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 own and operate an LNG deepwater port
F/NER/2010/01455
GARFO-2010-00006

Conducted by: National Marine Fisheries Service
Northeast Regional Office

Date Issued: July 12, 2010

Approved by: [signature]

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 and operate a liquefied natural gas (LNG) deepwater port off the coast of Massachusetts on threatened and endangered species in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). MARAD has served as the lead Federal action agency for this consultation, but this BO also considers the effects of permits issued by the Army Corps of Engineers (ACOE), the Federal Energy Regulatory Commission (FERC), and the Environmental Protection Agency (EPA) for various portions of the maintenance and operation of the port and associated pipeline. This BO is based on information provided in the Neptune LNG Deepwater Port License biological assessment (BA), correspondence with MARAD, the previous BO dated January 12, 2007 (F/NER/2006/04000) on the issuance of a license to Neptune to construct, own, and operate an LNG deepwater port 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 March 19, 2010.

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1.0 CONSULTATION HISTORY

Previous consultation on MARAD's issuance of a license to Neptune LNG to own, construct, and operate the Neptune Deepwater Port was initiated on August 21, 2006 and completed on January 12, 2007. Complete consultation history for this action is available in the BO dated January 12, 2007 (NMFS 2007).

During the previous consultation, NMFS assessed the impacts of construction and operation of the Neptune port on listed species. The BO concluded that project activities were likely to result in take of Northern right (*Eubalaena glacialis*), humpback (*Megaptera novaeaengliae*), and fin (*Balaenoptera physalus*) whales in the form of harassment, but were not likely to jeopardize the continued existence of these species. Because takes had not yet been authorized pursuant to section 101(a)(5) of the Marine Mammal Protection Act (MMPA), the January 12, 2007 BO did not include an incidental take statement (ITS).

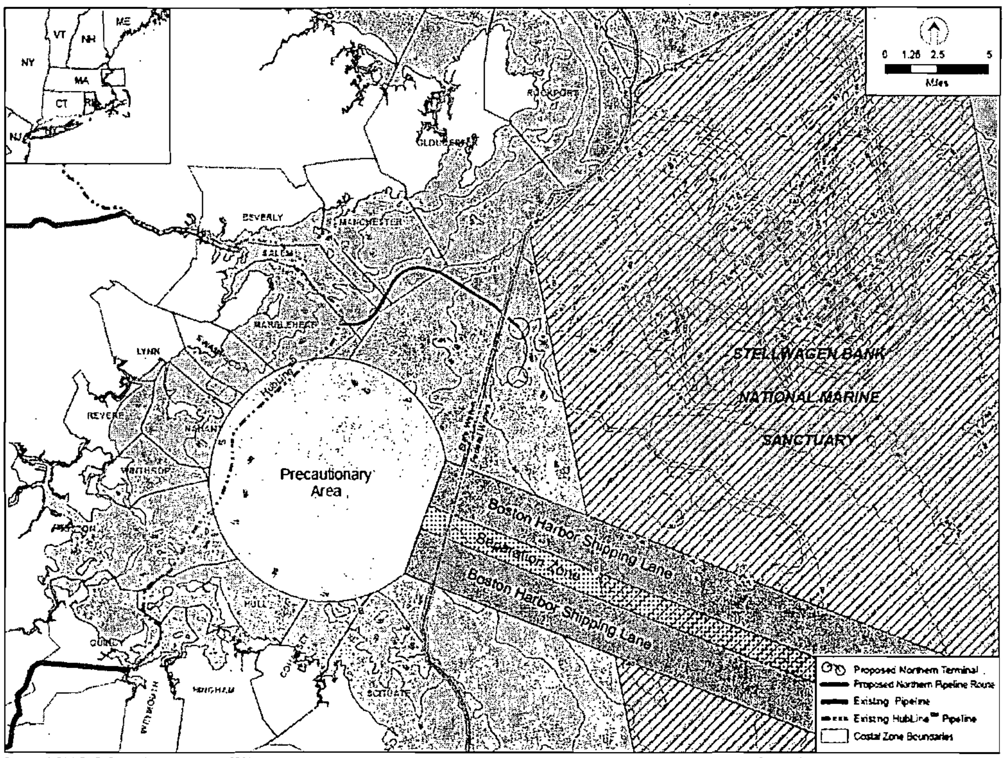
On December 27, 2007, NMFS received Neptune's application for an Incidental Harassment Authorization (IHA) pursuant to the MMPA. The application included some proposed modifications that differed from what was analyzed in the January 12, 2007 BO. On January 25, 2008, the US Coast Guard (USCG) notified NMFS and other permitting agencies that Neptune had submitted a project change request to the USCG. The project change included slight alterations to the buoy locations and pipeline route, as well as a modified construction schedule. Neptune proposed to shift the northern buoy approximately 1,000 ft. from its originally proposed location, and shift the southern buoy approximately 2,000 ft. from its originally proposed location. However, the new locations were within the corridors initially analyzed in the Environmental Impact Statement (EIS) for the project. The sediment type in the new locations was similar to that at the previous locations, and allowed Neptune to eliminate the possibility of requiring impact pile driving at the port installation site. The new buoy locations also resulted in a shorter pipeline route. Neptune also proposed to begin construction one year earlier (in July 2008 as opposed to May 2009), but divide construction across 2 years in order to maintain the originally anticipated operational start date of summer/fall 2009. Neptune committed to adhere to the original May-November seasonal construction window to avoid impacts to North Atlantic right whales and further clarified that construction would be limited to the originally proposed 7-month total duration. NMFS reviewed the proposed changes and determined that the triggers for reinitiation of consultation at 50 CFR 402.16 had not been met, and Neptune was issued an IHA on June 12, 2008. Subsequently, an ITS was appended to the BO on June 16, 2008.

Construction of the Neptune port proceeded as scheduled from July 2008-November 2009. On December 14, 2009, Neptune submitted an application to NMFS to renew their IHA for potential take of marine mammals during operations from July 1, 2010-June 30, 2011. The application included a description of potential pipeline and port repair and maintenance activities that had not been included in the previous request, and could potentially result in additional take of marine mammals that had not been analyzed in the January 12, 2007 BO. The potential for this additional level of take is considered a modification not previously considered in the January 12, 2007 BO and ITS. As the lead action agency for the Neptune LNG project, MARAD requested reinitiation of consultation on March 2, 2010 and submitted Neptune's IHA application as the biological assessment for the project. Consultation was reinitiated on March 19, 2010.

2.0 DESCRIPTION OF THE PROPOSED ACTION

The Neptune LNG port is located in the federal waters of the Outer Continental Shelf (OCS) in blocks NK 19-04 6525 and NK 19-04 6575, approximately 22 miles northeast of Boston, Massachusetts, in a water depth of approximately 260 feet (Figure 1). The purpose of Neptune is for import of liquefied natural gas into the New England region. The Neptune port is capable of mooring LNG Shuttle and Regasification Vessels (SRVs) with a capacity of approximately 140,000 cubic meters. Up to two SRVs will temporarily moor at the deepwater port by means of a submerged unloading buoy system. Each buoy is 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 are submerged approximately 100 ft (30.5 m) below the sea surface. The dual buoy design allows 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 will 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. The annual average throughput capacity will be around 500 mmscfd with an initial throughput of 400 mmscfd, and a peak capacity of approximately 750 mmscfd. The SRVs are equipped to store, transport, and vaporize LNG, and to odorize, meter, and send out natural gas by means of two 16-inch flexible risers and one 24-inch subsea flowline. These risers and flowline lead to a 24-inch gas transmission pipeline connecting the deepwater port to the existing 30-inch Algonquin HubLineSM (HubLineSM) located approximately 9 miles west of the deepwater port location. The deepwater port has an expected operating life of approximately 25 years.

Figure 1. Project location



Sourece: NOAA ENC (Electronic Nautical Chart) 2004

Figure 2. Neptune port schematic

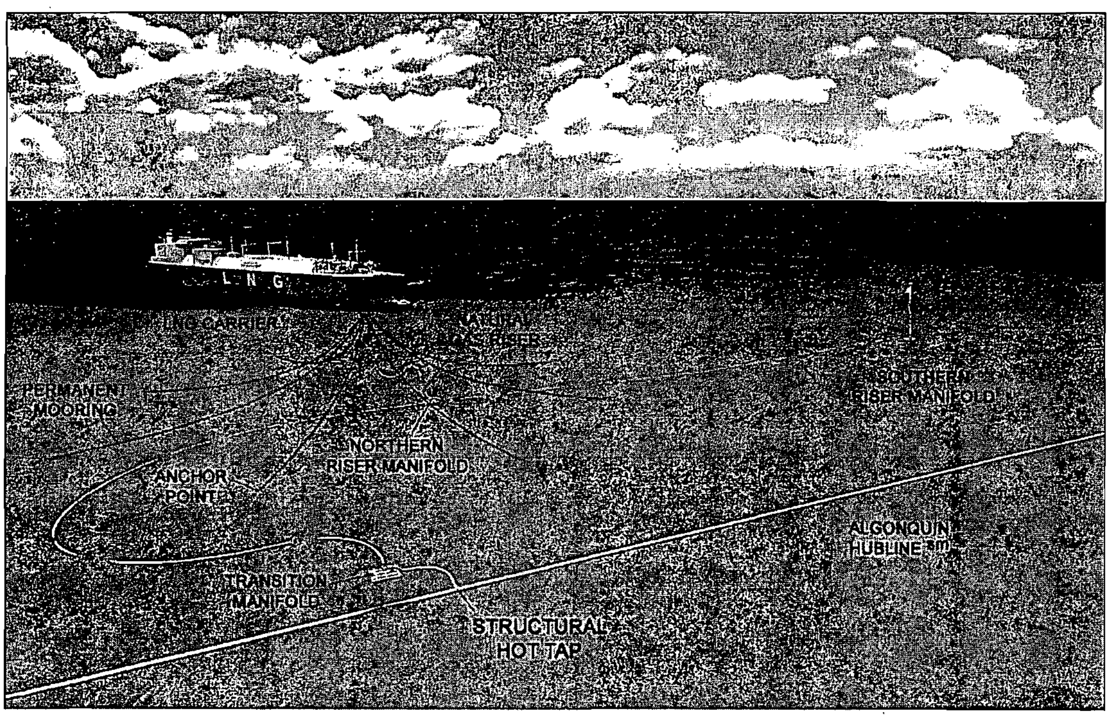
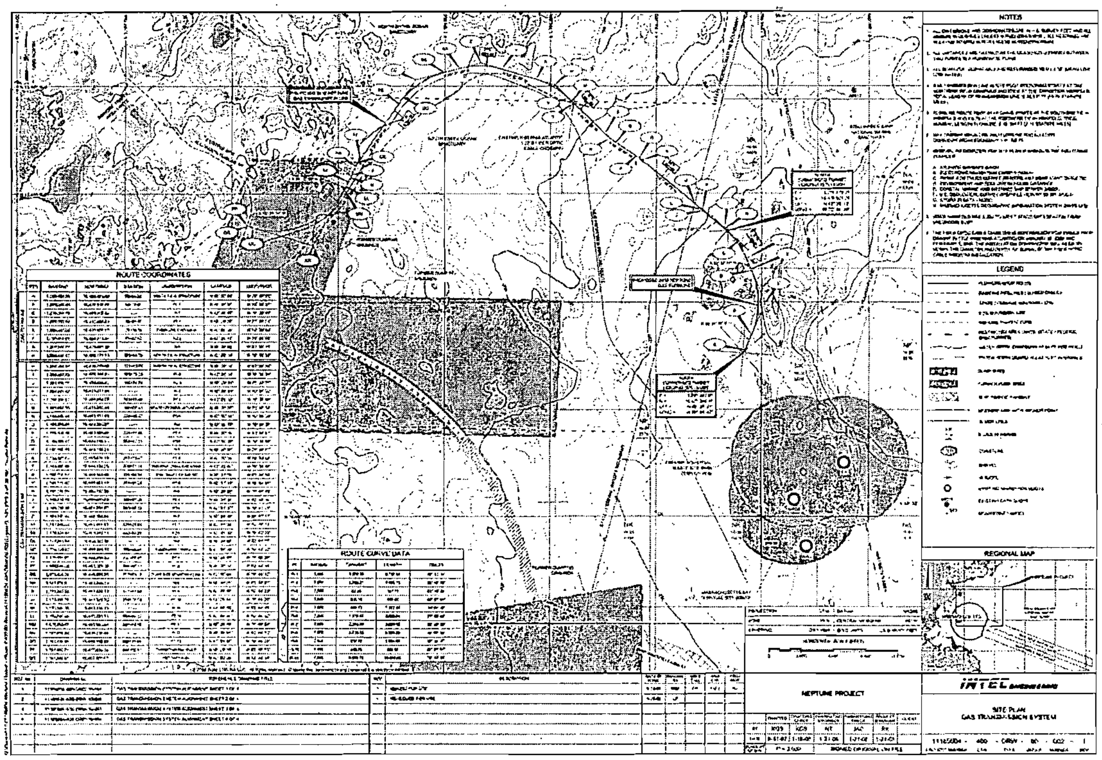


Figure 3. Pipeline and flowline routes



The previous BO, dated January 12, 2007, assessed the impacts of construction and operation of the Neptune port and pipeline lateral on NMFS listed species in the action area. As described in the Consultation History, construction of the Neptune port and pipeline lateral was completed in November 2009, and commissioning of the port was completed in May 2010. However, periodic maintenance work on the port and pipeline had the potential to result in additional take of listed whales that had not been considered in the previous BO and therefore, triggered reinitiation of consultation on the Neptune deepwater port activities. Since construction has already been completed, the only activities remaining for the project are ongoing operations and maintenance and future decommissioning at the end of the useful life of the port. Therefore, the action for this consultation will be limited to these activities. For a complete assessment of the effects of port and pipeline construction on listed species, please see the previous BO dated January 12, 2007.

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.

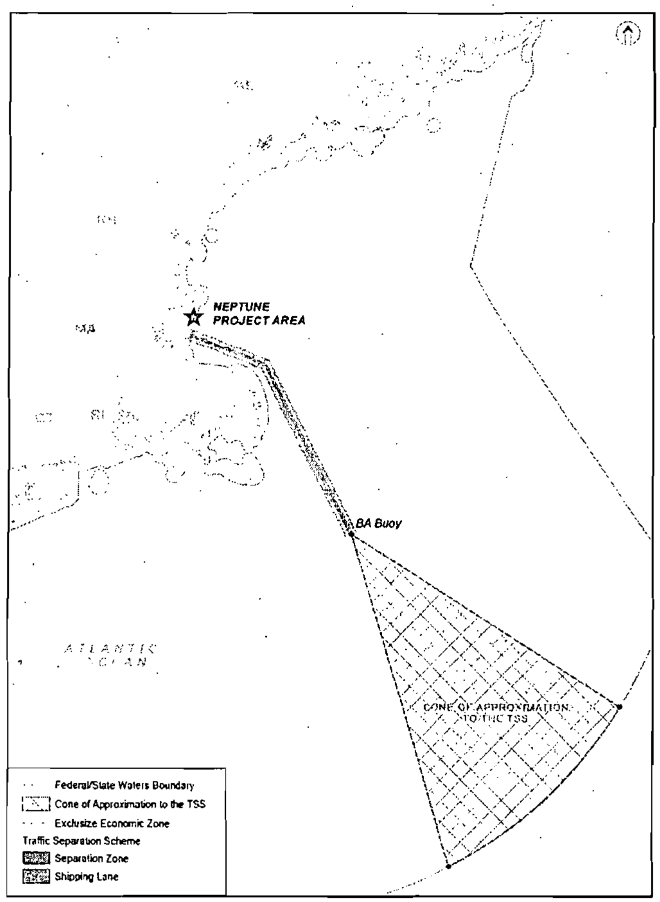
Fifty roundtrip SRV transits will take place each year to supply a continuous flow of natural gas into the pipeline (one transit every 3.65 days). The vessels would be traveling to and from LNG supply locations such as Trinidad, Africa, and the Middle East. The SRVs will approach the port using the Boston 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 will be met by a pilot vessel and a support vessel. A pilot will board the SRV, and the support vessel will 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 4 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

Figure 4. SRV cone of approach into US EEZ



SRVs carrying LNG typically travel at speeds up to 19.5 knots. However, Neptune SRVs will 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.

