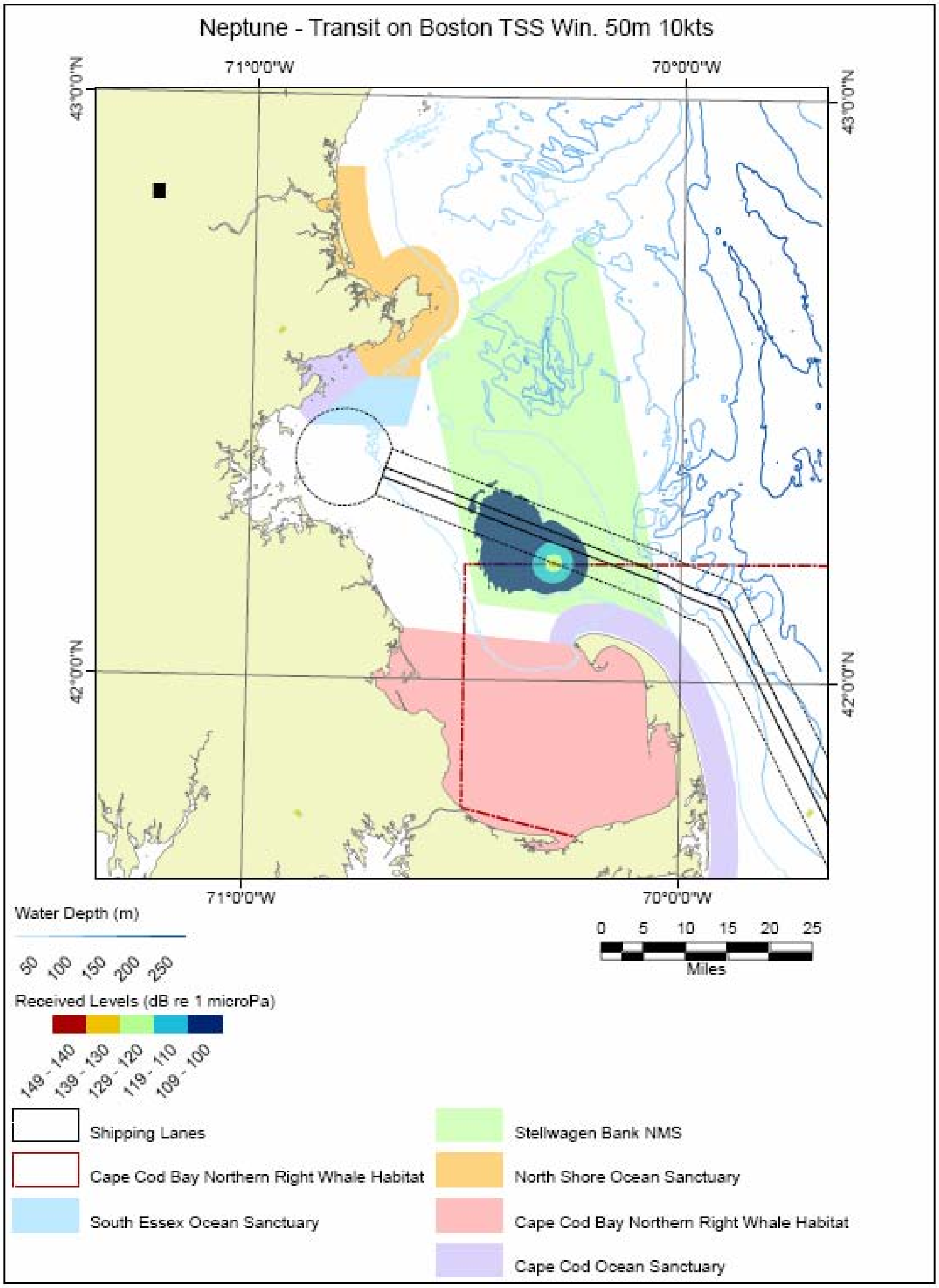


Table 7. Summary of operational noise source characteristics

	Source level (dB re 1μPa RMS)	Dominant Frequencies	120 dB zone (surface)	120 dB zone (50 m-bottom)
Bow thrusters – dynamic positioning	187.9	10-100 Hz	1.5 km	5-6 km
Bow thrusters – maintaining position	183.2	10-100 Hz	0.92-0.96 km	3-4 km
SRV transit with support vessel (10 knots)	174.7 (SRV) 183.6 (support)	50 Hz	Not modeled	2.4-2.8 km
SRV transit alone (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 SRV'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 SRV 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 Neptune 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.