Regasification System
Each SRV will be equipped with three vaporization units, each with the capacity to vaporize 250 MMscfd. Under normal operation, two units will 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 will 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 will be pressurized using pumps and is heated from –261 degrees Fahrenheit (°F) to a minimum of 32°F. LNG from the storage tanks in an SRV is withdrawn by means of low-pressure in-tank pumps. The LNG is boosted to a working pressure of up to 1,740 pounds per square inch (psi) using a high-pressure cryogenic pump.

The LNG is heated in a two-step closed-loop system. In the first step, a water-glycol solution is 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 heats 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 will be metered and odorized, then discharged via a trunk in the forward part of the SRV that houses 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 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 are located in the unloading buoy trunk within the hull of the SRV. The trunk is 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 will use approximately 2.25 million gallons per day (mmgpd) of seawater for supplying ballast tank needs. The ballast water will 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 will 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 will 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 will not exceed 0.47 fps. No seawater will be discharged while SRVs are moored and regasifying cargo. All cooling water will 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 will 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 Maintenance/Repairs

Routine maintenance activities typically are short in duration (several days or less) and require small (vessels less than 300 gross tons) vessels to perform. Such activities include attaching and detaching and/or cleaning the buoy pick up line to the STL buoy, performing surveys and inspections with a remotely operated vehicle, and cleaning or replacing parts (e.g., bulbs, batteries, etc.) on the floating navigation buoys. Every seven to 10 years, Neptune will run an intelligent pig down the pipeline to assess its condition. This particular activity will require several larger, construction-type vessels and several weeks to complete.

Unplanned repairs can be either relatively minor, or in some cases, major requiring several large, construction-type vessels and an extensive mitigation program similar to that employed during the construction phase of the project. Minor repairs are typically shorter in duration and could include fixing flange or valve leaks, replacing faulty pressure transducers, or repairing a stuck valve. These kinds of repairs require one diver support vessel with three or four anchors to hold its position. Minor repairs could take from a few days to one to two weeks depending on the nature of the problem. Major repairs, on the other hand, are longer in duration and typically require large construction vessels similar to those used to install the pipeline and set the buoy and anchoring system. These vessels will typically mobilize from local ports or the Gulf of Mexico. Major repairs require upfront planning, equipment procurement, and mobilization of vessels and saturation divers. Examples of major repairs – although unlikely to occur – are damage to a riser or umbilical and their possible replacement, damage to the pipeline and manifolds, or anchor chain replacement. These types of repairs could take one to four weeks or possibly longer.

2.3 Decommissioning

The Neptune deepwater port will have an expected operating life of 25 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 operations, 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.

Port and Pipeline Major Maintenance/Repair Measures (May 1 to November 30)

Visual Monitoring Program

- During maintenance- and repair-related activities, Neptune LNG shall employ two qualified marine mammal observers (MMOs) on each vessel that has a DP system. All MMOs must receive NOAA-approved marine mammal observer training and be approved in advance by NOAA after a review of their resume. Qualifications for these MMOs shall include direct field experience on a marine mammal observation vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico.

- The MMOs (one primary and one secondary) are responsible for visually locating marine mammals at the ocean's surface and, to the extent possible, identifying the species. The primary MMO shall act as the identification specialist and the secondary MMO will serve as data recorder and will assist with identification. Both MMOs shall have responsibility for monitoring for the presence of marine mammals.

- The MMOs shall monitor the area where maintenance and repair work is conducted beginning at daybreak using 25x power binoculars and/or hand-held binoculars. Night-vision devices must be provided as standard equipment for monitoring during low-light hours and at night. The MMOs shall scan the ocean surface by eye for a minimum of 40 minutes every hour. All sightings must be recorded on marine mammal field sighting logs.

Passive Acoustic Monitoring (PAM) Program

- In addition to visual monitoring, Neptune LNG shall work with NOAA (NMFS and SBNMS) to install a passive acoustic system (similar to the surface acoustic buoys used during construction) to detect and provide early warnings for potential occurrence of right whales in the vicinity of any major repair area. The number of passive acoustic detection buoys installed around the activity site will be commensurate with the type and spatial extent of maintenance/repair work required, but must be sufficient to detect vocalizing right whales within the 120-dB impact zone.

- Neptune LNG shall provide empirically measured source level data for all sources of noise associated with LNG port maintenance and repair activities. Measurements will be carefully coordinated with noise-producing activities and will be collected from the PAM network. Results will be provided to NOAA through annual reporting.

Distance and Noise Level for Cut-Off

- During maintenance or repair activities, the following procedures shall be followed upon detection of a marine mammal within 0.5 mile (0.8 kilometer) of the repair/maintenance vessels:
  - If any marine mammals are visually detected within 0.5 mile (0.8 kilometer) of the repair vessel(s), the vessel(s) superintendent or on-deck supervisor must be notified immediately. The vessel's crew shall be put on a heightened state of alert. The marine mammal must be monitored constantly to determine if it is moving toward the repair area.
  - Repair vessel(s) must cease any movement and/or cease all activities that emit noises with source level of 139 dB re 1 µPa or higher when a right whale is sighted within or approaching at 500 yards (457 meters) from the construction vessel.
  - Repair vessel(s) must cease any movement and/or cease all activities that emit noises with source levels of 139 dB re 1 µPa or higher when a marine mammal other than a right whale is sighted within or approaching at 100 yards (91 meters) from the repair vessel.
  - Any vessels transiting the repair area, such as pipe haul barge tugs, must also maintain these separation distances.
  - Repair activities must not resume before the marine mammal is positively reconfirmed outside the established zones (either 500 yards [457 meters] or 100 yards [91 meters] range, depending upon the species).

- Vessel captains must understand that noise generated from thrusters during DP is the most likely source of a "take" to marine mammals; therefore, DP vessel captains shall focus on reducing thruster power to the maximum extent practicable, taking into account diver safety. Likewise, vessel captains shall shut down thrusters whenever they are not needed.

Vessel Strike Avoidance

- While underway, all repair vessels must remain 500 yards (457 meters) away from right whales and 100 yards (91 meters) away from all other whales to the extent physically feasible, given navigational constraints as required by NOAA.

- All repair vessels greater than or equal to 300 gross tons must maintain a speed of 10 knots or less. Vessels of less than 300 gross tons carrying supplies or crew between the shore and the repair site shall contact the Mandatory Ship Reporting System (MSRS), the USCG, or the MMOs at the repair site before leaving shore for reports of recent right whale sightings or active Dynamic Management Areas (DMAs) and, consistent with navigation safety, restrict speeds to 10 knots or less within 5 miles (8 kilometers) of any sighting location and within any existing DMA.

- Vessels transiting through the Cape Cod Canal and Cape Cod Bay between January 1 and May 15 must reduce speed to 10 knots or less, follow the recommended routes charted by NOAA to reduce interactions between right whales and shipping traffic, and avoid identified aggregations of right whales in the eastern portion of Cape Cod Bay.

Additional Measures for Major Maintenance/Repair Work from December-April

If unplanned/emergency repair activities cannot be conducted between the May 1 and November 30 optimal window, the following additional mitigation measures shall be implemented:

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

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

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

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

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

- Vessels transiting through the Cape Cod Canal and Cape Cod Bay between January 1 and May 15 must reduce speed to 10 knots or less, follow the recommended routes charted by NOAA to reduce interactions between right whales and shipping traffic, and avoid identified aggregations of right whales in the eastern portion of Cape Cod Bay.

Reporting

- For any repair work associated with the pipeline lateral or other port components, Neptune LNG shall notify appropriate NOAA staff as soon as practicable after it is determined that repair work must be conducted.

- During maintenance and repair of the pipeline lateral or other port components, weekly status reports must be provided to NOAA using standardized reporting forms. The weekly reports should include data collected for each distinct marine mammal species observed in the project area in the Massachusetts Bay during the period of port repair activities. The weekly reports shall include:
  - The location, time, and nature of the pipeline lateral repair activities;
  - Whether the DP system was operated and, if so, the number of thrusters used and the time and duration of DP operation;
  - Marine mammals observed in the area (number, species, age group, and initial behavior);
  - The distance of observed marine mammals from the repair activities;
  - Whether there were changes in marine mammal behaviors during the observation;
  - Whether any mitigation measures (power-down, shutdown, etc.) were implemented;

- Weather condition (sea state, wind speed, wind direction, ambient temperature, precipitation, and percent cloud cover, etc.);
- Condition of the marine mammal/sea turtle observation (visibility and glare)
- Details of passive acoustic detections and any action taken in response to those detections.

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 appears likely to occur, all potentially entangling material will be removed from the water immediately.

- Knotless and nonfloating lines will be used on maintenance/repair 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.

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 and/or DMA information through NAVTEX, NOAA Weather Radio, NOAA's Right Whale Sighting Advisory System (SAS) or other means. 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) and/or DMAs, 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 Section 7 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 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 maintenance/repair 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 maintenance/repair support vessel transits from local ports such as Boston, MA and Gloucester, MA, or the Gulf of Mexico, 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. Buoy coordinates

Component	Latitude	Longitude	Lease Block
Northern Buoy	42° 29′ 13″	70° 36′ 30″	NK 19-04 6525
Southern Buoy	42° 27′ 21″	70° 36′ 07″	NK 19-04 6575

The gas transmission pipeline begins at the existing HubLine pipeline approximately 3 miles east of Marblehead Neck, Massachusetts. From this point, the pipeline extends toward the northeastcrossing 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 6.4 miles. The transmission line route continues to the southeast for approximately 4.5 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
North Atlantic 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.

Effects of Neptune port and pipeline construction and operation on listed loggerhead, Kemp's ridley, leatherback, and green sea turtles and sperm and blue whales were considered in the previous biological opinion dated January 12, 2007. The BO concluded that the activities were not likely to adversely affect these species. Installation of the pipeline and the associated plowing and trenching activities were the activities that were most likely to affect sea turtles due to destruction of benthic prey resources and increased turbidity that might impact foraging success. The maintenance and repair work being considered as part of the action in this BO may involve limited excavation of portions of the pipeline, which will take place using diver-operated jetting or dredging tools. These activities will disturb the benthic environment and result in temporarily increased turbidity, but never on the scale of the initial pipeline installation. Sea turtles are known to be taken in hopper dredges, but are not likely to be impacted by hand-operated dredging equipment due to the much lower suction power and slower speed of hand-operated dredges. In addition, the dredge will be manipulated by a diver on the sea floor who will be able to maintain dredge contact with the sea floor and avoid any sea turtles in the path of

[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.

the dredge. Therefore, the unplanned maintenance work is not likely to adversely affect listed sea turtles, and these species will not be considered further in this BO. For a complete assessment of the effects of construction and operation on sea turtles, refer to the BO dated January 12, 2007.

LNG carrier transits to and from the port during the course of operations are the only activities that have the potential to impact sperm and blue whales, as these species generally occur further offshore and are rare in the vicinity of the port and pipeline. The maintenance and repair work will occur only in the vicinity of the port and/or pipeline where presence of these species is unlikely. Operational carrier transits or their anticipated effects on blue and sperm whales have not changed. Therefore, the operation of the Neptune port is not likely to adversely affect sperm and blue whales, and these species will not be considered further in this BO. For a complete assessment of the effects of port construction and operation on these species, refer to the BO dated January 12, 2007.

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.

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 can be found in a number of published documents including recent status reviews and stock assessments, Recovery Plans for the humpback whale (NMFS 1991a), right whale (NMFS 1991b, NMFS 2005), fin and sei whale (NMFS 1998b), and the 2009 marine mammal stock assessment report (Waring *et al.* 2009).

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, and sei whales. 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 North Atlantic Right Whale

Historically, right whales have occurred 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).

The North Atlantic right whale (*Eubalaena glacialis*) has been listed as endangered under the Endangered Species Act (ESA) since 1973. It was originally listed as the "northern right whale" as endangered under the Endangered Species Conservation Act, the precursor to the ESA in June 1970. The species is also designated as depleted under the Marine Mammal Protection Act (MMPA).

In December 2006, NMFS completed a comprehensive review of the status of right whales in the North Atlantic and North Pacific Oceans. Based on the findings from the status review, NMFS concluded that right whales in the northern hemisphere exist as two species: North Atlantic right whale (*Eubalaena glacialis*) and the North Pacific right whale (*Eubalaena japonica*). NMFS determined that each of the species is in danger of extinction throughout its range. In 2008, based on the status review, NMFS listed the endangered northern right whale (*Eubalaena spp.*) as two separate endangered species: the North Atlantic right whale (*E. glacialis*) and North Pacific right whale (*E. japonica*) (73 FR 12024).

The International Whaling Commission (IWC) recognizes two right whale populations in the North Atlantic: a western and eastern population (IWC, 1986). It is thought that the eastern population historically migrated along the coast from northern Europe to northwest Africa. The current distribution and migration patterns of the eastern North Atlantic right whale population, if extant, are unknown. Sighting surveys from the eastern Atlantic Ocean suggest that right whales present in this region are rare (Best *et al.*, 2001), 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.

Habitat and Distribution

Western North Atlantic right whales generally occur from the southeast U.S. to Canada (*e.g.*, Bay of Fundy and Scotian Shelf) (Kenney 2002; Waring *et al.* 2007). 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). Right whale movements and habitat have been described as follows:

> The distribution of right whales seems linked to the distribution of their principal zooplankton prey, calanoid copepods (Winn *et al.* 1986; NMFS 2005; Baumgartner and Mate 2005; Waring *et al.* 2007). 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; Kenney *et al.* 1995; Kenney 2001) where they have been observed feeding predominantly on copepods of the genera *Calanus* and *Pseudocalanus* (Baumgartner and Mate 2005; Waring *et al.* 2007). 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 summer through fall (Mitchell *et al.* 1986; Winn *et al.* 1986; Stone *et al.* 1990). Calving occurs in the winter months in coastal waters off of Georgia and Florida (Kraus *et*

al. 1988). In the North Atlantic it appears that not all reproductively active females return to the calving grounds each year (Kraus *et al.*, 1986; Payne, 1986). The location of the majority of the population during the winter months remains unknown (NMFS 2005).

While right whales are known to congregate in the aforementioned areas, much is still not understood and movements within and between these areas are extensive (Waring *et al.* 2009). 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 (NMFS 2005, Waring *et al.* 2007). 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.* 2007). 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; Bowman 2003; Baumgartner and Mate 2005). Knowlton *et al.* (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland; in addition, resightings of photographically identified individuals have been made off Iceland, arctic Norway, and in the old Cape Farewell whaling ground east of Greenland. The Norwegian sighting (September 1999) represents one of only two sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. Similarly, records from the Gulf of Mexico (Moore and Clark, 1963; Schmidly *et al.*, 1972) represent either geographic anomalies or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern United States. The frequency with which right whales occur in offshore waters in the southeastern U.S. remains unclear (Waring *et al.*, 2009).

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).

Abundance estimates and trends

Although an estimate of the pre-exploitation population size for the North Atlantic right whale is not available, it is well known and documented that there are relatively few right whales remaining in the western North Atlantic. 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 to a minimum direct-count estimate of 263 right whales alive in 1996 and noted that the true population was unlikely to be greater than this estimate (Best *et al.* 2001). Based on a census of individual whales using photo-identification techniques and an assumption of mortality for those whales not seen in seven years, a total 299 right whales was estimated in 1998 (Kraus *et al.* 2001), and a review of the photo-ID recapture database on October 10, 2008, indicated that 345 individually recognized whales were known to be alive during 2005 (Waring *et al.* 2009). Because this 2008 review was a nearly complete census, it is assumed this estimate represents a minimum population size. The minimum number alive population index for the years 1990-2004 suggests a positive trend in numbers. These data reveal a significant increase in the number of catalogued whales alive during this period, but with significant variation due to apparent losses exceeding gains during 1998-1999. Mean growth rate for the period was 1.9% (Waring *et al.* 2009).

A total of 235 right whale calves have been born from 1993-2007 (Waring *et al.* 2009). The mean calf production for the 15-year period from 1993-2007 is estimated to be 15.6/year (Waring *et al.* 2009). Calving numbers have been sporadic, with large differences among years, including a record calving season in 2000/2001 with 31 right whale births (Waring *et al.* 2007). The three calving years (97/98; 98/99; 99/00) prior to this record year provided low recruitment levels with only 11 calves born. The last seven calving seasons (2000-2007) have been remarkably better with 31, 21, 19, 17, 28, 19, and 23 births, respectively (Waring *et al.* 2009). A preliminary calf count for the 2008/2009 season indicates a new record calving season of 39 calves (Zoodsma, pers. comm.). However, the subpopulation has also continued to experience losses of calves, juveniles and adults. As of August 1, 2008, there were 528 individually identified right whales in the photo-identification catalog of which 25 were known to be dead, 135 were presumed to be dead as they had not been sighted in the past six years and 368 were presumed to be alive (Hamilton *et al.* 2008). Although the population has seen some growth over the past 8 years, the level of growth is significantly lower than healthy populations of large whales (Pace *et al.* 2008).

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). As of 2005, 92 reproductively-active females had been identified (Kraus *et al.* 2007). From 1983-2005, the number of new mothers recruited to the population (with an estimated age of 10 for the age of first calving), varied from 0-11 each year with no significant increase or decline over the period (Kraus *et al.* 2007). By 2005, 16 right whales had produced at least 6 calves each, and 4 cows had at least seven calves. Two of these cows were at an age which indicated a reproductive life span of at least 31 years (Kraus *et al.* 2007). As described above, the 2000/2001 - 2006/2007 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 (like that described in Glass *et al.* 2009, below). Of the 15 serious injuries and mortalities between 2003-2007, at least 9 were adult females, three of which were carrying near-term fetuses and 4 of which were just starting to bear calves (Waring *et al.* 2009). Since the average lifetime calf production is 5.25 calves (Fujiwara and Caswell 2001), the deaths of these 9 females represent a loss of reproductive potential of as many as 47 animals. However, it is important to note that not all right whale mothers are equal with regards to calf production. Right whale #1158 had only one calf over a 25-year period (Kraus *et al.* 2007). In contrast, one of the largest right whales on record was a female nicknamed "Stumpy," who was killed in February 2004 of an apparent ship strike (NMFS 2006). She was first sighted in 1975 and known to be a prolific breeder, successfully rearing calves in 1980, 1987, 1990, 1993, and 1996 (Moore *et. al* 2007). At the time of her death, she was estimated to be 30 years of age and carrying her sixth calf; the near-term fetus also died (NMFS 2006).

Abundance estimates are an important part of assessing the status of the species. However, for Section 7 purposes, the population trend (*i.e.,* whether increasing or declining) provides better information for assessing the effects of a proposed action on the species. As described in previous Opinions, 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, apparently affected (Best *et al.* 2001, Waring *et al.* 2007). 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 *et al.* 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 has continued to decline and seems to be focused on females (Clapham *et al.* 2002). Mortalities, including those in the first half of 2005, suggest an increase in the annual mortality rate (Kraus *et. al* 2005). Calculations indicate that this increased mortality rate would reduce population growth by approximately 10% per year (Kraus *et. al* 2005).

Reproductive Fitness
Healthy reproduction is critical for the recovery of the North Atlantic right whale (Kraus *et al.* 2007). While modeling work suggests a decline in right whale abundance as a result of reduced survival, particularly for females, some researchers have also suggested that the subpopulation is being affected by a decreased reproductive rate (Best *et al.* 2001; Kraus *et al.* 2001). Kraus *et al.* (2007) reviewed reproductive parameters for the period 1983-2005, and estimated calving intervals to have changed from 3.5 years in 1990 to over five years between 1998-2003, and then suddenly decreased to just over 3 years in 2004 and 2005.

Factors that have been suggested as affecting the right whale reproductive rate include reduced genetic diversity (and/or inbreeding), contaminants, biotoxins, disease, nutritional stress, and loss of critical habitat. Although it is believed that a combination of these factors is likely causing an effect on right whales (Kraus *et al.* 2007), there is currently no evidence available to determine their potential effect, if any. The dramatic reduction in the North Atlantic right whale population believed to have occurred due to commercial whaling 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). The current hypothesis is that the low level of genetic variability in this species produces a high rate of mate incompatibility and unsuccessful pregnancies (Frasier *et al.* 2007). Analyses are currently under way to assess this relationship further as well as the influence of genetic characteristics on the potential for species recovery (Frasier *et al.* 2007). 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). Another suite of contaminants (i.e. antifouling agents and flame retardants) that have been proven to disrupt reproductive patterns and have been found in other marine animals, have raised new concerns (Kraus *et al.* 2007). Recent data also support a hypothesis that chromium, an industrial pollutant, may be a concern for the health of the North Atlantic right whales and that inhalation may be an important exposure route (Wise *et al.* 2008). A number of diseases could be also affecting reproduction, however tools for assessing disease factors in free-swimming large whales currently do not exist (Kraus *et al.* 2007). Once developed, such methods may allow for the evaluation of disease effects on right whales. Impacts of biotoxins on marine mammals are also poorly understood, yet data is showing that marine algal toxins may play significant roles in mass mortalities of these animals (Rolland *et al.* 2007). Although there are no published data concerning the effects of biotoxins on right whales, researchers are now certain that right whales are being exposed to measurable quantities of paralytic shellfish poisioning (PSP) toxins and domoic acid via trophic transfer through the copepods upon which they feed (Durbin *et al.* 2002, Rolland *et al.* 2007).

Data indicating right whales are food-limited are difficult to evaluate (Kraus *et al.* 2007). 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. 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 climatic event, does affect the survival of mothers and the reproductive rate of mature females, and it also seems to affect calf survival (Clapham *et al.* 2002). Greene *et al.* (2003) described the potential oceanographic processes linking climate variability to the reproduction of North Atlantic right whales. Climate-driven changes in ocean circulation have had a significant impact on the plankton ecology of the Gulf of Maine, including effects on *Calanus finmarchicus*, a primary prey resource for right whales. Researchers found that during the 1980's, when the NAO index was predominately positive, *C.*

finmarchicus abundance was also high; when a record drop occurred in the NAO index in 1996, *C. finamarchicus* abundance levels also decreased significantly. Right whale calving rates since the early 1980's seem to follow a similar pattern, where stable calving rates were noted from 1982-1992, but then two major, multi-year declines occurred from 1993-2001, consistent with the drops in copepod abundance. It has been hypothesized that right whale calving rates are thus a function of food availability as well as the number of females available to reproduce (Greene *et al* 2003, Greene and Pershing 2004). Such findings suggest that future climate change may emerge as a significant factor influencing the recovery of right whales. Some believe the effects of increased climate variability on right whale calving rates should be incorporated into future modeling studies so that it may be possible to determine how sensitive right whale population numbers are to variable climate forcing (Greene and Pershing 2004).

Anthropogenic Mortality

There is general agreement that right whale recovery is negatively affected by anthropogenic mortality. From 2004-2008, right whales had the highest proportion of entanglement and ship strike events relative to the number of reports for a species (Glass *et al.* 2010). Given the small population size and low annual reproductive rate of right whales, human sources of mortality may have a greater effect to relative population growth rate than for other large whale species (Waring *et al.* 2009). For the period 2004-2008, the annual human-caused mortality and serious injury rate for the North Atlantic right whale averaged 2.8 per year (2.2 in U.S. waters; 0.6 in Canadian waters) (Glass *et al.* 2010). Twenty-one confirmed right whale mortalities were reported along the U.S. east coast and adjacent Canadian Maritimes from 2004-2008 (Glass *et al.* 2010). These numbers represent the minimum values for serious injury and mortality for this period. Given the range and distribution of right whales in the North Atlantic, and the fact that positively buoyant species like right whales may become negatively buoyant if injury prohibits effective feeding for prolonged periods, it is highly unlikely that all carcasses will be observed (Moore *et. al.* 2004, Glass *et al.* 2009). Moreover, carcasses floating at sea often cannot be examined sufficiently and may generate false negatives if they are not towed to shore for further necropsy (Glass *et al.* 2009). Decomposed and/or unexamined animals represent lost data, some of which may relate to human impacts (Waring *et al.* 2009).

Considerable effort has been made to examine right whale carcasses for the cause of death (Moore *et al.* 2004). Because they live in an ocean environment, examining right whale carcasses is often very difficult. Some carcasses are discovered floating at sea and cannot be retrieved. Others are in such an advanced stage of decomposition when discovered that a complete examination is not possible. Wave action and post-mortem predation by sharks can also damage carcasses, and preclude a thorough examination of all body parts. It should also be noted that mortality and serious injury event judgments are based upon the best available data and additional information may result in revisions (Glass *et al.* 2010). Of the 21 total, confirmed right whale mortalities (2004-2008) described in Glass *et al.* (2010), 3 were confirmed to be entanglement mortalities (1 adult female, 1 female calf, 1 male calf) and 8 were confirmed to be ship strike mortalities (5 adult females, 1 female of unknown age, 1 male calf, and 1 yearling male). Serious injury involving right whales was documented for 1 entanglement event (adult male) and 2 ship strike events (1 adult female and 1 yearling male).

Although disentanglement is either unsuccessful or not possible for the majority of cases, during the period of 2003-2007, there were at least 4 documented cases of entanglements for which the intervention of disentanglement teams averted a likely serious injury determination (Waring *et al.* 2009). Even when entanglement or vessel collision does not cause direct mortality, it may weaken or otherwise affect individuals so that further injury or death is likely (Waring *et. al* 2007). 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. Similarly, skeletal fractures and/or broken jaws sustained during a vessel collision may heal, but then compromise a whale's ability to efficiently filter feed (Moore *et al.* 2007). A necropsy of right whale #2143 ("Lucky) found dead in January 2005 suggested the animal (and her near-term fetus) died after healed propeller wounds from a previous ship strike re-opened and became infected as a result of pregnancy (Moore *et al.* 2007, Glass *et al.* 2008). Sometimes, even with a successful disentanglement, an animal may die of injuries sustained by fishing gear (e.g. RW #3107) (Waring *et al.* 2009).

Entanglement records from 1990-2007 maintained by NMFS include 46 confirmed right whale entanglement events (Waring *et al.* 2009). Because whales often free themselves of gear following an entanglement event, scarification analysis of living animals may provide better indications of fisheries interactions rather than entanglement records (Waring *et al.* 2009). Data presented in Knowlton *et al.* 2008 indicate the annual rate of entanglement interaction remains at high levels. Four hundred and ninety-three individual, catalogued right whales were reviewed and 625 separate entanglement interactions were documented between 1980 and 2004. Approximately 358 out of 493 animals (72.6% of the population) were entangled at least once; 185 animals bore scars from a single entanglement, however one animal showed scars from 6 different entanglement events. The number of male and female right whales bearing entanglement scars was nearly equivalent (142/202 females, 71.8%; 182/224 males, 81.3%), indicating that right whales of both sexes are equally vulnerable to entanglement. However, juveniles appear to become entangled at a higher rate than expected if all age groups were equally vulnerable. For all years but one (1998), the proportion of juvenile, entangled right whales exceeded their proportion within the population. Based on photographs of catalogued animals from 1935 through 1995, Hamilton *et al.* (1998) estimated that 6.4 percent of the North Atlantic right whale population exhibit signs of injury from vessel strikes. Reports received from 2004-2008 indicate that right whales had the greatest number of ship strike mortalities (n=8) and serious injuries (n=2) (Glass *et al.* 2010) of all the large whales. In 2006 alone, four reported mortalities and one serious injury resulted from right whale ship strikes (Glass *et al.* 2009).

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 in the winter where calving and breeding takes place (Perry *et al.* 1999). Humpbacks are listed under the ESA at the species level. Therefore, information is presented below regarding the status of humpback whales throughout their range.

North Pacific, Northern Indian Ocean and Southern Hemisphere
Humpback whales in the North Pacific feed in coastal waters from California to Russia and in the Bering Sea. They migrate south to wintering destinations off Mexico, Central America, Hawaii, southern Japan, and the Philippines (Carretta *et al.* 2009). Although the IWC only considered one stock (Donovan 1991) there is evidence to indicate multiple populations migrating between their respective summer/fall feeding areas to winter/spring calving and mating areas within the North Pacific Basin (Angliss and Outlaw 2007, Carretta *et al.* 2007). NMFS recognizes three management units within the U.S. EEZ for the purposes of managing this species under the MMPA. These are: the eastern North Pacific stock (feeding areas off the US west coast), the central North Pacific stock (feeding areas from Southeast Alaska to the Alaska Peninsula) and the western North Pacific stock (feeding areas from the Aleutian Islands, the Bering Sea, and Russia) (Carretta *et al.* 2009). Because fidelity appears to be greater in feeding areas than in breeding areas, the stock structure of humpback whales is defined based on feeding areas (Carretta *et al.* 2009). Recent research efforts via the Structure of Populations, Levels of Abundance, and Status of Humpback Whales (SPLASH) Project estimate the abundance of humpback whales to be just under 20,000 whales for the entire North Pacific, a number which doubles previous population predictions (Calambokidis *et al.* 2008). There are indications that the eastern North Pacific stock was growing in the 1980's and early 1990's with a best estimate of 8% growth per year (Carretta *et al.* 2009). The best available estimate for the eastern North Pacific stock is 1,391 whales (Carretta *et al.* 2009). The central North Pacific stock is estimated at 4,005 (Angliss and Allen 2009), and various studies report that it appears to have increased in abundance at rates between 6.6%-10% per year (Angliss and Allen 2009). Although there is no reliable population trend data for the western North Pacific stock, as surveys of the known feeding areas are incomplete and many feeding areas remain unknown, minimum population size is currently estimated at 367 whales (Angliss and Allen 2009).

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 1990's revealed that 48,477 southern hemisphere humpback whales were taken from 1947-1980, contrary to the original reports to the IWC which accounted for the take of only 2,710 humpbacks (Zemsky *et al.* 1995, IWC 1995, Perry *et al.* 1999).