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 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 20-30 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 20-30 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 (Neptune 2006). 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, 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 20-30 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 range 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 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 SRV 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 SRV 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 Neptune SRV 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 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 Neptune 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 Neptune 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

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 2006). 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 2006). 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.

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).

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 SRVs to and from the Neptune 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 pile driving or other 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 SRVs or construction vessels to and from the Neptune 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. Mitigation measures implemented during impact pile driving minimize the potential for acoustic-related injuries to 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 SRV 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 SRV. 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 Neptune 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 Neptune 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 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 ESA 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 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), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of an Incidental Take Statement (ITS).

NMFS has concluded that the construction and operation of the Neptune LNG deepwater port is likely to result in take of Northern right, humpback, and fin whales in the form of harassment, where habitat conditions (i.e., 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 (20-30 minutes per week).

This BO does not include an ITS at this time. Upon issuance of regulations or authorizations under Section 101(a)(5) of the Marine Mammal Protection Act and/or its 1994 Amendments, NMFS will amend this BO to include an incidental take statement(s) for the described work.

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.

11.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the issuance of a license for the construction and operation of the Neptune 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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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 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: 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.

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.

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.

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.

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.

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 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.

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.

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.

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.

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. 2006. 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.

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 physalu*s) and humpback *(Megaptera novaeanglia*e) 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.

Weinrich, M., J. Tackaberry, and K. Sardi. 2006. The distribution of endangered baleen whales in the waters surrounding the Neptune LNG proposed deepwater port site: 1996-2005. Report prepared for Neptune LNG LLC by 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. 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.

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 Neptune LNG Deepwater Port (July 17, 2006), available on the USCG docket at http://dms.dot.gov, docket #22611. Since SBNMS issued their recommendations, details have been further developed and modified through discussions with the USCG and Neptune. 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.

Proposal 1: Mitigate increased risk of vessel collision due to operation of the Neptune 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 Neptune SRVs 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.