Gulf of Maine (North Atlantic)
Humpback whales from most Atlantic feeding areas calve and mate in the West Indies and migrate to feeding areas in the northwestern Atlantic during the summer months. Most of the humpbacks that forage in the Gulf of Maine visit Stellwagen Bank and the waters of Massachusetts and Cape Cod Bays. Previously, the North Atlantic humpback whale population was treated as a single stock for management purposes, however due to the strong fidelity to the region displayed by many whales, the Gulf of Maine stock was reclassified as a separate feeding stock (Waring *et al.* 2009). Sightings are most frequent from mid-March through November between 41 °N and 43 °N, 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. They feed on a number of species of small schooling fishes, particularly sand lance and Atlantic herring, targeting fish schools and filtering large amounts of water for their associated prey. It is hypothesized humpback whales may also feed on euphausiids (krill) as well as capelin (Waring *et al.* 2009, Stevick *et al.* 2006).

In winter, whales from waters off New England, Canada, Greenland, Iceland, and Norway, migrate to mate and calve primarily in the West Indies where spatial and genetic mixing among these groups does occur (Waring *et al.* 2009). Various papers (Clapham and Mayo 1990; Clapham 1992; Barlow and Clapham 1997; Clapham *et al.* 1999) summarize 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).

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 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 11,570 animals during 1992/1993 and an additional genotype-based analysis yielded a similar by less precise estimate of 10,400 whales (95% c.i. = 8,000 - 13,600) (Waring *et al.* 2009). For management purposes under the MMPA, the estimate of 11,570 individuals is regarded as the best available estimate for the North Atlantic population (Waring *et al.* 2007). The best, recent estimate for the Gulf of Maine stock is 847 whales, derived from the 2006 aerial survey (Waring *et al.* 2009).

As is the case with other large whales, the major known sources of anthropogenic mortality and injury of humpback whales occur from fishing gear entanglements and ship strikes. For the period 2004 through 2008, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 4.6 animals per year (U.S. waters, 4.2; Canadian waters, 0.4) (Glass *et al.* 2010). Between 2004 and 2008 humpback whales were involved in 81 confirmed entanglement events and 14 confirmed ship strike events (Glass *et al.* 2010). Over the five-year period, humpback whales were the most commonly observed entangled whale species; entanglements accounted for 5 mortalities and 11 serious injuries (Glass *et al.* 2010). Although ship strikes were relatively uncommon, 8 of the 14 confirmed events were fatal (Glass *et al.* 2010). It was assumed that all of these events involved members of the Gulf of Maine stock of humpback whales unless a whale was confirmed to be from another stock; in reports prior to 2007, only events involving whales confirmed to be members of the Gulf of Maine stock were included. There were also many carcasses that washed ashore or were spotted floating at sea for which the cause of death could not be determined. Given the number of decomposed and incompletely or unexamined animals in the records, there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies; decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or no necropsy performed) represent 'lost data' some of which may relate to human impacts (Glass *et al.* 2009, Waring *et al.* 2009).

Based on photographs taken between 2000-2002 of the caudal peduncle and fluke of humpback whales, Robbins and Mattila (2004) estimated that at least half (48-57%) of the sample (187 individuals) was coded as having a high likelihood of prior entanglement. Evidence suggests that entanglements have occurred at minimum rate of 8-10% per year. Scars acquired by Gulf of Maine stock humpback whales between 2000 and 2002 suggest a minimum of 49 interactions with gear took place. Based on composite scar patterns, it was believed that male humpback whales were more vulnerable to entanglement than females. Males may be subject to other sources of injury that could affect scar pattern interpretation. Images were obtained from a humpback whale breeding ground; 24% exhibited raw injuries, presumable a result from agonistic interactions. However, current evidence suggests that breeding ground interactions alone cannot explain the higher frequency of healed scar patterns among Gulf of Maine stock male humpback whales (Robbins and Matilla 2004).

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 fisheries operations, vessel traffic, and coastal development. Currently, there is no evidence that these types of activities are affecting humback whales. However, Geraci *et al.* (1989) provide strong evidence that a mass mortality of humpback whales from 1987-1988 resulted from the consumption of mackerel whose livers contained high levels of saxitoxin, a naturally occurring red tide toxin, the origin of which remains unknown. It has been suggested that the occurrence of a red tide event is related to an increase in freshwater runoff from coastal development, leading some observers to suggest that such events may become more common among marine mammals as coastal development continues (Clapham *et al.* 1999). Since that mass mortality event, there have been three additional known cases of a mass mortality involving large whale species along the east coast: 2003, 2005, and 2006. In the most recent event, 21 dead humpback whales were found between July 10 and December 31, 2006, triggering NMFS to declare an unusual mortality event (UME) for humpback whales in the Northeast United States. The UME was officially closed on December 31, 2007 after a review of 2007 humpback whale strandings and mortality showed that the elevated numbers were no longer being observed. The cause of the UME has not been determined to date, although investigations are ongoing.

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 (Stevick *et al.* 2006, Waring *et al.* 2007). Shifts in relative finfish species abundance correspond to changes in observed humpback whale movements (Stevick *et al.* 2006). 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 1998a). 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 US 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 and Allen *2009*). Although stock structure in the Pacific is not fully understood, NMFS recognizes three fin whale stocks in the US Pacific waters for the purposes of managing this species under the MMPA. These are: Alaska (Northeast Pacific), California/Washington/Oregon, and Hawaii (Carretta *et al.* 2009). Reliable estimates of current abundance for the entire Northeast Pacific fin whale stock are not available (Angliss and Allen 2009). A provisional population estimate of 5,700 was calculated for the Alaska stock west of the Kenai Peninsula by adding estimates from multiple surveys (Angliss and Allen 2009). This can be considered a minimum estimate for the entire

stock because it was estimated from surveys that covered only a portion of the range of the species (Angliss and Allen 2009). An annual population increase of 4.8% between 1987-2003 was estimated for fin whales in coastal waters south of the Alaska Peninsula (Angliss and Allen 2009). This is the first estimate of population trend for North Pacific fin whales; however, it must be interpreted cautiously due to the uncertainty in the initial population estimate and the population structure (Angliss and Allen 2009). The best available estimate for the California/Washington/Oregon stock is 2,636, which is likely an underestimate (Carretta *et al.* 2009). The best available estimate for the Hawaii stock is 174, based on a 2002 line-transect survey (Carretta *et al.* 2009).

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 US 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 US waters of the North Atlantic (Waring *et al.* 2008). 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. These are: (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.* 2008).

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.*2009). 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).

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. 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 US Mid-Atlantic coast from October through January suggest the possibility of an offshore calving area (Hain *et al.* 1992).

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). Fin whales feed by filtering large volumes of water for their prey through their baleen plates.

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. The mean annual rate of confirmed human-caused serious injury and mortality to North Atlantic fin whales from 2004-2008 was 3.2 (Glass *et al.* 2010). During this five year period, there were 14 confirmed entanglements (3 fatal; 3 serious injuries) and 13 ship strikes (10 fatal) (Glass *et al.* 2010). Fin whales are believed to be the cetacean most commonly struck 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.

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 US continental shelf waters. The Draft 2009 Stock Assessment Report (SAR) gives a best estimate of abundance for fin whales of 2,269 (CV = 0.37). However, this estimate must be considered extremely conservative in view of the incomplete coverage of the known habitat of the stock and the uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas (Waring *et al.* 2009). The minimum population estimate for the western North Atlantic fin whale is 1,678 (Waring *et al.* 2009). However, there are insufficient data at this time to determine population trends for the fin whale (Waring *et al.* 2009).

3.4 Sei Whale

Sei whales are a widespread species in the world's temperate, subpolar, subtropical, and even tropical marine waters. Sei whales reach sexual maturity at 5-15 years of age. The calving interval is believed to be 2-3 years (Perry *et al.* 1999).

North Pacific and Southern Hemisphere. The IWC only considers one stock of sei whales in the North Pacific (Donovan 1991), but for NMFS management purpose under the MMPA, sei whales in the eastern North Pacific are considered a separate stock (Carretta *et al.* 2008). There are no abundance estimates for sei whales in the entire eastern North Pacific. The best estimate of abundance for U.S. Pacific EEZ (California, Oregon, and Washington waters out to 300nmi) is 46 (CV=0.61) sei whales (Barlow and Forney 2007; Forney 2007,Carretta *et al.* 2008). No fishery related serious injuries or mortality have been documented from 2002 through 2006 in the North Pacific stock of sei whales (Carretta *et al.* 2008). During 2002-2006 there was one reported ship strike mortality in Washington in 2003 (NMFS Northwest Regional Office, unpublished data).

The stock structure of sei whales in the southern hemisphere is unknown. Like other whale species, sei whales in the southern hemisphere were heavily impacted by commercial whaling, particularly in the mid-20th century as humpback, fin and blue whales became scarce. Sei whales were protected by the IWC in 1977 after their numbers had substantially decreased and they also became more difficult to find (Perry *et al.* 1999). Since southern hemisphere sei whales do not occur in U.S. waters, there is no recovery plan or stock assessment report for southern hemisphere sei whales.

North Atlantic. Sei whales occur in deep water throughout their range, typically over the continental slope or in basins situated between banks (NMFS 1998). In the northwest Atlantic, the whales travel along the eastern Canadian coast in June, July, and autumn on their way to and from the Gulf of Maine and Georges Bank where they occur in winter and spring. Within the U.S. Atlantic EEZ, the sei whale is most common on Georges Bank and into the Gulf of Maine/Bay of Fundy region during spring and summer, primarily in deeper waters. 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 (Waring *et al.* 2009).

Although sei whales may prey upon small schooling fish and squid in the action area, available information suggests that calanoid copepods and euphausiids are the primary prey of this species (Flinn *et al.* 2002). Sei whales are occasionally seen feeding in association with right whales in the southern Gulf of Maine and in the Bay of Fundy. However, there is no evidence to demonstrate interspecific competition between these species for food resources.

There is limited information on the stock identity of sei whales in the North Atlantic (Waring *et al.* 2009). For purposes of the Marine Mammal Stock Assessment Reports, and based on a proposed IWC stock definition, NMFS recognizes the sei whales occurring from the U.S. east coast to Cape Breton, Nova Scotia, and east to 42° W longitude as the "Nova Scotia stock" of sei whales (Waring *et al.* 2009).

The abundance estimate of 386 sei whales (CV=0.85), obtained from aline-transect sighting survey conducted during 12 June to 4 August 2004, by a ship and a plane covering 10,761 km of trackline in the region from the 100 m depth contour on the southern of Georges Bank to the lower Bay of Fundy is considered the best available for the Nova Scotia stock of sei whales according to the 2009 SAR (Waring *et al.* 2009). This estimate is considered extremely conservative in view of the known range of the sei whale in the entire western North Atlantic, and the uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas. The minimum population estimate for this sei whale stock is 128 (Waring *et al.* 2009). Current and maximum net productivity rates are unknown for this stock. There are insufficient data to determine trends of the sei whale population (Waring *et al.* 2009).

Few instances of injury or mortality of sei whales due to entanglement or vessel strikes have been recorded in U.S. waters, possibly because sei whales typically inhabit waters further offshore than most commercial fishing operations, or perhaps entanglements do occur but are less likely to be observed. The mean annual rate of confirmed human-caused serious injury and mortality to Nova Scotian sei whales from 2004-2008 was 1.0 (Glass *et al.* 2010). During this five year period, there were 3 confirmed entanglements (1 fatal; 2 serious injuries) and 3 ship strikes (2 fatal) (Glass *et al.* 2010). Other impacts noted above for other baleen whales may also occur.

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.

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

Several commercial fisheries operating in the action area use gillnet and trap/pot gear that is known to capture, injure, or kill listed whales. NMFS has undertaken ESA section 7 consultations 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 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 designed to address the problem of take of whales in the fishing industry.

Federal Fishery Operations

Section 7 consultations on fishery actions have occurred on the level of individual FMPs, which are developed around the target species of the fishery. Impacts to listed species, however, depend on gear type and location (i.e., overlap between effort and the presence of listed species) as opposed to target species. In addition, because interactions with gear are often not observed at the time the interaction actually occurs, it is often impossible to attribute the entangling gear to a particular fishery. Therefore, this section will briefly describe the fisheries that use gear that could potentially interact with listed right, humpback, fin, and sei whales, discuss the impacts of fisheries in general on listed whales, and summarize the conclusions of recent section 7 consultations. For further detail on specific fishery management plans and the characteristics of individual fisheries, please refer to the respective BO for that fishery.

Right, humpback, and fin whales are known to become entangled in buoy lines, anchor lines, net panels, and groundlines. Sei whales can also become entangled in fishing gear, although entanglements of sei whales have been observed less often than entanglements of other species. This may be due to their offshore distribution which does not overlap with fishing activity to the extent that right, humpback, and fin whale distribution overlaps with fishing activity. Their offshore distribution may also simply make it less likely that a sei whale entanglement will be observed. Although the exact mechanism for entanglements is not known, it is thought that the whale may thrash or roll upon encountering a line or panel and feeling the resistance of the lines. Lines may also become caught in the baleen as whales swim through the water column with mouths gaped for feeding. Entanglements have been observed primarily around the head, flippers, or tail. If the animal is not able to break free from anchored gear, it may drown. In other cases, the whale may separate the gear from its anchors, but may swim away with multiple wraps of line remaining around its body. Depending on the severity of the entanglement, the whale may shed the gear on its own, or in some cases, a disentanglement team may be able to cut the gear partially or completely free. However, in many cases, whales will carry gear for many years. This can be life-threatening if the gear constricts blood flow, causes abrasions that become infected, or hinders mobility or other essential activities such as feeding.

Gear used in the federal fisheries described below is expected to have an insignificant effect on whale prey species. As described in section 3.0, right whales and sei whales feed on copepods

(Horwood 2002; Kenney 2002). Copepods are very small organisms that will pass through fishing gear rather than being captured in it. Humpback whales and fin whales also feed on krill as well as small schooling fish (*e.g.*, sand lance, herring, mackerel) (Aguilar 2002; Clapham *et al.* 2002). Some fisheries described below do target fish (*i.e.*, herring, mackerel) that are food items for humpback and fin whales, which presents some level of trophic competition for these species. However, given the diversity of their diet, the harvesting of some humpback and fin whale prey as part of commercial fishery operations is not expected to have a significant effect on the availability of humpback and fin whale prey species.

The following fisheries operating under a federal FMP occur in the action area for the Neptune project and are known to use trap/pot or gillnet gear: American Lobster, Multispecies, Monkfish, Spiny Dogfish, Atlantic Mackerel/Squid/Butterfish, Atlantic Herring, and Red Crab. 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 routes that will be used by the Neptune LNG tankers. 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 the impacts of each fishery 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. They are most abundant from Maine to New Jersey with abundance declining from north to south (ASMFC 1999). Most lobster trap effort occurs in the Gulf of Maine, constituting 76% of the U.S. landings between 1981 and 2007, and 87% since 2002. 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. Management measures have been implemented under the ASFMC's Interstate Fishery Management Plan (ISFMP) to constrain or reduce fishing effort in the lobster fishery, including reduction of effort and capping of effort, such as 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. Such measures are of benefit to listed whales by reducing the amount of gear (specifically buoy lines) in waters where whales also occur. In all waters regulated by the ALWTRP, pot/trap gear set by the American lobster fishery is required to follow regulations set by the plan.

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 for the species being considered in this BO is sink gillnet gear that can entangle whales (*i.e.*, in buoy lines and/or net panels). Data indicate that sink gillnet gear has seriously injured or killed North Atlantic right whales, humpback whales, and fin whales. The northeast multispecies sink gillnet fishery has historically occurred from the periphery of the Gulf of Maine to Rhode Island in water as deep as 360 feet. 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. Amendment 13 implemented limits on Category A days at sea (DAS), which reduced the number of DAS that can be fished on any stock from about 71,000 in fishing year 2003 to about 41,000 in fishing year 2004, a reduction of approximately 42%. Actual DAS used in 2003 were 42,118, and actual DAS used in fishing year 2004 were 32, 973. As described above, Category A DAS were further limited to 55% of effective effort for fishing years 2006-2008, and were reduced to 45% for fishing years 2009 and thereafter.

Amendment 16 was implemented on May 1, 2010. Amendment 16 contains many proposed actions including major alterations, such as the introduction of sectors as operational/management units, and new annual catch limits and accountability measures. Effort in the Northeast multispecies fisheries as a result of Amendment 16, including the implementation of new sectors rules and Framework 44, is expected to be reduced by nearly 75% when compared to fishing effort and capacity in the early 1990's (NEFMC 2009). While some fishing effort may increase in the future as fisheries stocks respond to management measures to rebuild them, there are measures in place that will prevent overcapacity from redeveloping (i.e., nearly all U.S. Atlantic commercial fisheries are closed/limited access). Furthermore, as fish stocks increase, a more likely outcome will be increased catches/landings with constant or even reduced fishing effort. The exact relationship between multispecies fishing effort and the number of whale interactions with gear used in the fishery is unknown. However, in general, less fishing effort results in less time that gear is in the water and therefore less opportunity for whales to be captured or entangled in multispecies fishing gear.

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. Gillnet gear accounts for only a portion of monkfish landings, with the majority of landings coming from trawls. 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 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.

The *spiny dogfish fishery* in the U.S. EEZ is managed under the Spiny Dogfish FMP. The primary gear types for the spiny dogfish fishery are sink gillnets, otter trawls, bottom longline, and driftnet gear (NEFSC 2006). The predominance of any one gear type has varied over time

(NEFSC 2006). In 2005, 62.1% of landings were taken by sink gillnet gear, followed by 18.4% in otter trawl gear, 2.3% in line gear, and 17.1% in gear defined as "other" (excludes drift gillnet gear) (NEFSC 2006). The FMP for spiny dogfish called for a 30% reduction in quota allocation levels for 2000 and a 90% reduction in 2001. Although there were delays in implementing the plan, quota allocations were substantially reduced over the 4.5 year rebuilding schedule; this has resulted in a substantial decrease in effort directed at spiny dogfish.

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. Trawl gear is the primary fishing gear for the fisheries, but several other types of gear may also be used, including pot/trap and gillnet gear. In 2003, bottom trawl gear accounted for 97%, and 99.4% of *Loligo*, and *Illex* landings, respectively (MAFMC 2007). Mid-water trawl gear accounted for the majority (82%) of mackerel landings with an additional 17% of landings attributed to bottom trawls (MAFMC 2007). Gillnet gear to land squid/mackerel/butterfish species is currently used primarily in the bait fishery for the lobster and tuna fisheries. However, vessels deploying gillnet gear to catch squid, mackerel, or butterfish as bait must still comply with all reporting and gear modification requirements under the ALWTRP. At this time, the gillnet portion of the SMB fishery presents some risk of entanglement to listed whales, although the number of interactions is expected to be low.

Section 7 consultation was completed on the *Atlantic herring fishery* on September 17, 1999 (NMFS 1999b). This fishery is managed under the Northeast Atlantic Herring FMP, which was implemented on December 11, 2000. Purse seines, mid-water trawls (single), and pair trawls are the three primary gears involved in the Atlantic herring fishery (NEFMC 2006). However, gillnet gear has also historically been used to target herring and is authorized under the FMP. Although gillnet gear was once a primary gear type for vessels whose primary target species was herring, the use of gillnet gear to target herring is currently largely limited to the bait fishery. Since 2005, gillnet gear has accounted for less than one percent of the total herring landed, and herring is not a species targeted commercially with gillnet gear. Humpback and fin whales are the large whales most likely to be affected by the Atlantic herring fishery since both species are known to prey on Atlantic herring, and have the greatest spatial and temporal overlap with the fishery. However, there are no records of takes of listed species in the herring fishery from NMFS sea sampling program (NMFS Sea Sampling Database, through February 2009). Consultation on the Atlantic herring fishery was reinitiated on March 23, 2005, in order to consider the effects of the fishery on Atlantic salmon. An informal consultation was completed on February 9, 2010, and concluded that the fishery was not likely to adversely affect any listed species under NMFS jurisdiction.

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 right, humpback, fin and sei whales.

The table below summarizes the conclusions of the most recent BO or informal consultation on each of the fisheries described above. For details, refer to the specific BO for the fishery.

Table 3. Summary of Section 7 Consultations on Federally Managed Fisheries

Fishery	Date of most recent BO or Consultation	Conclusion for Right whales	Conclusion for Humpback whales	Conclusion for Fin whales	Conclusion for Sei whales	Current status of consultation
American Lobster	10/31/2002	Jeopardy; RPA implemented	May adversely affect, not likely to jeopardize	May adversely affect, not likely to jeopardize	May adversely affect, not likely to jeopardize	Reinitiated to consider new ALWTRP regulations – in progress
Multispecies	6/14/2001	Jeopardy; RPA implemented	May adversely affect, not likely to jeopardize	May adversely affect, not likely to jeopardize	May adversely affect, not likely to jeopardize	Reinitiated due to new information on loggerhead takes and new ALWTRP regulations – in progress
Monkfish	4/14/2003	May adversely affect, not likely to jeopardize	May adversely affect, not likely to jeopardize	May adversely affect, not likely to jeopardize	May adversely affect, not likely to jeopardize	Reinitiated due to new information on loggerhead takes and new ALWTRP regulations– in progress
Spiny Dogfish	6/14/2001	Jeopardy; RPA implemented	May adversely affect, not likely to jeopardize	May adversely affect, not likely to jeopardize	May adversely affect, not likely to jeopardize	Reinitiated to consider new ALWTRP regulations – in progress
Atlantic Mackerel/ Squid/ Butterfish	4/28/1999	May adversely affect, not likely to	May adversely affect, not likely to	May adversely affect, not likely to	May adversely affect, not likely to	Reinitiated due to new information on loggerhead

		jeopardize	jeopardize	jeopardize	jeopardize	takes- in progress
Atlantic Herring	2/9/2010	Not likely to adversely affect	Not likely to adversely affect	Not likely to adversely affect	Not likely to adversely affect	Complete
Red Crab	2/6/2002	Not likely to adversely affect	Not likely to adversely affect	May adversely affect, not likely to jeopardize	Not likely to adversely affect	Complete

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 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.

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 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 may not kill a whale directly, but could result in injuries that weaken or otherwise affect it so that it is more vulnerable to other impacts. 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.

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 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. Ship strikes have been identified as a significant source of mortality to the North Atlantic 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 1999c). 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 to mitigate impacts of the whale watch and shipping industries on endangered whales are discussed in Section 4.4 below.

Other than injuries and mortalities resulting from collisions, the effects of disturbance (primarily acoustic) caused by vessel activity on listed species is a growing concern that is receiving increased attention in international forums. It is thought that a significant portion of human noise input is attributable to the increasing number of large commercial ships operating over wide-ranging geographic areas. Large commercial ships produce relatively loud and primarily low-frequency sounds that overlap with the peak hearing sensitivity of baleen whales and other marine mammals. Low frequency sounds from ships can travel hundreds of miles and can increase ambient noise levels in large areas of the ocean. The primary concern regarding potential adverse effects of shipping noise is not related to acute exposures, but rather to the general increase in background ambient noise that may result from concentrations of vessel operation and may result in masking of communication systems. Because of the logarithmic nature of sound and what is known about hearing systems in mammals, seemingly small changes in background noise levels can result in large reductions of communication ranges. (IMO-MEPC 2007)

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 5.6 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 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, listed whales and optimal whale 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 right whale feeding habitat in Cape Cod Bay. 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 and seriously injure or kill whales. Chemical contaminants may also have an effect on whale reproduction and survival, although the effects of contaminants on whales are relatively unclear.

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 important right whale feeding 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. The most recent monitoring overview was produced in October 2009, and summarizes eight years of outfall monitoring. The report concludes that no changes in baseline conditions in Massachusetts Bay have been detected. Phytoplankton and zooplankton communities have not changed in either Massachusetts Bay or Cape Cod Bay, although there has been an increase in some nuisance species that is not attributable to the outfall. In each year from 2002-2007, concentrations of nuisance algal species *Phaeocystis pouchetii* exceeded the caution level at some point during the

year, 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, Werme and Hunt 2007). 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. A large, short-duration *Alexandrium* bloom also exceeded the caution threshold in 2008, but this bloom also followed the historically typical pattern for red tides in the region, beginning off the coast of Maine and moving southward along the coast with winds from the northeast. The patterns of these blooms suggest no effect of the MWRA outfall on the timing or region-wide magnitude of the bloom (Werme and Hunt 2006, Werme and Hunt 2009).

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 1999c). 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 and/or licensed along the US east coast, the only other currently existing 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.

The NEG terminal is nearly identical in technology and operation to the Neptune terminal, and is located approximately 3 miles south of the Neptune terminal. BOs were issued for this project on February 5, 2007 and November 30, 2007, which concluded that the construction and operation of the NEG facility was likely to result in acoustic harassment of listed right, humpback, and fin whales. Construction of the NEG port was completed in December 2007, and limited operations began in 2008. Operational impacts associated with the NEG port will overlap in space and time with operation-related impacts of the Neptune port. The NEG port will contribute up to 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 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 will 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.

An array of passive acoustic detection buoys has been installed around the Neptune port site as a requirement of MARAD's license to construct the port. This buoy array will assist NMFS in assessing the contribution of the Neptune port to the background noise levels in the action area and what the impact, if any, may be on listed species.

Global Climate Change

There is a large and growing body of literature on past, present, and future impacts of global climate change induced by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The Environmental Protection Agency's climate change webpage provides basic background information on these and other measured or anticipated effects (see www.epa.gov/climatechange/index.html). Activities in the action area that may have contributed to global warming include the combustion of fossil fuels by vessels.

The impact of climate change on cetaceans is likely to be related to changes in sea temperatures, potential freshening of sea water due to melting ice and increased rainfall, sea level rise, the loss of polar habitats and potential shifts in the distribution and abundance of prey species. Of the main factors affecting distribution of cetaceans, water temperature appears to be the main influence on geographic ranges of cetacean species (Macleod 2009). Humpback and fin whales are distributed in all water temperature zones, therefore, it is unlikely that their range will be directly affected by an increase in water temperature.

The North Atlantic right whale currently has a range of sub-polar to sub-tropical waters. An increase in water temperature would likely result in a northward shift of range, with both the northern and southern limits moving poleward. The northern limit, which may be determined by feeding habitat and the distribution of preferred prey, may shift to a greater extent than the southern limit, which requires ideal temperature and water depth for calving. This may result in an unfavorable affect on the North Atlantic right whale due to an increase in the length of migrations (Macleod 2009) or a favorable effect by allowing them to expand their range.

Sei whales currently range from sub-polar to tropical waters. An increase in water temperature may be a favorable effect on sei whales, allowing them to expand their range into higher latitudes (Macleod 2009).

Cetaceans are unlikely to be directly affected by sea level rise, although important coastal bays for humpback breeding could be affected (IWC 1997). Some indirect effects to marine mammals that may be associated with sea level rise include the construction of sea-wall defenses and protective measures for coastal habitats, which may impact coastal marine species and may interfere with migration (Learmonth *et al.* 2006). The effect of sea level rise to cetaceans is likely negligible.

The direct effects of increased CO_2 concentrations, and associated decrease in pH (ocean acidification), on marine mammals are unknown (Learmonth *et al.* 2006). Marine plankton is a vital food source for many marine species. Studies have demonstrated adverse impacts from ocean acidification on the ability of marine algae and free-swimming zooplankton to maintain protective shells as well as a reduction in the survival of larval marine species. A decline in the marine plankton could have serious consequences for the marine food web.

There are many direct and indirect effects that global climate change may have on marine mammal prey species. For example, Greene *et al.* (2003) described the potential oceanographic processes linking climate variability to the reproduction of North Atlantic right whales. Climate-driven changes in ocean circulation have had a significant impact on the plankton ecology of the Gulf of Maine, including effects on *Calanus finmarchicus*, a primary prey resource for right whales. More information is needed in order to determine the potential impacts global climate change will have on the timing and extent of population movements, abundance, recruitment, distribution and species composition of prey (Learmonth *et al.* 2006). Changes in climate patterns, ocean currents, storm frequency, rainfall, salinity, melting ice, and an increase in river inputs/runoff (nutrients and pollutants) will all directly affect the distribution, abundance and migration of prey species (Waluda *et al.* 2001; Tynan & DeMaster 1997; Learmonth *et al.* 2006). These changes will likely have several indirect effects on marine mammals, which may include changes in distribution including displacement from ideal habitats, decline in fitness of individuals, population size due to the potential loss of foraging opportunities, abundance, migration, community structure, susceptibility to disease and contaminants, and reproductive success (Macleod 2009). Global climate change may also result in changes to the range and abundance of competitors and predators which will also indirectly affect marine mammals (Learmonth *et al.* 2006). A decline in the reproductive fitness as a result of global climate change could have profound effects on the abundance and distribution of large whales in the Atlantic.

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 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 Program, extensive education and outreach activities, and NMFS regulations.

NOAA's Right Whale Ship Strike Reduction Program

Development of NOAA's Ship Strike Reduction Program has been ongoing over the past several years. The program 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 program 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., Sighting Advisory System (SAS), Mandatory Ship Reporting (MSR) System, 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. 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 exempted 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 proposal was approved by the IMO in December 1998 and 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 or management areas 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 program is the implementation of speed restrictions for vessels transiting the US Atlantic in areas and seasons where right whales predictably occur in high concentrations. Through numerous meetings and discussions with stakeholders, as well as review of available data on the incidence of ship strikes, speed restrictions in high risk areas was determined to be the most effective and pragmatic option for reducing serious injury and mortality of right whales due to ship strikes (NMFS 2008). 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). NMFS published final regulations on October 10, 2008 (73 FR 60173), which became effective on December 9, 2008. The regulations implement vessel speed restrictions of ten knots or less for vessels 65 ft and greater in overall length in Seasonal Management Areas (SMAs) along the US East coast where right whales are known to occur. A safety exemption is in place for situations when navigational safety concerns dictate a speed greater than 10 knots due to conditions that severely restrict vessel maneuverability. In addition, Federal vessels are exempt from the rule. Speed restrictions are in place in the following SMAs:

- Cape Cod Bay – January 1-May 15
- Off Race Point – March 1-April 30
- Great South Channel – April 1-July 31
- Block Island – November 1-April 30
- Mid-Atlantic ports (20 nm radius seaward of COLREGS lines) – November 1-April 30
  - Ports of New York/New Jersey
  - Entrance to Delaware Bay (ports of Philadelphia and Wilmington)
  - Entrance to Chesapeake Bay (ports of Hampton Roads and Baltimore)
  - Ports of Morehead City and Beaufort, NC
- Mid-Atlantic ports (continuous area 20-nm from shore between Wilmington, NC to Bruswick, GA) – November 1-April 30
- Southeast calving grounds – November 15-April 15

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 program 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 feeding grounds and southeast calving 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 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 was implemented in June 2007.