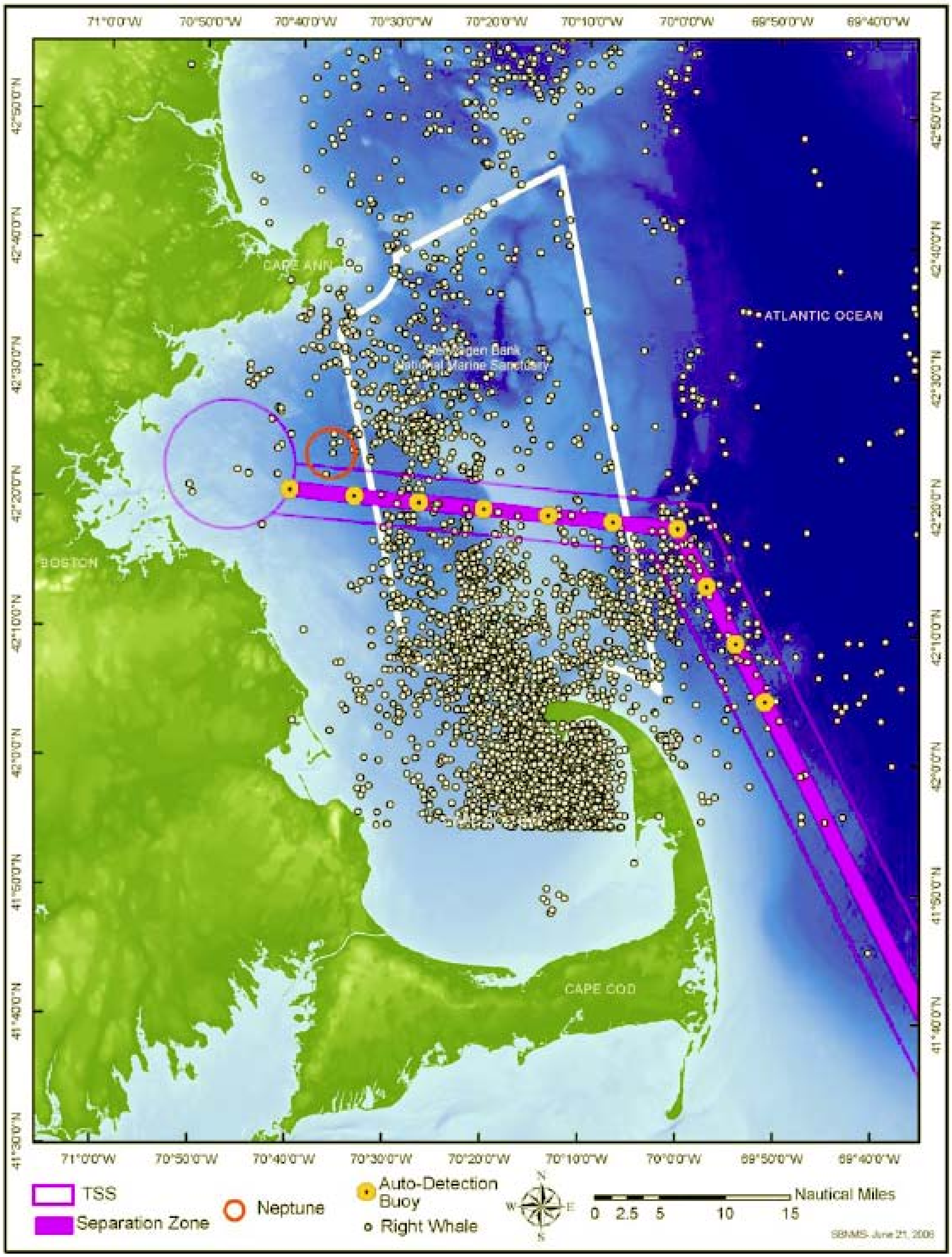


Figure 1. Research design for near-real-time auto detection of endangered whales for vessels in and around the Boston TSS to reduce risk of vessel collisions. Right whale sighting data for areas of interest was taken from the North Atlantic Right Whale Consortium Database.

Proposal 2: Monitor acoustic output during construction of the Neptune 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

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.

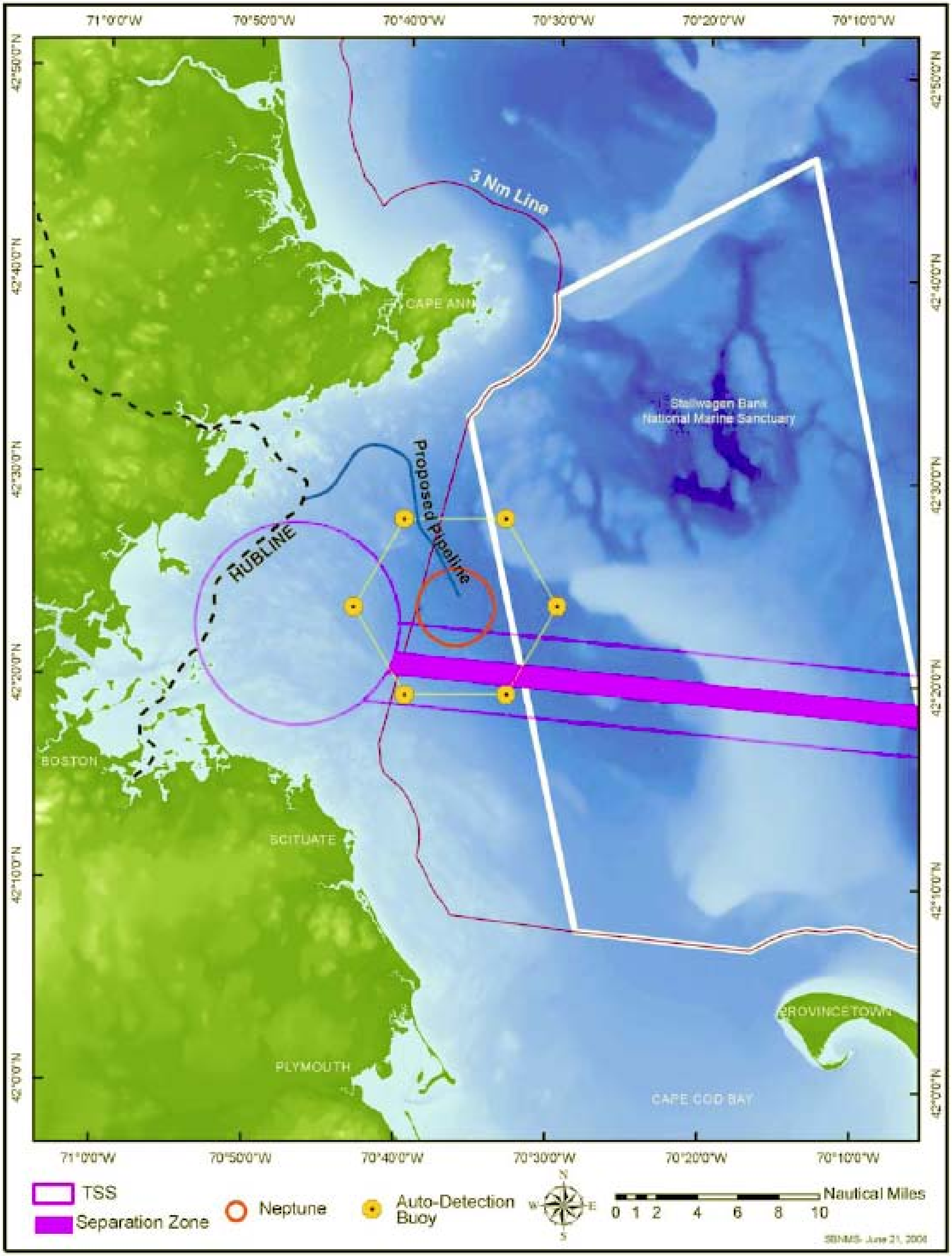


Figure 2. Research design for near-real-time auto detection of endangered whales in the Neptune LNG deepwater port and pipeline construction area to minimize acoustic harassment.