In December 2008, the IMO approved two additional US proposals to reduce the overlap between vessel traffic and right whales. The first proposal established a seasonal, recommendatory Area To Be Avoided (ATBA) in the Great South Channel for all vessels 300 gross tons and greater. The ATBA is in effect from April 1-July 31 of each year. The second proposal narrows the north-south leg of the Boston TSS down from 2 miles per lane to 1.5 miles per lane. Both measures became effective June 1, 2009.

Dynamic Management Area (DMA) Program
The DMA program was initiated in December 2008 as a supplement to the ship speed regulations discussed above. The program implements dynamic vessel traffic management zones in order to provide protection for unpredictable aggregations of right whales that occur outside of SMAs. When NOAA aerial surveys or other reliable sources report aggregations of 3 or more right whales in a density that indicates the whales are likely to persist in the area, NOAA calculates a buffer zone around the aggregation and announces the boundaries of the zone to mariners via various mariner communication outlets, including NOAA Weather Radio, USCG Broadcast Notice to Mariners, MSR return messages, email distribution lists, and the Right Whale Sighting Advisory System (SAS). NOAA requests mariners to route around these zones or transit through them at 10 knots or less. Compliance with these zones is voluntary.

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 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 feeding 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.

In 2009, with the implementation of the new ship strike regulations and the DMA program, the SAS alerts were modified to provide current SMA and DMA information to mariners on a weekly basis in an effort to maximize compliance with all active right whale protection zones.

Education and Outreach Activities
NMFS 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, as well as the measures in place to reduce the risk. The Southeast Implementation Team (SEIT) for the recovery of the North Atlantic right whale has 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 implementing high priority tasks on an ongoing basis as funding allows. In 2006, the SEIT released a multimedia CD to educate commercial mariners about right whale ship strike issues. This CD was distributed to over 3000 mariners

worldwide. An updated version of the CD containing information about the new ship speed regulations was released and distributed in April 2009.

NMFS has also distributed over 3,000 compliance guides to mariners outlining the new ship strike regulations and has incorporated information about the regulations in US Coast Pilots. 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.

A comprehensive merchant mariner education module has been developed 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. The module has been distributed and implemented in various maritime academies.

Miscellaneous Activities
NMFS and the National Ocean Service (NOS) recently revised the whale watch guidelines for the Northeast, including the 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. In 2009, NMFS and SBNMS, in partnership with the Whale and Dolphin Conservaton Society (WDCS), launched the Whale SENSE program, a voluntary program for the commercial whale watch industry that recognizes companies that are committed to engaging in responsible whale watch practices, providing customers with a high standard of education, and promoting ocean stewardship and conservation. Upon successful completion of annual training and evaluation, participants are provided with materials containing the Whale SENSE logo that can be posted on board their vessels and used to promote their businesses to customers who wish to support responsible whale watching practices. The Whale SENSE web site also provides customers with a list of all companies participating in the program. The Whale SENSE program is expected to further promote industry adherence to the whale watch guidelines and practices that minimize disturbance and harassment of endangered whales.

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 large whales 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 an evolving plan, 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.

The ALWTRT initially concluded that all parts of gillnet and trap/pot gear can and have caused entanglements. Initial measures in the ALWTRP addressed both parts of the gear, and since then, the ALWTRT has identified the need to further reduce risk posed by both vertical and horizontal portions of gear. Research and testing has been ongoing to identify risk reduction measures that are feasible. The regulations recently placed in effect focus on horizontal lines.

The ALWTRP measures vary by designated area that roughly approximate the Federal Lobster Management Areas (FLMAs) designated in the Federal lobster regulations. The major requirements of the ALWTRP are:

- No buoy line floating at the surface.
- No wet storage of gear (all gear must be hauled out of the water at least once every 30 days).
- Surface buoys and buoy line need to be marked to identify the vessel or fishery.

- All buoys, floatation devices and/or weights must be attached to the buoy line with a weak link. This measure is designed so that, if a large whale does become entangled, it could exert enough force to break the weak link and break free of the gear reducing the risk of injury or mortality.
- All groundline must be made of sinking line.

In addition to gear modification requirements the ALWTRP prohibits all trap/pot fishing in The Great South Channel from April 1 – June 30.

In addition to the regulatory measures recently implemented to reduce the risk of entanglement in horizontal/ground lines, NMFS, in collaboration with the ALWTRT, has developed a strategy to further reduce risk associated with vertical lines.

It is anticipated that the final regulations implementing the vertical line strategy will prioritize risk reduction in areas where there is the greatest co-occurrence of vertical lines and large whales. There are two ways to achieve a reduced risk: (1) maintain the same number of active lines but decrease the risk from each one (not currently feasible), or (2) reduce the number of lines in the water column.

Whale distribution data will be used to help prioritize areas for implementation of future vertical line action(s). These data will be overlaid with the vertical line distribution data to look at the combined densities by area. A model is being developed and constructed to allow gear configurations to be manipulated and determine what relative co-occurrence reductions (as a proxy for risk) can be achieved by gear configuration changes and/or effort reductions by area. This co-occurrence analysis is an integral component of the vertical line strategy that will further minimize the risk of large whale entanglement and associated serious injury and death. The actions and timeframe for the implementation of the vertical line strategy is as follows:

- Vertical line model development over the next year for all areas to gather as much information as possible regarding the distribution and density of vertical line fishing gear. Time frame: Northeast and Southeast areas finalized by April 2010 and Mid-Atlantic by April 2011;

- Compile and analyze whale distribution and density data in a manner to overlay with vertical line density data. Time frame: complete by February 2010 for the Northeast, and refined and completed for the Southeast by April 2010 and Mid-Atlantic by April 2011;

- Development of vertical line and whale distribution co-occurrence overlays. Time frame: by October 2010 for the Northeast and April 2011 and Mid- and South Atlantic;

- Develop and publish proposed rule to implement risk reduction from vertical lines. Time frame: by April 2013;

- Develop and publish final rule to implement risk reduction from vertical lines. Time frame: by April 2014;

- Implement final rule to implement risk reduction from vertical lines. Time frame: by January 1, 2015;

- Develop an ALWTRP monitoring plan designed to track implementation of vertical line strategy, including risk reduction. Time frame: Adopt plan by January 2012, with annual interim reports beginning in July 2012.

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 to take place. 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, but strong enough to allow continued fishing. Development of gear modifications are ongoing and are primarily used to minimize risk of large whale entanglement. The ALWTRT has now moved into the next phase with the focus and priority being research to reduce risk associated with vertical lines. 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. Currently, NMFS is developing a co-occurrence risk model that will allow us to examine the density of whales and density of vertical lines in time and space to identify those areas and times that appear to pose the greatest vertical line risk and prioritize those areas for management. The current schedule would result in a proposed rule for additional vertical line risk reduction to be published in 2013.

NMFS, in consultation with the ALWTRT, is currently developing a monitoring plan for the ALWTRP. While the number of serious injuries and mortalities caused by entanglements is higher than our goals, it is still a relatively small number which makes monitoring difficult. Specifically, we want to know if the most recent management measures, which became fully effective April 2009, have resulted in a reduction in entanglement related serious injuries and mortalities of right, humpback and fin whales. Because these are relatively rare events and the data obtained from each event is sparse, this is a difficult question to answer. The NEFSC has identified proposed metrics that will be used to monitor progress and they project that five years of data would be required before a change may be able to be detected. Therefore, data from 2010-2014 may be required and the analysis of that data would not be able to occur until 2016.

Large Whale Disentanglement Network

The Large Whale Disentanglement Network provides disentanglement response 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 disentangled 20 humpback and 6 right whales (NMFS data).

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.

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 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 in the vicinity of the 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 are expected to improve conditions for listed whales and reduce sources of human-induced mortality.

Summary of status of whale species

Summary of Right Whale Status
In March 2008, NMFS listed the North Atlantic right whale as a separate, endangered species (*Eubalaena glacialis*) under the ESA. This decision was based on an analysis of the best scientific and commercial data available. The decision took into consideration current population trends and abundance, demographic risk factors affecting the continued survival of the species, and ongoing conservation efforts. NMFS determined that the North Atlantic right whale is in danger of extinction throughout its range because of: (1) overutilization for commercial, recreational, scientific or educational purposes; (2) the inadequacy of existing regulatory mechanisms; and (3) other natural and manmade factors affecting its continued existence.

Previous models estimated that the right whale population in the Atlantic numbered 300 (+/-10%) (Best *et al.* 2001). However, a review of the photo-ID database on October 10, 2008 indicated that 345 individually recognized right whales were known to be alive in 2005 (Waring *et al.* 2009). The 2000/2001 - 2007/2008 calving seasons have had relatively high calf production (31, 21, 19, 17, 28, 19, and 23 calves, respectively) and have included additional first time mothers (*e.g.*, eight new mothers in 2000/2001) (Waring *et al.* 2009). There are some indications that climate-driven ocean changes impacting the plankton ecology of the Gulf of Maine, may, in some manner, be affecting right whale fitness and reproduction. However, there is also general agreement that right whale recovery is negatively affected by human sources of mortality, which may have a greater impact on population growth rate given the small population size and low annual reproductive rate of right whales (Waring *et al.* 2009a). Of particular concern is the death of mature females. Of the recent mortalities, including those in the first half of 2005, six were adult females, three of which were carrying near-term fetuses and four of which were just starting to bear calves (Glass *et al.* 2009).

Over the five-year period 2004-2008, right whales had the highest proportion of entanglements and ship strikes relative to the number of reports for a species: of 64 reports involving right whales, 24 were confirmed entanglements and 17 were confirmed ship strikes. There were 21 verified right whale mortalities, three due to entanglements, and eight due to ship strikes (Glass *et al.* 2010). This represents 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 will be observed. Scarification analysis indicates that some whales do survive encounters with ships and fishing gear. However, the long-term consequences of these interactions are unknown.

A variety of modeling exercises and analyses indicate that survival probability declined in the 1990s (Best *et al.* 2001), and recent mortalities, including a number of adult females, also suggest an increase in the annual mortality rate (Kraus *et al.* 2005). Nonetheless, a census of the minimum number of right whales alive based on the photo-ID catalog as it existed on October 10, 2008, indicates a positive trend in numbers for the years 1990-2004 (Waring *et al.* 2009a). In addition, calving intervals appear to have declined to 3 years in recent years (Kraus *et al.* 2007), and calf production has been relatively high over the past several seasons. Based on the information currently available, for the purposes of this BO, NMFS believes that the minimum estimate for the western North Atlantic right whale subpopulation is 345 individuals and that the population is increasing.

Summary of Humpback Whale Status

The best available population estimate for humpback whales in the North Atlantic Ocean is estimated as 11,570 animals, and the best, recent estimate for the Gulf of Maine stock is 847 whales (Waring *et al.* 2009). Anthropogenic mortality associated with fishing gear entanglements and ship strikes remains significant. In the winter, mating and calving occurs in areas located outside of the United States where the species is afforded less protection. Despite all of these factors, current data suggest that the Gulf of Maine humpback stock is steadily increasing in size (Waring *et al.* 2009). Population modeling, using data obtained from photographic mark-recapture studies, estimates the growth rate of the Gulf of Maine stock to be at 6.5% for the period 1979-1991 (Barlow and Clapham 1997). More recent analysis for the period 1992-2000 revealed lower growth rates ranging from 0% to 4.0%, depending on calf survival rate (Clapham *et al.* 2003 in Waring *et al.* 2009). However, it is unclear whether the decline is an artifact resulting from a shift in distribution documented for the period 1992-1995, or whether it is a real decline related to high mortality of young-of-the-year whales in US mid-

Atlantic waters (Waring *et al.* 2009). Regardless, calf survival appears to have increased since 1996, presumably accompanied by an increase in population growth (Waring *et al.* 2009). Stevick *et al.* (2003) calculated an average population growth rate of 3.1% in the North Atlantic population overall for the period 1979-1993 (Waring *et al.* 2009). With respect to the species overall, there are also indications of increasing abundance for the eastern and central North Pacific stocks. Trend and abundance data is lacking for the western North Pacific stock, the Southern Hemisphere humpback whales, and the Southern Indian Ocean humpbacks. However, changes in status of the North Atlantic humpback population are likely to affect the overall survival and recovery of the species. Therefore, given the best available information, for the purposes of this biological opinion, NMFS believes the humpback whale population is increasing.

Summary of Fin Whale Status

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 noted above, the best population estimate for the western North Atlantic fin whale is 2,269 which is believed to be an underestimate. The minimum population estimate for the western North Atlantic fin whale is 1,678. The 2009 SAR indicates that there are insufficient data at this time to determine population trends for the fin whale. Fishing gear appears to pose less of a threat to fin whales in the North Atlantic Ocean than to North Atlantic right or humpback whales. However, fin whales continue to be struck by large vessels and some level of whaling for fin whales in the North Atlantic may still occur. As this species continues to be subject to natural and anthropogenic mortality, for the purposes of this Opinion, NMFS considers this population to be at best stable and at worst declining.

Summary of Sei Whale Status

The best estimate of abundance for the Nova Scotia stock of sei whales is 386, but is considered a very conservative estimate of abundance for this stock in the North Atlantic (Waring *et al.* 2009). There are insufficient data to determine trends of the Nova Scotian sei whale population. One sei whale serious injury from fishery interaction and three mortalities from shipstrike have been recorded in U.S. waters between 2003-2007 (Glass *et al.* 2009). Information on the status of sei whale populations worldwide is similarly lacking. There are no abundance estimates for sei whales in the entire eastern North Pacific; however the best estimate of abundance for in U.S. Pacific EEZ is 46 (Carretta *et al.* 2008). The stock structure of sei whales in the southern hemisphere is unknown.

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 ongoing operation and maintenance of the Neptune LNG terminal will impact the water column, and thus may affect listed whales or their prey. 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 whales. NMFS' rationale for these determinations is provided in the following sections. Of the impacts listed above, NMFS identified vessel collisions and acoustic disturbance and harassment as the potential impacts of greatest concern. As such, these effects will be considered separately in Sections 5.5 and 5.6.

5.1 Species Presence in the Action Area

Several listed species are likely to be present in the action area at various times of the year and may therefore be affected either directly or indirectly by the operation of the Neptune LNG terminal. The primary concern for endangered whales involves interactions with project vessels and acoustic harassment due to the noise associated with ongoing operational and occasional maintenance and repair work.

Endangered whales 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. Although right whale sightings are concentrated in the Cape Cod Bay and Great South Channel feeding areas, the Gulf of Maine serves as an important spring and summer nursery/feeding area. Therefore, right whales may be transiting near the Neptune port.

Sei whales are known to occur in northeast waters, but tend to remain further offshore in deep water near shelf edges. Sightings of sei whales near the project site are rare, and the previous BO for the construction and operation of the Neptune LNG port determined that sei whales were not likely to be adversely affected by the proposed activities. However, during Neptune port construction, marine mammal observers sighted one whale that was tentatively identified as a sei whale within the vicinity of the construction activities. Sei whales may also occur in the portion of the action area that encompasses the transit path of the SRVs from the EEZ to the port site. Therefore, sei whales will be considered to be present in the action area for the Neptune LNG port.

5.2 Effects of Maintenance and Repair Work

For purposes of this biological opinion, maintenance and repair activities include all inspections, maintenance, and repairs that are necessary to keep the port and pipeline operating safely and efficiently. This includes routine, scheduled inspections of the port and pipeline and their components as well as unscheduled repairs that may be deemed necessary as a result of routine inspections. In general, the term "maintenance" is used to describe routine, planned inspections and the term "repair" is used to describe unplanned work done on the port or pipeline components in order to address deficiencies noted during inspections or routine operations. Maintenance activities include attaching and detaching and/or cleaning the buoy pick up line to the STL buoy, performing surveys and inspections with a remotely operated vehicle, and cleaning or replacing parts (e.g., bulbs, batteries, etc.) on the floating navigation buoys. Every seven to 10 years, Neptune will run an intelligent pig down the pipeline to assess its condition. This particular activity will require several larger, construction-type vessels and several weeks to complete. Any replacement of pipeline or port components, or other unanticipated work that needs to be done as a result of these inspections would be characterized as "unplanned repairs." Unplanned repairs can be classified as "minor" or "major." Minor repairs are typically shorter in duration and could include fixing flange or valve leaks, replacing faulty pressure transducers, or repairing a stuck valve. These kinds of repairs require only one diver support vessel with three or four anchors to hold its position. Minor repairs could take from a few days to one to two weeks depending on the nature of the problem. Major repairs are longer in duration and unlikely to occur, but could include damage to a riser or umbilical and their possible replacement, damage to the pipeline and manifolds, or anchor chain replacement. Major repairs could take one to four weeks and possibly longer and would typically require large construction vessels similar to those used to install the pipeline and set the buoy and anchoring system. These vessels will typically mobilize from local ports or the Gulf of Mexico. Major repairs require upfront planning, equipment procurement, and mobilization of vessels and saturation divers.

Potential effects of pipeline and port maintenance and repair activities on listed whales include:

- Interactions with maintenance/repair equipment
- Water quality degradation (turbidity, contaminants, discharges)
- Light pollution
- Increased risk of vessel strike due to construction-related vessel traffic (see section 5.5)
- Acoustic disturbance and harassment (see section 5.6)

Interactions with Maintenance/Repair Equipment

As noted previously, the only equipment involved in routine port and pipeline maintenance includes remotely operated vehicles (ROV) and dive support vessels. The majority of maintenance and repair activities will involve a limited number of small vessels similar to the support vessels used during normal port operations, meaning that maintenance/repairwork will not involve significant additional vessel activity at the port. In addition, for any major maintenance/repair work that involves multiple large vessels, vessel strike mitigation measures will be implemented as specified in the project description and Marine Mammal Detection, Mitigation, and Response Plan (MMDMRP). ROVs move at slow speeds and whales would most likely be able to avoid contact with the ROV. Although the specifics of repair work cannot be known until the work is ready to happen, repairs are expected to involve a limited subset of activities. The most extensive type of repair work that is reasonably foreseeable would involve limited excavation of the pipeline. This work would be done by divers using hand-operated dredging or jetting equipment. Hand-operated equipment moves at very slow speeds and whales would be able to avoid contact with the hose. Therefore, interactions between whales and maintenance/repair equipment such as ROVs and hand-operated dredging and jetting equipment are extremely unlikely.

Although any whales present in the vicinity of dredging and jetting activities are likely to be able to avoid interactions with equipment by moving out of the area as described above, avoidance of maintenance/repair equipment may result in temporary displacement from the area. However, there is no evidence to suggest that whales are more attracted to the resources at the port site or 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 dredging and jetting 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 whales to forage effectively by obscuring visual detection of or dispersing potential prey. Disturbance of the sea floor through jetting, laybarge anchoring, and other repair activities can also release contaminated sediments back into the water column, thus exposing marine organisms to contaminants that were previously attached to sediment particles.

Of the possible repair activities that may cause increased turbidity, jetting is expected to generate the most turbidity and disturbance of bottom sediments. Sediment transport modeling conducted for jetting activity for a similar project indicates that initial turbidity could reach 5,000-20,000 mg/L in the upper water column immediately above the jetting apparatus while jetting is ongoing in areas where the sediment is composed of fine sand (NEG 2006). However, sediment concentrations would decrease to 500 mg/L in two hours, and 200 mg/L in three hours. Near-background concentrations would be seen after 12 hours. The aerial extent of impact was 1 x 0.35 miles exceeding 20 mg/L in the water column. In areas with clay sediment, the model indicates that the sediment concentration in the water column would be lower than for sand (500-1000 mg/L), but the aerial extent of increased suspended sediment would be larger (1 x 1.4 nm) and of longer duration (30 hours). Although increased turbidity may cause displacement of whales or their prey, displacement will be temporary (turbidity will persist for 12-30 hours), and whales are likely to find suitable prey in surrounding areas. As noted above, although increased turbidity may cause displacement of whales or their prey, displacement will be temporary, 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 excavation of limited portions of the pipeline will result in less resuspension than typical dredging projects, the limited pipeline excavation that may be necessary for repairs is expected to have a very low potential to cause contaminant dissolution. Based on this information, limited pipeline excavation 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 jetting, the overall effect of project repairs on listed species due to turbidity and exposure to contaminants is discountable.

Marine Debris

Personnel will be present onboard the barges and support vessels throughout maintenance/repair activities, thus presenting some potential for accidental releases of debris overboard. As noted in the Environmental Baseline section, whales may be adversely affected if they become entangled in marine debris. 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, maintenance/repair activities are not likely to result in increased marine debris.

Light Pollution
Repair activities would take place 24 hours per day, 7 days per week during the repair period. Maintenance/repair 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 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 repair-related impacts (turbidity, destruction of benthic habitat) are indirect.

5.3 Effects of Operation

Potential effects of port operation on listed whales include:
- Loss of prey resources
- 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
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 is 64.6 acres. The areas that were 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 will permanently remove 64.6 acres of potential foraging habitat, loss of this habitat is not likely to have a measurable adverse impact on normal 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, there is no evidence to suggest that the pipeline or port sites offer more favorable foraging habitat for whales than surrounding areas. Whales 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 port operations.

Ballast and cooling water withdrawal at the port as the SRVs unload 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 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.

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 is expected to be 100-200 mg/L, and will 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 will be approximately 16.4-19.7 ft depending on the current. 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. 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 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 will 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 will 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 will have spill pans or will be fitted with welded steel containment barriers. These would prevent contaminated rainwater from washing over the side. The water will be collected in holding tanks and treated by on-board oil-water separators. The residual oil will be stored and disposed of at shoreside docks. Spill pans will collect approximately 913 gpd of rainwater, machine washdown water, and other fluids, and will divert it to holding tanks. The water will 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, there will be some potential for accidental releases of debris overboard. As noted in the Environmental Baseline section, whales may be adversely affected if they become entangled in marine debris. 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 are incorporated as enforceable conditions into the DWPA license.

In spite of these prohibitions, however, accidental discharges associated with offshore structures do occur. A condition of the license requires 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 whales.

Entanglement

The buoy structure involves 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 is approximately 1,000 m (3,281 ft) long and is separated by hundreds of feet from the other lines. Although it is possible that a whale 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. 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 Neptune port operations.

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 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 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 will not be carrying oil as cargo, the only oil available for release will 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. 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 will 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 will be taken on board and turned off. Moored SRVs will 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) will be used to illuminate working decks during regasification activities. However, the overall amount of light used will be low. Lights will be downshielded to illuminate the deck only, and will 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 will be stationary and therefore pose no risk of strike or other adverse impacts.

5.4 Effects of Decommissioning

At the conclusion of the 25-year life of the Neptune deepwater port, port components will be retrieved and removed from the site, with the exception of the pipelines, which will most likely be abandoned in place. The pipelines will be pigged, flushed, and filled with seawater. The ends of the flowline and transmission line will be exposed, cut, filled, and covered with protective concrete mats. The manifolds and tie-in spools will be removed. Anchor piles will be removed completely, or cut below the mudline and the top portion removed if complete removal is 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 will be of less magnitude than those resulting from initial 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 whales. The Neptune project will lead to increased vessel traffic during maintenance/repair work and long-term operation that would not exist but for the existence of the Neptune port. 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, 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 a number of mitigation measures to further reduce the likelihood of a Neptune vessel (SRV, maintenance/repair, or support) interacting with a whale. The ship strike mitigation measures are summarized below, but for complete details, see the Neptune Marine Mammal Detection, Mitigation, and Response Plan (MMDMRP)for Operations.

- Prior to maintenance/repair work and operations, 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.

- All repair vessels greater than or equal to 300 gross tons must maintain a speed of 10 knots or less. Vessels of less than 300 gross tons carrying supplies or crew between the shore and the repair site shall contact the Mandatory Ship Reporting System (MSRS), the USCG, or the MMO's at the repair site before leaving shore for reports of recent right whale sightings or active DMAs and, consistent with navigation safety, restrict speeds to 10 knots or less within 5 miles (8 kilometers) of any sighting location and within any existing DMA.

- Vessels transiting through the Cape Cod Canal and Cape Cod Bay between January 1 and May 15 must reduce speed to 10 knots or less, follow the recommended routes charted by NOAA to reduce interactions between right whales and shipping traffic, and avoid identified aggregations of right whales in the eastern portion of Cape Cod Bay.

- 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 and/or Dynamic Management Area (DMA) 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 or DMAs (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 Section 7 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 24 additional confirmed or suspected ship strikes reported in Massachusetts waters (1 minke, 4 right, 11 humpback, 2 fin, 1 sei, 5 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 right whales are not the species reported struck most often overall, 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).

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 five years, at least seven 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 implemented measures to regulate speed in the approaches to major port entrances, including the approaches to Boston (50 CFR 224.105). Tankers bound for the Neptune LNG terminal are required to comply with these regulations. In addition, Neptune has agreed to implement a more stringent year-round speed restriction in the Off Race Point management area as described in section 2.4 of this BO. Because right whales have been sighted year-round in Massachusetts waters, Neptune also agreed to consult recent right whale sighting information and/or Dynamic Management Area (DMA) zones 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 or DMAs.

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 Program as the best available means of reducing ship strikes of right whales. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist *et al.* 2001). An analysis by Vanderlaan and Taggart (2006) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%. The seasonal management time periods developed through the right whale ship strike reduction strategy were designed to capture the majority of predictable right whale concentrations (Merrick 2005). 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.

Maintenance and Repair Vessel Traffic
Depending on the specific maintenance/repair activity required, different types and numbers of support vessels will be transiting to and from the port site from local ports or ports in the Gulf of Mexico. These vessels may include dive support vessels, anchored barges, and dynamically positioned vessels. Vessels for most routine maintenance and minor repairs would originate from local ports such as Gloucester and Boston. Vessels required for major repairs would likely come from the Gulf of Mexico. The exact number and nature of transits will depend on the type of activity and cannot be specified at this time. However, while transiting to and from the construction sites, supply vessels and dive support vessels 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. It is important to note that this total does not include vessel traffic contributed by private recreational vessels. The small number of additional transits contributed by maintenance and repair support vessels represents a minimal increase in overall vessel traffic in the area. 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 site of the maintenance/repair activity 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 maintenance/repair-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.

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. Neptune has agreed to limit SRV and construction vessel transit speeds to ten knots or less in 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, or sei whales.

5.6 Acoustic Effects

When anthropogenic disturbances elicit responses from 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 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 operation will produce sound that may affect listed 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 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 marine mammals exposed to the noise
- determine the significance of those effects to individuals and populations.

Characterization of Maintenance/Repair Noise Sources

Noise-generating activities associated with maintenance and repair activities at the Neptune LNG terminal could include the following:

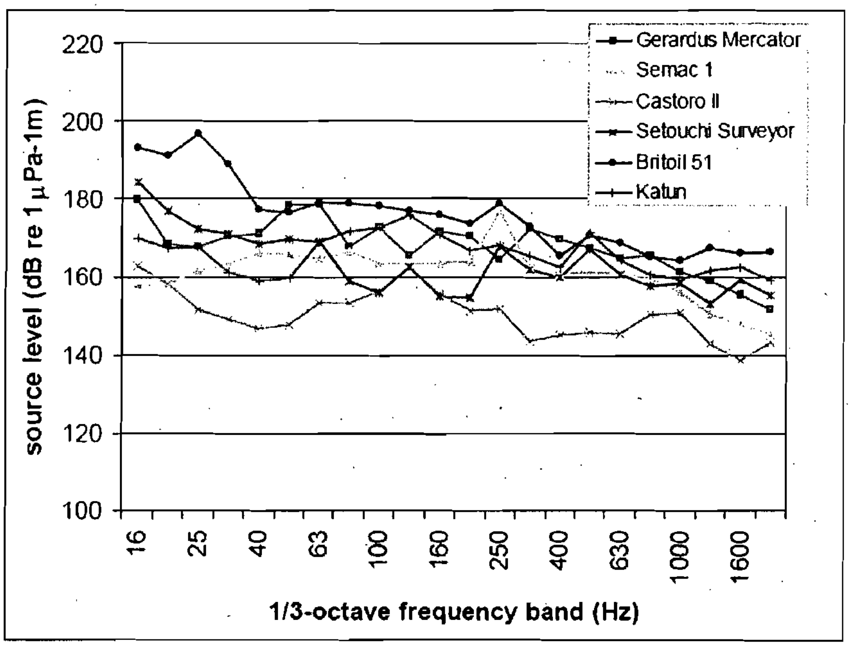
- Lowering materials to the sea floor (pipes, anchors, chains)
- Limited pipeline excavation
- Construction vessel transit

Noise associated with maintenance/repair scenarios comes primarily from the vessels performing the operations. Minor repairs would typically require one diver support vessel with three or four anchors to hold its position. Minor repairs could take from a few days to one to two weeks depending on the nature of the problem. Major repairs typically require large construction vessels similar to those used to install the pipeline and set the buoy and anchoring system. Major repairs are not anticipated to occur frequently (e.g., there may be one major repair over a five-year period), but could take up to four weeks to complete. A major repair scenario would be similar to the pipelaying scenarios modeled previously for port/pipeline construction impacts, and could include an anchored barge, anchor handling tugs, and a survey vessel. Noise output from these vessels varies slightly depending on individual vessel specifications. The exact vessels to be used during major repairs cannot be specified at this time; however, examples of typical construction vessels and their corresponding broadband source levels are in Table 4 below. The 1/3rd octave band source levels for each vessel are shown graphically in Figure 5.

Table 4. 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 5. 1/3rd octave band source levels for pipelaying vessels



Modeling conducted to evaluate the impacts of pipeline construction for the Neptune port indicates that, depending on the specific vessels involved in the activity, water depth, location, and season, the 120 dB noise contour from typical pipelaying scenarios could extend 3.9 to 11 km from the activity (LGL and JASCO 2005). The scenarios modeled would be considered a worst-case scenario for repair activities, and actual repair scenarios are likely to be limited in scope compared to initial port and pipeline construction. Thus, the acoustic impact zone for repairs is likely to be smaller than the impact zones modeled for initial pipelaying and trenching activities.

Maintenance/Repair Vessel Traffic
In addition to vessels engaged in repair activities, support vessel transits will occur regularly throughout the repair period. These vessels will be shuttling personnel and supplies between local ports and the repair site, and will represent an additional transient source of noise along the transit path. 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.

Exposure Analysis – Maintenance/Repair Noise
The endangered whale species most likely to be present near the maintenance/repair activities during the preferred May-November timeframe 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. Sei whales are generally found further offshore, but as mentioned previously, a whale tentatively identified as a sei whale was sighted by marine mammal observers during construction of the Neptune port, so we will consider sei whales to be potentially present also.