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

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.

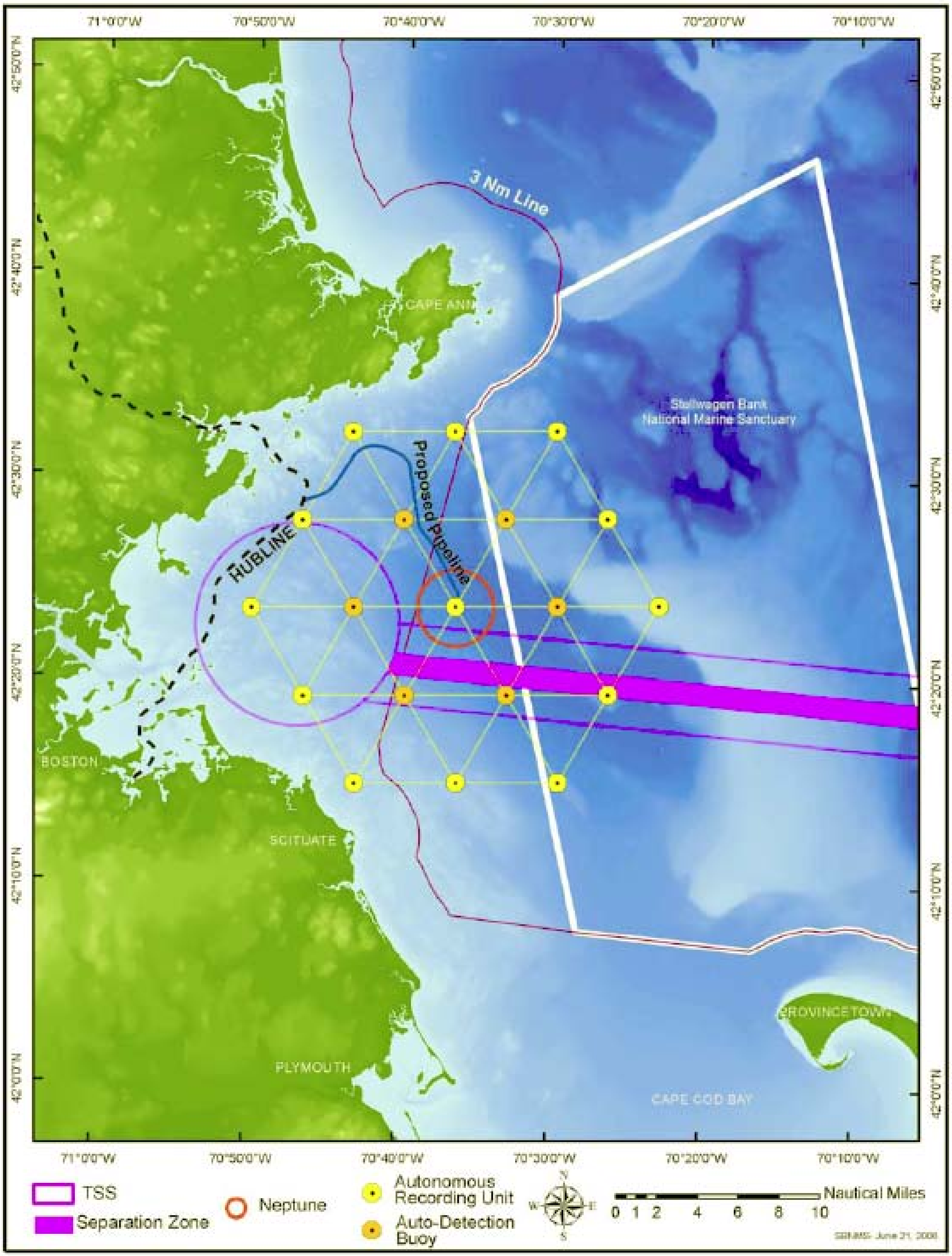


Figure 3. Research design for long-term passive acoustic monitoring program for Neptune port operations

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 Neptune in the biological opinion on the construction and operation of the Neptune 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, 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.