Right, Humpback, Fin, and Sei Whale Hearing
In order for right, humpback, fin, and sei 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, fin, and sei whales (from Au *et al.* 2000):

Table 5. Summary of known right, humpback, fin, and sei whale vocalizations

Species	Signal type	Frequency Limits (Hz)	Dominant Frequencies (Hz)	Source Level (dB re 1μPa RMS)	References
North Atlantic 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)
Sei	FM sweeps	1500-3500	1500-3500	--	Knowlton, Clark, and Kraus (1991)

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, based on available behavioral data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data, Southall *et al.* (2007) designated "functional hearing groups" for marine mammals and estimated the lower and upper frequencies of functional hearing of these groups. Baleen whales are categorized as low frequency cetaceans, with functional hearing estimated to occur between approximately 7 Hz and 22 kHz. From what is known of baleen whale functional hearing and the source levels and dominant frequencies of typical vessel noise sources, it is evident that right, humpback, fin, and sei whales are capable of perceiving these noises, and have hearing ranges that are likely to have peak sensitivities in low frequency ranges that overlap the dominant frequencies of vessel noise.

Exposure to Injurious Levels of Sound

No blasting, pile driving, or other activities that generate impulse sounds are anticipated during maintenance and repair work. The predominant noise source associated with maintenance and repair activities is caused by the noise generated by the actual vessels involved in the process. Noise generated by large vessels used during maintenance/repair activities 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 will approach the vessel within a distance to be exposed to potentially injurious sound levels.

Exposure to disturbing levels of sound
Although the potential for maintenance/repair-related sounds to cause injury to whales 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 maintenance/repair-related noise (120 dB) are expected to propagate over distances ranging from 3.9-11 km from the source (LGL and JASCO 2005). Since humpback and fin whales are abundant in Massachusetts waters during the summer months, they are likely to be exposed to noise during the preferred May-November work window. Right and sei whales may also be exposed to disturbing levels of noise during maintenance/repair activities, but will be present in the action area to a lesser degree than humpback or fin whales.

Effects of Maintenance/Repair 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. As such, this analysis of maintenance/repair-related acoustic effects will focus on behavioral harassment that may result from maintenance and repairs at the Neptune port and pipeline.

Continuous non-pulses (general construction noise)

All of the noise sources associated with maintenance and repair work can be 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 maintenance/repair activities during the summer months are humpback and fin whales.

The 120 dB contour around pipelaying scenarios was modeled prior to Neptune port construction and estimated to extend 3.9-11 km, although the scenarios modeled represent the worst-case scenario for a major repair activity, and the actual zone of impact is expected to be on the lower end of the modeled range. Noise associated with maintenance/repair work is generated primarily by the actual vessels supporting the work. Vessel noise is dominated by low frequencies, which can propagate long distances 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 maintenance/repair 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.

Throughout the construction period for the Neptune project, MMOs were on board to record marine mammal presence in the area and initiate any shut down procedures as necessary. Neptune submitted weekly reports on marine mammal sightings in the area as recorded by the MMOs. While it is difficult to draw biological conclusions from these reports, it is worth noting that no instances of obvious behavioral disturbance as a result of Neptune's activities were observed by the MMOs. Of course, these observations only cover the animals and behaviors that were observable at the surface and within the distance that the MMOs could detect marine mammals.

We expect the right, humpback, fin, and sei whales exposed to maintenance/repair activities and associated vessel traffic to respond similarly to those observed during the studies discussed above. 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 – Maintenance/Repair 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 maintenance/repair 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 maintenance/repair-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 maintenance/repair activity has ceased, any animal temporarily displaced for the duration of the 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 maintenance/repair activities may result in temporary

harassment of right, humpback, fin and sei whales, but are not likely to result in death or injury of any individuals.

Characterization of Operational Noise Sources

In addition to maintenance/repair-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
- 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, and will not be considered further in this discussion.

Bow and Stern Thrusters

Neptune SRVs will use both bow and stern thrusters when approaching the unloading buoy and when docking the buoy inside the Submerged Turret Loading (STL) compartment, as well as when releasing the buoy after the regasifying process is finished. The thrusters will be energized for up to 2 hours during the docking process and up to 1 hour during the undocking/release process, for a total of 150 hours per year. When energized, the thrusters will rotate at a constant RPM with the blades set at zero pitch. There will be little cavitation when the thruster propellers idle in this mode. The sound levels in this operating mode are expected to be approximately 8 decibels (dB) less than at 100 percent load, based on measured data from other vessels (Neptune 2010). During this 2 hour period when the thrusters are energized but idle, the thrusters will be engaged intermittently, meaning the pitch of the blades will be adjusted in short bursts for the amount of thrust needed to maintain the SRV's position at the buoy. These short bursts will cause cavitation and elevated sound levels. Underwater noise generated by a 145,000 m^3 SRV (the type of vessel to be used at the Neptune port) with stern thrusters operating at 100% load (100% rpm and 100% pitch) and no propulsion, was measured in June 2009 (Neptune 2010). The overall broadband source level was measured at 180.7 dB re: 1µPa. This is not the typical operating mode, but a worst-case scenario, as cavitation is greatest when the propellers are at 100% pitch. Typically, thrusters are operated for only seconds at a time and not at continuous full loading. The thrusters will be engaged (i.e., producing elevated sound levels) for no more than 20 minutes in total when docking or undocking at the buoy. Modeling indicates that a source level of 180.7 dB re: 1µPa will not exceed the 120 dB threshold for harassment beyond 3 km from the source (Neptune 2010).

In addition, thrusters may be used under certain conditions while the SRV is weathervaning on the mooring system in order to maintain the vessel's heading into the wind when competing tides operate to push the vessel broadside to the wind. Neptune has assumed a total of 200 hr/yr operating under these conditions. In these circumstances, the ambient sound will already be high because of the wind and associated wave sound.

Total thruster use will be intermittent, equating to about 350 hours of use per year (150 hours for docking maneuvers and 200 hours for weathervaning).

Vessel Transits (LNG carriers and support vessels)
Source level data for vessel transits 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.

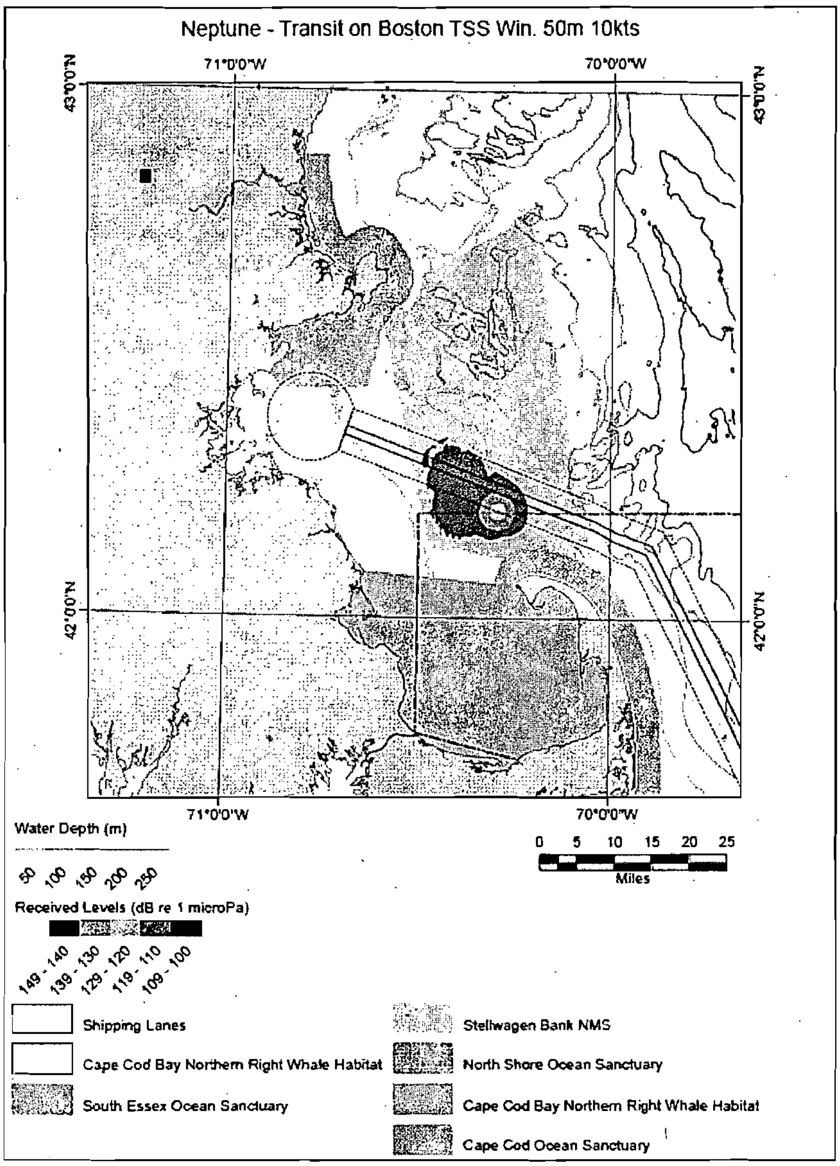
SRV transits associated with the Neptune terminal will also involve a support vessel accompanying the SRV. The support vessel used in the model was the Neftegaz 22 which is a supply tug 81 m long with 7200 hp and a maximum speed of 15 knots. The support vessel expected to be used is about 40 m long with 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 6).

Figure 6. Transit of single LNG carrier at 10 knots during winter at 50 m depth



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 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 will be exposed to operational noise less often than other species that are present year-round.

As established previously in relation to maintenance/repair noise, right, humpback, fin and sei whales are all known to be sensitive to sounds within the frequency ranges of vessel noise and thrusters.

Effects of Operational Noise on Right, Humpback, Fin, and Sei 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 maintenance/repair 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 maintenance/repair-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. Acoustic monitoring of the Neptune port site during construction activities revealed obvious increases in noise levels in the frequency bands relevant to right, humpback, and fin whales during the construction period compared to pre-construction noise levels (Cornell 2010). Fin and humpback whales were acoustically detected in the vicinity of the Neptune port during all 88 days of port construction activities (Cornell 2010). Although it is difficult to interpret these data or draw any conclusions, the results suggest that whales continued to use the area in spite of the elevated noise levels. 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, fin, and sei 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, fin, and sei 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 3 km zone of ensonification from thruster use. 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, fin, and sei 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 Neptune 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 operation of the Neptune 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 Vessel Transit Noise

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, a passing vessel represents a temporary, transient noise source that will expose a whale to noise for a very limited portion of the SRV transit through the action area. Since the vessel will be moving through the area, an individual 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 the action area. Responses to SRV transits will be similar to those discussed above for thruster use at the port site, 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, right, humpback, fin, 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, fin, and sei whales affected by the 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 has been 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. 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 (NMFS unpublished data). 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. 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.

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.

7.0 INTEGRATION AND SYNTHESIS OF EFFECTS

As noted in sections above, interactions with whales, while possible, are unlikely to occur during the transit of SRVs or maintenance/repair 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. Right, humpback, fin, and sei whales may be exposed to potentially disturbing levels of sound during operation of the proposed facility, including during periodic maintenance and/or repair work and SRV transits through offshore portions of the vessel transit path. Temporary, short-term behavioral effects during maintenance/repair-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. 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 may adversely affect but is not likely to appreciably reduce the likelihood of survival and recovery of right, humpback, fin, and sei 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 operation of the Neptune LNG deepwater port, including required maintenance and repair work, is likely to adversely affect, but is not likely to jeopardize the continued existence of the North Atlantic right, humpback, fin, and sei whale.

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 North Atlantic right, humpback, fin, and sei 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 for operations; 1-4 weeks every 5 years for maintenance/repairs).

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.

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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.

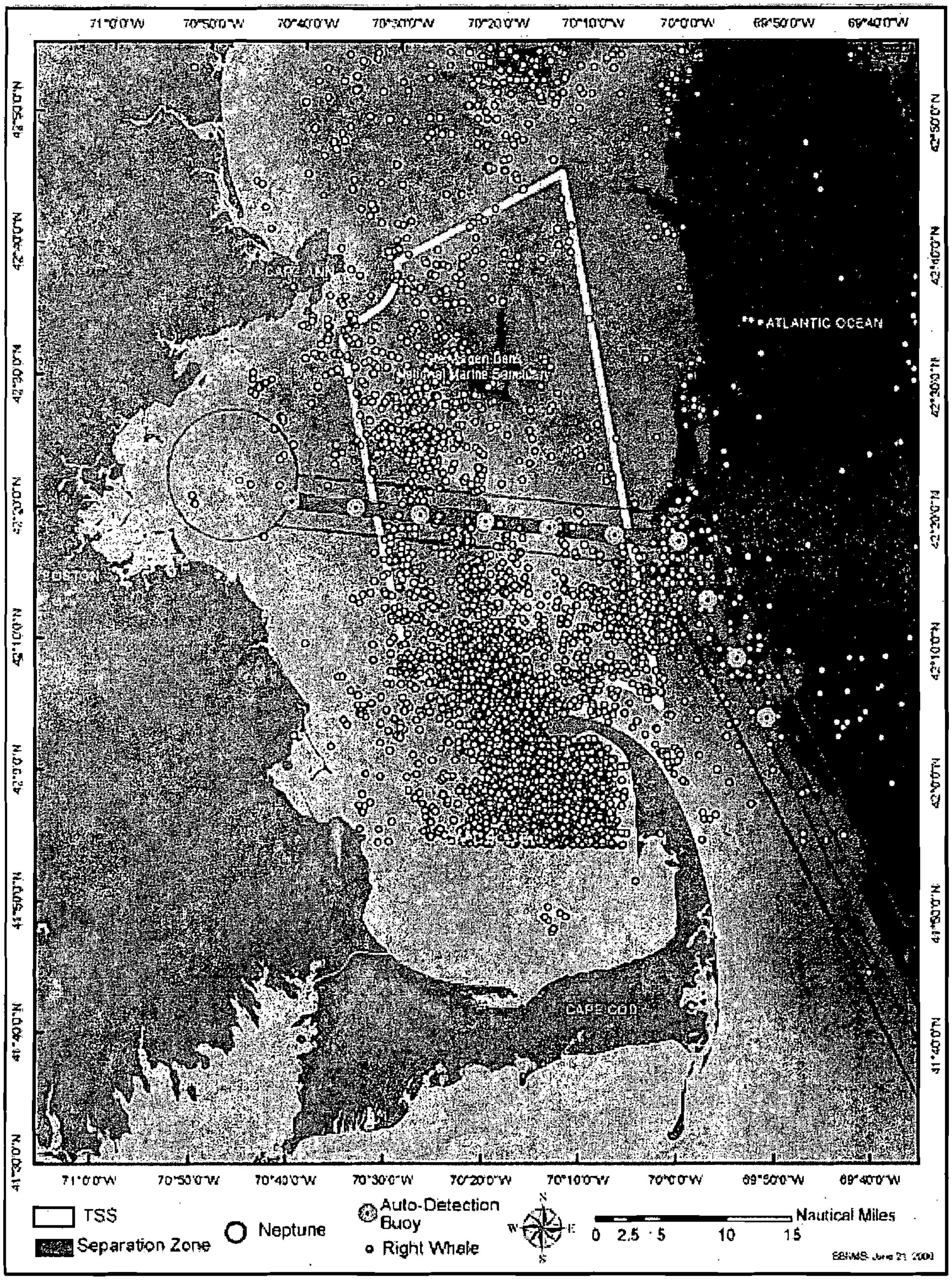

Figure 1. Research design for near-real-time auto detection of endangered whales for vessels in and around the Boston TSS to reduce risk of vessel collisions. Right whale sighting data for areas of interest was taken from the North Atlantic Right Whale Consortium Database.